TAQA Bratani Ltd.

TAQA Subsea Decommissioning Support

Comparative Assessment Report

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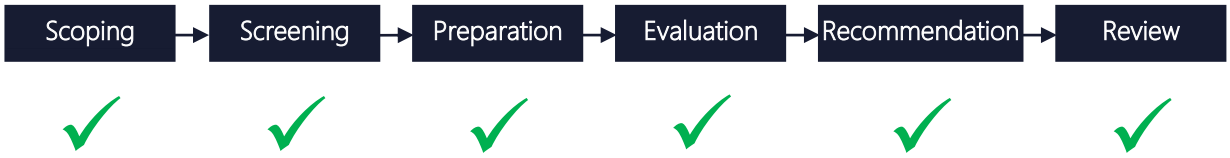
EXECUTIVE SUMMARY

TAQA Bratani have conducted a Comparative Assessment (CA) for the decommissioning of the subsea infrastructure associated with their Northern North Sea Subsea Infrastructure. The following steps from the Oil and Gas UK CA Guidelines have been completed:



This CA report for the Northern North Sea Subsea Infrastructure presents the methodology, decisions taken, the preparation works carried out, and the outcomes (recommendations) from the internal and external (with stakeholders) workshops. A total of 18 decommissioning groups were considered during the CA with seven groups being confirmed at the CA Scoping and Screening stage to be required to be fully removed from the field. Full evaluation was conducted on the remaining eleven decommissioning groups with the outcomes obtained as described in the table below. Overall, the outcome of the CA process has made the following recommendations:

GROUP	TITLE	DECOMMISSIONING APPROACH
1	Pipe-in-Pipe Hybrids (Surface Laid and Exposed)	Option 4A – Rock Placement over areas of Spans / Exposures / Shallow Burial • Pipelines will be disconnected • Removal and recovery of line ends • Rock placement to remediate snag risk from cut ends • Rock placement at all areas of spans to an appropriate depth of cover • Future survey & monitoring programme
2	Trunk Lines (Partially Trenched and Buried) [1]	Option 4A – Rock Placement over areas of Spans / Exposures / Shallow Burial • Pipeline will be disconnected • Removal and recovery of offshore line end • Rock placement to remediate snag risk from cut end • Rock placement at all areas of spans, exposures and shallow burial to an appropriate depth of cover • Future survey & monitoring programme
3	Flexible Pipelines and Umbilicals (Trenched and Buried)	Option 5 – Remove Line Ends Only and Remediate Snag Risk • Pipelines / Umbilicals will be disconnected • Removal and recovery of line ends including trench transition • Rock placement to remediate snag risk from cut ends • Future survey & monitoring programme
4	Flexible Pipelines and Umbilicals (Trenched and Rock Covered)	Option 5 – Remove Line Ends Only and Remediate Snag Risk • Pipelines / Umbilicals will be disconnected • Removal and recovery of line ends including trench transition

[1] *While re-use opportunities were explored by TAQA as part of the CA process [14], it is recognised that general discussions surrounding the re-use opportunities for trunk lines are ongoing. This CA has been conducted on the basis that no viable re-use opportunities will remain for PL4 but shall not be taken to prejudice the outcome of those ongoing discussions between TAQA and the regulators.*

GROUP	TITLE	DECOMMISSIONING APPROACH
		• Rock placement to remediate snag risk from cut ends • Future survey & monitoring programme
5	Umbilicals (Surface Laid)	Full Removal selected during scoping phase.
6	Rigid Pipelines (Surface Laid, Exposed and Non-Concrete Coated)	Option 4A – Rock Placement over areas of Spans / Exposures / Shallow Burial • Pipeline will be disconnected • Removal and recovery of line ends • Rock placement to remediate snag risk from cut ends • Rock placement at all areas of spans to an appropriate depth of cover • Future survey & monitoring programme
7	Rigid Pipelines (Surface Laid, Exposed and Concrete Coated)	Option 4A – Rock Placement over areas of Spans / Exposures / Shallow Burial • Pipelines will be disconnected • Removal and recovery of line ends • Rock placement to remediate snag risk from cut ends • Rock placement at all areas of spans to an appropriate depth of cover • Future survey & monitoring programme
8	Rigid Pipelines (Surface Laid and Rock Covered)	Option 4A – Rock Placement over areas of Spans / Exposures / Shallow Burial • Pipeline will be disconnected • Removal and recovery of line ends including transition to existing rock cover • Rock placement to remediate snag risk from cut ends • Rock placement at all areas of spans, exposure and shallow burial to an appropriate depth of cover • Future survey & monitoring programme
9	Rigid Pipelines (Trenched and Buried)	Option 4C – Removal of areas of Spans / Exposures / Shallow Burial • Pipelines will be disconnected • Removal and recovery of line ends including trench transition • Removal (by cut and lift) of all areas of spans, exposure and shallow burial • Rock placement to remediate snag risk from cut ends • Future survey & monitoring programme
10	Flexible Risers and Riser Umbilicals	Full Removal selected during scoping phase.
11	Rigid Risers	Full Removal selected during scoping phase.
12	Spools and Jumpers	Full Removal selected during scoping phase.
13	Large Structures	Full Removal selected during scoping phase.
14	Structures	Full Removal selected during scoping phase.
15	Protection and Stabilisation	Full Removal selected during scoping phase.

GROUP	TITLE	DECOMMISSIONING APPROACH
16	Blocked Rigid Pipeline (Trenched and Buried)	Option 5 – Remove Line Ends Only and Remediate Snag Risk • Pipeline will be disconnected • Removal and recovery of line ends including trench transition • Rock placement to remediate snag risk from cut ends • Future survey & monitoring programme
17	In-Use Rigid Pipelines (Trenched and Partially Buried)	Option 3B – Trench and Bury Entirety of Line • Pipelines will be disconnected • Trench / re-trench and bury full length of the lines to remove areas of spans, exposure and shallow burial • Future survey & monitoring programme
18	Uncertain Integrity and Concrete Coated Rigid Pipelines (Trenched and Buried)	Option 5 – Remove Line Ends Only and Remediate Snag Risk • Pipelines will be disconnected • Removal and recovery of line ends including trench transition • Rock placement to remediate snag risk from cut ends • Future survey & monitoring programme

The decisions were reached on completion of an appropriate amount of preparatory study work, with clear decision outcomes.

1 INTRODUCTION

1.1 Background

TAQA has engaged Xodus Group to conduct a comparative assessment (CA) for the decommissioning of their Northern North Sea (NNS) subsea assets across the Tern, Eider, Cormorant North and South, Cladhan, Pelican, Otter, Kestrel, Falcon and Hudson fields (collectively referred to as the Northern North Sea Subsea Infrastructure).

The infrastructure is located in the Northern North Sea as shown in Figure 1-1 below.

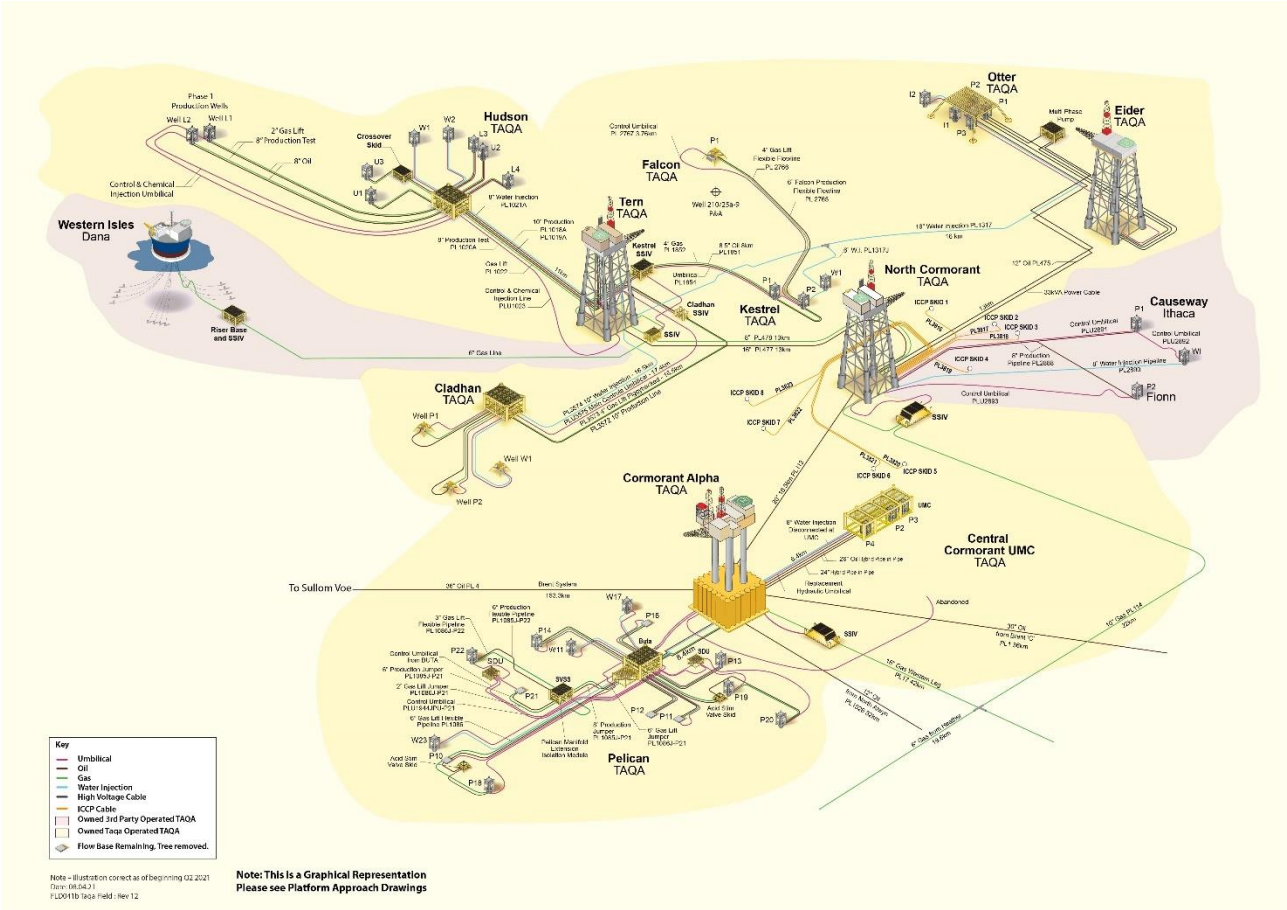


Figure 1-1 - NNS Assets Layout

The Cormorant Alpha Platform hosts the subsea facilities for the Central Cormorant Underwater Manifold Centre (UMC) and the Pelican Fields. The UMC Field consisted of 6 production wells and 3 water injection wells. The UMC itself is covered under Group 13, Large Structures, and was scoped out of the CA at the Scoping Stage. The options for UMC removal are to be considered in a separate study, albeit with full removal as the base case.

The Pelican Field consists of 12 production wells and four water injection wells.

Processed oil is exported via the Brent System Pipeline (PL4) to Sullom Voe. Gas is imported / exported from / to the Western Leg Pipeline (PL17) via a Subsea Isolation Valve (SSIV).

The Eider Platform was previously used to host the subsea facilities for the Otter Field. In 2017, the Eider bypass project was completed to reroute production fluids from the Otter Field to the North Cormorant Platform. Additionally, water injection to the Otter Field was rerouted and is now supplied to Otter from the 16" water injection pipeline from the Tern Platform. In January 2018, the Eider Platform reached Cessation of Production (CoP) and is now primarily used to provide power and controls to the Otter Field.

The Otter Field consists of three production wells and two water injection wells. The field is tied back to the North Cormorant Platform via a subsea manifold and multiphase pump. The Causeway Field (owned by Ithaca Energy) is also tied back to the North Cormorant Platform but is not part of this CA process. Processed oil is exported via PL113 to the Cormorant Alpha Platform. Gas is exported into the Western Leg Pipeline (PL17) via PL114.

The Tern Platform hosts the subsea facilities for the Cladhan, Falcon, Kestrel and Hudson fields and also supplies water injection to the Otter Field. The Cladhan Field consists of two production wells and one water injection well. The Falcon Field consists of a single production well tied back to the Tern Platform via the Kestrel Field. The Kestrel Field consists of two production wells and one water injection well. The Hudson Field consists of nine wells: seven production and two water injection which all remain in operation. The Western Isles Field (owned by Dana Petroleum) is also tied into the Tern pipeline system but is not part of this CA process. Oil and gas from the Tern Platform is exported to the Cormorant Alpha Platform via the North Cormorant Platform.

1.2 Purpose

The purpose of this document is to present the Comparative Assessment (CA) process and emerging recommendations for the Comparative Assessment of the Northern North Sea Subsea Infrastructure in support of the Decommissioning Programmes (DPs). It is produced to satisfy the requirement to perform a CA for all pipeline Decommissioning Programmes and considers all feasible decommissioning options as specified within the BEIS Decommissioning Guidelines ref. [1].

This document describes the field infrastructure addressed, the decommissioning options considered, the CA methodology conducted, and the recommendations concluded during the CA process.

1.3 Report Structure

This CA Report contains the following:

- Section 1 – An introduction to the document and project, including acronyms and references.
- Section 2 – An overview of the CA methodology and definition of the scoping and boundaries of the CA.
- Section 3 – The decommissioning groups identified and the initial decommissioning approach.
- Section 4 – The CA summary for Group 1 – Pipe-in-Pipe Hybrids (Surface Laid and Exposed).
- Section 5 – The CA summary for Group 2 – Trunk Lines (Partially Trenched and Buried).
- Section 6 – The CA summary for Group 3 – Flexible Pipelines and Umbilicals (Trenched and Buried).
- Section 7 – The CA summary for Group 4 – Flexible Pipelines and Umbilicals (Trenched and Rock Covered).
- Section 8 – The CA summary for Group 6 – Rigid Pipelines (Surface Laid, Exposed and Non-Concrete Coated).
- Section 9 – The CA summary for Group 7 – Rigid Pipelines (Surface Laid, Exposed and Concrete Coated).
- Section 10 – The CA summary for Group 8 – Rigid Pipelines (Surface Laid and Rock Covered).
- Section 11 – The CA summary for Group 9 – Rigid Pipelines (Trenched and Buried).
- Section 12 – The CA summary for Group 16 – Blocked Rigid Pipeline (Trenched and Buried).
- Section 13 – The CA summary for Group 17 – In-Use Rigid Pipelines (trenched and Partially Buried).
- Section 14 – The CA summary for Group 18 – Uncertain Integrity and Concrete Coated Rigid Pipelines (Trenched and Buried).
- Section 15 – Discussion and Recommendations.
- Appendix A – Evaluation Methodology.
- Appendix B – Stakeholder CA Workshop Minutes.
- Appendix C – Group 1 – Detailed Evaluation Results.
- Appendix D – Group 2 – Detailed Evaluation Results.
- Appendix E – Group 3 – Detailed Evaluation Results.
- Appendix F – Group 4 – Detailed Evaluation Results.
- Appendix G – Group 6 – Detailed Evaluation Results.
- Appendix H – Group 7 – Detailed Evaluation Results.
- Appendix I – Group 8 – Detailed Evaluation Results.
- Appendix J – Group 9 – Detailed Evaluation Results.
- Appendix K – Group 16 – Detailed Evaluation Results.
- Appendix L – Group 17 – Detailed Evaluation Results.
- Appendix M – Group 18 – Detailed Evaluation Results.

1.4 Terms, Abbreviations and Acronyms

AHP	Analytical Hierarchy Process
BAT	Best Available Technology
BEP	Best Environmental Practice
BEIS	Department for Business, Energy and Industrial Strategy
BOM	Business Opportunity Manager
CA	Comparative Assessment
CNRL	Canadian Natural Resources Limited
CP	Cathodic Protection
CSV	Construction Support Vessel
DoC	Depth of Cover
DP	Decommissioning Programme
DSV	Dive Support Vessel
DWC	Diamond Wire Cutting
ESDV	Emergency Shutdown Valve
FAR	Fatal Accident Rate
HAZID	Hazard Identification
HCE	High Consequence Events
HSE	Health and Safety Executive
ID	Identifier
IP	Institute of Petroleum (now the Energy Institute)
ISBN	International Standard Book Number
JIP	Joint Industry Project
JNCC	Joint Nature Conservation Committee
JV	Joint Venture
KP	Kilometre Point
MCDA	Multi-Criteria Decision Analysis
MFE	Mass Flow Excavator
MPP	Multi-phase Pump
MS	Much Stronger
MW	Much Weaker
NB	Nominal Bore
NNS	Northern North Sea
NORM	Naturally Occurring Radioactive Material
NSTA	North Sea Transition Authority
O&G	Oil and Gas
OD	Outside Diameter
ODU	Offshore Decommissioning Unit

OGUK	Oil & Gas UK
OPRED	Offshore Petroleum Regulator for Environment & Decommissioning
P&A	Plugging and Abandonment
PL	Pipeline
PLL	Potential for Loss of Life
POB	Personnel on Board
PSR	Pipeline Safety Regulations
S	Stronger
SAC	Special Area of Conservation
SEPA	Scottish Environmental Protection Agency
SFF	Scottish Fisherman's Federation
SPA	Special Protection Area
SSIV	Subsea Isolation Valve
TA	Technical Authority
TFL	Test Flowline
UK	United Kingdom
UMC	Underwater Manifold Centre
VC	Video Conference
VMS	Very Much Stronger
VMW	Very Much Weaker
W	Weaker

1.5 References

1. BEIS Guidance Notes	BEIS, Guidance Notes: Decommissioning of Offshore Oil and Gas Installations and Pipelines, Nov 2018.
2. OGUK Decommissioning CA Guidelines	OGUK – Guidelines for Comparative Assessment in Decommissioning Programmes, Dated: October 2015, ISBN: 1 903 004 55 1, Issue: 1.
3. CA Scoping Report	Xodus, Subsea Comparative Assessment Scoping Report, Doc. No.: 77IFS-154925-L99-0001, Rev.: 02, Dated: 22/10/2019.
4. CA Screening Report	Xodus, Subsea Comparative Assessment Screening Report, Doc. No.: 77IFS-154925-L99-0003, Rev.: 02, Dated: 06/10/2020.
5. CA Screening Report (Hudson)	Xodus, CA Scoping & Screening Report, Doc. No.: A-301661-S10-REPT-001, Rev.: A01, Dated: 04/02/2021.
6. Pipeline Status Report	Xodus, Pipelines Status Summary Report, Doc. No.: 77IFS-154925-H99-0004, Rev. 01, Dated: 09/04/2020.

7. HAZID Report	Xodus, Subsea Comparative Assessment HAZID Report, Doc. No.: 77IFS-154925-H27-0001, Rev. 01, Dated: 05/05/2021.
8. Methodologies Report	Xodus, Subsea Decommissioning Methodologies Report, Doc. No.: 77IFS-154925-L99-0004, Rev.: 07, Dated: 27/08/2021.
9. Risk Analysis of Decommissioning Activities	Safetec, Joint Industry Project Report "Risk Analysis of Decommissioning Activities (http://www.hse.gov.uk/research/misc/safetec.pdf), 2005.
10. Analytical Hierarchy Process	T.L. Saaty, The Analytical Hierarchy Process, 1980.
11. OGUK North Sea Pipeline Decommissioning Guidelines	Decommissioning of Pipelines in the North Sea Region – 2013, Issued by Oil & Gas UK.
12. IP 2000	The Institute of Petroleum, Guidelines for the Calculations of estimates of energy use and gaseous emissions in the decommissioning of offshore structures, Dated: February 2000, ISBN: 0 85293 255 3.
13. Memorandum Hudson L1 Pipeline Blockage	Dana Petroleum, Memorandum Hudson L1 Pipeline Blockage, 2020
14. Trunk Line Re-Use Assessment	Xodus, PL4 Trunk Line Re-Use Assessment, Doc. No.: 77IFS-189460-F99-0001, Rev.: 02, Dated: 12/09/2022.
15. Technical Note for Flexible Lines	TAQA, Technical Note: Comparative Assessment of Buried Flexible Lines in the CNS and NNS, Doc. No.: TB-DEC00009-X-TN-0001-000
16. Wax Discharge Assessment	Xodus, Wax Discharge Environmental Assessment, Doc. No.: A-30558-S38-A-REPT-001, Rev.: 01, Dated: 16/05/2024

2 COMPARATIVE ASSESSMENT METHODOLOGY

2.1 Overview

Comparative Assessment 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 TAQA for the Northern North Sea Subsea Infrastructure.

The OGUK Decommissioning CA Guidelines ref. [2] were prepared in 2015 by Oil and Gas UK, where seven steps to the CA process were recommended. Table 2.1 introduces each of these steps, along with a status and commentary to demonstrate the current position.

TITLE	SCOPE	STATUS	COMMENTARY
Scoping	Decide on appropriate CA method, confirm criteria, identify boundaries of CA (physical and phase).	✓	CA methodology and criteria established for screening to ensure appropriate evaluation phase. Detailed in Section 2.2 and Appendix A.
Screening	Consider alternative uses and deselect unfeasible options.	✓	Screening workshops were held in 2019 and were attended by members of the project team and appropriate TAQA subject matter experts.
Preparation	Undertake technical, safety, environmental and other appropriate studies. Undertake stakeholder engagement.	✓	Studies identified during screening phase undertaken to inform the evaluation of the remaining options. Detailed in Section 2.4.
Evaluation	Evaluate the options using the chosen evaluation methodology.	✓	Internal workshops held Q2 2021 and Stakeholder Workshop on 30th June 2021.
Recommendation	Document the recommendation in the form of narrative supported by charts explaining key trade-offs.	✓	The emerging recommendations for the decommissioning options selected are as identified during the Stakeholder Workshop and as detailed in the CA Report (this document). Recommendations can be found in Section 8.
Review	Review the recommendation with internal and/or external stakeholders.	✓	The Stakeholder CA Review Workshop was held on 30th June 2021 and the minutes can be found in Appendix B.
Submit	Submit to OPRED in support of Decommissioning Programme(s).	Planned Q1 2022	Planned Q1 2022

Table 2.1 - CA Process Overview and Status

2.2 Scoping

The scoping phase of the CA process addresses the following elements:

- Boundaries for the CA;
- Physical attributes of equipment;
- Decommissioning options.

These are addressed in the following sub-sections.

2.2.1 CA Boundaries

The CA Scoping phase includes the definition of the boundaries of the CA. Offshore oil and gas production systems are complex and are often interconnected, and as a result of that, it is important to understand the limitations of the scope. The platforms and various subsea wells within the Northern North Sea are linked together via the subsea infrastructure including pipelines and subsea installations. The boundaries of the infrastructure are the low water mark of the trunk line shore approach, the ESDV / hang-off at the top of the risers / umbilicals and the wellhead tie-in flanges. The subsea installations are also included. The boundary limits of the infrastructure are detailed fully in the CA Scoping Report ref. [3]. As a summary, the Northern North Sea Subsea Infrastructure that will be considered under this CA is as follows:

- All subsea structures (installations) including their foundations.
- The large UMC structure including its foundations.
- All rigid risers.
- All flexible and umbilical risers.
- All rigid subsea pipelines and flexible flowlines.
- All umbilicals.
- All spools.
- All control and chemical jumpers.
- All mattresses and deposits.

The starting conditions for the CA are defined below:

- The following will be complete prior to the subsea infrastructure decommissioning scope commencing:
  - The pipelines will be flushed, cleaned and cut / disconnected from subsea infrastructure.
  - The umbilical cores will be flushed, cleaned and cut / disconnected from subsea infrastructure.

2.2.2 Physical Attributes of Equipment

All equipment within the scope of the Northern North Sea Subsea Infrastructure is considered along with the physical attributes that define the equipment. Attributes considered include the following:

- Structures:
  - Type.
  - Weight / size / shape.
  - General arrangement.
  - Installation method / foundation type.
  - Integrity issues.
- Pipelines / Flowlines / Spools:
  - Pipeline number.
  - Type (rigid / flexible).
  - Service (gas / oil / water).
  - Material / diameter / wall thickness / coatings / length.
  - Seabed configuration (trenched / buried / surface laid).
  - Details of crossings / mattresses.
  - As-left cleanliness / ability to clean lines.
  - Integrity issues.
- Umbilicals / Jumpers:
  - Materials / diameter / length.
  - Seabed configuration (trenched / buried / surface laid).
  - Details of crossings / mattresses.
  - As-left cleanliness / ability to clean lines / chemicals used.
  - Integrity issues.

2.2.3 Decommissioning Groups

Once the equipment to be decommissioned and their attributes are captured, it is desirable to group similar items of equipment together. This has the benefit that many items can be considered as a single group and can reduce the number of items for consideration from potentially hundreds, down to a few, thus streamlining the process.

For the Northern North Sea Subsea Infrastructure, the decommissioning groups are summarised in Table 3.1 herein.

2.2.4 Decommissioning Options

With the decommissioning groups established, all potential decommissioning options for each of the groups are identified. The base case for all groups is full removal as per the BEIS Guidance Notes ref. [1] and it is only those

decommissioning groups where default full removal is not considered to be the clear recommended solution, that alternative decommissioning options are considered.

The following scenarios were considered for applicable pipelines as specified in the BEIS Guidance Notes ref. [1] and OGUK North Sea Pipeline Decommissioning Guidelines ref. [11].

- Re-use Opportunities.
- Full Removal:
  - Cut and Lift - Cut pipe into small sections and recover.
  - Lift and tow – recover to surface using Ambient Lifter and tow to shore
  - Reverse Installation with de-burial – Recover pipe using reverse s-lay or reverse reeling without prior de-burial.
  - Reverse Installation without de-burial – Recover pipe using reverse s-lay or reverse reeling with de-burial of any existing cover.
- Decommissioning In-situ – Major Intervention:
  - Rock Placement over entirety of lines.
  - Trench and bury entirety of lines.
- Decommissioning In-situ – Minor Intervention:
  - Rock Placement over areas of Spans / Exposure / Shallow Burial and remove line ends.
  - Trench and bury areas of Spans / Exposure / Shallow Burial and line ends.
  - Remove areas of Spans / Exposure / Shallow Burial and line ends.
  - Accelerated Decomposition of lines using reverse cathodic protection / chemicals / etc.
- Decommissioning In-situ – Minimal Intervention:
  - Remove line ends only.
- Decommissioning In-situ – No Intervention:
  - Leave lines in-situ as is.

At this stage any potential re-use options should be considered. If there are viable in-situ re-use scenarios for any of the infrastructure there is no need to proceed with CA for that infrastructure.

Table 3.1 lists the decommissioning groups and identifies those which were judged to be appropriate for decommissioning by full removal and those where full removal was not considered the clear recommended solution.

2.3 Screening Phase

The screening phase of the comparative assessment was carried out during a series of workshops held in 2019. The methodology adopted, workshop attendance and outcomes obtained are detailed fully in the CA Screening Report ref. [4] and the CA Screening Report (Hudson) ref. [5]. The methodology is briefly summarised below.

- Identify Northern North Sea Subsea Infrastructure common groups for full removal.
- Review proposed decommissioning options for each remaining group.
- Assess decommissioning options against the primary criteria and record assessment and outcome in screening worksheets.
- Primary Criteria:
  - Safety
  - Environmental
  - Technical
  - Societal
  - Economic
- Record any actions required to support retained decommissioning options.
- Compile Screening Report.

The assessment was performed using a coarse Red / Amber / Green method, as recommended in the OGUK Decommissioning CA Guidelines ref. [2]. An additional category of 'showstopper', coloured dark grey, was used as described below. These categories are described Table 2.2.

CATEGORY	DESCRIPTION
Attractive	The option is considered attractive i.e. it has positive attributes in terms of the criterion being assessed.
Acceptable	The option is considered acceptable i.e. its attributes are not positive or negative in terms of the criterion being assessed.
Unattractive	The option is considered unattractive i.e. it has negative attributes in terms of the criterion being assessed.
Showstopper	The option is considered unacceptable. Should an option be assessed as unacceptable against any of the criteria, no further assessment is required.

Table 2.2 – Screening Assessment Categories

The cumulative assessment for each decommissioning option was then captured based on some basic ground rules. These are:

- Three or more criteria assessed as red resulted in the option being screened out (red).
- For similar full removal options, the likely least onerous option was retained (green) with any more onerous option considered as a sub-set of the less onerous option (light grey). Should the easiest full removal option be selected, the manner in which the removal would be conducted would be agreed with the removal contractor during execution to maintain flexibility.
- For similar leave in-situ options, the most onerous option was retained (green) with any less onerous options considered as a sub-set of the more onerous option (light grey). This approach promotes the principle of not unduly 'burdening' the retained full removal option.

- This approach was considered appropriate to ensure that the best-case full removal options were compared to the most onerous leave in-situ options. This ensures, during the evaluation phase, that the assessment is not skewed in favour of leave in-situ options over full removal options.

The outcomes for each group are summarised in Table 4.3, Table 5.3, Table 6.3, Table 8.3, Table 9.3, Table 10.3, Table 11.3, Table 12.3, Table 13.3 and Table 14.3.

2.4 Preparation Phase

During the preparation phase, detailed studies / analyses are conducted to provide information to support the Evaluation phase of the Comparative Assessment. The detailed studies / analyses that may be required are often identified early in the CA process. These studies / analyses are then supplemented by additional studies / analyses identified during the Screening phase of the CA.

The studies / analyses conducted during the preparation phase of the Northern North Sea Subsea Infrastructure CA process were as follows:

- Burial Status Review — Review of historical survey data to understand current and historical burial status of lines summarised in the Pipelines Status Report ref. [6].
- Cost Estimate — The methodologies for each option were defined along with necessary resources to execute the option, detailed in the Methodologies Report ref. [8]. From this, indicative costs were able to be calculated, also detailed in the Methodologies Report.
- Safety Calculations — Using the methodologies detailed within the Methodologies Report, safety calculations are made for each of the options using the Fatal Accident Rates from the JIP conducted by Safetec ref. [9] into decommissioning activities. This allows cumulative PLL values to be provided to represent the risk exposure for the options for comparative purposes.
- HAZID Assessment — A HAZID was conducted to identify options with a greater potential for High Consequence Events and to qualitatively inform the legacy risk assessment. The HAZID is detailed in the HAZID Report ref. [7].
- Emissions Assessment — Fuel consumption and atmospheric emissions assessment performed for each option carried forward based upon activities and resources identified within the cost estimates and according to the factors from IP2000 ref. [12] and detailed in the Methodologies Report ref. [8].
- Environmental Impact Review — Environmental impact reviews were conducted for options carried forward in areas of planned discharges, unplanned discharges and seabed disturbance based on activities and resources identified in cost estimates. Underwater noise impact was based on a qualitative assessment of the vessels and activities employed as detailed in the Methodologies Report ref. [8].
- Summary Data Sheets — Compiling all necessary data together for evaluation purposes, data sheets were prepared for each option as detailed in the Methodologies Report ref. [8].

The findings of the studies / analyses are gathered in preparation for the evaluation phase of the CA. The key information obtained from these studies / analyses, used during the evaluation phase, are provided in the attributes tables included in Appendices C, D, E, F, G, H, I, J, K, L and M.

2.5 Evaluation Phase

The evaluation phase of the comparative assessment is where the remaining decommissioning options for each group are evaluated against each other. This evaluation process is conducted according to the OGUK CA Guidelines ref. [2] and employs the data obtained during the preparation phase as summarised in the attributes tables, included in Appendices C, D, E, F, G, H, I, J, K, L and M.

The evaluation phase was performed during several evaluation workshops where the decommissioning project team were represented. This enabled the supporting information for each of the decommissioning groups and associated decommissioning options to be thoroughly interrogated and amended as required.

Once the evaluation of the remaining decommissioning groups and options was ready, a CA Workshop was convened with external stakeholders; the CA process to date was described and the evaluation of the remaining options was reviewed.

This CA Stakeholder Workshop enabled the invited stakeholders to gain familiarity with the evaluation methodology and the information generated through the supporting studies and analyses. It also allowed the evaluation to be challenged in key areas and, at the culmination of the workshop, outcomes for each of the decommissioning groups were validated.

The CA Stakeholder Workshop was held via VC / Microsoft Teams Wednesday 30th June 2021. The attendees were as detailed in Table 2.3.

COMPANY	NAME	ROLE
BP	Allen Deans	Commercial Advisor
CNRL	Caroline Lawford	Project Lead - Decommissioning
Fairfield	Peter Lee	Decommissioning Manager
HSE	Hywel Williams	Pipelines Inspector
	Tim Dean	Specialist Inspector
JNCC	Niki Piesinger	Offshore Industry Advisor
	Tetrienne Kerswell-Box	Offshore Industry Advisor
MOL Energy	Vivek Bansal	JV Asset & Facilities Manager
OPRED ODU	Ruth Ledingham	Senior Decommissioning Manager
	Caitlyn Cox	Decommissioning Manager
	Sam Pattie	Assistant Decommissioning Manager
OGA	Peter Cacela	Decommissioning Engineer (Strategy)

COMPANY	NAME	ROLE
SEPA	Louise Brown	Principle Decommissioning Officer
SFF	Andrew Third	Offshore Industry Liaison
	Steven Alexander	Managing Director
Shell	James Blackburn	UK Decom BOM
TAQA	Alan Campbell	Area Manager Tern, Eider and North Cormorant
	Alastair McLean	Decommissioning Program Manager
	David Holland	HSE Manager
	Iain Milne	Marine Focal Point
	John Taylor	Subsea TA
	Katie Lilford	Decommissioning Stakeholder & Compliance Analyst
	Kevin Barrie	Production Optimisation Lead
	Martin Rae	Subsea Inspection Engineer
	Mik Crosby	Senior Pipeline Engineer
	Robbie Jones	Senior Environmental Advisor
	Robin Ritchie	Decommissioning Subsea Engineer
	Steve Sapp	Decommissioning Manager – Subsea and Wells
Xodus Group	Nic Duncan	Project Manager
	John Foreman	Comparative Assessment Lead
	Gareth Jones	Decommissioning Manager
	Jeff McCleary	Senior Decommissioning Consultant

Table 2.3 - Stakeholder Workshop Attendees & Roles

3 NORTHERN NORTH SEA SUBSEA INFRASTRUCTURE DECOMMISSIONING GROUPS

3.1 Decommissioning Scoping Groups

Table 3.1 lists all decommissioning groups identified for the Northern North Sea Subsea Infrastructure. Early CA scoping and screening activities, detailed in the CA Screening Report ref. [4], identified the decommissioning groups where full removal is the recommended decommissioning approach. The remaining groups are subjected to the remainder of the CA process to identify the recommended decommissioning option. These outcomes are also captured in Table 3.1.

GRP	TITLE	DESCRIPTION	DECOMMISSIONING APPROACH
1	Pipe-in-Pipe Hybrids (Surface Laid and Exposed)	All Pipe-in-Pipe Hybrid lines across all fields. These lines are contained within a carrier pipe, were towed into position and surface laid when installed and have no cover.	Subject to full Comparative Assessment
2	Trunk Lines (Partially Trenched and Buried)	All rigid trunk lines running from the offshore field to the low water mark at shore approach.	Subject to full Comparative Assessment
3	Flexible Pipelines and Umbilicals (Trenched and Buried)	All flexible pipelines and umbilicals across all fields which were trenched and buried when installed. Inclusion of flexible pipelines and umbilicals in the same group deemed appropriate as they share similar design and manufacture characteristics, consisting of multiple layers of metals and polymers.	Subject to full Comparative Assessment
4	Flexible Pipelines and Umbilicals (Trenched and Rock Covered)	All flexible pipelines and umbilicals across all fields which were trenched and rock covered when installed. Inclusion of flexible pipelines and umbilicals in the same group deemed appropriate as they share similar design and manufacture characteristics, consisting of multiple layers of metals and polymers.	Subject to full Comparative Assessment
5	Umbilicals (Surface Laid)	All umbilicals that are surface laid with no cover.	Full Removal
6	Rigid Pipelines (Surface Laid, Exposed and Non-Concrete Coated)	All rigid pipelines without concrete coating that are surface laid with no cover.	Subject to full Comparative Assessment

GRP	TITLE	DESCRIPTION	DECOMMISSIONING APPROACH
7	Rigid Pipelines (Surface Laid, Exposed and Concrete Coated)	All rigid pipelines with concrete coating that are surface laid with no cover.	Subject to full Comparative Assessment
8	Rigid Pipelines (Surface Laid and Rock Covered)	All rigid pipelines that are surface laid and rock covered.	Subject to full Comparative Assessment
9	Rigid Pipelines (Trenched and Buried)	All rigid pipelines that are trenched and buried.	Subject to full Comparative Assessment
10	Flexible Risers and Riser Umbilicals	All flexible riser and dynamic umbilicals.	Full Removal
11	Rigid Risers	All rigid risers.	Full Removal
12	Spools and Jumpers	All spools associated with the tie-in of pipelines to subsea installations / risers. All jumpers associated with the tie-in of umbilicals to subsea installations.	Full Removal
13	Large Structures	The Underwater Manifold Centre (UMC) Template and all internals.	Full Removal
14	Structures	All subsea structures excluding the UMC Template.	Full Removal
15	Protection and Stabilisation	All protection, support and stabilisation materials such as mattresses and grout bags.	Full Removal
16	Blocked Rigid Pipeline (Trenched and Buried)	Hudson rigid pipeline with known blockage, trenched and buried.	Subject to full Comparative Assessment
17	In-Use Rigid Pipelines (Trenched and Partially Buried)	All rigid pipelines, trenched and partially buried.	Subject to full Comparative Assessment
18	Uncertain Integrity [Note 1] and Concrete Coated Rigid Pipelines (Trenched and Buried)	All disused rigid pipelines (trenched and buried) with uncertain integrity. Also includes concrete coated pipelines (trenched and buried) as the full removal options are consistent for both types of line.	Subject to full Comparative Assessment

Table 3.1 - Decommissioning Groups and Initial Decommissioning Recommendation

Notes

1. In this context, uncertain integrity refers to pipelines which lack sufficient inspection data to have confidence that a reverse installation (reverse reel / reverse S-lay) decommissioning option would be considered viable, and thus, cut and lift is the appropriate feasible full removal option.

3.2 Decommissioning Groups for Evaluation

In summary, the 11 decommissioning groups for the Northern North Sea Subsea Infrastructure where full removal was not considered to be the clear recommended solution and that are to be subjected to the full CA process are:

- Group 1 – Pipe-in-Pipe Hybrids (Surface Laid and Exposed)
- Group 2 – Trunk Lines (Partially Trenched and Buried)
- Group 3 – Flexible Pipelines and Umbilicals (Trenched and Buried)
- Group 4 – Flexible Pipelines and Umbilicals (Trenched and Rock Covered)
- Group 6 – Rigid Pipelines (Surface Laid, Exposed and Non-Concrete Coated)
- Group 7 – Rigid Pipelines (Surface Laid, Exposed and Concrete Coated)
- Group 8 – Rigid Pipelines (Surface Laid and Rock Covered)
- Group 9 – Rigid Pipelines (Trenched and Buried)
- Group 16 – Blocked Rigid Pipeline (Trenched and Buried)
- Group 17 – In-Use Rigid Pipelines (Trenched and Partially Buried)
- Group 18 – Uncertain Integrity and Concrete Coated Rigid Pipelines (Trenched and Buried)

Given that there are 11 groups retained for evaluation, due to the limited time available for the assessment participants the scope of the CA Stakeholder Workshop focussed on the following five representative groups:

- Group 1 – Pipe-in-Pipe Hybrids (Surface Laid and Exposed)
- Group 2 – Trunk Lines (Partially Trenched and Buried)
- Group 3 – Flexible Pipelines and Umbilicals (Trenched and Buried)
- Group 16 – Blocked Rigid Pipeline (Trenched and Buried)
- Group 18 – Uncertain Integrity and Concrete Coated Rigid Pipelines (Trenched and Buried)

These groups were selected to give a broad cross-section of the line types being considered under the Northern North Sea Subsea Infrastructure.

3.3 Potential Residual Wax Deposits

During the decommissioning preparation activities progressed since the original CA was conducted in 2021, the potential for wax deposits in various lines within various groups has been discussed with OPRED. As with all pipeline contents, flushing and cleaning operations will be executed to best environmental practices and outcomes as was factored into the original CA conducted. Where there is potential for increased levels of wax deposits remaining post-cleaning, the environmental impact of these deposits has been considered in the Wax Discharge Assessment ref. [16]. No increase to the legacy impact considered during the original CA has been identified and therefore no amendments to the conclusions within this CA are required.

4 GROUP 1 – PIPE-IN-PIPE HYBRIDS (SURFACE LAID AND EXPOSED)

4.1 Group 1 Characteristics

The items that make up Group 1 and their key characteristics are listed in Table 4.1.

ID	DESCRIPTION	OD (INCHES)	LENGTH (KM
PL167 (N1208)	Oil Pipe-in-Pipe Hybrid – East [1] – from UMC to Cormorant A	26	3.345
PL167 (N1208)	Oil Pipe-in-Pipe Hybrid - East [2] – from UMC to Cormorant A	26	3.345
PL210 (N1209)	Oil Pipe-in-Pipe Hybrid - West [1] – from UMC to Cormorant A	26	3.343
PL210 (N1209)	Oil Pipe-in-Pipe Hybrid - West [2] – from UMC to Cormorant A	26	3.343
PL168 (N1207)	Oil Pipe-in-Pipe Hybrid – from UMC to Cormorant A	24	3.345
PL168 (N1207)	Oil Pipe-in-Pipe Hybrid – from UMC to Cormorant A	24	3.345

Table 4.1 - Group 1 Items

Refer to Appendix N for details of the Pipe in Pipe Hybrid components and appurtenances.

There are no crossings associated with this group.

4.2 Group 1 Decommissioning Options & Screening Outcome

During the Screening Phase, all potential decommissioning options were assessed against the Safety, Environmental, Technical, Societal and Economic criteria using a coarse screening methodology. The assessment performed and the resultant outcomes are detailed fully in the CA Screening Report ref. [4] and summarised in Table 4.2 below.

CATEGORY	OPTION	DESCRIPTION	DISCUSSION
Re-use	1 – Re-use	Leave pipeline / umbilicals in-situ for use in any potential new developments	The integrity of (PL167 and PL210 in this group is unknown and this rules out re-use opportunities. The integrity of PL168 is known to be good, however a review of potential reuse options has indicated that there are no viable reuse options in this location. Option screened out as a technical showstopper on that basis.

CATEGORY	OPTION	DESCRIPTION	DISCUSSION
Full Removal	2A – Cut and Lift with De-burial	Pipelines / umbilicals will be disconnected De-burial of pipelines / umbilicals using MFE (if buried) Recover by cutting into sections and removal Cutting by hydraulic shears or Diamond Wire Cutting (DWC) depending on diameter / coating type	Assessed as attractive in one, acceptable in two and unattractive in two criteria. Retained for evaluation as the most viable full removal option.
	2B – Reverse Installation (S-lay or Reel) without De-burial	Pipelines / umbilicals will be disconnected No de-burial prior to removal Recover by reverse reel or reverse s-lay Removal technique based on diameter / construction type / coating type If removal by reverse reel, lines are recovered by reeling to vessel, if removal by reverse s-lay, lines are recovered to vessel and cut into sections on vessel	Carrier pipe for these Pipe-in-Pipe Hybrid lines never designed for reverse reeling / reverse s-lay. Strength / integrity not expected to support reverse installation. Lines were tow installed and are not considered structurally suitable for catenary recovery. Option screened out as a technical showstopper on that basis.
	2C – Reverse Installation (S-lay or Reel) with De-burial	As per 2B but with de-burial of pipelines / umbilicals using MFE (if buried)	Not applicable option as lines are surface laid therefore no de-burial is needed making option same as 2B.
	2D – Reverse Installation (Buoyancy)	Pipelines will be disconnected Surface laid line so no de-burial required Perform re-float using a suitable technique (Added buoyancy / aided lift / existing buoyancy, other) Entire line returned to shore via tow	Re-float of Pipe-in-Pipe Hybrid has never been done before. Considered highly novel and potentially a technical showstopper from an integrity of carrier pipe for re-float / tow purposes. Option screened out as a technical showstopper on that basis.
	2E – Cut, Float & Transport	Pipelines will be disconnected Surface laid line so no de-burial required Cut into 50m sections subsea (likely to be with hydraulic shears) Float to surface using a suitable technique Return to shore on vessel / towed in basket / retained buoyancy system	Various technical challenges such as the cutting of the lines, lifting / dropped object of the lines, line cleanliness / integrity of carrier pipe / towing over infrastructure. No significant benefits of this option over Option 2A – Cut and Lift. Option screened out as a technical showstopper on that basis.

CATEGORY	OPTION	DESCRIPTION	DISCUSSION
Leave In-situ (Major Intervention)	3A – Rock Placement over entire line	Pipelines / umbilicals will be disconnected Rock placement over full length of pipeline / umbilical to address areas of spans, exposure & shallow burial No recovery of pipelines / umbilicals	Assessed as attractive in one, acceptable in one and unattractive in three criteria. This is due to the impact of the high / long rock berm introduced and the large quantity / impact of rock required for this option. This is sufficient for option to be screened out on a cumulative basis.
	3B – Retrench and Bury entire line	Pipelines / umbilicals will be disconnected Re-trench and backfill full length of pipeline / umbilical to remove areas of spans, exposure & shallow burial depth No recovery of pipelines / umbilicals No introduction of new material	Assessed as attractive in two and acceptable in three criteria. Trench and bury is believed to be achievable to the depth required for these lines. Retained for evaluation against other remaining options.
Leave In-situ (Minor Intervention)	4A – Rock Placement over areas of Spans / Exposure / Shallow Burial	Pipelines / umbilicals will be disconnected Removal and recovery of surface laid sections out with existing trench (including transitions) Rock placement to remediate snag risk from cuts ends Rock placement at all areas of spans, exposure and shallow burial depth	Assessed as attractive in four and acceptable in one criterion. These are large diameter, surface laid lines so only spans would be considered a problem area as, by definition, surface laid lines are fully exposed. Retained for evaluation against other remaining options.
	4B – Trench & Bury areas of Spans / Exposure / Shallow Burial	Pipelines / umbilicals will be disconnected Removal and recovery of surface laid sections out with existing trench (including transitions) Rock placement to remediate snag risk from cut ends Trench / bury areas of spans, exposure and shallow burial depth Minimal introduction of new material	Not applicable option as trenching only spans / exposed areas of surface laid lines not viable – rock cover or removal of problem areas is considered more applicable.
	4C – Remove areas of Spans / Exposure / Shallow Burial	Pipelines / umbilicals will be disconnected Removal and recovery of surface laid sections out with existing trench (including transitions) Rock placement to remediate snag risk from cut ends Removal of areas of spans, exposure and shallow burial depth using cut and lift techniques	Assessed as acceptable in four and attractive in one criteria. These are large diameter, surface laid lines so only spans would be a considered a problem area as, by definition, surface laid lines are fully exposed. Retained for evaluation against other remaining options.

CATEGORY	OPTION	DESCRIPTION	DISCUSSION
Leave In-situ (Minor Intervention)	4D – Accelerated Decomposition	Pipelines / umbilicals will be disconnected Removal and recovery of surface laid sections out with existing trench Rock placement to remediate snag risk from cut ends Introduce material / techniques to accelerate the decomposition process Potential options include reverse polarity CP, Sulphate Reducing Bacteria (SRBs), chemicals, etc.	Accelerated Decomposition not proven technology for any lines at this stage. The technical challenges that may be associated with using novel / un-proven approach for Pipe-in-Pipe Hybrid lines likely to be even greater than for traditional rigid line. Option **screened out** as a technical showstopper on that basis.
Leave In-situ (Minimum Intervention)	5 – Remove Line Ends & Remediate Snag Risk	Pipelines / umbilicals will be disconnected Removal and recovery of surface laid sections out with existing trench (including transitions) Rock placement to remediate snag risk from cut ends	Removing ends of these surface laid pipe-in-pipe hybrid lines offers little benefit given the remainder of the lines will remain in-situ. Option screened out as a technical showstopper on that basis. Note 1
Leave As-is and Monitor	6 – Leave As-is	There will be no planned subsea intervention Appropriate legislative considerations shall be addressed and any advisory zones implemented for remaining subsea infrastructure	Considered an unacceptable solution from a safety perspective due to the potential residual snag risk from the ends of the surface laid lines once their structures have been removed. Option **screened out** as a safety showstopper on that basis.

Table 4.2 - Group 1 Decommissioning Options & Screening Summary

Note 1: During the original screening activity, Option 5 was considered a viable option, however additional information was identified during the preparation phase which subsequently resulted in this option being screened out.

4.3 Group 1 Decommissioning Options for Evaluation

The decommissioning options for Group 1 that remained after screening and which were taken forward to the evaluation phase are therefore:

- Full Removal
  - 2A – Cut and Lift with De-burial
- Leave In-situ (Major intervention)
  - 3B – Trench and Bury entire line
- Leave In-situ (Minor intervention)
  - 4A – Rock Placement over areas of Spans / Exposure / Shallow Burial
  - 4C – Remove areas of Spans / Exposures / Shallow Burial

4.4 Group 1 Evaluation Summary

GROUP 1 – PIPE-IN-PIPE HYBRIDS (SURFACE LAID AND EXPOSED) (See Section 15.1 for detailed discussion and Appendix C for full attributes table and assessment)	
Safety	**Option 3B is assessed as being preferred from a Safety perspective.** All partial removal options are equally preferred over Option 2A (full removal) against the Operations Personnel criterion due to the lower offshore and onshore scopes with the partial removal options. All partial removal options are equally preferred over Option 2A (full removal) against the Other Users criterion due to the full removal option having a higher number of vessel days of operations and a higher number of transits to / from the field. Option 3B (trench entirety of lines) and Option 4A (rock placement over problem areas) are equally preferred over Option 4C (remove problem areas) and Option 2A (full removal) against the High Consequence Events criterion due to the potential for high consequence events from dropped object associated with the high number of offshore lifting operations in Option 4C (remove problem areas) and the much higher number of offshore lifting operations in Option 2A (full removal by cut and lift). Option 2A (full removal) is preferred from a legacy risk perspective, marginally over Option 3B (trench entirety of lines) as both options present a clear seabed although the lines remain in-situ in Option 3B. There was stronger preference for Option 2A over the other options as the lines remain in-situ and surface laid in those options.
Environment	**Option 2A is assessed as being preferred from an Environment perspective.** All partial removal options are equally preferred over Option 2A (full removal) against the Operational Marine Impact criterion due to the marginally higher noise impact from the longer duration of vessels on-site and cutting operations in the full removal option. There is additional impact from the discharges of pipeline contents and loss of insulation material at all cut locations in the full removal option. All partial removal options are also equally preferred over Option 2A (full removal) against the Atmospheric Emissions & Fuel Use criterion due to the full removal option generating around 3 to 4 times higher atmospheric emissions than the other options. The full removal option is marginally preferred over the other options against the Other Consumptions criterion. This is due to the lower lifecycle environmental impact from recycling the returned material in the full removal option when compared to the impact of replacing material left in-situ in the partial removal options. The full removal option is also marginally preferred over the other options against the Seabed Disturbance criterion. This is due to the cut and lift of these surface laid lines having negligible seabed disturbance versus significant area of temporary impact in Option 3B (trenching entirety of lines) or the smaller area of permanent habitat change from the introduction of rock cover in the other options. The full removal option is significantly preferred over the partial removal options from a Legacy Marine Impacts perspective. This is due to there being no legacy environmental impact from the full removal of these lines versus a small impact associated with the slow discharge of line contents / degradation products with the partial removal options as the lines remain in-situ.
Technical	**Option 4A is assessed as being preferred from a Technical perspective.** All options employ relatively routine operations for their execution, however the simple and smaller scope associated with the rock cover operations in Option 4A are considered to carry the least technical risk of the options. Option 3B (trench entirety of lines) has potential for technical challenges associated with the geotechnical conditions in the area and trenching of lines with these diameters. Option 2A (full removal) has challenges associated with the stability of lift / retention of the pipe-in-pipe hybrid internals during recovery operations although the 'crimping' effect of the hydraulic shears on the carrier pipe are expected to mitigate this. Option 4C has similar challenges but is on a much smaller scale than full removal as only problem areas are recovered in this option.

GROUP 1 – PIPE-IN-PIPE HYBRIDS (SURFACE LAID AND EXPOSED)

(See Section 15.1 for detailed discussion and Appendix C for full attributes table and assessment)

Societal

Option 2A is assessed as being preferred from a Societal perspective.

The full removal option is preferred from a Societal – Fishing perspective as the lines are fully removed versus the lines remaining in-situ in the other options.

There is also a small preference for the full removal option from Societal – Other Users perspective due to a combination of the quantity of useful, recyclable material (steel) returned and the job creation / retention offered by the larger scope in this option. It is noted that extraction of the useful steel from the insulation material on these pipe-in-pipe hybrids could be challenging.

Economic

Option 4A and Option 4C are assessed as being equally preferred from an Economic perspective.

There is a preference for Option 4A and Option 4C over the other options from a Short-term Costs perspective as the cost to deliver these options is lower than the Option 3B and much lower than Option 2A.

All options are equally preferred from a Long-term Costs perspective as, while there are no costs associated with Option 2A, the costs associated with survey and monitoring of lines left in-situ are relatively low.

Summary

Overall Option 4A is the emerging recommendation.

The outcome shows that the preference for Option 4A (rock placement problem areas) over Option 2A (full removal) is small. While Option 2A is preferred over Option 4A against the Safety and Environmental criteria, these preferences are modest. There is a stronger preference for the full removal option against the Societal criterion. Option 4A gets a significant preference over the full removal option against the Technical Risk criterion due to the concerns surrounding the stability of lift / retention of internals when recovering around 20 km of pipe-in-pipe hybrid lines in short sections in Option 2A.

Once the Economics criterion is included, the small preference for Option 4A is strengthened and hence Option 4A is the emerging recommendation for Group 1.

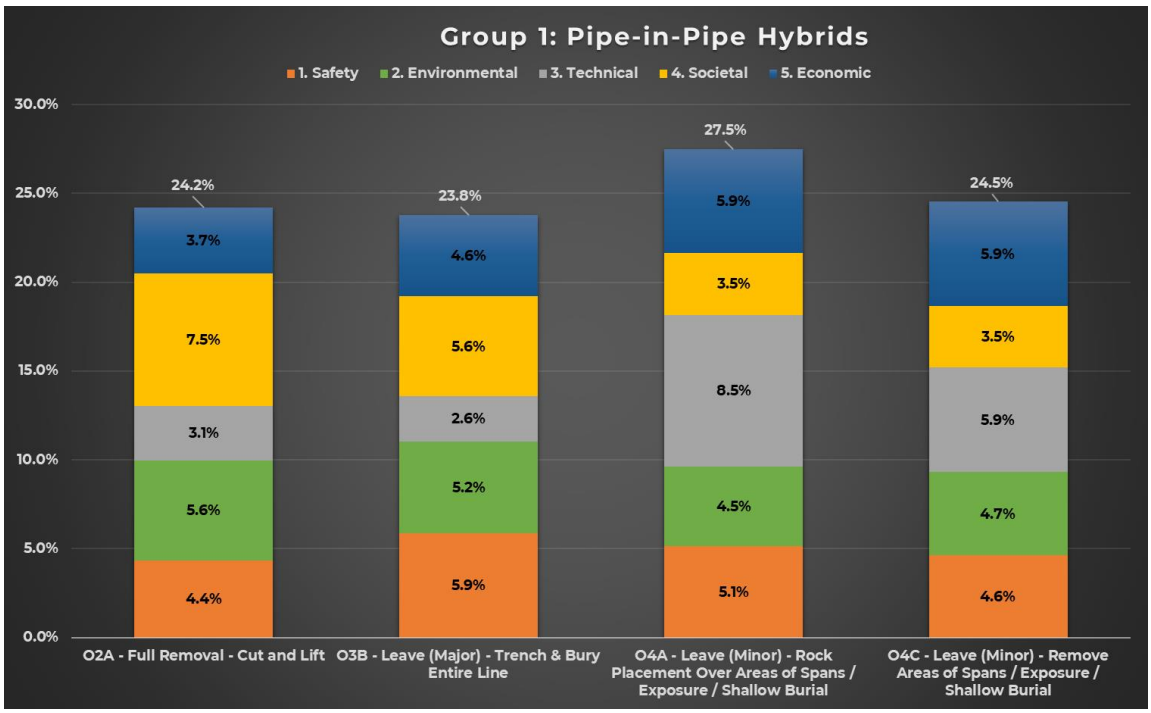


Table 4.3 - Group 1 Evaluation Summary

5 GROUP 2 – TRUNK LINES (PARTIALLY TRENCHED AND BURIED)

5.1 Group 2 Characteristics

The items that make up Group 2 and their key characteristics are listed in Table 5.1.

ID	DESCRIPTION	OD (INCHES)	LENGTH (KM
PL4	Oil Pipeline from ESDV on Cormorant Alpha to landfall on Shetland.	36	153.3

Table 5.1 - Group 2 Items

In accordance with North Sea Transition Authority's (NSTA) decommissioning strategy, TAQA has considered whether there are any alternative uses (repurposing) for the PL4 pipeline prior to decommissioning. Findings of this assessment are documented within a technical note, 'PL4 Trunk Line Re-Use Assessment', ref. [14]. In summary, there were no re-use or re-purposing options identified. However, TAQA propose to maintain the integrity of the line post cessation of production such that future re-use or re-purposing options are not excluded.

5.2 Group 2 Decommissioning Options & Screening Outcome

During the Screening Phase, all potential decommissioning options were assessed against the Safety, Environmental, Technical, Societal and Economic criteria using a coarse screening methodology. The assessment performed and the resultant outcomes are detailed fully in the CA Screening Report ref. [4] and summarised in Table 5.2 below.

CATEGORY	OPTION	DESCRIPTION	DISCUSSION
Re-use	1 – Re-use	Leave pipeline in-situ for use in any potential new developments	The integrity of the single trunk line (PL4) in this group is known to be good. A review of potential reuse options has indicated that there are no viable reuse options in this location, Ref [14]. Option **screened out** as a Technical Showstopper on that basis. Note 1
Full Removal	2A – Cut and Lift with De-burial	Pipeline will be disconnected De-burial of pipelines / umbilicals using MFE (if buried) Recover by cutting into sections and removal Cutting by hydraulic shears or Diamond Wire Cutting (DWC) depending on diameter / coating type	Assessed as acceptable in two and unattractive in three criteria. **Retained for evaluation** as the most viable full removal option.

CATEGORY	OPTION	DESCRIPTION	DISCUSSION
	2B – Reverse Installation (S-lay or Reel) without De-burial	Pipeline will be disconnected No de-burial prior to removal Recover by reverse reel or reverse s-lay Removal technique based on diameter / construction type / coating type If removal by reverse reel, lines are recovered by reeling to vessel, if removal by reverse s-lay, lines are recovered to vessel and cut into sections on vessel	Assessed as acceptable in two and unattractive in three criteria. Significant concerns surrounding the ability to remove this line using reverse installation (s-lay) techniques, with the concrete coating likely to present significant challenges. Option screened out as a technical showstopper on that basis.
Full Removal	2C – Reverse Installation (S-lay or Reel) with De-burial	As per 2B but with de-burial of pipelines / umbilicals using MFE (if buried)	Assessed as acceptable in two and unattractive in three criteria. Significant concerns surrounding the ability to remove this line using reverse installation (s-lay) techniques, with the concrete coating likely to present significant challenges. Option screened out as a technical showstopper on that basis.
	2D – Reverse Installation (Buoyancy)	Pipeline will be disconnected Perform re-float using a suitable technique (Added buoyancy / aided lift / existing buoyancy, other) Entire line returned to shore via tow	Not applicable option as this line does not lend itself to reverse installation using buoyancy techniques.
	2E – Cut, Float & Transport	Pipeline will be disconnected Cut into 50m sections subsea (likely to be with hydraulic shears) Float to surface using a suitable technique Return to shore on vessel / towed in basket / retained buoyancy system	Not applicable option as this line does not lend itself to floatation for recovery and transportation to shore.
Leave In-situ (Major Intervention)	3A – Rock Placement over entire line	Pipeline will be disconnected Rock placement over full length of pipeline / umbilical to address areas of spans, exposure & shallow burial No recovery of pipelines / umbilicals	Assessed as attractive in one, acceptable in one and unattractive in three criteria. This is due to the impact of the high / extremely long rock berm introduced, and the extremely large quantity / impact of rock required for this option. This is sufficient for option to be screened out.
	3B – Retrench and Bury entire line	Pipeline will be disconnected Re-trench and backfill full length of pipeline / umbilical to remove areas of spans, exposure & shallow burial depth No recovery of pipelines / umbilicals No introduction of new material	The original design basis for the installation of this line was for it to be trenched. This has been achieved in some areas but was unsuccessful in others. The likelihood of being able to successfully trench the line is consequently very low. Option screened out as a Technical Showstopper on that basis.

CATEGORY	OPTION	DESCRIPTION	DISCUSSION
Leave In-situ (Minor Intervention)	4A – Rock Placement over areas of Spans / Exposure / Shallow Burial	Pipeline will be disconnected Removal and recovery of surface laid sections out with existing trench (including transitions) Rock placement to remediate snag risk from cut ends Rock placement at all areas of spans, exposure and shallow burial depth	Assessed as attractive in four and acceptable in one criterion. Retained for evaluation against other remaining options.
	4B – Trench & Bury areas of Spans / Exposure / Shallow Burial	Pipeline will be disconnected Removal and recovery of surface laid sections out with existing trench (including transitions) Rock placement to remediate snag risk from cut ends Trench / bury areas of spans, exposure and shallow burial depth Minimal introduction of new material	Not applicable option as trenching only spans / exposed areas of the line, where trenching has been attempted in the past and has been unsuccessful, is not viable – rock cover or removal of problem areas is considered more applicable.
	4C – Remove areas of Spans / Exposure / Shallow Burial	Pipeline will be disconnected Removal and recovery of surface laid sections out with existing trench (including transitions) Rock placement to remediate snag risk from cut ends Removal of areas of spans, exposure and shallow burial depth using cut and lift techniques	Assessed as acceptable in three and attractive in two criteria. Retained for evaluation against other remaining options.
	4D – Accelerated Decomposition	Pipeline will be disconnected Removal and recovery of surface laid sections out with existing trench Rock placement to remediate snag risk from cut ends Introduce material / techniques to accelerate the decomposition process Potential options include reverse polarity CP, Sulphate Reducing Bacteria (SRBs), chemicals, etc.	Not applicable decommissioning option for concrete coated lines as the coating would be left in-situ.
Leave In-situ (Minimum Intervention)	5 – Remove Line Ends & Remediate Snag Risk	Pipeline will be disconnected Removal and recovery of surface laid sections out with existing trench (including transitions) Rock placement to remediate snag risk from cut ends	Considered an unacceptable solution from a safety perspective due to the potential residual snag risk from the presence of reportable spans along the line. Option screened out as a safety showstopper on that basis
Leave As-is and Monitor	6 – Leave As-is	There will be no planned subsea intervention Appropriate legislative considerations shall be addressed, and any advisory zones implemented for remaining subsea infrastructure	Considered an unacceptable solution from a safety perspective due to the potential residual snag risk from the subsea line end and presence of reportable spans along the line. Option screened out as a safety showstopper on that basis.

Table 5.2 - Group 2 Decommissioning Options and Screening Summary

Note 1: While there are no re-use options identified for the trunk line in Group 2 (PL4) at this stage [14], it is recognised that the general discussion around re-use of trunk lines is progressing. As such, a commitment is made to ensure that the chosen decommissioning solution for PL4 will not preclude any potential future re-use options.

5.3 Group 2 Decommissioning Options for Evaluation

The decommissioning options for Group 2 that remained after screening, and which were taken forward to the evaluation phase are therefore:

- Full Removal
  - 2A – Cut and Lift with De-burial
- Leave In-situ (Minor intervention)
  - 4A – Rock Placement over areas of Spans / Exposure / Shallow Burial
  - 4C – Remove areas of Spans / Exposures / Shallow Burial

5.4 Group 2 Evaluation Summary

GROUP 2 – TRUNK LINES (PARTIALLY TRENCHED AND BURIED) (See Section 15.2 for detailed discussion and Appendix D for full attributes table and assessment)	
Safety	**Option 4A is assessed as being preferred from a Safety perspective.** Option 4A (rock placement over problem areas) is preferred against the Operations Personnel criterion due to the lower offshore and onshore scopes and lower risk operations associated with this option. The full removal option was least preferred due to the risk exposure associated with recovering 153 km of line by cut and lift. Option 4A is also preferred against the Other Users criterion due to it having the fewest number of vessel days of operations and transits to / from the field of the options. Again, the full removal option was least preferred due to the much higher number of vessel days / transits associated with the large full removal scope. Option 4A is also preferred against the High Consequence Events criterion due to there being no offshore lifting in Option 4A versus hundreds of offshore lifts in Option 4C to recover the problem areas and thousands of offshore lifts in Option 2A to fully recover the line. Option 2A (full removal) is preferred from a legacy risk perspective as the line is fully removed versus remaining in-situ in the other options.
Environment	**Option 4C is assessed as being preferred from an Environment perspective.** Option 4A is preferred against the Operational Marine Impact criterion as Option 4C has a higher noise impact from the longer duration of vessels on-site and cutting operations with Option 2A (full removal) being significantly higher again. This relative preference is magnified due to the potential impact on marine mammals and seal haul out area in nearshore location of the trunk line. Option 4A is also preferred against the Atmospheric Emissions & Fuel Use criterion due to the full removal option generating around 16 times more atmospheric emissions than Option 4A. Option 2A is preferred against the Other Consumptions criterion as no rock cover is required versus the moderate quantity of rock required in Option 4C and the significantly higher quantity of rock required in Option 4A. Option 4C is preferred over the other options against the Seabed Disturbance criterion. This is due to the smaller area impacted by rock cover (permanent habitat change) in Option 4C, of which around 10% would be located in the East Mainland Coast Shetland SPA, over Option 4A. The full removal option is significantly preferred over the partial removal options from a Legacy Marine Impacts perspective. This is due to there being no legacy environmental impact from the full removal of this line versus a small impact associated with the slow discharge of line contents / degradation products with the partial removal options as the line remains in-situ.
Technical	**Option 4A is assessed as being preferred from a Technical perspective.** All options employ relatively routine operations for their execution, however the simple and smaller scope associated with the rock cover operations in Option 4A are considered to carry the least technical risk of the options. Option 2A (full removal) has challenges associated with the scale of the operations required to de-bury (where required) and cut and lift sections of this 153 km line. Option 4C has similar operations to Option 2A but is on a much smaller scale than full removal as only problem areas are recovered in this option.
Societal	**Options 2A is assessed as being preferred from a Societal perspective.** The full removal option is preferred from a Societal – Fishing perspective as the line is fully removed versus the line remaining in-situ in the other options. There is a small preference for the partial removal options from a Societal – Other Users perspective despite the job creation / retention offered by the large scope and the large quantity of useful and recyclable steel associated with the full removal option. This is due to the detrimental impact from the large quantity of seawater contaminated concrete coating returned under the full removal option as it is likely to take up limited landfill capacity.

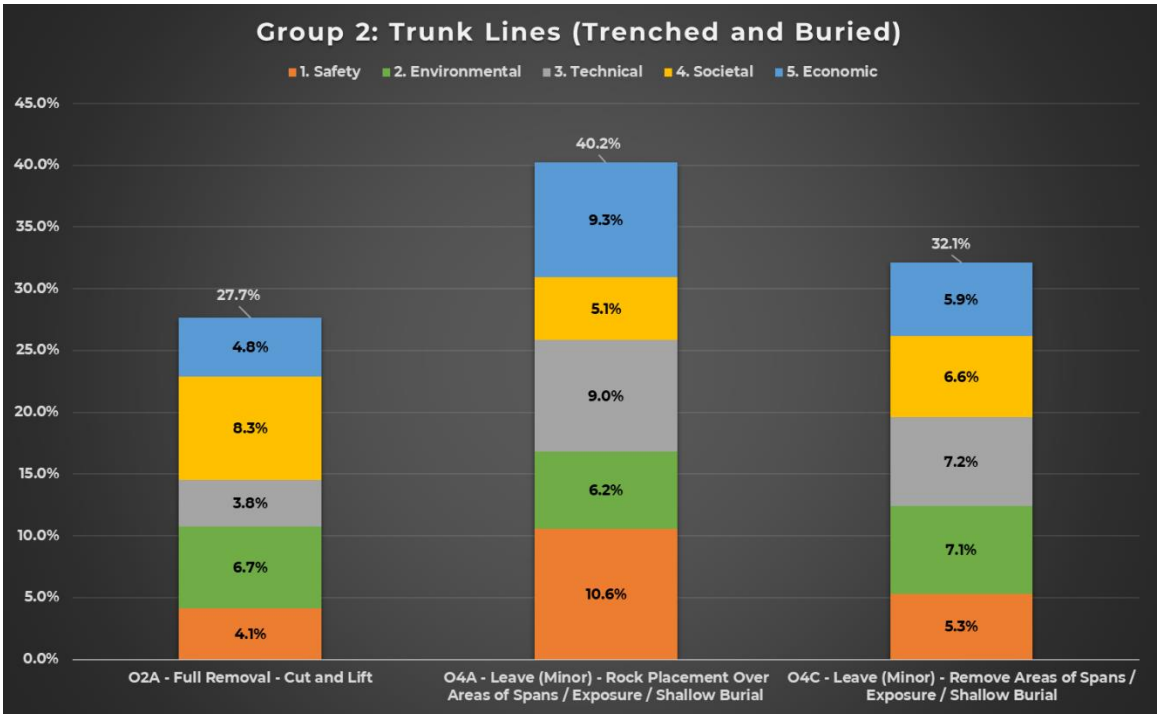
GROUP 2 – TRUNK LINES (PARTIALLY TRENCHED AND BURIED) (See Section 15.2 for detailed discussion and Appendix D for full attributes table and assessment)	
Economic	**Option 4A is assessed as being preferred from an Economic perspective.** There is a preference for Option 4A from a Short-term Costs perspective as the cost to deliver Option 4C is around 5 times higher and the cost to deliver Option 2A is around 40 times higher. There is a small preference for Option 2A over the other options from a Long-term Costs perspective as there are no costs associated with Option 2A versus moderate costs associated with survey and monitoring of the line left in-situ.
Summary	**Overall Option 4A is the emerging recommendation.** The outcome shows that the preference for Option 4A (rock placement problem areas) is significant. Option 4A is significantly preferred over the options against the Safety and Technical criteria. There is a smaller preference for Option 4C against the Environmental criterion and Option 2A against the Societal criterion where Option 4A is the least preferred option in both cases. However, this is insufficient to offset the preference from a Safety and Technical perspective. Once the Economics criterion is included, the preference for Option 4A is strengthened and hence Option 4A is the emerging recommendation for Group 2. 

Table 5.3 - Group 2 Evaluation Summary

6 GROUP 3 – FLEXIBLE PIPELINES AND UMBILICALS (TRENCHED AND BURIED)

6.1 Group 3 Characteristics

The items that make up Group 3 and their key characteristics are listed in Table 6.1.

ID	DESCRIPTION	OD (INCHES)	LENGTH (KM
PL118 (N0701)	Oil 2 – TFL from Well P1 to Cormorant A	3	5.600
PL118 (N0702)	Oil 1 – TFL from Well P1 to Cormorant A	3	5.600
PL1558 (N0927)	Water Injection Pipeline from UMC to Well W4	6	3.537
PL169 (N0803)	Umbilical – East from Cormorant A to UMC	3	7.669
PL169 (N0804)	Umbilical – West from Well P1 to Cormorant A	3	7.962
PL308/PL309 (N0805)	Umbilical from UMC to Well P5	10	3.300
PLU6227 (N0806)	Umbilical from UMC to Well W4	10	3.845
PL1165 (N0874)	Replacement Umbilical Cormorant A to UMC	112 mm	7.200
PL1088/89/90 (N0843)	Control Umbilical from Cormorant A to Pelican	136 mm	8.542
PLU1944 (N1862)	Replacement Control Umbilical Cormorant A to Pelican	4	8.434
PL3815 (N0809)	Power Cable from North Cormorant to Eider	4	13.110
PLU1870 (T0127)	Control Umbilical from Eider to Otter	162 mm	21.000
PL4438 (T0126)	Power Cable (MPP Supply) from Eider to Otter	91 mm	21.600
PL4439	Power Cable (MPP Supply) from Eider to Otter	91 mm	21.600
PL4440	Power Cable (Manifold Supply) from Eider to Otter	91 mm	21.600
PLU3575 (N1869)	Control Umbilical from Tern to Cladhan	144 mm	16.600
PL1851 (N0791)	Oil Flexible Pipeline from Kestrel P1 to SSIV	8.5	7.796
PL1852 (N1128)	Gas Lift Flexible Pipeline from Tern to Kestrel	4	7.737
PLU1854 (N1827)	Umbilical from Tern to Kestrel P2	8.5	7.900
PL1023 Note 1	Hudson Main Umbilical from Tern to Hudson Manifold	N/A	11.000

Table 6.1 - Group 3 Items

Notes:

1. Includes PL1023.15, PL1023.16, PL1023.17, PL1023.20, PL1023.21, PL1023.22, PL1023.23, PL1023.24 and sections of PL1023.1 – 14, PL1023.18, PL1023.19, PL1023.26, PL1023.27, PL1023.28, PL1023.29, PL1023.30 and PL1023.31 that run between Tern Platform and the Hudson Manifold.

There are 119 crossings associated with this group, 72 under and 44 over. Where crossings under existing infrastructure are encountered an allowance to cut either side of the crossing and re-initiate reeling operations has been included within the supporting calculations for the full removal option, Ref. [8]. For over crossings, the lines shall be fully removed (in the full removal option).

6.2 Group 3 Decommissioning Options & Screening Outcome

During the Screening Phase, all potential decommissioning options were assessed against the Safety, Environmental, Technical, Societal and Economic criteria using a coarse screening methodology. The assessment performed and the resultant outcomes are detailed fully in the CA Screening Report ref. [4] and summarised in Table 6.2 below.

Q2 2024 Update: In the original screening phase, the retained option for full removal of the equipment in this group was Option 2B – Reverse Installation (S-lay or Reel) without De-burial. Upon engagement with decommissioning contractors in 2024, full removal of the equipment in this group was considered not feasible as detailed in a Technical Note ref. [15]. The full removal methodology was changed to Option 2A – Cut and Lift with De-burial accordingly. The screening outcome described in Table 6.2 has been updated and a revised evaluation conducted as presented in Section 6.4.

CATEGORY	OPTION	DESCRIPTION	DISCUSSION
Re-use	1 – Re-use	Leave pipeline / umbilicals in-situ for use in any potential new developments	While the integrity of the lines in this group is known to be good, a review of potential reuse options has indicated that there are no viable reuse options at any of these locations. Option screened out as a Technical Showstopper on that basis.
Full Removal	2A – Cut and Lift with De-burial	Pipelines / umbilicals will be disconnected De-burial of pipelines / umbilicals using MFE (if buried) Recover by cutting into sections and removal Cutting by hydraulic shears or Diamond Wire Cutting (DWC) depending on diameter / coating type	Originally assessed as attractive in two, acceptable in one and unattractive in two criteria. An assessment of the feasibility of reverse reeling these lines was completed in Q2 2024 which concluded that reverse reeling was not feasible as detailed in a Technical Note ref. [15]. Option 2A retained for evaluation as the only viable full removal option.
	2B – Reverse Installation (S-lay or Reel) without De-burial	Pipelines / umbilicals will be disconnected No de-burial prior to removal Recover by reverse reel or reverse s-lay Removal technique based on diameter / construction type / coating type If removal by reverse reel, lines are recovered by reeling to vessel, if removal by reverse s-lay, lines are recovered to vessel and cut into sections on vessel	Originally assessed as attractive in two and acceptable in three criteria. Screened out due to findings of a Technical Note ref. [15].

CATEGORY	OPTION	DESCRIPTION	DISCUSSION
Full Removal	2C – Reverse Installation (S-lay or Reel) with De-burial	As per 2B but with de-burial of pipelines / umbilicals using MFE (if buried)	Originally assessed as attractive in two and acceptable in three criteria. Screened out due to findings of a Technical Note ref. [15].
	2D – Reverse Installation (Buoyancy)	Pipelines will be disconnected Surface laid line so no de-burial required Perform re-float using a suitable technique (Added buoyancy / aided lift / existing buoyancy, other) Entire line returned to shore via tow	Not applicable option as these lines do not lend themselves to removal using buoyancy techniques.
	2E – Cut, Float & Transport	Pipelines will be disconnected Surface laid line so no de-burial required Cut into 50m sections subsea (likely to be with hydraulic shears) Float to surface using a suitable technique Return to shore on vessel / towed in basket / retained buoyancy system	Not applicable option as these lines do not lend themselves to floatation for recovery and transportation to shore.
Leave In-situ (Major Intervention)	3A – Rock Placement over entire line	Pipelines / umbilicals will be disconnected Rock placement over full length of pipeline / umbilical to address areas of spans, exposure & shallow burial No recovery of pipelines / umbilicals	There are limited areas of spans / exposure or shallow burial on any of these lines and therefore there is no benefit in full rock cover. Option screened out as a technical showstopper on that basis.
	3B – Retrench and Bury entire line	Pipelines / umbilicals will be disconnected Re-trench and backfill full length of pipeline / umbilical to remove areas of spans, exposure & shallow burial depth No recovery of pipelines / umbilicals No introduction of new material	There are limited areas of spans / exposure or shallow burial on any of these lines and therefore there is no benefit in full trench and bury. Option screened out as a technical showstopper on that basis.
Leave In-situ (Minor Intervention)	4A – Rock Placement over areas of Spans / Exposure / Shallow Burial	Pipelines / umbilicals will be disconnected Removal and recovery of surface laid sections out with existing trench (including transitions) Rock placement to remediate snag risk from cut ends Rock placement at all mid-line areas of spans, exposure and shallow burial depth	Assessed as attractive in four and acceptable in one criterion. There are limited areas of spans / exposure or shallow burial on any of these lines hence addressing just these areas by rock cover is a viable option. Retained for evaluation against other remaining options.
	4B – Trench & Bury areas of Spans / Exposure / Shallow Burial	Pipelines / umbilicals will be disconnected Removal and recovery of surface laid sections out with existing trench (including transitions) Rock placement to remediate snag risk from cut ends Trench / bury mid-line areas of spans, exposure and shallow burial depth Minimal introduction of new material	Assessed as attractive in two and acceptable in three criteria. There are limited areas of spans / exposure or shallow burial on any of these lines hence addressing just these areas by trenching is a viable option. Retained for evaluation against other remaining options.

CATEGORY	OPTION	DESCRIPTION	DISCUSSION
Leave In-situ (Minor Intervention)	4C – Remove areas of Spans / Exposure / Shallow Burial	Pipelines / umbilicals will be disconnected Removal and recovery of surface laid sections out with existing trench (including transitions) Rock placement to remediate snag risk from cut ends Removal of mid-line areas of spans, exposure and shallow burial depth using cut and lift techniques	Assessed as attractive in two and acceptable in three criteria. There are limited areas of spans / exposure or shallow burial on any of these lines hence addressing just these areas by removal is a viable option. Retained for evaluation against other remaining options.
	4D – Accelerated Decomposition	Pipelines / umbilicals will be disconnected Removal and recovery of surface laid sections out with existing trench Rock placement to remediate snag risk from cut ends Introduce material / techniques to accelerate the decomposition process Potential options include reverse polarity CP, Sulphate Reducing Bacteria (SRBs), chemicals, etc.	Not applicable option due to the use of polymers and multiple layer construction method of the lines.
Leave In-situ (Minimum Intervention)	5 – Remove Line Ends & Remediate Snag Risk	Pipelines / umbilicals will be disconnected Removal and recovery of surface laid sections out with existing trench (including transitions) Rock placement to remediate snag risk from cut ends	Assessed as attractive in four and acceptable in one criteria. There are limited areas of spans / exposure or shallow burial on any of these lines hence leaving these areas unaddressed considered a viable option. Retained for evaluation against other remaining options.
Leave As-is and Monitor	6 – Leave As-is	There will be no planned subsea intervention Appropriate legislative considerations shall be addressed, and any advisory zones implemented for remaining subsea infrastructure	Considered an unacceptable solution from a safety perspective due to the potential residual snag risk from the surface laid sections of these lines out with their trench. Option screened out as a safety showstopper on that basis.

Table 6.2 - Group 3 Decommissioning Options and Screening Summary

6.3 Group 3 Decommissioning Options for Evaluation

The decommissioning options for Group 3 remaining after screening and taken forward to evaluation are:

- Full Removal
  - 2A – Cut and Lift with De-burial
- Leave In-situ (Minor intervention)
  - 4A – Rock Placement over areas of Spans / Exposure / Shallow Burial
  - 4B – Trench and Bury areas of Spans / Exposure / Shallow Burial
  - 4C – Remove areas of Spans / Exposures / Shallow Burial
- Leave In-situ (Minimal Intervention)
  - 5 – Remove Line Ends and Remediate Snag Risk

6.4 Group 3 Evaluation Summary

GROUP 3 – FLEXIBLE PIPELINES AND UMBILICALS (TRENCHED AND BURIED) (See Section 15.3 for detailed discussion and Appendix E for full attributes table and assessment)	
Safety	**Option 5 is assessed as being preferred from a Safety perspective.** Option 5 (remove line ends only) is preferred against the Operations Personnel criterion as it has the lowest risk exposure from the lowest offshore and onshore scopes of all options. Option 5 is also preferred against the Other Users criterion due to it having the fewest vessel days of operations and transits to / from the field. Option 5 is also preferred (equally with Option 4A and Option 4B) against the High Consequence Events criterion due to there being limited potential from dropped object from the lower lifting operations. Option 2A is preferred from a legacy risk perspective as the lines are fully removed versus being left in-situ in the other options.
Environment	**Option 5 is assessed as being preferred from an Environment perspective.** Option 5 (remove line ends only) is preferred against the Operational Marine Impact criterion as it has the lowest noise impact from the shortest duration of vessels on-site and cutting operations across the options. Option 5 is preferred against the Atmospheric Emissions & Fuel Use criterion as it has the lowest emissions and fuel use of the options. Option 2A (full removal), Option 4B (trench problem areas) and Option 5 are preferred against the Other Consumptions criterion. This is due to the limited rock resource required across these options with the other options having a requirement for significant quantities of rock. Option 5 is preferred against the Seabed Disturbance criterion as this option has the lowest temporary / permanent seabed impact of the options. Option 2A is preferred from a Legacy Marine Impacts perspective due to there being no legacy environmental impact from the full removal of these lines.
Technical	**Option 5 is assessed as being preferred from a Technical perspective.** All options employ relatively routine operations for their execution however there are challenges associated with the trenching operations in Option 4B and from the scale of cutting operations required in Option 2A (full removal). Option 5 is marginally preferred over the other options given the smallest scale of routine operations.

GROUP 3 – FLEXIBLE PIPELINES AND UMBILICALS (TRENCHED AND BURIED)

(See Section 15.3 for detailed discussion and Appendix E for full attributes table and assessment)

Societal

Option 2A is assessed as being preferred from a Societal perspective.

The full removal option is preferred from a Societal – Fishing perspective as the lines are fully removed versus the lines remaining in-situ in the other options.

There is also a small preference for the full removal option from Societal – Other Users perspective due to a combination of the quantity of useful, recyclable material (steel) returned and the job creation / retention offered by the larger scope in this option.

Economic

Option 5 is assessed as being preferred from an Economic perspective.

There is a preference for Option 5 from a Short-term Costs perspective as the costs to deliver this option are significantly lower (minimum of around 50% lower) than any of the other options.

There is a small preference for Option 2A over the other options from a Long-term Costs perspective as there are no costs associated with Option 2A versus moderate costs associated with survey and monitoring of the lines left in-situ.

Summary

Overall Option 5 is the emerging recommendation.

The outcome shows that the preference for Option 5 is significant. Option 5 is preferred over the options against the Safety, Environment and Technical criteria. It being less preferred against the Societal criterion is insufficient to offset these preferences.

Once the Economics criterion is included, the preference for Option 5 remains and hence Option 5 is the emerging recommendation for Group 3.

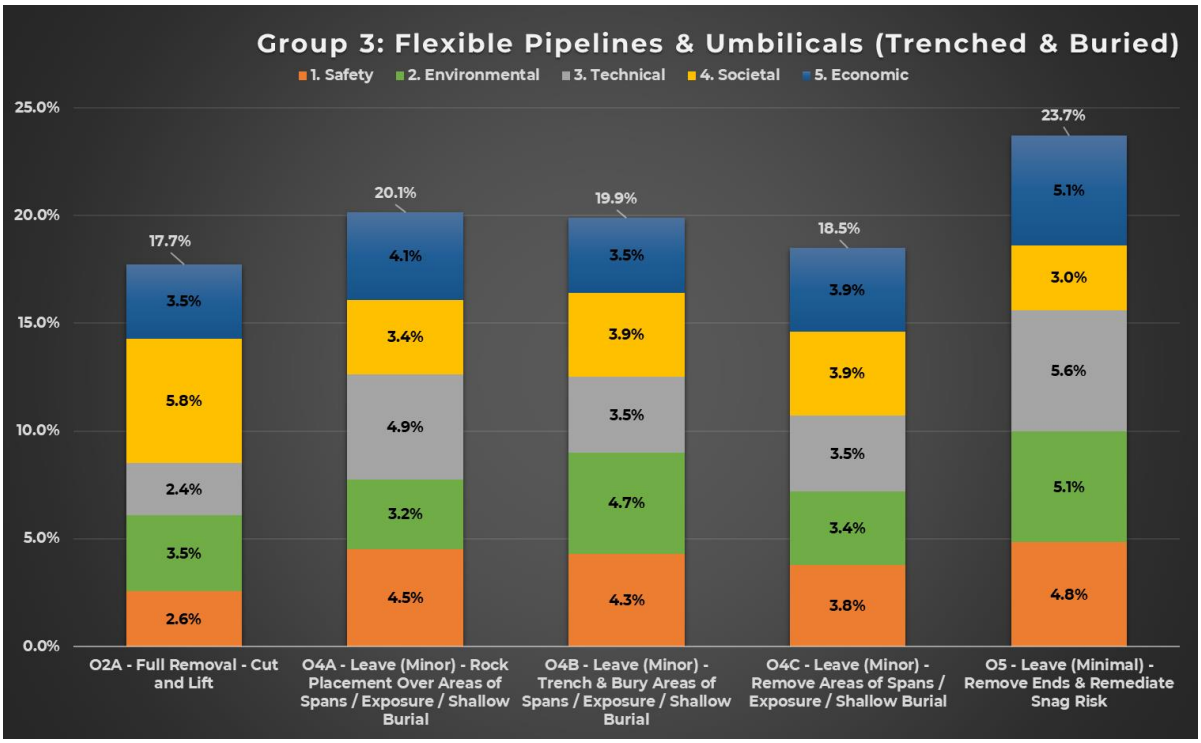


Table 6.3 – Group 3 Evaluation Summary

7 GROUP 4 – FLEXIBLE PIPELINES AND UMBILICALS (TRENCHED AND ROCK COVERED)

7.1 Group 4 Characteristics

The items that make up Group 4 and their key characteristics are listed in Table 7.1.

ID	DESCRIPTION	OD (INCHES)	LENGTH (KM
PL2765 (N0793)	Production Flexible Flowline from Falcon to Kestrel P2 Note 1	6	3.800
PL2766 (N1129)	Gas Lift Flexible Flowline from Kestrel P2 to Falcon Note 1	4	3.800
PL2767 (N1864)	Control Umbilical from Kestrel P2 to Falcon Note 1	93 mm	3.800

Table 7.1 - Group 4 Items

Note 1: All three of these lines are laid in the same trench.

There are two crossings associated with these lines, both under. Where crossings under existing infrastructure are encountered an allowance to cut either side of the crossing and re-initiate reeling operations has been included within the supporting calculations, Ref. [8] for the full removal option.

7.2 Group 4 Decommissioning Options & Screening Outcome

During the Screening Phase, all potential decommissioning options were assessed against the Safety, Environmental, Technical, Societal and Economic criteria using a coarse screening methodology. The assessment performed and the resultant outcomes are detailed fully in the CA Screening Report ref. [4] and summarised in Table 7.2 below.

Q2 2024 Update: In the original screening phase, the retained option for full removal of the equipment in this group was Option 2C – Reverse Installation (S-lay or Reel) with De-burial. Upon engagement with decommissioning contractors in 2024, full removal of the equipment in this group was considered not feasible as detailed in a Technical Note ref. [15]. The full removal methodology was changed to Option 2A – Cut and Lift with De-burial accordingly. The screening outcome described in Table 7.2 has been updated and the preferred option revised, based on the revised evaluation conducted for Group 3 as presented in Section 6.4.

CATEGORY	OPTION	DESCRIPTION	DISCUSSION
Re-use	1 – Re-use	Leave pipeline / umbilicals in-situ for use in any potential new developments	While the integrity of the lines in this group is known to be good, a review of potential reuse options has indicated that there are no viable reuse options in this location. Option screened out as a Technical Showstopper on that basis.

CATEGORY	OPTION	DESCRIPTION	DISCUSSION
Full Removal	2A – Cut and Lift with De-burial	Pipelines / umbilicals will be disconnected De-burial of pipelines / umbilicals using MFE (if buried) Recover by cutting into sections and removal Cutting by hydraulic shears or Diamond Wire Cutting (DWC) depending on diameter / coating type	Assessed as attractive in two, acceptable in one and unattractive in two criteria. An assessment of the feasibility of reverse reeling these lines was completed in Q2 2024 which concluded that reverse reeling was not feasible as detailed in a Technical Note ref. [15]. Retained for evaluation as the only viable full removal option.
Full Removal	2B – Reverse Installation (S-lay or Reel) without De-burial	Pipelines / umbilicals will be disconnected No de-burial prior to removal Recover by reverse reel or reverse s-lay Removal technique based on diameter / construction type / coating type If removal by reverse reel, lines are recovered by reeling to vessel, if removal by reverse s-lay, lines are recovered to vessel and cut into sections on vessel	Assessed as attractive in two and acceptable in three criteria. Screened out due to findings reported in a Technical Note ref. [15].
	2C – Reverse Installation (S-lay or Reel) with De-burial	As per 2B but with de-burial of pipelines / umbilicals using MFE (if buried)	Assessed as attractive in two and acceptable in three criteria. Screened out due to findings reported in a Technical Note ref. [15].
	2D – Reverse Installation (Buoyancy)	Pipelines will be disconnected De-burial of pipelines / umbilicals using MFE Perform re-float using a suitable technique (Added buoyancy / aided lift / existing buoyancy, other) Entire line returned to shore via tow	Not applicable option as these lines do not lend themselves to removal using buoyancy techniques.
	2E – Cut, Float & Transport	Pipelines will be disconnected De-burial of pipelines / umbilicals using MFE Cut into sections subsea (likely to be with hydraulic shears) Float to surface using a suitable technique Return to shore on vessel / towed in basket / retained buoyancy system	Not applicable option as these lines do not lend themselves to floatation for recovery and transportation to shore.
Leave In-situ (Major Intervention)	3A – Rock Placement over entire line	Pipelines / umbilicals will be disconnected Rock placement over full length of pipeline / umbilical to address areas of spans, exposure & shallow burial No recovery of pipelines / umbilicals	Not applicable option as these lines are already trenched and rock covered therefore there is no benefit in full rock cover.
	3B – Retrench and Bury entire line	Pipelines / umbilicals will be disconnected Re-trench and backfill full length of pipeline / umbilical to remove areas of spans, exposure & shallow burial depth No recovery of pipelines / umbilicals No introduction of new material	Not applicable option as these lines are already trenched and rock covered therefore there is no benefit in full trench and bury.

CATEGORY	OPTION	DESCRIPTION	DISCUSSION
Leave In-situ (Minor Intervention)	4A – Rock Placement over areas of Spans / Exposure / Shallow Burial	Pipelines / umbilicals will be disconnected Removal and recovery of surface laid sections out with existing trench (including transitions) Rock placement to remediate snag risk from cut ends Rock placement at all areas of spans, exposure and shallow burial depth	Assessed as attractive in four and acceptable in one criterion. There are limited areas of spans / exposure or shallow burial on any of these lines hence addressing just these areas by rock cover is a viable option. Retained for evaluation against other remaining options.
Leave In-situ (Minor Intervention)	4B – Trench & Bury areas of Spans / Exposure / Shallow Burial	Pipelines / umbilicals will be disconnected Removal and recovery of surface laid sections out with existing trench (including transitions) Rock placement to remediate snag risk from cut ends Trench / bury areas of spans, exposure and shallow burial depth Minimal introduction of new material	Assessed as attractive in two and acceptable in three criteria. There are challenges associated with trenching lines already rock covered and alternative options would be selected. Option screened out as a technical showstopper on that basis.
	4C – Remove areas of Spans / Exposure / Shallow Burial	Pipelines / umbilicals will be disconnected Removal and recovery of surface laid sections out with existing trench (including transitions) Rock placement to remediate snag risk from cut ends Removal of areas of spans, exposure and shallow burial depth using cut and lift techniques	Assessed as attractive in two and acceptable in three criteria. There are limited areas of spans / exposure or shallow burial on any of these lines hence addressing just these areas by removal is a viable option. Retained for evaluation against other remaining options.
	4D – Accelerated Decomposition	Pipelines / umbilicals will be disconnected Removal and recovery of surface laid sections out with existing trench Rock placement to remediate snag risk from cut ends Introduce material / techniques to accelerate the decomposition process Potential options include reverse polarity CP, Sulphate Reducing Bacteria (SRBs), chemicals, etc.	Not applicable option due to the use of polymers and multiple layer construction method of the lines.
Leave In-situ (Minimum Intervention)	5 – Remove Line Ends & Remediate Snag Risk	Pipelines / umbilicals will be disconnected Removal and recovery of surface laid sections out with existing trench (including transitions) Rock placement to remediate snag risk from cut ends	Assessed as attractive in four and acceptable in one criterion. There are limited areas of spans / exposure or shallow burial on any of these lines hence leaving these areas unaddressed considered a viable option. Retained for evaluation against other remaining options.

CATEGORY	OPTION	DESCRIPTION	DISCUSSION
Leave As-is	6 – Leave As-is	There will be no planned subsea intervention Appropriate legislative considerations shall be addressed, and any advisory zones implemented for remaining subsea infrastructure	Considered an unacceptable solution from a safety perspective due to the potential residual snag risk from the surface laid sections of these lines out with their trench. Option **screened out** as a safety showstopper on that basis.

Table 7.2 - Group 4 Decommissioning Options and Screening Summary

7.3 Group 4 Decommissioning Options for Evaluation

The decommissioning options for Group 4 remaining after screening and taken forward to evaluation are:

- Full Removal
  - 2A – Cut and Lift with De-burial
- Leave In-situ (Minor Intervention)
  - 4A – Rock Placement over areas of Spans / Exposure / Shallow Burial
  - 4C – Remove areas of Spans / Exposures / Shallow Burial
- Leave In-situ (Minimal Intervention)
  - 5 – Remove Line Ends and Remediate Snag Risk

7.4 Group 4 Evaluation Summary

Given the similarity between the equipment in Group 3, where the flexible flowlines and umbilicals are trenched and buried and Group 4 where the flexible flowlines are trenched and rock covered, the outcome of the evaluation for Group 4 is in line with the outcome obtained during the evaluation of Group 3 as described in Section 6.4. On this basis, the preferred decommissioning option for Group 4 is Option 5, Remove Ends and Remediate Snag Risk. See also section 15.4 and Appendix F for further discussion.

8 GROUP 6 – RIGID PIPELINES (SURFACE LAID, EXPOSED AND NON-CONCRETE COATED)

8.1 Group 6 Characteristics

The items that make up Group 6 and their key characteristics are listed in Table 8.1.

ID	DESCRIPTION	OD (INCHES)	LENGTH (KM
PL1317 (N1002)	Water Injection Pipeline from Tern to Eider (Water Injection Tee)	16	16.104

Table 8.1 - Group 6 Items

There are two crossings associated with this line, one under and one over. Where crossings under existing infrastructure are encountered an allowance to cut either side of the crossing and re-initiate reeling operations has been included within the supporting calculations, Ref. [8] for the full removal option.

8.2 Group 6 Decommissioning Options & Screening Outcome

During the Screening Phase, all potential decommissioning options were assessed against the Safety, Environmental, Technical, Societal and Economic criteria using a coarse screening methodology. The assessment performed and the resultant outcomes are detailed fully in the CA Screening Report ref. [4] and summarised in Table 8.2 below.

CATEGORY	OPTION	DESCRIPTION	DISCUSSION
Re-use	1 – Re-use	Leave pipeline in-situ for use in any potential new developments	While the integrity of the line in this group is known to be good, a review of potential reuse options has indicated that there are no viable reuse options in this location. Option screened out as a Technical Showstopper on that basis.
Full Removal	2A – Cut and Lift with De-burial	Pipeline will be disconnected De-burial of pipeline using MFE (if buried) Recover by cutting into sections and removal Cutting by hydraulic shears or Diamond Wire Cutting (DWC) depending on diameter / coating type	Assessed as attractive in three, and unattractive in two criteria. Option screened out as a more onerous full removal option than Option 2B.

CATEGORY	OPTION	DESCRIPTION	DISCUSSION
Full Removal	2B – Reverse Installation (S-lay or Reel) without De-burial	Pipeline will be disconnected No de-burial prior to removal Recover by reverse reel or reverse s-lay Removal technique based on diameter / construction type / coating type If removal by reverse reel, lines are recovered by reeling to vessel, if removal by reverse s-lay, lines are recovered to vessel and cut into sections on vessel	Assessed as attractive in three and acceptable in two criteria. Retained for evaluation as the most viable full removal option.
	2C – Reverse Installation (S-lay or Reel) with De-burial	As per 2B but with de-burial of pipelines / umbilicals using MFE (if buried)	Not applicable option as line is surface laid.
	2D – Reverse Installation (Buoyancy)	Pipeline will be disconnected Surface laid line so no de-burial required Perform re-float using a suitable technique (Added buoyancy / aided lift / existing buoyancy, other) Entire line returned to shore via tow	Not applicable option as this line does not lend itself to reverse installation using buoyancy techniques.
	2E – Cut, Float & Transport	Pipeline will be disconnected Surface laid line so no de-burial required Cut into sections subsea (likely to be with hydraulic shears) Float to surface using a suitable technique Return to shore on vessel / towed in basket / retained buoyancy system	Not applicable option as this line does not lend itself to recovery by floatation and transportation to shore.
Leave In-situ (Major Intervention)	3A – Rock Placement over entire line	Pipeline will be disconnected Rock placement over full length of pipeline / umbilical to address areas of spans, exposure & shallow burial No recovery of pipeline	Assessed as attractive in one, acceptable in two and unattractive in two criteria. This is due to the impact of the high / long rock berm introduced and the large quantity / impact of rock required for this option. This is sufficient for option to be screened out on a cumulative basis.
	3B – Retrench and Bury entire line	Pipeline will be disconnected Re-trench and backfill full length of pipeline to remove areas of spans, exposure & shallow burial depth No recovery of pipeline No introduction of new material	Assessed as attractive in two and acceptable in three criteria. Trench and bury is believed to be achievable to the depth required for this line. Retained for evaluation against other remaining options.
Leave In-situ (Minor Intervention)	4A – Rock Placement over areas of Spans / Exposure / Shallow Burial	Pipeline will be disconnected Removal and recovery of surface laid sections out with existing trench (including transitions) Rock placement to remediate snag risk from cut ends Rock placement at all areas of spans, exposure and shallow burial depth	Assessed as attractive in three, acceptable in one and unattractive in one criterion. There are known areas of spanning on this line which would benefit from being addressed by rock cover. Retained for evaluation against other remaining options.

CATEGORY	OPTION	DESCRIPTION	DISCUSSION
Leave In-situ (Minor Intervention)	4B – Trench & Bury areas of Spans / Exposure / Shallow Burial	Pipeline will be disconnected Removal and recovery of surface laid sections out with existing trench (including transitions) Rock placement to remediate snag risk from cut ends Trench / bury areas of spans, exposure and shallow burial depth Minimal introduction of new material	Not applicable option as trenching only spans / exposed areas of surface laid lines not viable – rock cover or removal of problem areas is considered more applicable.
	4C – Remove areas of Spans / Exposure / Shallow Burial	Pipeline will be disconnected Removal and recovery of surface laid sections out with existing trench (including transitions) Rock placement to remediate snag risk from cut ends Removal of areas of spans, exposure and shallow burial depth using cut and lift techniques	Assessed as attractive in three, acceptable in one and unattractive in one criterion. There are known areas of spanning on this line which would benefit from being addressed by removal. Retained for evaluation against other remaining options.
	4D – Accelerated Decomposition	Pipeline will be disconnected Removal and recovery of surface laid sections out with existing trench Rock placement to remediate snag risk from cut ends Introduce material / techniques to accelerate the decomposition process Potential options include reverse polarity CP, Sulphate Reducing Bacteria (SRBs), chemicals, etc.	Not applicable option due to this line having a polymer liner.
Leave In-situ (Minimum Intervention)	5 – Remove Line Ends & Remediate Snag Risk	Pipeline will be disconnected Removal and recovery of surface laid sections out with existing trench (including transitions) Rock placement to remediate snag risk from cut ends	Considered an unacceptable solution from a safety perspective due to the potential residual snag risk from the presence of known spans along the line. Option screened out as a safety showstopper on that basis
Leave As-is and Monitor	6 – Leave As-is	There will be no planned subsea intervention Appropriate legislative considerations shall be addressed, and any advisory zones implemented for remaining subsea infrastructure	Considered an unacceptable solution from a safety perspective due to the potential residual snag risk from the presence of known spans along the line and ends of the surface laid line once the structures have been removed. Option screened out as a safety showstopper on that basis.

Table 8.2 - Group 6 Decommissioning Options and Screening Summary

8.3 Group 6 Decommissioning Options for Evaluation

The decommissioning options for Group 6 remaining after screening and taken forward to evaluation are:

- Full Removal
  - 2B – Reverse Installation (S-lay or Reel) without De-burial
- Leave In-situ (Major intervention)
  - 3B – Trench and Bury entire line
- Leave In-situ (Minor intervention)
  - 4A – Rock Placement over areas of Spans / Exposure / Shallow Burial
  - 4C – Remove areas of Spans / Exposures / Shallow Burial

8.4 Group 6 Evaluation Summary

GROUP 6 – RIGID PIPELINES (SURFACE LAID, EXPOSED AND NON-CONCRETE COATED) (See Section 0 for detailed discussion and Appendix G for full attributes table and assessment)	
Safety	**Option 4A is assessed as being preferred from a Safety perspective.** Option 4A (rock placement problem areas) is preferred against the Operations Personnel criterion due to the lower offshore and onshore scopes with this option. All options are equally preferred against the Other Users criterion as, while there are differences in the number of vessel days of operations and transits to / from the field across the options, these differences are insufficient to express a preference. Option 3B (trench entirety of line) and Option 4A are equally preferred against the High Consequence Events criterion due to there being limited potential from dropped object from the limited / no offshore lifting in these options. All other options have offshore lifting operations to varying degrees. Option 2B is preferred from a legacy risk perspective as the line is fully removed versus being left in-situ in the other options.
Environment	**Option 2B is assessed as being preferred from an Environment perspective.** All options are equally preferred against the Operational Marine Impact criterion as the impact from all options is considered largely similar. All options are also equally preferred against the Atmospheric Emissions & Fuel Use criterion as, while there are differences in the atmospheric emissions generated across the options, these differences are insufficient to express a preference. All options are also equally preferred against the Other Consumptions criterion as, while there are differences in the impact from recycling returned material / replacing material left in-situ and the rock consumed across the options, these differences are insufficient to express a preference. Option 2B (full removal) is preferred against the Seabed Disturbance criterion as there is limited seabed disturbance from this surface laid line whereas all other options have varying degrees of temporary (from trenching) / permanent (from rock cover) seabed impact. Option 2B is also preferred from a Legacy Marine Impacts perspective due to there being no legacy environmental impact from the full removal of this line.
Technical	**Option 4A and Option 4C are assessed as being equally preferred from a Technical perspective.** Option 4A (rock placement over problem areas) and Option 4C (removal of problem areas by cut and lift) employ relatively routine operations for their execution, whereas there are challenges associated with reverse reeling a rigid line of this diameter and trenching a line with the prevailing geotechnical conditions and of this diameter.

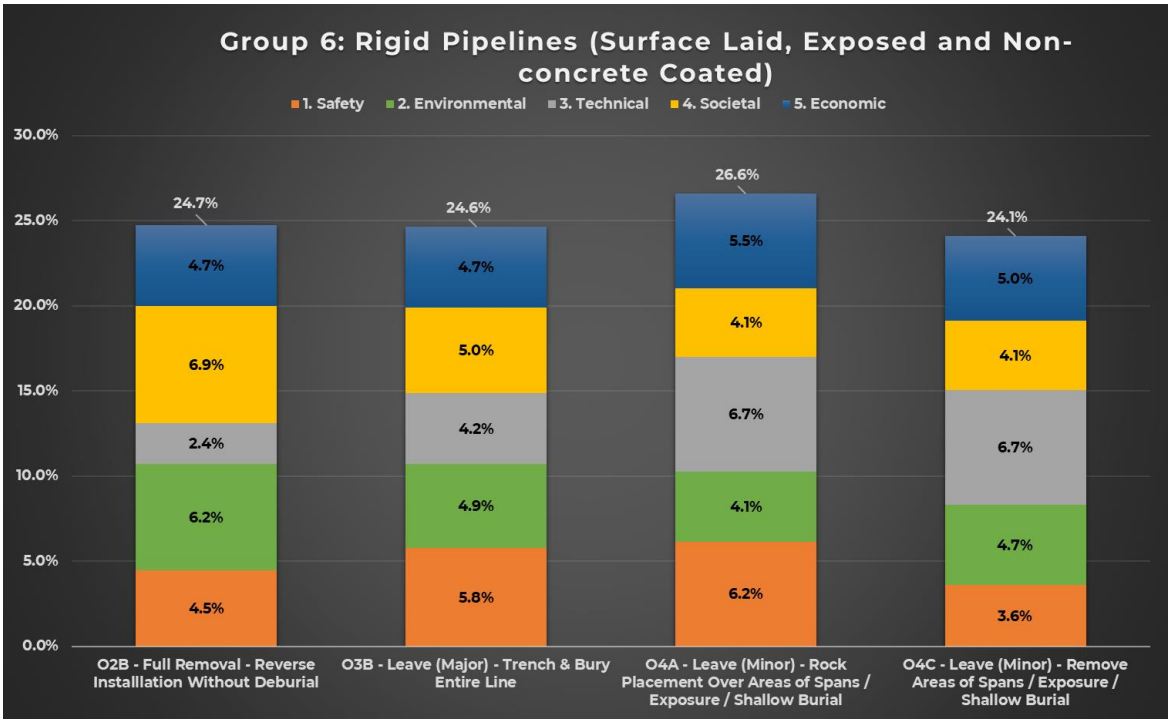
GROUP 6 – RIGID PIPELINES (SURFACE LAID, EXPOSED AND NON-CONCRETE COATED) (See Section 0 for detailed discussion and Appendix G for full attributes table and assessment)	
Societal	**Option 2B is assessed as being preferred from a Societal perspective.** Option 2B (full removal) is preferred from a Societal – Fishing perspective as the line is fully removed versus the line remaining in-situ in the other options. All options are equally preferred from a Societal – Other Users perspective as the societal impacts are considered largely similar across the options.
Economic	**Option 4A is assessed as being preferred from an Economic perspective.** Option 4A (rock placement problem areas) is preferred from a Short-term Costs perspective as the costs to deliver this option is less than half the next least expensive option and significantly lower than the other options. All options are equally preferred from a Long-term Costs perspective as, while there are no costs associated with Option 2B, the costs associated with survey and monitoring of the line left in-situ are relatively low.
Summary	**Overall Option 4A is the emerging recommendation.** The outcome shows that the preference for Option 4A (rock placement over problem areas) is moderate. Option 4A is preferred over the other options against the Safety and Technical criteria. Option 4A is the least preferred option against the Environmental and Societal criteria where Option 2B (full removal) is most preferred, however there remains a preference for Option 4A overall. Once the Economics criterion is included, the preference for Option 4A is strengthened and hence Option 4A is the emerging recommendation for Group 6. 

Table 8.3 - Group 6 Evaluation Summary

9 GROUP 7 – RIGID PIPELINES (SURFACE LAID, EXPOSED AND CONCRETE COATED)

9.1 Group 7 Characteristics

The items that make up Group 7 and their key characteristics are listed in Table 9.1.

ID	DESCRIPTION	OD (INCHES)	LENGTH (KM
PL113 (N0305)	Oil Pipeline from North Cormorant to Cormorant A	20	16.586
PL477 (N0505)	Oil Pipeline from Tern to North Cormorant	16	12.597

Table 9.1 - Group 7 Items

There are five crossings associated with these lines, all over existing infrastructure and, as such, will be fully removed with an allowance to do so included within the supporting calculations, Ref. [8] for the full removal option.

9.2 Group 7 Decommissioning Options & Screening Outcome

During the Screening Phase, all potential decommissioning options were assessed against the Safety, Environmental, Technical, Societal and Economic criteria using a coarse screening methodology. The assessment performed and the resultant outcomes are detailed fully in the CA Screening Report ref. [4] and summarised in Table 9.2 below.

CATEGORY	OPTION	DESCRIPTION	DISCUSSION
Re-use	1 – Re-use	Leave pipelines in-situ for use in any potential new developments	While the integrity of the lines in this group are known to be good, a review of potential reuse options has indicated that there are no viable reuse options in this location. Option screened out as a Technical Showstopper on that basis.
Full Removal	2A – Cut and Lift with De-burial	Pipelines will be disconnected De-burial of pipelines using MFE (if buried) Recover by cutting into sections and removal Cutting by hydraulic shears or Diamond Wire Cutting (DWC) depending on diameter / coating type	Assessed as attractive in one, acceptable in two and unattractive in two criteria. Retained for evaluation as the most viable full removal option.

CATEGORY	OPTION	DESCRIPTION	DISCUSSION
Full Removal	2B – Reverse Installation (S-lay or Reel) without De-burial	Pipelines will be disconnected No de-burial prior to removal Recover by reverse reel or reverse s-lay Removal technique based on diameter / construction type / coating type If removal by reverse reel, lines are recovered by reeling to vessel, if removal by reverse s-lay, lines are recovered to vessel and cut into sections on vessel	Assessed as attractive in one, acceptable in one and unattractive in three criteria. Significant concerns surrounding the ability to remove this line using reverse installation (S-lay) techniques, with the concrete coating likely to present significant challenges. This is sufficient for option to be screened out on a cumulative basis.
	2C – Reverse Installation (S-lay or Reel) with De-burial	As per 2B but with de-burial of pipelines using MFE (if buried)	Not applicable option as lines are surface laid.
	2D – Reverse Installation (Buoyancy)	Pipelines will be disconnected Surface laid line so no de-burial required Perform re-float using a suitable technique (Added buoyancy / aided lift / existing buoyancy, other) Entire line returned to shore via tow	Not applicable option as these lines do not lend themselves to reverse installation using buoyancy techniques.
	2E – Cut, Float & Transport	Pipelines will be disconnected Surface laid line so no de-burial required Cut into sections subsea (likely to be with diamond wire cutting) Float to surface using a suitable technique Return to shore on vessel / towed in basket / retained buoyancy system	Not applicable option as these lines do not lend themselves to recovery by floatation and transportation to shore.
Leave In-situ (Major Intervention)	3A – Rock Placement over entire line	Pipelines will be disconnected Rock placement over full length of pipeline / umbilical to address areas of spans, exposure & shallow burial No recovery of pipelines	Assessed as attractive in one, acceptable in two and unattractive in two criteria. This is due to the impact of the high / long rock berm introduced and the large quantity / impact of rock required for this option. This is sufficient for option to be screened out on a cumulative basis.
	3B – Retrench and Bury entire line	Pipelines will be disconnected Re-trench and backfill full length of pipeline / umbilical to remove areas of spans, exposure & shallow burial depth No recovery of pipelines No introduction of new material	Assessed as attractive in two and acceptable in three criteria. Trench and bury is believed to be achievable to the depth required for these lines. Retained for evaluation against other remaining options.
Leave In-situ	4A – Rock Placement over areas of Spans / Exposure / Shallow Burial	Pipelines will be disconnected Removal and recovery of surface laid sections out with existing trench (including transitions) Rock placement to remediate snag risk from cuts ends Rock placement at all areas of spans, exposure and shallow burial depth	Assessed as attractive in two, acceptable in two and unattractive in one criterion. There are known areas of spanning on these lines which would benefit from being addressed by rock cover. Retained for evaluation against other remaining options.

CATEGORY	OPTION	DESCRIPTION	DISCUSSION
	4B – Trench & Bury areas of Spans / Exposure / Shallow Burial	Pipelines will be disconnected Removal and recovery of surface laid sections out with existing trench (including transitions) Rock placement to remediate snag risk from cut ends Trench / bury areas of spans, exposure and shallow burial depth Minimal introduction of new material	Not applicable option as trenching only spans / exposed areas of surface laid lines not viable – rock cover or removal of problem areas is considered more applicable.
	4C – Remove areas of Spans / Exposure / Shallow Burial	Pipelines will be disconnected Removal and recovery of surface laid sections out with existing trench (including transitions) Rock placement to remediate snag risk from cut ends Removal of areas of spans, exposure and shallow burial depth using cut and lift techniques	Assessed as attractive in three, acceptable in one and unattractive in one criterion. There are known areas of spanning on these lines which would benefit from being addressed by removal. Retained for evaluation against other remaining options.
	4D – Accelerated Decomposition	Pipelines will be disconnected Removal and recovery of surface laid sections out with existing trench Rock placement to remediate snag risk from cut ends Introduce material / techniques to accelerate the decomposition process Potential options include reverse polarity CP, Sulphate Reducing Bacteria (SRBs), chemicals, etc.	Not applicable decommissioning option for concrete coated lines as the coating would be left in-situ.
Leave In-situ (Minimum Intervention)	5 – Remove Line Ends & Remediate Snag Risk	Pipelines will be disconnected Removal and recovery of surface laid sections out with existing trench (including transitions) Rock placement to remediate snag risk from cut ends	Considered an unacceptable solution from a safety perspective due to the potential residual snag risk from the presence of known spans along the lines. Option screened out as a safety showstopper on that basis
Leave As-is and Monitor	6 – Leave As-is	There will be no planned subsea intervention Appropriate legislative considerations shall be addressed, and any advisory zones implemented for remaining subsea infrastructure	Considered an unacceptable solution from a safety perspective due to the potential residual snag risk from the presence of known spans along the lines and ends of the surface laid lines once the structures have been removed. Option screened out as a safety showstopper on that basis.

Table 9.2 - Group 7 Decommissioning Options and Screening Summary

9.3 Group 7 Decommissioning Options for Evaluation

The decommissioning options for Group 7 remaining after screening and taken forward to evaluation are:

- Full Removal
  - 2A – Cut & Lift
- Leave In-situ (Major intervention)
  - 3B – Trench and Bury entire line
- Leave In-situ (Minor intervention)
  - 4A – Rock Placement over areas of Spans / Exposure / Shallow Burial
  - 4C – Remove areas of Spans / Exposures / Shallow Burial

9.4 Group 7 Evaluation Summary

GROUP 7 – RIGID PIPELINES (SURFACE LAID, EXPOSED AND CONCRETE COATED) (See Section 15.5.1 for detailed discussion and Appendix H for full attributes table and assessment)	
Safety	**Option 4A is assessed as being preferred from a Safety perspective.** Option 4A (rock placement over problem areas) is preferred against the Operations Personnel criterion due to the lower offshore and onshore scopes with this option. All partial removal options are equally preferred over Option 2A (full removal) against the Other Users criterion due to the full removal option having a higher number of vessel days of operations and a higher number of transits to / from the field. Option 3B (trench entirety of lines) and Option 4A are equally preferred against the High Consequence Events criterion due to there being limited potential from dropped object from the limited / no offshore lifting in these options. All other options have offshore lifting operations to varying degrees. Option 2A is preferred from a legacy risk perspective as the lines are fully removed versus being left in-situ in the other options.
Environment	**Option 2A is assessed as being preferred from an Environment perspective.** All partial removal options are equally preferred over Option 2A (full removal) against the Operational Marine Impact criterion due to the marginally higher noise impact from the longer duration of vessels on-site and cutting operations in the full removal option. There is additional impact from the discharges of pipeline contents at all cut locations in the full removal option. All partial removal options are also equally preferred over Option 2A against the Atmospheric Emissions & Fuel Use criterion due to this option generating around 3 to 5 times higher atmospheric emissions than the other options. The full removal option is marginally preferred over the other options against the Other Consumptions criterion due to the lower impact from recycling the returned material versus the impact of replacing material left in-situ in the partial removal options. Additionally, there is no rock resource required in Option 2A. The full removal option is also preferred over the other options against the Seabed Disturbance criterion due to the cut and lift of these surface laid lines having negligible seabed disturbance whereas all other options have varying degrees of temporary (from trenching) / permanent (from rock cover) seabed impact. The full removal option is significantly preferred over the partial removal options from a Legacy Marine Impacts perspective due to there being no legacy environmental impact from the full removal of these lines.

GROUP 7 – RIGID PIPELINES (SURFACE LAID, EXPOSED AND CONCRETE COATED)

(See Section 15.5.1 for detailed discussion and Appendix H for full attributes table and assessment)

Technical

Option 4A and Option 4C are assessed as being equally preferred from a Technical perspective.

Option 4A (rock placement over problem areas) and Option 4C (removal of problem areas by cut and lift) employ relatively routine operations for their execution, whereas there are challenges associated with the full removal of these lines with their aging concrete coating (spalling) on this scale (almost 30 km) or trenching lines of this diameter.

Societal

Option 2A is assessed as being preferred from a Societal perspective.

The full removal option is preferred from a Societal – Fishing perspective as the lines are fully removed versus the lines remaining in-situ in the other options.

There is a small preference for the partial removal options from a Societal – Other Users perspective despite the job creation / retention offered by the large scope and the large quantity of useful and recyclable steel associated with the full removal option. This is due to the detrimental impact from the large quantity of seawater contaminated concrete coating returned under the full removal option as it is likely to take up limited landfill capacity.

Economic

Option 4A is assessed as being preferred from an Economic perspective.

Option 4A (rock placement problem areas) is preferred from a Short-term Costs perspective as the cost to deliver this option is almost a quarter of the next lowest cost option and significantly lower than the full removal option.

All options are equally preferred from a Long-term Costs perspective as, while there are no costs associated with Option 2A, the costs associated with survey and monitoring of lines left in-situ are relatively low.

Summary

Overall Option 4A is the emerging recommendation.

The outcome shows that the preference for Option 4A (rock placement over problem areas) is moderate. Option 4A is preferred over the other options against the Safety and Technical criteria. Option 4A is the least preferred option against the Environmental and Societal criteria where Option 2A (full removal) is most preferred, however there remains a preference for Option 4A overall.

Once the Economics criterion is included, the preference for Option 4A is strengthened and hence Option 4A is the emerging recommendation for Group 7.

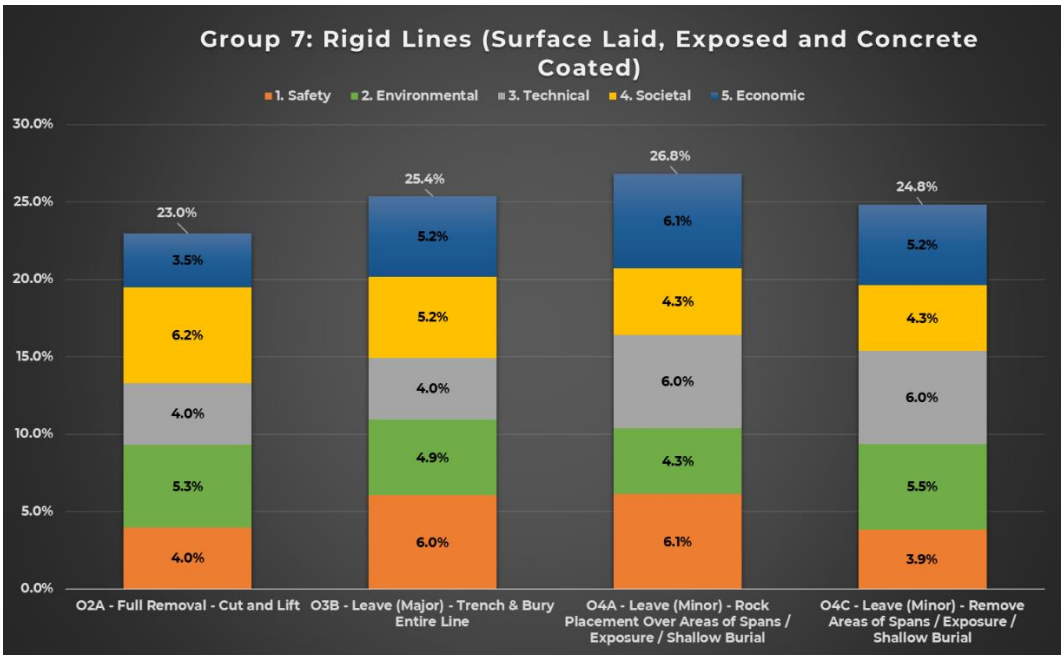


Table 9.3 - Group 7 Evaluation Summary

10 GROUP 8 – RIGID PIPELINES (SURFACE LAID AND ROCK COVERED)

10.1 Group 8 Characteristics

The items that make up Group 8 and their key characteristics are listed in Table 10.1.

ID	DESCRIPTION	OD (INCHES)	LENGTH (KM
PL114 (N0602)	Gas Pipeline from North Cormorant to Western Leg Tee	10	22.245

Table 10.1 - Group 8 Items

There are two crossings associated with these lines, both under. Where crossings under existing infrastructure are encountered an allowance to cut either side of the crossing and re-initiate reeling operations has been included within the supporting calculations, Ref. [8] for the full removal option.

10.2 Group 8 Decommissioning Options & Screening Outcome

During the Screening Phase, all potential decommissioning options were assessed against the Safety, Environmental, Technical, Societal and Economic criteria using a coarse screening methodology. The assessment performed and the resultant outcomes are detailed fully in the CA Screening Report ref. [4] and summarised in Table 10.2 below.

CATEGORY	OPTION	DESCRIPTION	DISCUSSION
Re-use	1 – Re-use	Leave pipeline in-situ for use in any potential new developments	While the integrity of the line in this group is known to be good, a review of potential reuse options has indicated that there are no viable reuse options in this location. Option screened out as a Technical Showstopper on that basis.
Full Removal	2A – Cut and Lift with De-burial	Pipeline will be disconnected De-burial of pipelines using MFE Recover by cutting into sections and removal Cutting by hydraulic shears or Diamond Wire Cutting (DWC) depending on diameter / coating type	Assessed as attractive in two, acceptable in one and unattractive in two criteria. Option screened out as a more onerous full removal option than Option 2C.

CATEGORY	OPTION	DESCRIPTION	DISCUSSION
	2B – Reverse Installation (S-lay or Reel) without De-burial	Pipeline will be disconnected No de-burial prior to removal Recover by reverse reel or reverse s-lay Removal technique based on diameter / construction type / coating type If removal by reverse reel, lines are recovered by reeling to vessel, if removal by reverse s-lay, lines are recovered to vessel and cut into sections on vessel	Residual integrity to allow reverse installation (reel) through rock cover expected to be insufficient. Option screened out as a Technical Showstopper on that basis.
Full Removal	2C – Reverse Installation (S-lay or Reel) with De-burial	As per 2B but with de-burial of pipelines using MFE (if buried)	Assessed as attractive in one and acceptable in four criteria. Retained for evaluation as the most viable full removal option.
	2D – Reverse Installation (Buoyancy)	Pipeline will be disconnected De-burial of pipelines using MFE Perform re-float using a suitable technique (Added buoyancy / aided lift / existing buoyancy, other) Entire line returned to shore via tow	Not applicable option as the line does not lend itself to recovery using buoyancy techniques.
	2E – Cut, Float & Transport	Pipeline will be disconnected De-burial of pipelines using MFE Cut into sections subsea (likely to be with hydraulic shears) Float to surface using a suitable technique Return to shore on vessel / towed in basket / retained buoyancy system	Not applicable option as the line does not lend itself to floatation for recovery and transportation to shore.
Leave In-situ (Major Intervention)	3A – Rock Placement over entire line	Pipeline will be disconnected Rock placement over full length of pipeline / umbilical to address areas of spans, exposure & shallow burial No recovery of pipelines	Not applicable option as this line is already fully rock covered therefore there is no benefit in full rock cover.
	3B – Retrench and Bury entire line	Pipeline will be disconnected Re-trench and backfill full length of pipeline / umbilical to remove areas of spans, exposure & shallow burial depth No recovery of pipelines No introduction of new material	Not applicable option as this line is already fully rock covered therefore there is no benefit in full trench and bury.
Leave In-situ (Minor Intervention)	4A – Rock Placement over areas of Spans / Exposure / Shallow Burial	Pipeline will be disconnected Removal and recovery of surface laid sections out with existing cover Rock placement to remediate snag risk from cuts ends Rock placement at all areas of spans, exposure and shallow burial depth	Assessed as attractive in one and acceptable in four criteria. There are limited areas of spans / exposure / areas of shallow burial hence rock cover to address these areas is justified. Retained for evaluation against other remaining options.

CATEGORY	OPTION	DESCRIPTION	DISCUSSION
	4B – Trench & Bury areas of Spans / Exposure / Shallow Burial	Pipeline will be disconnected Removal and recovery of surface laid sections out with existing cover Rock placement to remediate snag risk from cut ends Trench / bury areas of spans, exposure and shallow burial depth Minimal introduction of new material	Not applicable option as trenching spans / exposures / areas of shallow burial of surface laid and rock covered lines not viable – rock cover or removal of problem areas is considered more applicable.
Leave In-situ (Minor Intervention)	4C – Remove areas of Spans / Exposure / Shallow Burial	Pipeline will be disconnected Removal and recovery of surface laid sections out with existing trench (including transitions) Rock placement to remediate snag risk from cut ends Removal of areas of spans, exposure and shallow burial depth using cut and lift techniques	There is insufficient areas of spans / exposure or shallow burial on any of these lines to justify removing the rock cover to remove problem areas. Option screened out as a technical showstopper on that basis.
	4D – Accelerated Decomposition	Pipeline will be disconnected Removal and recovery of surface laid sections out with existing trench Rock placement to remediate snag risk from cut ends Introduce material / techniques to accelerate the decomposition process Potential options include reverse polarity CP, Sulphate Reducing Bacteria (SRBs), chemicals, etc.	Assessed as acceptable in four and unattractive in one criterion. Latest developments in accelerated decomposition still not sufficiently mature to be proposed as a viable decommissioning option. Option screened out as a technical showstopper due to insufficient maturity.
Leave In-situ (Minimum Intervention)	5 – Remove Line Ends & Remediate Snag Risk	Pipeline will be disconnected Removal and recovery of surface laid sections out with existing trench (including transitions) Rock placement to remediate snag risk from cut ends	Assessed as attractive in four and acceptable in one criterion. There are limited areas of spans / exposure / areas of shallow burial hence leaving these areas unaddressed considered a viable option. Retained for evaluation against other remaining options.
Leave As-is and Monitor	6 – Leave As-is	There will be no planned subsea intervention Appropriate legislative considerations shall be addressed, and any advisory zones implemented for remaining subsea infrastructure	Considered an unacceptable solution from a safety perspective due to the potential residual snag risk from the surface laid sections of these lines out with their rock cover. Option screened out as a safety showstopper on that basis.

Table 10.2 - Group 8 Decommissioning Options and Screening Summary

10.3 Group 8 Decommissioning Options for Evaluation

The decommissioning options for Group 8 remaining after screening and taken forward to evaluation are:

- Full Removal
  - 2C – Reverse Installation (S-lay or Reel) with De-burial
- Leave In-situ (Minor Intervention)
  - 4A – Rock Placement over areas of Spans / Exposure / Shallow Burial
- Leave In-situ (Minimal Intervention)
  - 5 – Remove Line Ends and Remediate Snag Risk

10.4 Group 8 Evaluation Summary

GROUP 8 – RIGID PIPELINES (SURFACE LAID AND ROCK COVERED) (See Section 15.6.1 for detailed discussion and Appendix I for full attributes table and assessment)	
Safety	**Option 4A is assessed as being preferred from a Safety perspective.** Option 4A (rock placement problem areas) and Option 5 (remove line ends only) are equally preferred against the Operations Personnel criterion due to the lower offshore and onshore scopes with these options over Option 2C (full removal). All options are equally preferred against the Other Users criterion as, while there are differences in the number of vessel days of operations and transits to / from the field across the options, these differences are insufficient to express a preference. Option 4A and Option 5 are equally preferred against the High Consequence Events criterion due to the potential for residual torsion in the rigid line when offloading (reeling) to the quayside in Option 2C. Option 2C is preferred from a legacy risk perspective as the line is fully removed versus being left in-situ in the other options.
Environment	**Option 2C is assessed as being preferred from an Environment perspective.** All options are equally preferred against the Operational Marine Impact criterion as the impact from all options is considered largely similar. All options are also equally preferred against the Atmospheric Emissions & Fuel Use criterion as, while there are differences in the atmospheric emissions generated across the options, these differences are insufficient to express a preference. All options are also equally preferred against the Other Consumptions criterion as, while there are differences in the impact from recycling returned material / replacing material left in-situ and the rock consumed across the options, these differences are insufficient to express a preference. Both partial removal options are equally preferred over the full removal option against the Seabed Disturbance criterion as the full removal option impacts a larger area of seabed during the de-burial operations to enable reverse reeling, the rock displaced represents a permanent impact. The area of permanent impact from the rock introduced in the other options is small and considered less significant. The full removal option is significantly preferred over the partial removal options from a Legacy Marine Impacts perspective due to there being no legacy environmental impact from the full removal of the line.
Technical	**Option 4A and Option 5 are assessed as being equally preferred from a Technical perspective.** Option 4A (rock placement over problem areas) and Option 5 (removal of line ends only) employ relatively routine operations for their execution, whereas there are challenges associated with the de-burial and cut and lift of the line on this scale (over 22 km).

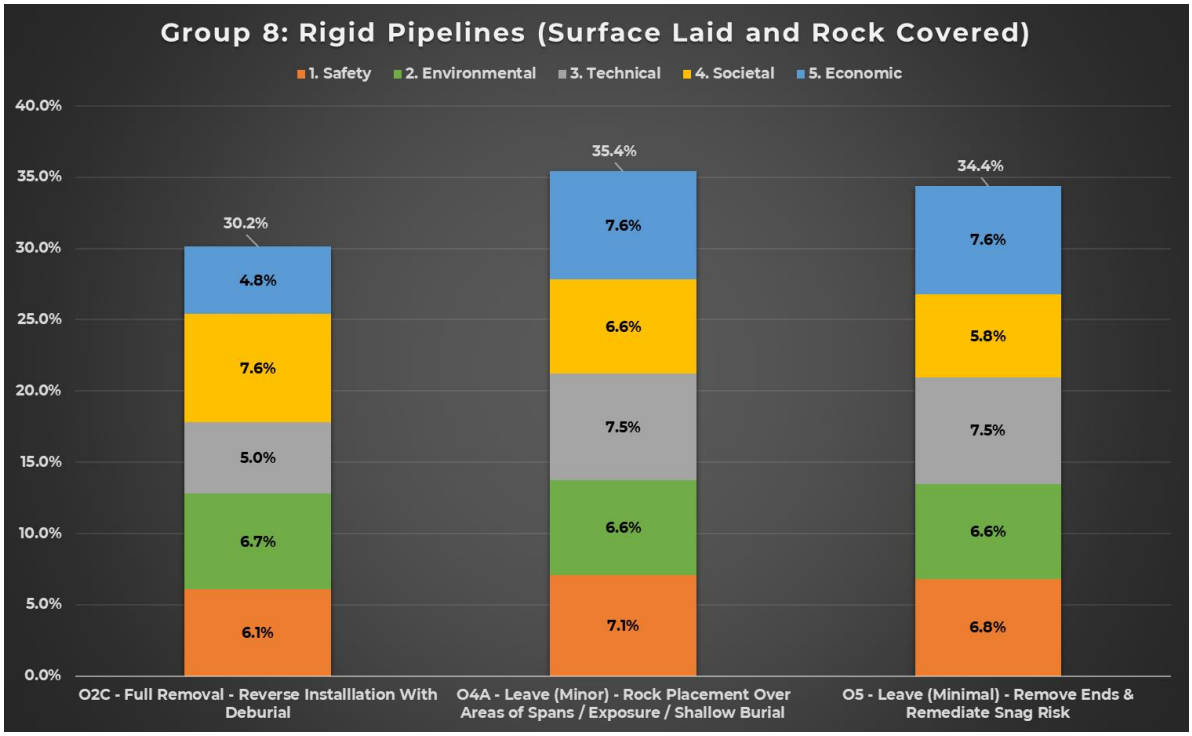
GROUP 8 – RIGID PIPELINES (SURFACE LAID AND ROCK COVERED) (See Section 15.6.1 for detailed discussion and Appendix I for full attributes table and assessment)	
Societal	**Option 2C is assessed as being preferred from a Societal perspective.** The full removal option is preferred from a Societal – Fishing perspective as the line is fully removed versus the line remaining in-situ in the other options, although it is noted that displaced rock cover will remain on the surrounding seabed All options are equally preferred from a Societal – Other Users perspective as the societal impacts are considered largely similar across the options.
Economic	**Option 4A and Option 5 are assessed as being equally preferred from an Economic perspective.** Option 4A (rock placement problem areas) and Option 5 are equally preferred from a Short-term Costs perspective as the costs to deliver these options are similar and lower than the full removal option. All options are equally preferred from a Long-term Costs perspective as, while there are no costs associated with Option 2C, the costs associated with survey and monitoring of line left in-situ are relatively low.
Summary	**Overall Option 4A is the emerging recommendation.** The outcome shows that the preference for Option 4A (rock placement over problem areas) is moderate. Option 4A is preferred over the other options against the Safety criterion, equally preferred (with Option 5) against the Technical criterion and only marginally less preferred (to Option 2C) against the Environmental criterion. Option 4A is less preferred (to Option 2C) against the Societal criteria however, there remains a preference for Option 4A overall. Once the Economics criterion is included, the preference for Option 4A is strengthened and hence Option 4A is the emerging recommendation for Group 8. 

Table 10.3 - Group 8 Evaluation Summary

11 GROUP 9 – RIGID PIPELINES (TRENCHED AND BURIED)

11.1 Group 9 Characteristics

The items that make up Group 9 and their key characteristics are listed in Table 11.1.

ID	DESCRIPTION	OD (INCHES)	LENGTH (KM
PL1084 (N0740)	Oil Pipeline 1 from Pelican to Cormorant A	8	8.467
PL1085 (N0741)	Oil Pipeline 2 from Pelican to Cormorant A	8	8.338
PL1086 (N1121)	Gas Lift Pipeline from Cormorant A to Pelican	6	8.387
PL1087 (N0915)	Water Injection Pipeline from Cormorant A to Pelican	8	8.337
PL3572 (N0605)	Production Pipeline from Cladhan to Tern	10	16.800
PL3573 (N1149)	Gas Lift Pipeline from Tern to Cladhan (Piggybacked to PL3572)	4	16.866
PL3574 (N0942)	Water Injection Pipeline from Tern to Cladhan	10	16.600
PL1018/A	Production Pipeline from Hudson to Tern	10	10.167
PL1019/A	Production Pipeline from Hudson to Tern	10	10.150
PL1020/A	Production / Test Pipeline from Hudson to Tern	8	10.134
PL1025/A	L2 Production/Test Pipeline from Well L2 to Hudson Manifold	6	1.610

Table 11.1 - Group 9 Items

There are 19 crossings associated with this group. Where crossings under existing infrastructure are encountered an allowance to cut either side of the crossing and re-initiate reeling operations has been included within the supporting calculations, Ref. [8] for the full removal option.

11.2 Group 9 Decommissioning Options & Screening Outcome

During the Screening Phase, all potential decommissioning options were assessed against the Safety, Environmental, Technical, Societal and Economic criteria using a coarse screening methodology. The assessment performed and the resultant outcomes are detailed fully in the CA Screening Report ref. [4] and summarised in Table 11.2 below.

CATEGORY	OPTION	DESCRIPTION	DISCUSSION
Re-use	1 – Re-use	Leave pipelines in-situ for use in any potential new developments	While the integrity of the lines in this group are known to be good, a review of potential reuse options has indicated that there are no viable reuse options in this location. Option **screened out** as a Technical Showstopper on that basis.
Full Removal	2A – Cut and Lift with De-burial	Pipelines will be disconnected De-burial of pipelines using MFE Recover by cutting into sections and removal Cutting by hydraulic shears or Diamond Wire Cutting (DWC) depending on diameter / coating type	Assessed as acceptable in three and unattractive in two criteria. Option **screened out** as a more onerous full removal option than Option 2C.
	2B – Reverse Installation (S-lay or Reel) without De-burial	Pipelines will be disconnected No de-burial prior to removal Recover by reverse reel or reverse s-lay Removal technique based on diameter / construction type / coating type If removal by reverse reel, lines are recovered by reeling to vessel, if removal by reverse s-lay, lines are recovered to vessel and cut into sections on vessel	Residual integrity to allow reverse installation (reel) through cover expected to be insufficient. Option **screened out** as a Technical Showstopper on that basis.
	2C – Reverse Installation (S-lay or Reel) with De-burial	As per 2B but with de-burial of pipelines using MFE (if buried)	Assessed as attractive in one, acceptable in three and unattractive in one criterion. **Retained for evaluation** as the most viable full removal option.
	2D – Reverse Installation (Buoyancy)	Pipelines will be disconnected De-burial of pipelines using MFE Perform re-float using a suitable technique (Added buoyancy / aided lift / existing buoyancy, other) Entire line returned to shore via tow	**Not applicable** option as these lines do not lend themselves to recovery using buoyancy techniques.
	2E – Cut, Float & Transport	Pipelines will be disconnected De-burial of pipelines using MFE Cut into sections subsea (likely to be with hydraulic shears) Float to surface using a suitable technique Return to shore on vessel / towed in basket / retained buoyancy system	**Not applicable** option as these lines do not lend themselves to floatation for recovery and transportation to shore.
Leave In-situ (Major Intervention)	3A – Rock Placement over entire line	Pipelines will be disconnected Rock placement over full length of pipeline / umbilical to address areas of spans, exposure & shallow burial No recovery of pipelines	There are limited areas of spans / exposure or shallow burial on any of these lines and therefore there is no benefit in full rock cover. Option **screened out** as a technical showstopper on that basis.

CATEGORY	OPTION	DESCRIPTION	DISCUSSION
Leave In-situ (Major Intervention)	3B – Retrench and Bury entire line	Pipelines will be disconnected Re-trench and backfill full length of pipeline / umbilical to remove areas of spans, exposure & shallow burial depth No recovery of pipelines No introduction of new material	There are limited areas of spans / exposure or shallow burial on any of these lines and therefore there is no benefit in full trench and bury. Option **screened out** as a technical showstopper on that basis.
Leave In-situ (Minor Intervention)	4A – Rock Placement over areas of Spans / Exposure / Shallow Burial	Pipelines will be disconnected Removal and recovery of surface laid sections out with existing trench (including transitions) Rock placement to remediate snag risk from cut ends Rock placement at all areas of spans, exposure and shallow burial depth	Assessed as attractive in four and acceptable in one criterion. There are limited areas of spans / exposure / areas of shallow burial hence rock cover to address these areas is justified. **Retained for evaluation** against other remaining options.
	4B – Trench & Bury areas of Spans / Exposure / Shallow Burial	Pipelines will be disconnected Removal and recovery of surface laid sections out with existing trench (including transitions) Rock placement to remediate snag risk from cut ends Trench / bury areas of spans, exposure and shallow burial depth Minimal introduction of new material	Assessed as attractive in three and acceptable in two criteria. There are limited areas of spans / exposure or shallow burial hence trench and bury of these areas is justified. **Retained for evaluation** against other remaining options.
	4C – Remove areas of Spans / Exposure / Shallow Burial	Pipelines will be disconnected Removal and recovery of surface laid sections out with existing trench (including transitions) Rock placement to remediate snag risk from cut ends Removal of areas of spans, exposure and shallow burial depth using cut and lift techniques	Assessed as attractive in three and acceptable in two criteria. There are limited areas of spans / exposure or shallow burial hence removal of these areas is justified. **Retained for evaluation** against other remaining options.
Leave In-situ (Minor Intervention)	4D – Accelerated Decomposition	Pipelines will be disconnected Removal and recovery of surface laid sections out with existing trench Rock placement to remediate snag risk from cut ends Introduce material / techniques to accelerate the decomposition process Potential options include reverse polarity CP, Sulphate Reducing Bacteria (SRBs), chemicals, etc.	Assessed as acceptable in four and unattractive in one criterion. Latest developments in accelerated decomposition still not sufficiently mature to be proposed as a viable decommissioning option. Option **screened out** as a technical showstopper due to insufficient maturity.
Leave In-situ (Minimum Intervention)	5 – Remove Line Ends & Remediate Snag Risk	Pipelines will be disconnected Removal and recovery of surface laid sections out with existing trench (including transitions) Rock placement to remediate snag risk from cut ends	Assessed as attractive in three and acceptable in two criteria. There are limited areas of spans / exposure / areas of shallow burial hence leaving these areas unaddressed considered a viable option. **Retained for evaluation** against other remaining options.

CATEGORY	OPTION	DESCRIPTION	DISCUSSION
Leave As-is and Monitor	6 – Leave As-is	There will be no planned subsea intervention Appropriate legislative considerations shall be addressed, and any advisory zones implemented for remaining subsea infrastructure	Considered an unacceptable solution from a safety perspective due to the potential residual snag risk from the surface laid sections of these lines out with their trenches. Option screened out as a safety showstopper on that basis.

Table 11.2 - Group 9 Decommissioning Options and Screening Summary

11.3 Group 9 Decommissioning Options for Evaluation

The decommissioning options for Group 9 remaining after screening and taken forward to evaluation are:

- Full Removal
  - 2C – Reverse Installation (S-lay or Reel) with De-burial
- Leave In-situ (Minor Intervention)
  - 4A – Rock Placement over areas of Spans / Exposure / Shallow Burial
  - 4B – Trench and Bury areas of Spans / Exposure / Shallow Burial
  - 4C – Remove areas of Spans / Exposures / Shallow Burial
- Leave In-situ (Minimal Intervention)
  - 5 – Remove Line Ends and Remediate Snag Risk

11.4 Group 9 Evaluation Summary

GROUP 9 – RIGID PIPELINES (TRENCHED AND BURIED) (See Section 15.7.1 for detailed discussion and Appendix J for full attributes table and assessment)	
Safety	**Option 4B is assessed as being preferred from a Safety perspective.** Option 5 (remove line ends only) is preferred against the Operations Personnel criterion due to the lower offshore and onshore scopes with this option. All partial removal options are equally preferred over Option 2C (full removal) against the Other Users criterion due to the full removal option having a higher number of vessel days of operations and a higher number of transits to / from the field. Option 2C, Option 4A, Option 4B, and Option 5 are equally preferred against the High Consequence Events criterion due Option 4C having more offshore lifting operations than the other options. Option 2C is preferred from a legacy risk perspective as the lines are fully removed versus being left in-situ in the other options.

GROUP 9 – RIGID PIPELINES (TRENCHED AND BURIED) (See Section 15.7.1 for detailed discussion and Appendix J for full attributes table and assessment)	
Environment	**Option 4B is assessed as being preferred from an Environment perspective.** All partial removal options are equally preferred over Option 2C (full removal) against the Operational Marine Impact criterion due to the marginally higher noise impact from the longer duration of vessels on-site and cutting operations in the full removal option. There is additional impact from the discharges of pipeline contents at all cut locations in the full removal option. All partial removal options are also equally preferred over Option 2C against the Atmospheric Emissions & Fuel Use criterion due to this option generating more than double the atmospheric emissions of the other options. Options 2C, 4B, 4C and 5 are equally preferred. While there are differences in the impact associated with recycling material returned or generating replacement material for the lines left in-situ, these differences are insufficient to express a preference within these options. Option 4A is the least preferred option due to the greater quantity of rock required in this option. Option 4B (trenching problem areas) and Option 5 (remove line ends only) are equally preferred against the Seabed Disturbance criterion as they have the lowest area of temporary / permanent impact on the seabed. The full removal option is significantly preferred over the partial removal options from a Legacy Marine Impacts perspective due to there being no legacy environmental impact from the full removal of the lines.
Technical	**Option 4A, Option 4C and Option 5 are assessed as being equally preferred from a Technical perspective.** Option 4A (rock placement problem areas), Option 4C (removal of problem areas) and Option 5 (removal of line ends only) are equally preferred against the Technical criterion as, while all options employ relatively routine operations for their execution, there are greater technical challenges from the scale associated with the full removal of the lines (115 km) or successfully performing the trenching operations in Option 4B.
Societal	**Option 2C is assessed as being preferred from a Societal perspective.** The full removal option is preferred from a Societal – Fishing perspective as the lines are fully removed versus the lines remaining in-situ in the other options. All options are equally preferred from a Societal – Other Users perspective as the societal impacts are considered largely similar across the options.
Economic	**Option 4A, Option 4B, Option 4C and Option 5 are assessed as being equally preferred from an Economic perspective.** All options are equally preferred over the full removal option from a Short-term Costs perspective as the costs to deliver the full removal option is much higher than the other options. The differences in costs across the remaining options are considered insufficient to express a preference. All options are equally preferred from a Long-term Costs perspective as, while there are no costs associated with Option 2C, the costs associated with survey and monitoring of line left in-situ are relatively low.

GROUP 9 – RIGID PIPELINES (TRENCHED AND BURIED)

(See Section 15.7.1 for detailed discussion and Appendix J for full attributes table and assessment)

Summary

Overall Option 4C is the emerging recommendation.

The outcome shows that the preference for Option 4C (remove problem areas) is small. Option 4C is preferred over the other options against the Technical criteria. Option 4C is marginally less preferred to other options against the Safety, Environmental and Societal criteria however, there remains a preference for Option 4C overall.

Once the Economics criterion is included, the preference for Option 4C remains and hence Option 4C is the emerging recommendation for Group 9.

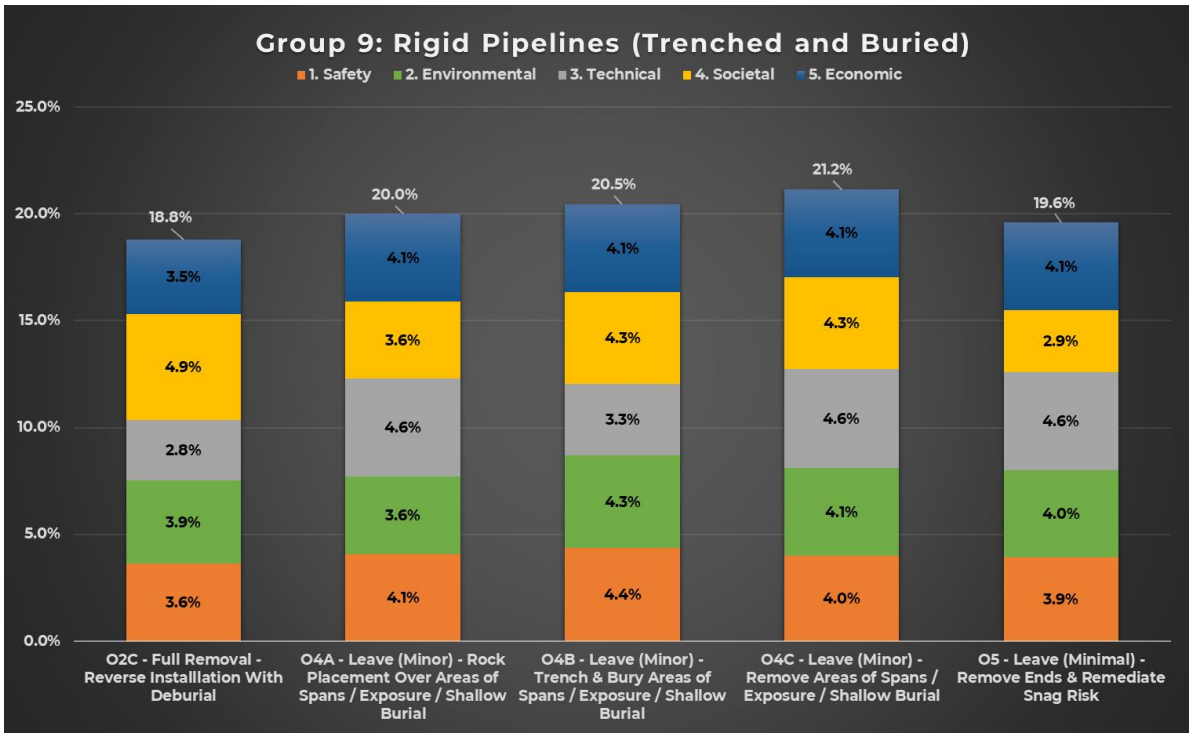


Table 11.3 - Group 9 Evaluation Summary

12 GROUP 16 – BLOCKED RIGID PIPELINE (TRENCHED AND BURIED)

12.1 Group 16 Characteristics

The items that make up Group 16 and their key characteristics are listed in Table 12.1.

ID	DESCRIPTION	OD (INCHES)	LENGTH (KM
PL1024/A	L1 Production / Test Pipeline (Disused) from Well L1 to Hudson Manifold	6	1.631

Table 12.1 - Group 16 Items

A file note was produced, 'Memorandum Hudson L1 Pipeline Blockage', ref. [13], that describes the potential scenarios causing the blockage. TAQA plan to investigate the blockage during the 2023 offshore campaign.

There are no crossings associated with this line.

12.2 Group 16 Decommissioning Options & Screening Outcome

During the Screening Phase, all potential decommissioning options were assessed against the Safety, Environmental, Technical, Societal and Economic criteria using a coarse screening methodology. The assessment performed and the resultant outcomes are detailed fully in the CA Screening Report ref. [4] and summarised in Table 12.2 below.

CATEGORY	OPTION	DESCRIPTION	DISCUSSION
Re-use	1 – Re-use	Leave pipeline in-situ for use in any potential new developments	Field reviewed for any additional opportunities - review indicated that there are no opportunities as detailed in Hudson CoP Application. Option screened out as a technical showstopper on that basis.
Full Removal	2A – Cut and Lift with De-burial	Pipeline will be disconnected De-burial of pipeline using MFE Recover by cutting into sections and removal Cutting by hydraulic shears or Diamond Wire	Assessed as attractive in one, acceptable in three and unattractive in one criterion. Retained for evaluation as the most viable full removal option.

CATEGORY	OPTION	DESCRIPTION	DISCUSSION
Full Removal	2B – Reverse Installation (S-lay or Reel) without De-burial	Pipeline will be disconnected No de-burial prior to removal Recover by reverse reel or reverse s-lay Removal technique based on diameter / construction type / coating type If removal by reverse reel, lines are recovered by reeling to vessel, if removal by reverse s-lay, lines are recovered to vessel and cut into sections on vessel	Assessed as unattractive from a Safety and Technical perspective due to concerns regarding integrity of the lines to recover using reverse installation techniques. Option **screened out** as a less credible full removal option than Option 2A.
Full Removal	2C – Reverse Installation (S-lay or Reel) with De-burial	As per 2B but with de-burial of pipeline using MFE (if buried)	Assessed as unattractive from a Safety and Technical perspective due to concerns regarding integrity of the lines to recover using reverse installation techniques. Option **screened out** as a less credible full removal option than Option 2A.
	2D – Reverse Installation (Buoyancy)	Pipeline will be disconnected De-burial of pipeline using MFE Perform re-float using a suitable technique (Added buoyancy / aided lift / existing buoyancy, other) Entire line returned to shore via tow	**Not applicable** option as these lines do not lend themselves to reverse installation using buoyancy techniques.
	2E – Cut, Float & Transport	Pipeline will be disconnected De-burial of pipeline using MFE Cut into sections subsea (likely to be with hydraulic shears) Float to surface using a suitable technique Return to shore on vessel / towed in basket / retained buoyancy system	**Not applicable** option as these lines do not lend themselves to floatation for recovery and transportation to shore.
Leave In-situ (Major Intervention)	3A – Rock Placement over entire line	Pipeline will be disconnected Rock placement over full length of pipeline / umbilical to address areas of spans, exposure & shallow burial No recovery of pipeline	As the line is fully trenched and buried to sufficient DoC there is no benefit in rock covering full length of the line. Option **screened out** as a technical showstopper accordingly.
	3B – Retrench and Bury entire line	Pipeline will be disconnected Re-trench and backfill full length of pipeline / umbilical to remove areas of spans, exposure & shallow burial depth No recovery of pipeline No introduction of new material	As the line is fully trenched and buried to sufficient DoC there is no benefit in trenching full length of the line. Option **screened out** as a technical showstopper accordingly.
Leave In-situ (Minor Intervention)	4A – Rock Placement over areas of Spans / Exposure / Shallow Burial	Pipeline will be disconnected Removal and recovery of surface laid sections out with existing trench (including transitions) Rock placement to remediate snag risk from cuts ends Rock placement at all areas of spans, exposure and shallow burial depth	As the line is fully trenched and buried to sufficient DoC there are no areas of spans, exposure or shallow burial to be addressed and this option becomes the same as Option 5. Option **screened out** as a technical showstopper accordingly.

CATEGORY	OPTION	DESCRIPTION	DISCUSSION
	4B – Trench & Bury areas of Spans / Exposure / Shallow Burial	Pipeline will be disconnected Removal and recovery of surface laid sections out with existing trench (including transitions) Rock placement to remediate snag risk from cut ends Trench / bury areas of spans, exposure and shallow burial depth Minimal introduction of new material	As the line is fully trenched and buried to sufficient DoC there are no areas of spans, exposure or shallow burial to be addressed and this option becomes the same as Option 5. Option screened out as a technical showstopper accordingly.
Leave In-situ (Minor Intervention)	4C – Remove areas of Spans / Exposure / Shallow Burial	Pipeline will be disconnected Removal and recovery of surface laid sections out with existing trench (including transitions) Rock placement to remediate snag risk from cut ends Removal of areas of spans, exposure and shallow burial depth using cut and lift techniques	As the line is fully trenched and buried to sufficient DoC there are no areas of spans, exposure or shallow burial to be addressed and this option becomes the same as Option 5. Option screened out as a technical showstopper accordingly.
	4D – Accelerated Decomposition	Pipeline will be disconnected Removal and recovery of surface laid sections out with existing trench Rock placement to remediate snag risk from cut ends Introduce material / techniques to accelerate the decomposition process Potential options include reverse polarity CP, Sulphate Reducing Bacteria (SRBs), chemicals, etc.	Not applicable option as no benefit in exploring Accelerated Corrosion options for polymer coated lines.
Leave In-situ (Minimum Intervention)	5 – Remove Line Ends & Remediate Snag Risk	Pipeline will be disconnected Removal and recovery of surface laid sections out with existing trench (including transitions) Rock placement to remediate snag risk from cut ends	This option has been assessed as being unattractive in one, acceptable in two and attractive in the remaining two criteria. As the line is fully trenched and buried to sufficient DoC there are no areas of spans, exposure or shallow burial to be addressed and removing the line ends only is a viable option. Retained for evaluation against other remaining options.
Leave As-is and Monitor	6 – Leave As-is	There will be no planned subsea intervention Appropriate legislative considerations shall be addressed, and any advisory zones implemented for remaining subsea infrastructure	Considered an unacceptable solution from a safety perspective due to the potential residual snag risk from the surface laid sections of these lines out with their trenches. Option screened out as a safety showstopper on that basis.

Table 12.2 - Group 16 Decommissioning Options and Screening Summary

12.3 Group 16 Decommissioning Options for Evaluation

The decommissioning options for Group 16 remaining after screening and taken forward to evaluation are:

- Full Removal
  - 2A – Cut and Lift with De-burial
- Leave In-situ (Minimal Intervention)
  - 5 – Remove Line Ends and Remediate Snag Risk

12.4 Group 16 Evaluation Summary

GROUP 16 – BLOCKED RIGID PIPELINE (TRENCHED AND BURIED) (See Section 15.8.1 for detailed discussion and Appendix K for full attributes table and assessment)	
Safety	**Option 5 is assessed as being preferred from a Safety perspective.** Option 5 (remove line ends only) is preferred against the Operations Personnel criterion due to the lower offshore and onshore scopes with this option. Both options are equally preferred against the Other Users criterion as, while there are differences in the number of vessel days of operations and transits to / from the field across the options, these differences are insufficient to express a preference. Option 5 is preferred against the High Consequence Events criterion due to there being lower potential from dropped object from the limited offshore lifting in Option 5. Option 2A is preferred from a legacy risk perspective as the line is fully removed versus being left in-situ in the other option.
Environment	**Option 5 is assessed as being preferred from an Environment perspective.** Option 5 is preferred against the Operational Marine Impact criterion due to the discharge of contents from the blocked line associated with the full removal option. Both options are equally preferred against the Atmospheric Emissions & Fuel Use criterion as, while there are differences in the atmospheric emissions generated across the options, these differences are insufficient to express a preference. Both options are also equally preferred against the Other Consumptions criterion due to the impact from recycling the returned material versus the impact of replacing material left in-situ being largely similar. Option 5 is preferred against the Seabed Disturbance criterion due to larger area of impact to de-burial of the line in the full removal option. The full removal option is preferred from a Legacy Marine Impacts perspective due to there being no legacy environmental impact from the full removal of the line.
Technical	**Option 2A and Option 5 are assessed as being equally preferred from a Technical perspective.** Both options are equally preferred against the Technical criterion as they both employ relatively routine operations for their execution. While there are greater challenges relating to the de-burial and recovery of the line, given the small scale (1.6 km) this is considered insufficient to express a preference.
Societal	**Option 2A and Option 5 are assessed as being equally preferred from a Societal perspective.** Both options are equally preferred from a Societal – Fishing perspective as, while the line is fully removed in Option 2A, it remains fully trenched and buried in Option 5 and thus presents a clear seabed in both options. Both options are also equally preferred from a Societal – Other Users perspective as the societal impacts are considered largely similar across the options.

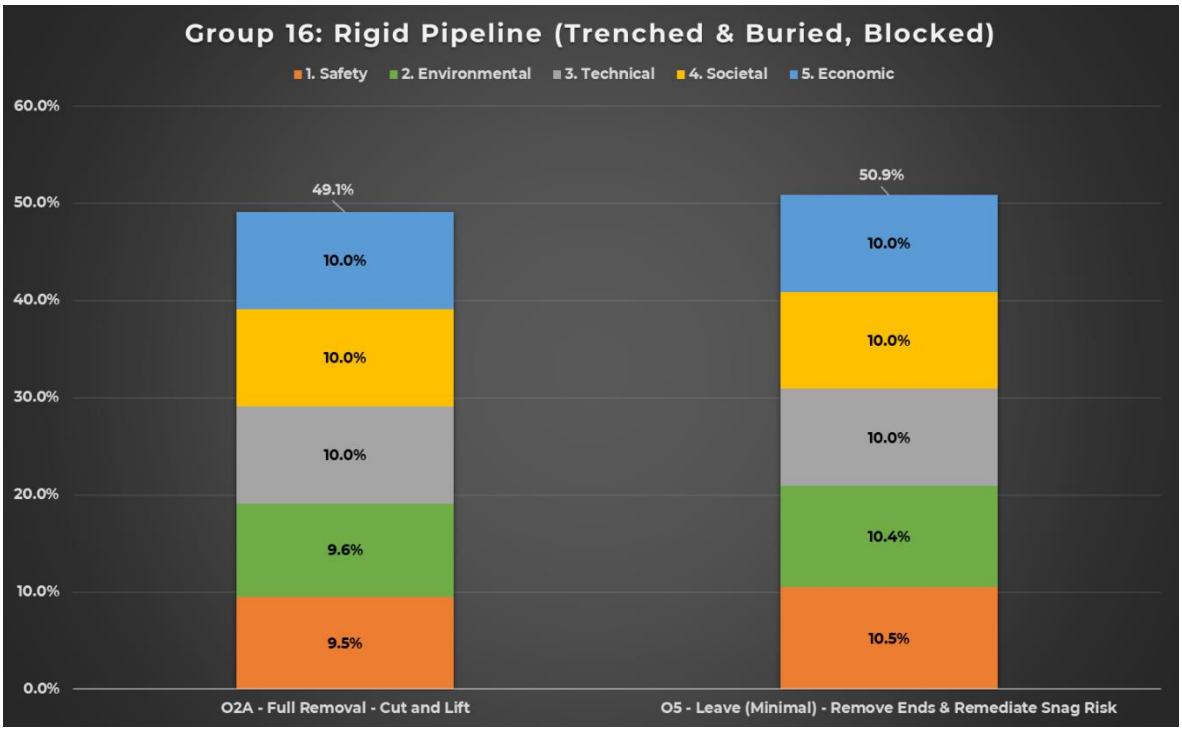
GROUP 16 – BLOCKED RIGID PIPELINE (TRENCHED AND BURIED) (See Section 15.8.1 for detailed discussion and Appendix K for full attributes table and assessment)	
Economic	**Option 2A and Option 5 are assessed as being equally preferred from an Economic perspective.** Both options are equally preferred from a Short-term Costs perspective as the cost to deliver the options is similar in both cases. Both options are also equally preferred from a Long-term Costs perspective as, while there are no costs associated with Option 2A, the costs associated with survey and monitoring of line left in-situ are relatively low.
Summary	**Overall Option 5 is the emerging recommendation.** The outcome shows that the preference for Option 5 (remove line ends only) is small. Option 5 is marginally preferred against the Safety and Environmental criteria and equally preferred against the remaining criteria. Once the Economics criterion is included, the preference for Option 5 remains and hence Option 5 is the emerging recommendation for Group 16. 

Table 12.3 - Group 16 Evaluation Summary

13 GROUP 17 – IN-USE RIGID PIPELINES (TRENCHED AND PARTIALLY BURIED)

13.1 Group 17 Characteristics

The items that make up Group 17 and their key characteristics are listed in Table 13.1.

ID	DESCRIPTION	OD (INCHES)	LENGTH (KM
PL1022	Gas Lift Pipeline from Tern to Hudson Manifold	6	10.161
PL1021/A	Water Injection Pipeline from Tern to Hudson Manifold	8	10.185

Table 13.1 - Group 17 Items

There are no crossings associated with this line.

13.2 Group 17 Decommissioning Options & Screening Outcome

During the Screening Phase, all potential decommissioning options were assessed against the Safety, Environmental, Technical, Societal and Economic criteria using a coarse screening methodology. The assessment performed and the resultant outcomes are detailed fully in the CA Screening Report ref. [4] and summarised in Table 13.2 below.

CATEGORY	OPTION	DESCRIPTION	DISCUSSION
Re-use	1 – Re-use	Leave pipelines in-situ for use in any potential new developments	Field reviewed for any additional opportunities - review indicated that there are no opportunities as detailed in Hudson CoP Application. Option screened out as a technical showstopper on that basis.
Full Removal	2A – Cut and Lift with De-burial	Pipelines will be disconnected De-burial of pipelines using MFE (if buried) Recover by cutting into sections and removal Cutting by hydraulic shears or diamond wire depending on diameter / coating type	Assessed as unattractive in one, acceptable in three and attractive in one criteria. Retained for evaluation as the most viable full removal option.
Full Removal	2B – Reverse Installation (S-lay or Reel) without De-burial	Pipelines will be disconnected No de-burial prior to removal Recover by reverse reel or reverse s-lay Removal technique based on diameter / construction type / coating type If removal by reverse reel, lines are recovered by reeling to vessel, if removal by reverse s-lay, lines are recovered to vessel and cut into sections on vessel	Assessed as unattractive from a Safety and Technical perspective due to concerns regarding integrity of the lines to recover using reverse installation techniques. Option screened out as a less credible full removal option than Option 2A.

CATEGORY	OPTION	DESCRIPTION	DISCUSSION
Full Removal	2C – Reverse Installation (S-lay or Reel) with De-burial	As per 2B but with de-burial of pipelines using MFE (if buried)	Assessed as unattractive from a Safety and Technical perspective due to concerns regarding integrity of the lines to recover using reverse installation techniques. Option **screened out** as a less credible full removal option than Option 2A.
	2D – Reverse Installation (Buoyancy)	Pipelines will be disconnected De-burial of pipelines using MFE Perform re-float using a suitable technique (Added buoyancy / aided lift / existing buoyancy, other) Entire line returned to shore via tow	**Not applicable** option as these lines do not lend themselves to reverse installation using buoyancy techniques.
	2E – Cut, Float & Transport	Pipelines will be disconnected De-burial of pipelines using MFE Cut into sections subsea (likely to be with hydraulic shears) Float to surface using a suitable technique Return to shore on vessel / towed in basket / retained buoyancy system	**Not applicable** option as these lines do not lend themselves to floatation for recovery and transportation to shore.
Leave In-situ (Major Intervention)	3A – Rock Placement over entire line	Pipelines will be disconnected Rock placement over full length of pipeline to address areas of spans, exposure & shallow burial No recovery of pipelines	As the majority of the lines fail to meet the required DoC, rock cover over the entire length of the lines is a justifiable solution. **Retained for evaluation** against other remaining options.
	3B – Retrench and Bury entire line	Pipelines will be disconnected Re-trench and backfill full length of pipeline to remove areas of spans, exposure & shallow burial depth No recovery of pipelines No introduction of new material	As the majority of the lines fail to meet the required DoC, trench and bury along the entire length of the lines is a justifiable solution. **Retained for evaluation** against other remaining options.
Leave In-situ (Minor Intervention)	4A – Rock Placement over areas of Spans / Exposure / Shallow Burial	Pipelines will be disconnected Removal and recovery of surface laid sections out with existing trench (including transitions) Rock placement to remediate snag risk from cuts ends Rock placement at all areas of spans, exposure and shallow burial depth	As the majority of the lines fail to meet the required DoC, the entire length of the lines needs to be addressed and this option becomes the same as Option 3A. Option **screened out** as a technical showstopper accordingly.
	4B – Trench & Bury areas of Spans / Exposure / Shallow Burial	Pipelines will be disconnected Removal and recovery of surface laid sections out with existing trench (including transitions) Rock placement to remediate snag risk from cut ends Trench / bury areas of spans, exposure and shallow burial depth Minimal introduction of new material	As the majority of the lines fail to meet the required DoC, the entire length of the lines needs to be addressed and this option becomes the same as Option 3B. Option **screened out** as a technical showstopper accordingly.

CATEGORY	OPTION	DESCRIPTION	DISCUSSION
Leave In-situ (Minor Intervention)	4C – Remove areas of Spans / Exposure / Shallow Burial	Pipelines will be disconnected Removal and recovery of surface laid sections out with existing trench (including transitions) Rock placement to remediate snag risk from cut ends Removal of areas of spans, exposure and shallow burial depth using cut and lift techniques	As the majority of the lines fail to meet the required DoC, the entire length of the lines needs to be addressed and this option becomes the same as the full removal options. Option screened out as a technical showstopper accordingly.
	4D – Accelerated Decomposition	Pipelines will be disconnected Removal and recovery of surface laid sections out with existing trench Rock placement to remediate snag risk from cut ends Introduce material / techniques to accelerate the decomposition process Potential options include reverse polarity CP, Sulphate Reducing Bacteria (SRBs), chemicals, etc.	Not applicable option as no benefit in exploring Accelerated Corrosion options for polymer coated lines.
Leave In-situ (Minimum Intervention)	5 – Remove Line Ends & Remediate Snag Risk	Pipelines will be disconnected Removal and recovery of surface laid sections out with existing trench (including transitions) Rock placement to remediate snag risk from cut ends	While the majority of the lines fails to meet the required DoC, there are few areas of spans hence removing the line ends only is a viable option. This option has been assessed as being unattractive in one, acceptable in two and attractive in the remaining two criteria. Retained for evaluation against other remaining options.
Leave As-is and Monitor	6 – Leave As-is	There will be no planned subsea intervention Appropriate legislative considerations shall be addressed, and any advisory zones implemented for remaining subsea infrastructure	Considered an unacceptable solution from a safety perspective due to the potential residual snag risk from the surface laid sections of these lines out with their trenches. Option screened out as a safety showstopper on that basis.

Table 13.2 - Group 17 Decommissioning Options and Screening Summary

13.3 Group 17 Decommissioning Options for Evaluation

The decommissioning options for Group 17 remaining after screening and taken forward to evaluation are:

- Full Removal
  - 2A – Cut & Lift
- Leave In-situ (Major intervention)
  - 3A – Rock Cover entire line
  - 3B – Trench and Bury entire line
- Leave In-situ (Minimal Intervention)
  - 5 – Remove Line Ends and Remediate Snag Risk

13.4 Group 17 Evaluation Summary

GROUP 17 – IN-USE RIGID PIPELINES (TRENCHED AND PARTIALLY BURIED) (See Section 15.9.1 for detailed discussion and Appendix L for full attributes table and assessment)	
Safety	**Option 3B is assessed as being preferred from a Safety perspective.** Option 3B (trench entirety of lines) is preferred against the Operations Personnel criterion due to the lower offshore and onshore scopes with this option. Option 3B and Option 5 are equally preferred against the Other Users criterion due to these options having a lower number of vessel days of operations and transits to / from the field. Option 3A (rock cover entirety of line) and Option 3B (trench entirety of lines) are equally preferred against the High Consequence Events criterion due to there being limited potential from dropped object from the limited / no offshore lifting in these options. All other options have offshore lifting operations to varying degrees. Option 2A is preferred from a legacy risk perspective as the lines are fully removed versus being left in-situ in the other options.
Environment	**Option 5 is assessed as being preferred from an Environment perspective.** All partial removal options are equally preferred over Option 2A (full removal) against the Operational Marine Impact criterion due to the marginally higher noise impact from the longer duration of vessels on-site and cutting operations in the full removal option. There is additional impact from the discharges of pipeline contents at all cut locations in the full removal option. All partial removal options are also equally preferred over Option 2A against the Atmospheric Emissions & Fuel Use criterion due to this option generating around 2 to 3 times higher atmospheric emissions than the other options. Option 3A is less preferred to the other options against the Other Consumptions criterion due to the large quantity of rock resource required in Option 3A. Option 5 is preferred against the Seabed Disturbance criterion due the small area of impact versus all other options which have varying degrees of temporary (from trenching or de-burial) / permanent (from rock cover) seabed impact. The full removal option is significantly preferred over the partial removal options from a Legacy Marine Impacts perspective due to there being no legacy environmental impact from the full removal of these lines.
Technical	**Option 3A, Option 3B and Option 5 are assessed as being equally preferred from a Technical perspective.** Option 2A (full removal) is less preferred than the other options against the Technical criterion as, while all options employ relatively routine operations for their execution, there are challenges associated with the de-burial and cut and lift of the lines on this scale (over 20 km).
Societal	**Option 2A is assessed as being preferred from a Societal perspective.** The full removal option is preferred from a Societal – Fishing perspective as the lines are fully removed versus the lines remaining in-situ in the other options. All options are equally preferred from a Societal – Other Users perspective as the societal impacts are considered largely similar across the options.
Economic	**Option 3B and Option 5 are assessed as being equally preferred from an Economic perspective.** Option 3B and Option 5 are equally preferred from a Short-term Costs perspective as the cost to deliver these options are similar and much lower than the other options. All options are equally preferred from a Long-term Costs perspective as, while there are no costs associated with Option 2A, the costs associated with survey and monitoring of lines left in-situ are relatively low.

GROUP 17 – IN-USE RIGID PIPELINES (TRENCHED AND PARTIALLY BURIED)

(See Section 15.9.1 for detailed discussion and Appendix L for full attributes table and assessment)

Summary

Overall Option 3B is the emerging recommendation.

The outcome shows that the preference for Option 3B (trench entirety of lines) is moderate. Option 3B is preferred against the Safety and Technical criteria and marginally less preferred (to Option 5) against the Environmental criterion. Option 3B is less preferred against the Societal criterion however, there remains a preference for Option 3B overall.

Once the Economics criterion is included, the preference for Option 3B remains and hence Option 3B is the emerging recommendation for Group 17.

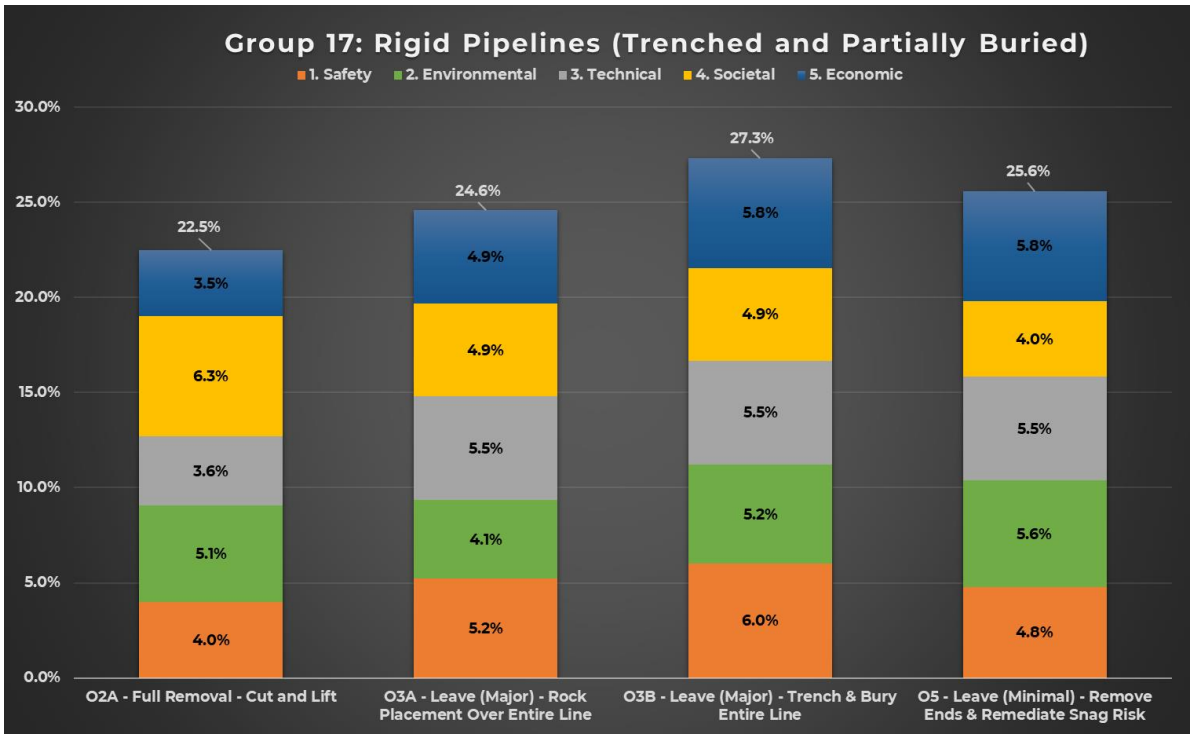


Table 13.3 - Group 17 Evaluation Summary

14 GROUP 18 – UNCERTAIN INTEGRITY AND CONCRETE COATED RIGID PIPELINES (TRENCHED AND BURIED)

14.1 Group 18 Characteristics

The items that make up Group 18 and their key characteristics are listed in Table 14.1.

ID	DESCRIPTION	OD (INCHES)	LENGTH (KM
PL1022.1	L1 Gas Lift Pipeline (piggybacked to PL1024) from Well L1 to Hudson Manifold	2	1.641
PL1022.2	L2 Gas Lift Pipeline (piggybacked to PL1025) from Well L2 to Hudson Manifold	2	1.761
PL1018	Production Pipeline (disused) from Hudson Manifold to Tern	10	10.410
PL1019	Production Pipeline (disused) from Hudson Manifold to Tern	10	10.410
PL1020	Production/Test Pipeline (disused) from Hudson Manifold to Tern	8	10.410
PL1024	L1 Production/Test Pipeline (disused) from Well L1 to Hudson Manifold	8	1.761
PL1025	L2 Production/Test Pipeline (disused) from Well L2 to Hudson Manifold	8	1.761
PL1021	Water Injection Pipeline (disused) from Tern to Hudson Manifold	8	10.410
PL475 (N0506)	Oil Pipeline from Eider (Oil Production Tee) to North Cormorant	12	13.145
PL476 (N1001)	Water Injection Pipeline – Disused from Tern to Eider	12	16.400
PL478 (N0604)	Gas Pipeline from North Cormorant to Tern	8	13.000
PL304 (N0902)	2 x Well Injection Flowlines from UMC to Well W4	3	3.524
PL305 (N0903)	2 x Well Injection Flowlines from UMC to Well W4	3	3.524
PL306 (N0707)	Oil – TFL from Well P5 to UMC	3	3.142
PL307 (N0708)	Oil – TFL from Well P5 to UMC	3	3.100
PL184 (N0901)	Water Injection Pipeline – New from Cormorant A to UMC	8	7.700
PL184 (N0930)	Water Injection Pipeline – Old from Cormorant A to UMC	8	7.500
PL3132 (T0129)	Water Injection Pipeline from Eider (Oil Production Tee) to Otter	10	21.100
PL1869 (T0124)	Water Injection Pipeline from Eider to Otter	10	21.100

Table 14.1 - Group 18 Items

There are 19 crossings associated with this group. Where crossings under existing infrastructure are encountered a clearance either side of the crossing has been included within the supporting calculations, Ref. [8] for the full removal option.

14.2 Group 18 Decommissioning Options & Screening Outcome

During the Screening Phase, all potential decommissioning options were assessed against the Safety, Environmental, Technical, Societal and Economic criteria using a coarse screening methodology. The assessment performed and the resultant outcomes are detailed fully in the CA Screening Report ref. [4] and summarised in Table 14.2 below.

CATEGORY	OPTION	DESCRIPTION	DISCUSSION
Re-use	1 – Re-use	Leave pipelines in-situ for use in any potential new developments	A review of potential reuse options has indicated that there are no viable reuse options in these locations. Option **screened out** as a Technical Showstopper on that basis.
Full Removal	2A – Cut and Lift with De-burial	Pipelines will be disconnected De-burial of pipelines using MFE (if buried) Recover by cutting into sections and removal Cutting by hydraulic shears or Diamond Wire Cutting (DWC) depending on diameter / coating type	Assessed as unattractive in one, acceptable in three and attractive in one criterion. **Retained for evaluation** as the most viable full removal option.
	2B – Reverse Installation (S-lay or Reel) without De-burial	Pipelines will be disconnected No de-burial prior to removal Recover by reverse reel or reverse s-lay Removal technique based on diameter / construction type / coating type If removal by reverse reel, lines are recovered by reeling to vessel, if removal by reverse s-lay, lines are recovered to vessel and cut into sections on vessel	Assessed as unattractive from a Safety and Technical perspective due to concerns regarding integrity of the lines to recover using reverse installation techniques. Option **screened out** as a less credible full removal option than Option 2A.
	2C – Reverse Installation (S-lay or Reel) with De-burial	As per 2B but with de-burial of pipelines using MFE (if buried)	Assessed as unattractive from a Safety and Technical perspective due to concerns regarding integrity of the lines to recover using reverse installation techniques. Option **screened out** as a less credible full removal option than Option 2A.
	2D – Reverse Installation (Buoyancy)	Pipelines will be disconnected De-burial of pipelines using MFE Perform re-float using a suitable technique (Added buoyancy / aided lift / existing buoyancy, other) Entire line returned to shore via tow	**Not applicable** option as these lines do not lend themselves to removal using buoyancy techniques.

CATEGORY	OPTION	DESCRIPTION	DISCUSSION
	2E – Cut, Float & Transport	Pipelines will be disconnected De-burial of pipelines using MFE Cut into sections subsea (likely to be with hydraulic shears) Float to surface using a suitable technique Return to shore on vessel / towed in basket / retained buoyancy system	Not applicable option as these lines do not lend themselves to floatation for recovery and transportation to shore.
Leave In-situ (Major Intervention)	3A – Rock Placement over entire line	Pipelines will be disconnected Rock placement over full length of pipeline to address areas of spans, exposure & shallow burial No recovery of pipelines	There are limited areas of spans / exposure or shallow burial on any of these lines and therefore there is no benefit in full rock cover. Option screened out as a technical showstopper on that basis.
	3B – Retrench and Bury entire line	Pipelines will be disconnected Re-trench and backfill full length of pipeline to remove areas of spans, exposure & shallow burial depth No recovery of pipelines No introduction of new material	There are limited areas of spans / exposure or shallow burial on any of these lines and therefore there is no benefit in full trench and bury. Option screened out as a technical showstopper on that basis.
	4A – Rock Placement over areas of Spans / Exposure / Shallow Burial	Pipelines will be disconnected Removal and recovery of surface laid sections out with existing trench (including transitions) Rock placement to remediate snag risk from cut ends Rock placement at all areas of spans, exposures and shallow burial depth	Assessed as attractive in four and acceptable in one criterion. There are limited areas of spans / exposures / areas of shallow burial hence rock cover to address these areas is justified. Retained for evaluation against other remaining options.
	4B – Trench & Bury areas of Spans / Exposure / Shallow Burial	Pipelines will be disconnected Removal and recovery of surface laid sections out with existing trench (including transitions) Rock placement to remediate snag risk from cut ends Trench / bury areas of spans, exposures and shallow burial depth Minimal introduction of new material	Assessed as attractive in three and acceptable in two criteria. There are limited areas of spans / exposures or shallow burial hence trench and bury of these areas is justified. Retained for evaluation against other remaining options.
	4C – Remove areas of Spans / Exposure / Shallow Burial	Pipelines will be disconnected Removal and recovery of surface laid sections out with existing trench (including transitions) Rock placement to remediate snag risk from cut ends Removal of areas of spans, exposure and shallow burial depth using cut and lift techniques	Assessed as attractive in three and acceptable in two criteria. There are limited areas of spans / exposure or shallow burial hence removal of these areas is justified. Retained for evaluation against other remaining options.

CATEGORY	OPTION	DESCRIPTION	DISCUSSION
Leave In-situ (Minor Intervention)	4D – Accelerated Decomposition	Pipelines will be disconnected Removal and recovery of surface laid sections out with existing trench Rock placement to remediate snag risk from cut ends Introduce material / techniques to accelerate the decomposition process Potential options include reverse polarity CP, Sulphate Reducing Bacteria (SRBs), chemicals, etc.	Assessed as acceptable in four and unattractive in one criterion. Latest developments in accelerated decomposition still not sufficiently mature to be proposed as a viable decommissioning option. Also, not a beneficial solution for the concrete coated lines. Option screened out as a technical showstopper due to insufficient maturity.
Leave In-situ (Minimum Intervention)	5 – Remove Line Ends & Remediate Snag Risk	Pipelines will be disconnected Removal and recovery of surface laid sections out with existing trench (including transitions) Rock placement to remediate snag risk from cut ends	Assessed as attractive in three and acceptable in two criteria. There are limited areas of spans / exposures / areas of shallow burial hence leaving these areas unaddressed considered a viable option. Retained for evaluation against other remaining options.
Leave As-is and Monitored	6 – Leave As-is	There will be no planned subsea intervention Appropriate legislative considerations shall be addressed, and any advisory zones implemented for remaining subsea infrastructure	Considered an unacceptable solution from a safety perspective due to the potential residual snag risk from the surface laid sections of these lines out with their trenches. Option screened out as a safety showstopper on that basis.

Table 14.2 - Group 18 Decommissioning Options and Screening Summary

14.3 Group 18 Decommissioning Options for Evaluation

The decommissioning options for Group 18 remaining after screening and taken forward to evaluation are:

- Full Removal
  - 2A – Cut and Lift with De-burial
- Leave In-situ (Minor intervention)
  - 4A – Rock Placement over areas of Spans / Exposure / Shallow Burial
  - 4B – Trench and Bury areas of Spans / Exposure / Shallow Burial
  - 4C – Remove areas of Spans / Exposures / Shallow Burial
- Leave In-situ (Minimal Intervention)
  - 5 – Remove Line Ends and Remediate Snag Risk

14.4 Group 18 Evaluation Summary

GROUP 18 – UNCERTAIN INTEGRITY AND CONCRETE COATED RIGID PIPELINES (TRENCHED AND BURIED) (See Section 15.10.1 for detailed discussion and Appendix M for full attributes table and assessment)	
Safety	**Option 4B is assessed as being preferred from a Safety perspective.** Option 5 (remove line ends only) is preferred against the Operations Personnel criterion due to the lower offshore and onshore scopes with this option. Option 4B (trench problem areas) and Option 5 are equally preferred against the Other Users criterion due to these options having a lower number of vessel days of operations and transits to / from the field. Option 4A (rock placement over problem areas), Option 4B and Option 5 are equally preferred against the High Consequence Events criterion due to there being limited potential from dropped object from the limited / no offshore lifting in these options. Other options have offshore lifting operations to varying degrees. Option 2A is preferred from a legacy risk perspective as the lines are fully removed versus being left in-situ in the other options.
Environment	**Option 4B is assessed as being preferred from an Environment perspective.** Option 4A, Option 4B and Option 5 are equally preferred against the Operational Marine Impact criterion due to the lower noise impact from the shorter duration of vessels on-site and cutting operations in these options. Option 4A, Option 4B and Option 5 are also equally preferred against the Atmospheric Emissions & Fuel Use criterion as the other options generate around 5 to 8 times higher atmospheric emissions. Option 2A is preferred against the Other Consumptions criterion due to the lower impact from recycling the returned material versus the impact of replacing material left in-situ in the partial removal options. Additionally, there is no rock resource required in Option 2A. Option 5 is preferred against the Seabed Disturbance criterion due the small area of impact versus all other options which have varying degrees of temporary (from trenching or de-burial) / permanent (from rock cover) seabed impact. The full removal option is significantly preferred over the partial removal options from a Legacy Marine Impacts perspective due to there being no legacy environmental impact from the full removal of these lines.
Technical	**Option 5 is assessed as being preferred from a Technical perspective.** Option 5 is preferred against the Technical criterion as, while all options employ relatively routine operations for their execution, there are greater technical challenges from the scale associated with the full removal of the lines (189 km) or successfully performing the trenching operations in Option 4B.
Societal	**Option 2A is assessed as being preferred from a Societal perspective.** The full removal option is preferred from a Societal – Fishing perspective as the lines are fully removed versus the lines remaining in-situ in the other options. There is also a small preference for the full removal option from Societal – Other Users perspective due to a combination of the quantity of useful, recyclable material (steel) returned and the job creation / retention offered by the larger scope in this option. While this is offset somewhat by the large quantity of concrete returned which is likely to go to landfill, there remains a small preference for the full removal option over the others.
Economic	**Option 5 is assessed as being preferred from an Economic perspective.** Option 5 is preferred from a Short-term Costs perspective as the cost to deliver this option is less than half the next least expensive option and much less than the other options. There is a small preference for Option 2A over the other options from a Long-term Costs perspective as there are no costs associated with Option 2A versus moderate costs associated with survey and monitoring of the lines left in-situ.

GROUP 18 – UNCERTAIN INTEGRITY AND CONCRETE COATED RIGID PIPELINES (TRENCHED AND BURIED)

(See Section 15.10.1 for detailed discussion and Appendix M for full attributes table and assessment)

Summary

Overall Option 5 is the emerging recommendation.

The outcome shows that the preference for Option 5 (remove line ends only) is moderate. Option 5 is preferred against the Technical criterion and marginally less preferred (to Option 4B) against the Safety and Environmental criteria. Option 2A is preferred from a Societal perspective however, there remains a preference for Option 5 overall

Once the Economics criterion is included, the preference for Option 5 is strengthened and hence Option 5 is the emerging recommendation for Group 18.

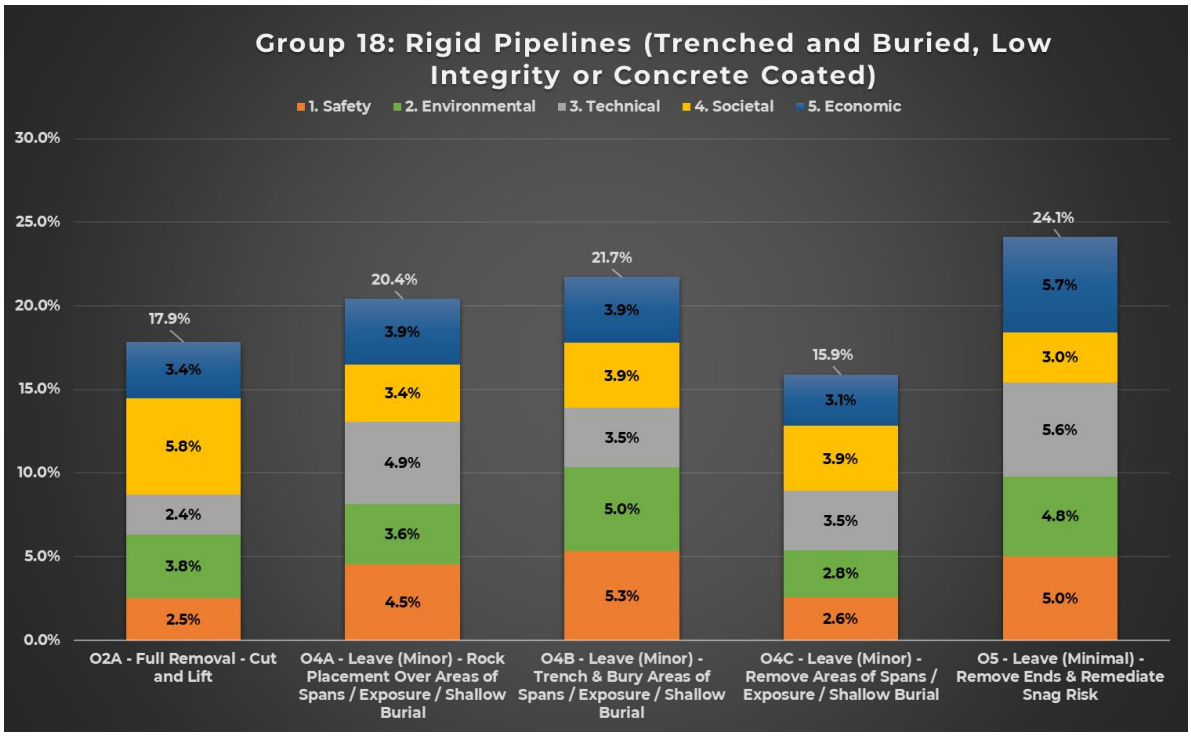


Table 14.3 - Group 18 Evaluation Summary

15 DISCUSSION AND RECOMMENDATIONS

The comparative assessment of each of the decommissioning groups for the Northern North Sea Subsea Infrastructure has identified several groups where the recommended decommissioning approach was full removal, with no further evaluation necessary. These are:

- Group 5 – Umbilicals (Surface Laid)
- Group 10 – Flexible Risers and Riser Umbilicals
- Group 11 – Rigid Risers
- Group 12 – Spools and Jumpers
- Group 13 – Large Structures
- Group 14 – Structures
- Group 15 – Protection and Stabilisation

The full comparative assessment process was applied to the remaining decommissioning groups (1, 2, 3, 4, 6, 7, 8, 16, 17 and 18). A discussion of the key drivers for the outcomes obtained from the comparative assessment of the decommissioning options within these decommissioning groups are provided here.

15.1 Group 1 Discussion

The following sections provide a discussion of the evaluation of the four most viable Group 1 – Pipe-in-Pipe Hybrids (Surface Laid and Exposed) decommissioning options (Option 2A – Full Removal by Cut and Lift, Option 3B – Trench and Bury Entire Line, Option 4A – Rock Placement over areas of Spans / Exposure / Shallow Burial and Option 4C – Remove areas of Spans / Exposure / Shallow Burial) against the five criteria.

15.1.1 Safety

In all the options evaluated, all operations considered are diverless, including removal of trim chains and vent valve assemblies, and pipe cutting operations. For all options, some equipment recovery to a support vessel deck is necessary; these being towheads and appurtenances as a minimum, specific sections of the pipe-in-pipe hybrids in addition to towheads and appurtenances or the pipe-in-pipe hybrids in their entirety. Against the Operations Personnel criterion, all partial removal options are equally preferred over Option 2A (full removal). This is due to the greater risk exposure associated with the more extensive scope to fully remove the lines and the greater onshore scope associated with the returned lines. There are differences in the risk exposure associated with the partial removal options, but these differences are considered minor and insufficient to express a preference within this evaluation. A HAZID was conducted ref. [7] to assess these operations.

Against the Other Users criterion, again all partial removal options are equally preferred over the full removal option. This is due the impact on the safety of other users expected to be marginally higher for the full removal option than the partial removal options. This marginally higher impact is due to the much higher number of days of vessel

operations and higher number of transits to / from the field to execute the full removal option. The safety impact on other users is similar across the partial removal options.

Against the High Consequence Events criterion, Option 3B (trench entirety of lines) and Option 4A (rock placement over problem areas) are equally preferred as Option 3B has limited offshore lifting relating to deployment and recovery of cutting equipment to remove chains and appurtenances and trenching equipment to perform trenching and burial of the lines. Option 4A has no offshore lifting associated with the rock placement operations as they are conducted from a Fall Pipe Vessel. It does, however, also include the deployment and recovery of cutting equipment to remove chains and appurtenances hence being assessed as equally preferred with Option 3B. Option 4C (removal of problem areas) is less preferred as there is a larger number of offshore lifting operations associated with the deployment and recovery of cutting equipment and the recovery of sections of the lines. Again, deployment and recovery of cutting equipment to remove chains and appurtenances is required. Option 2A is the worst option due to the very high number of offshore lifting operations (when compared to the other options) associated with the deployment and recovery of the cutting equipment and the recovery of approximately 20 km of lines in 10 m sections.

Against the Legacy Risk criterion, the full removal option is preferred over Option 3B as, while both options effectively leave a clear seabed, the line does remain in-situ in Option 3B and there is the legacy risk exposure from the future survey and monitoring to mitigate future snag risk of the lines left in-situ. These options are significantly preferred over Option 4C (remove problem areas) as the majority of the lines will remain on the seabed, albeit with existing areas of spans removed and Option 4A, where the majority of the lines will also remain on the seabed with large rock berms over existing areas of spans. Again, each of these options has an associated legacy risk exposure from the future survey and monitoring to mitigate future snag risk of the lines left in-situ.

Option 3B is the equally preferred option from an Operations Personnel, impact on Other Users and High Consequence Events perspective. It is marginally less preferred from a Legacy Risk perspective however, overall, there remains a preference for Option 3B from a Safety perspective.

15.1.2 Environment

Against the Operational Marine Impact criterion, all partial removal options are equally preferred over Option 2A (full removal). This is due to the greater noise impact from the longer durations that vessels are on-site and the longer duration cutting operations, although noise impact from cutting operations conducting using hydraulic shears is a smaller factor. It is noted that, while there is a preference for the partial removal operations, that preference is marginal as the greater noise impact is minor. There is an additional preference for the partial removal options due to the discharges of line contents and loss of insulation material that occurs at each cut location in the full removal option, but again, the impacts are minor.

Against the Atmospheric Emissions and Fuel Use criterion, all partial removal options are equally preferred over Option 2A. This is due to the increased emissions generated and fuel used from the extended offshore scope in the full removal option. There are differences in the emission generated and fuel used across the partial removal options, however these differences are considered minor and insufficient to express a preference within these options.

Against the Other Consumptions criterion, Option 2A is marginally preferred over Option 3B (trench entirety of lines) and Option 4C (remove problem areas) as the environmental impact from recycling returned material in Option 2A

is smaller than the impact associated with generating replacement material for the lines left in-situ in these options. Option 4A (rock placement over problem areas) is marginally less preferred again due to the quantity of rock required to deliver Option 4A is much greater than the other options, where the rock required is either negligible or zero.

Against the Seabed Disturbance criterion, Option 2A is preferred as there is negligible seabed disturbance associated with the cut and lift of these surface laid lines. Option 3B and Option 4C are less preferred but for different reasons. Option 3B is less preferred due to the large area of seabed impacted by trenching operations to bury the lines. While the area impacted is large, the impact is temporary in nature, with the seabed habitat recovering quickly. Option 4C has a much smaller area impact but as the impact is from the introduction of rock cover (over the cut line ends), this represents a greater impact on the seabed as it is a permanent habitat change. Option 4A is the least preferred option due to it having the largest area of permanent habitat change from rock covering the areas of spans on these lines.

Against the Legacy Marine Impact criterion, Option 2A is preferred as there are no legacy marine impacts associated with these lines being fully removed. While Option 3B is less preferred than the full removal option, it is preferred over the other options as it will be left in-situ but fully trenched and buried. As such, the legacy environmental impact is considered lower than the other partial removal options as the lines are isolated from the marine environment.

Option 2A is the least preferred option from an Operational Marine Impact and Atmospheric Emissions and Fuel Use perspective, although the preference for the partial removal options is relatively minor. Option 2A is however, significantly preferred from a Seabed Disturbance and Legacy Marine Impact perspective. This significant preference, along with a minor preference from an Other Consumptions perspective, results in an overall preference for Option 2A from an Environmental perspective.

15.1.3 Technical

Against the Technical criterion, Option 4A (rock placement over problem areas) is preferred over Option 4C (remove problem areas) and significantly preferred over Option 2A (full removal) and Option 3B (trench entirety of lines). While all options employ relatively routine operations such as de-burial, line cutting, trenching and rock cover, there are significant concerns regarding the lift stability and retention of loose internal equipment when recovering sections of these pipe-in-pipe hybrid lines under the full removal option. Hydraulic shears are proposed and there is an expectation that the 'crimping' effect will mitigate these concerns, however there is greater technical risk associated with this option than simple rock cover operations in Option 4A. Option 4C, which requires removal of problem areas, will face the same challenges, albeit on a much smaller scale than addressing the 20 km of the lines in the full removal option. Option 3B is the least preferred option from a technical perspective as, while trenching of lines is routine, the diameter of the lines (26" and 24") would require trenching equipment that is near the limit of current technology. That, coupled with the concerns regarding the geotechnical conditions in the area (stiff clays and 'shelly deposits') result in this being the least preferred option. It is noted that trim chains and appurtenance removal is included in all partial removal options.

15.1.4 Societal

Against the Societal – Fishing criterion, Option 2A (full removal) is preferred over Option 3B (trench entirety of lines) as, while both options effectively leave a clear seabed, the line does remain in-situ in Option 3B. These options are significantly preferred over Option 4C (remove problem areas) as the majority of the lines will remain on the seabed, albeit with existing areas of spans removed and Option 4A (rock placement over problem areas), where the majority of the lines will also remain on the seabed with large rock berms over existing areas of spans.

Against the Societal – Other Users criterion, Option 2A is preferred marginally over the partial removal options. This is due to the societal benefits of returning the steel for recycling in the full removal option. The benefit of this is tempered by the challenges that are associated with separating the useful steel from the insulation material surrounding the internal lines in these pipe-in-pipe hybrids. There is also a small preference due to the job creation / retention associated with the larger scope for the full removal option. All partial removal options have similar, minimal societal benefits / impacts.

As Option 2A (full removal) is preferred from a Fishing and Other Users perspective, overall, there is a moderate preference for Option 2A from a Societal perspective.

15.1.5 Economic

Against the Short-term Costs criterion, Option 4A (rock placement over problem areas) and Option 4C (remove problem areas) are equally preferred over the other options. This is due to the costs to execute these options being similar (£3.4 million and £4.5 million respectively) and around half the cost of Option 3B (trench entirety of lines - £8.4 million). They are also much less than Option 2A (full removal - £17.7 million).

Against the Long-term Costs criterion, all options are equally preferred. While there are no long-term costs associated with the full removal option, the long-term costs associated with the survey and monitoring of the lines left in-situ in the partial removal options are minor (less than £1 million) and would be spread out over many years. As such, the differences between the options are insufficient to express a preference.

As Option 4A and Option 4C are equally preferred from both a Short-term Costs and Long-term Costs perspective, overall, Option 4A and Option 4C are equally preferred from an Economic perspective.

15.1.6 Group 1 Recommendation

The recommended decommissioning option for Group 1 – Pipe-in-Pipe Hybrids (Surface Laid and Exposed) is Option 4A – Rock Placement over areas of Spans / Exposure / Shallow Burial. This option involves the following key activities:

- Pipelines will be disconnected
- Removal and recovery of line ends
- Removal of venting appurtenances and trim chains
- Rock placement to remediate snag risk from cut ends

- Rock placement at all areas of spans to an appropriate depth of cover
- Future survey & monitoring programme

15.2 Group 2 Discussion

The following sections provide a discussion of the evaluation of the three most viable Group 2 – Trunk Lines (Partially Trenched and Buried) decommissioning options (Option 2A – Full Removal by Cut and Lift, Option 4A – Rock Placement over areas of Spans / Exposure / Shallow Burial and Option 4C – Remove areas of Spans / Exposure / Shallow Burial) against the five criteria.

15.2.1 Safety

Against the Operations Personnel criterion, Option 4A (rock placement over problem areas) is significantly preferred over the other options. This is due to the greater risk exposure associated with the greater scope to remove the problem areas in Option 4C and the much greater scope for fully remove the line in Option 2A. There is also a much greater onshore scope associated with the returned line in Option 2A.

Against the Other Users criterion, Option 4A is preferred over Option 4C due to the higher number of days of vessel operations and higher number of transits to / from the field to remove the problem areas. The preference for Option 4A over Option 2A is more significant again due to the much higher number of days of vessel operations and higher number of transits to / from the field to execute the full removal option.

Against the High Consequence Events criterion, Option 4A is preferred over Option 4C as Option 4A has no offshore lifting associated with the rock placement operations as they are conducted from a Fall Pipe Vessel, whereas Option 4C has as a large number of offshore lifting operations associated with the deployment and recovery of cutting equipment and the recovery of sections of the line. Option 2A is the worst option due to the very high number of offshore lifting operations (many thousands) associated with the deployment and recovery of the cutting equipment and the recovery of 153 km of line in 10 m sections.

Against the Legacy Risk criterion, the full removal option is preferred over Option 4C as the majority of the line will remain in-situ, albeit with existing areas of spans removed and Option 4A, where the majority of the line will also remain in-situ with rock berms over existing areas of spans. Each of these options has an associated legacy risk exposure from the future survey and monitoring to mitigate future snag risk of the line left in-situ.

Option 4A is the preferred option from an Operations Personnel, impact on Other Users and High Consequence Events perspective. It is less preferred from a Legacy Risk perspective however, overall, there remains a preference for Option 4A from a Safety perspective.

15.2.2 Environment

Against the Operational Marine Impact criterion, Option 4A (rock placement over problem areas) is preferred over Option 4C (remove problem areas). This is due to the greater noise impact from the longer durations that vessels

are on-site and the cutting operations (with diamond wire) to remove problem areas. In addition, there are discharges of line contents at each cut location in Option 4C, although the impact of these discharges is less significant due to the line being flushed and cleaned prior to the line being cut into. Option 2A (full removal) is the least preferred option due to the much greater noise impact from the much longer durations that vessels are on-site, and the much greater cutting operation scope associated with cutting this 153 km line into 10m sections. The impact of these operations is also magnified when being conducted at the near shore portion of the trunk line where it impacts marine mammals (harbour porpoise) and seal haul out area. Again, there are line content discharges as each location, but the impact is considered minimal.

Against the Atmospheric Emissions and Fuel Use criterion, Option 4A is preferred over Option 4C due to the increased emissions generated and fuel used (almost 3 times higher) from the greater offshore scope to remove problem areas. Option 2A is the least preferred option as it involves by far the largest offshore scope and hence the emissions generated and fuel used are around 16 times higher for Option 2A over Option 4A.

Against the Other Consumptions criterion, Option 2A is preferred over Option 4C as the environmental impact from recycling returned material in Option 2A is smaller than the impact associated with generating replacement material for the line left in-situ in Option 4C. This is also true when comparing Option 2A to Option 4A, however, Option 4A is less preferred again due to the large quantity of rock required deliver Option 4A.

Against the Seabed Disturbance criterion, Option 4C is preferred as, while there is a significant area of seabed impacted by the rock cover introduced over cut ends of the line where problem areas are removed (permanent habitat change), this area is much smaller than the area impacted by de-burial operations to enable full removal of the line in Option 2A, although this impact is temporary in nature. Option 4A is the least preferred option as the area of permanent impact is much greater than Option 4C. It is noted that, of the areas impacted by rock cover in both Option 4A and Option 4C only a small amount (less than 10% in both cases) is within the East Mainland Coast Shetland SPA which reduces the overall impact of the introduced rock cover.

Against the Legacy Marine Impact criterion, Option 2A is significantly preferred over the other options as there are no legacy marine impacts associated with the line being fully removed versus the line remaining in-situ and exposed to the marine environment in the other options.

Option 4C is less preferred than Option 4A from an Operational Marine Impact and Atmospheric Emissions and Fuel Use perspective and less preferred than Option 2A from an Other Consumptions and Legacy perspective. Option 4C is however, significantly preferred from a Seabed Disturbance perspective. This significant preference, along with marginally lower preference across the other criteria results in a small overall preference for Option 4C from an Environmental perspective.

15.2.3 Technical

Against the Technical criterion, Option 4A (rock placement over problem areas) is preferred over Option 4C (remove problem areas) and significantly preferred over Option 2A (full removal). While all options employ relatively routine operations such as de-burial, line cutting and rock cover, there are significant concerns regarding performing the de-burial, cutting and lifting operations both in Option 4C and to a much greater extent when considering performing these operations over 153 km of line in Option 2A. In addition, there are challenges associated with the recovery of

the spalling of the concrete coating likely to occur at cut locations, especially on the scale of the full removal option. The simple operation of rock covering the problem areas in Option 4A carries much lower technical risk.

15.2.4 Societal

Against the Societal – Fishing criterion, Option 2A (full removal) is significantly preferred over the other options as, while there will be significant disruption to fishing operations from the removal of the line, a clear seabed is preferred from a fishing operations perspective. This is also a significant preference for Option 4C (remove problem areas) over Option 4A (rock placement over problem areas) due to the large rock berms that will be introduced when covering problem areas of this surface laid line with rock, which is less desirable than the removal of the problem areas with rock cover over cut line ends.

Against the Societal – Other Users criterion, Option 2A is less preferred than the other options as, while there are societal benefits of returning the steel for recycling in the full removal option, this is more than offset by the large quantity of seawater contaminated concrete, which is likely to take up limited landfill capacity on shore. There are also challenges in the segregation of the steel and concrete for recycling due to the coal tar layer between the materials and the concrete coating having 'chicken wire' type steel reinforcement further exacerbating the segregation challenges. This societal impact was considered to be a more significant contributor to the assessment than any benefits associated with the job creation / retention from the much larger scope to execute Option 2A. The other options were assessed to have similar, minimal societal benefits / impacts.

As Option 2A (full removal) is significantly preferred over the other options from a Fishing perspective but only marginally less preferred than the other options from an Other Users perspective, overall, there is a moderate preference for Option 2A from a Societal perspective.

15.2.5 Economic

Against the Short-term Costs criterion, Option 4A (rock placement over problem areas) is significantly preferred over the other options. This is due to the costs to execute this option (£4.3 million) being around a quarter of the cost of Option 4C (remove problem areas - £19.6 million) and much less than Option 2A (full removal - £170 million).

Against the Long-term Costs criterion, Option 2A is marginally preferred as there are no long-term costs associated with the full removal option whereas both Option 4A and Option 4C have long-term costs associated with the survey and monitoring of the line left in-situ. While these costs are relatively modest (c. £2 million) and would be spread over many years, they were sufficient to express a small preference for the full removal option.

As Option 4A is significantly preferred from a Short-term Costs and only marginally less preferred from a Long-term Costs perspective, overall, Option 4A is preferred from an Economic perspective.

15.2.6 Group 2 Recommendations

The recommended decommissioning option for Group 2 – Trunk Lines (Partially Trenched and Buried) is Option 4A – Rock Placement over areas of Spans / Exposures / Shallow Burial. This option involves the following key activities:

- Pipeline will be disconnected
- Removal and recovery of offshore line end
- Rock placement to remediate snag risk from cut ends
- Rock placement at all areas of spans, exposures and shallow burial to an appropriate depth of cover
- Future survey & monitoring programme

15.3 Group 3 Discussion

The following sections provide a discussion of the evaluation of the five most viable Group 3 – Flexible Pipelines and Umbilicals (Trenched and Buried) decommissioning options (Option 2A – Full Removal by Cut and Lift, Option 4A – Rock Placement over areas of Spans / Exposure / Shallow Burial, Option 4B – Trench and Bury areas of Spans / Exposure / Shallow Burial, Option 4C – Remove areas of Spans / Exposure / Shallow Burial) and Option 5 – Remove Line Ends and Remediate Snag Risk) against the five criteria.

15.3.1 Safety

Against the Operations Personnel criterion, Option 5 (remove line ends only) is the preferred option. It is marginally preferred over Option 4A (rock placement over problem areas) as the scope to rock cover over the problem areas is higher and therefore presents a marginally higher risk exposure. Option 5 is further preferred over Option 4B (trench and bury problem areas) and Option 4C (remove problem areas) as the scope associated with these options and the risk exposure is greater again. Option 2A (full removal) is the least preferred option as the scope to fully remove these lines is the greatest and thus has the highest risk exposure of all options. There is also a greater onshore scope associated with the returned lines.

Against the Other Users criterion, Option 5 (remove line ends only) is preferred over Options 4A, 4B and 4C (which are equally preferred). This is due the impact on the safety of other users expected to be lower in Option 5 as it has a lower number of days of vessel operations and transits to / from the field than the other options. The preference is marginal. Option 2A is least preferred due to the much higher number of vessel days and transits associated with the full removal option.

Against the High Consequence Events criterion, 4A (rock placement over problem areas), Option 4B (trench and bury problem areas) and Option 5 (remove line ends only) are equally preferred as there are less offshore lifting operations and hence lower potential for high consequence events than in Option 2A and Option 4C where there are thousands of offshore lifting operations to deploy and recover cutting equipment and recover line ends, thus presenting a greater risk of dropped object.

Against the Legacy Risk criterion, the full removal option is preferred over the other options as there is no legacy risk associated with the full removal of the lines. All other options are less preferred as the lines remain in-situ, albeit with the problem areas rock covered in Option 4A, trenched in Option 4B or removed in Option 4C. Option 5 is the least preferred option due to existing areas of spans, exposure and shallow burial remaining. All partial removal options also have an associated legacy risk exposure from the future survey and monitoring to mitigate future snag risk of the lines left in-situ.

Option 5 is the preferred option from an Operations Personnel, Other Users and High Consequence Events perspective. While it is less preferred from a Legacy Risk perspective, overall, there remains a preference for Option 5 from a Safety perspective.

15.3.2 Environment

Against the Operational Marine Impact criterion, Option 5 (remove line ends only) is preferred over all other options due to all other options have greater noise impact from the longer duration of vessels on-site and / or cutting operations in those options. The relative preference is however minor.

Against the Atmospheric Emissions and Fuel Use criterion, Option 5 (remove line ends only) is marginally preferred over the other options as it generates the lowest emissions of the options. Option 2A (full removal) is the least preferred option due to the increased emissions generated and fuel used from the longer durations associated with the full removal of the lines.

Against the Other Consumptions criterion, Option 2A (full removal), Option 4B (trench and bury problem areas) and Option 5 (remove line ends only) are equally preferred. While there are differences in the impact associated with recycling material returned or generating replacement material for the lines left in-situ, these differences are insufficient to express a preference within these options. Option 4C (remove problem areas) is less preferred due to the rock required over cut locations in this option. Option 4A (rock cover over problem areas) is the least preferred option due to the large quantity of rock required in this option.

Against the Seabed Disturbance criterion, Option 5 (remove line ends only) is preferred as there is minor seabed disturbance associated with the cut and lift of the surface laid line ends, limited to the footprint of the rock placed over cut locations. Option 4B (trench and bury problem areas) is marginally less preferred as, while the area impacted by trenching the problem areas is greater, the impact is temporary in nature. Option 2A (full removal) is less preferred again as the area impacted from the de-burial operations over these lines is much greater although, again, this is temporary in nature however there is an area of rock cover introduced at the line crossings. Option 4C (remove problem areas) is less preferred again due to the large area of permanent habitat change from the rock cover introduced over cut locations when removing problem areas. Option 4A (rock placement over problem areas) is the least preferred option as the area of permanent habitat change from rock covering problem areas is the greatest impact of all options.

Against the Legacy Marine Impact criterion, Option 2A (full removal) is preferred as there are no legacy marine impacts associated with these lines being fully removed. Option 4A (rock cover over problem areas), Option 4B (trench and bury problem areas) and Option 4C (remove problem areas) are less preferred as there will be slow discharges and degradation products from these lines remaining in-situ, although these will occur over a long time period and as such, their legacy environmental impact is expected to be minor, especially given these lines will be isolated from the marine environment. Option 5 (remove line ends only) is the least preferred option as any discharges and degradation products will occur over a shorter time period than the other options as the areas of existing spans and exposure will remain and are exposed to the marine environment. The legacy environmental impact is still expected to be minor.

Option 5 is preferred from an Operational Marine Impact, Atmospheric Emissions and Fuel Use and Seabed Disturbance perspective and equally preferred from an Other Consumptions perspective. Option 2A is preferred over Option 5 from a Legacy Marine Impact perspective. Overall, this results in Option 5 being preferred from an Environmental perspective.

15.3.3 Technical

Against the Technical criterion, Option 5 (remove line ends only) is preferred. While all options employ relatively routine operations such as de-burial, line cutting, trenching and rock cover, Option 4B (trenching of problem areas) and Option 4C are less preferred due to the increased scope over Option 5 leading to greater technical challenges on a cumulative basis. Option 2A (cut and lift) is least preferred due to de-burial, cut and lift operations over the 200+ km of lines in this group presenting the greatest technical challenges on a cumulative basis.

15.3.4 Societal

Against the Societal – Fishing criterion, Option 2A (full removal) is preferred over the other options as, while there will be disruption to fishing operations from the removal of the lines, a clear seabed is preferred from a fishing operations perspective. Option 4A (rock placement over problem areas) and Option 5 (remove line ends only) were least preferred due to the existing of rock berms or existing spans remaining respectively.

Against the Societal – Other Users criterion, Option 2A is also preferred over the partial removal options. This is due to the societal benefits of returning the steel and copper for recycling in the full removal option. The benefit of this is tempered by the quantity of polymer returned which is likely to end up in landfill. All partial removal options have similar, minimal societal benefits / impacts.

As Option 2A (full removal) is preferred over the other options from both a Fishing perspective and from an Other Users perspective, overall, there is a preference for Option 2A from a Societal perspective.

15.3.5 Economic

Against the Short-term Costs criterion, Option 5 (remove line ends only) is preferred over the other options. This is due to the costs to execute this option (£8 million) being around a half of the cost of next lowest option (Option 4A – rock placement over problem areas - £15.5 million) and less again than the other options.

Against the Long-term Costs criterion, Option 2A is marginally preferred as there are no long-term costs associated with the full removal option whereas all partial removal options have long-term costs associated with the survey and monitoring of the lines left in-situ. While these costs are relatively modest (c. £2 million) and would be spread over many years, they are sufficient to express a small preference for the full removal option.

As Option 5 is preferred from a Short-term Costs and only marginally less preferred from a Long-term Costs perspective, overall, Option 5 is preferred from an Economic perspective.

15.3.6 Group 3 Recommendations

The recommended decommissioning option for Group 3 – Flexible Pipelines and Umbilicals (Trenched and Buried) is Option 5 – Remove Line Ends Only and Remediate Snag Risk. This option involves the following key activities:

- Pipelines / umbilicals will be disconnected
- Removal and recovery of line ends including trench transition
- Rock placement to remediate snag risk from cut ends
- Future survey & monitoring programme

15.4 Group 4 Discussion

Given the similarity between the equipment in Group 3, where the flexible flowlines and umbilicals are trenched and buried and Group 4 where the flexible flowlines are trenched and rock covered, the outcome of the evaluation for Group 4 is in line with the outcome of the Group 3 evaluation. The discussion regarding group 3 as detailed in Section 15.3 applies to Group 4.

15.4.1 Group 4 Recommendations

The recommended decommissioning option for Group 4 – Flexible Pipelines and Umbilicals (Trenched and Rock Covered) is Option 5 – Remove Line Ends Only and Remediate Snag Risk. This option involves the following key activities:

- Pipelines / umbilicals will be disconnected
- Removal and recovery of line ends including trench transition
- Rock placement to remediate snag risk from cut ends
- Future survey & monitoring programme

15.5 Group 6 Discussion

The following sections provide a discussion of the evaluation of the four most viable Group 6 – Rigid Pipelines (Surface Laid, Exposed and Non-Concrete Coated) decommissioning options (Option 2B – Full Removal by Reverse Installation (Reeling) without De-burial, Option 3B – Trench and Bury Entire Line, Option 4A – Rock Placement over areas of Spans / Exposure / Shallow Burial and Option 4C – Remove areas of Spans / Exposure / Shallow Burial) against the five criteria.

15.5.1 Safety

Against the Operations Personnel criterion, Option 4A (rock placement over problem areas) is significantly preferred over the other options. This is due to the greater risk exposure associated with the greater scope to trench and bury the entire line in Option 3B or to remove the problem areas in Option 4C and the much greater scope to fully remove the line in Option 2B. There is also a much greater onshore scope associated with the returned line in Option 2B.

Against the Other Users criterion, all options are equally preferred as, while there are differences in the number of days of vessel operations and transits to / from the field across the options, these differences are considered insufficient to express a preference from a safety impact on other users' perspective.

Against the High Consequence Events criterion, Option 3B (trench entirety of line) and Option 4A (rock cover over problem areas) are equally preferred. This is due to these options having limited / no offshore lifting whereas Option 4C (remove problem areas) has as a large number of offshore lifting operations associated with the deployment and recovery of cutting equipment and the recovery of sections of the line. Option 2B is the least preferred option due to potential for High Consequence Events associated with the potential residual torsion in the line during offloading (reeling) to the quayside.

Against the Legacy Risk criterion, the full removal option is preferred over Option 3B (trench entirety of line) as, while both options effectively leave a clear seabed, the line does remain in-situ in Option 3B and there is the legacy risk exposure from the future survey and monitoring to mitigate future snag risk of the lines left in-situ. These options are significantly preferred over Option 4C (remove problem areas) as the majority of the lines will remain on the seabed, albeit with existing areas of spans removed and Option 4A, where the majority of the lines will also remain on the seabed with rock berms over areas existing areas of spans. Again, each of these options has an associated legacy risk exposure from the future survey and monitoring to mitigate future snag risk of the lines left in-situ.

Option 4A is the preferred option from an Operations Personnel perspective and equally preferred from an impact on Other Users and High Consequence Events perspective. It is less preferred from a Legacy Risk perspective however, overall, there remains a preference for Option 4A from a Safety perspective.

15.5.2 Environment

Against the Operational Marine Impact criterion, all options are equally preferred as the differences in the environmental impacts across the options are minor, and insufficient to express a preference.

Against the Atmospheric Emissions and Fuel Use criterion, all options are equally preferred. There are differences in the emissions generated and fuel used across the options, however these differences are considered minor and insufficient to express a preference within these options.

Against the Other Consumptions criterion, all options are equally preferred as, while there are differences in environmental impact from recycling returned material or generating replacement material for the lines left in-situ, and in the rock consumed across the options, these differences are considered minor and insufficient to express a preference within these options.

Against the Seabed Disturbance criterion, Option 2B (full removal) is preferred over all partial removal options as there is negligible seabed disturbance associated with the cut and lift of this surface laid line. Option 4C (remove problem areas) is less preferred as there is small area of seabed impacted by the rock cover over the cut line ends, which represents a permanent habitat change. Option 3B (trench entirety of lines) is less preferred again, due to the larger area of seabed impacted by trenching the entire line, although it is recognised that this impact is temporary in nature. Option 4A (rock placement over problem areas) is the least preferred option as there is a large area of seabed impacted from the rock cover over problem areas which is a permanent habitat change.

Against the Legacy Marine Impact criterion, Option 2B (full removal) is preferred as there are no legacy marine impacts associated with the line being fully removed. While Option 3B (trench entirety of line) is less preferred than the full removal option, it is preferred over the other options as it will be left in-situ but fully trenched and buried. As such, the legacy environmental impact is considered lower than the other partial removal options as the line is isolated from the marine environment.

Option 2B is the preferred option from a Legacy Marine Impacts perspective and equally preferred from an Operational Marine Impact, Atmospheric Emissions and Fuel Use and Other Consumptions perspective. While Option 2B is less preferred from a Seabed Disturbance perspective, overall, there remains a preference for Option 2B from an Environmental perspective.

15.5.3 Technical

Against the Technical criterion, Option 4A (rock placement over problem areas) and Option 4C (remove problem areas) are equally preferred. While all options employ relatively routine operations such as line cutting, trenching and rock cover, there are challenges associated with Option 3B (trench entirety of line) due to the geotechnical conditions in this location, although it is noted that the Kestrel line (not in this group but in the same general location) was trenched. Option 2B (reverse reeling) is the least preferred option as there are concerns regarding the reverse reeling of rigid lines of this diameter (16-inch) as this is near the limit of reverse reeling capabilities.

15.5.4 Societal

Against the Societal – Fishing criterion, Option 2B (full removal) is preferred over the other options as, while there will be disruption to fishing operations from the removal of the line, a clear seabed is preferred from a fishing operations perspective.

Against the Societal – Other Users criterion, all options are equally preferred as the positive and negative societal impacts are largely insignificant across all options due to the limited scope of returned material associated with the single, 16-inch, 16 km line in this group.

As Option 2B (full removal) is preferred over the other options from a Fishing perspective and equally preferred from an Other Users perspective, overall, there is a preference for Option 2B from a Societal perspective.

15.5.5 Economic

Against the Short-term Costs criterion, Option 4A (rock placement over problem areas) is preferred over the other options. This is due to the costs to execute this option (£1 million) being less than half the cost of next lowest option (Option 4C – remove problem areas - £2.5 million) and less again than the other options.

Against the Long-term Costs criterion, all options are equally preferred. While there are no long-term costs associated with the full removal option, the long-term costs associated with the survey and monitoring of the line left in-situ in the partial removal options are minor (less than £1 million) and would be spread out over many years. As such, the differences between the options are insufficient to express a preference.

As Option 4A is preferred from a Short-term Costs perspective and equally preferred from a Long-term Costs perspective, overall, Option 4A is preferred from an Economic perspective.

15.5.6 Group 6 Recommendations

The recommended decommissioning option for Group 6 – Rigid Pipelines (Surface Laid, Exposed and Non-Concrete Coated) is Option 4A – Rock Placement over areas of Spans / Exposures / Shallow Burial. This option involves the following key activities:

- Pipeline will be disconnected
- Removal and recovery of line ends
- Rock placement to remediate snag risk from cut ends
- Rock placement at all areas of spans to an appropriate depth of cover
- Future survey & monitoring programme

15.6 Group 7 Discussion

The following sections provide a discussion of the evaluation of the four most viable Group 7 – Rigid Pipelines (Surface Laid, Exposed and Concrete Coated) decommissioning options (Option 2A – Full Removal by Cut and Lift, Option 3B – Trench and Bury Entire Line), Option 4A – Rock Placement over areas of Spans / Exposure / Shallow Burial and Option 4C – Remove areas of Spans / Exposure / Shallow Burial) against the five criteria.

15.6.1 Safety

Against the Operations Personnel criterion, Option 4A (rock placement over problem areas) is significantly preferred over the other options. This is due to the greater risk exposure associated with the greater scope to trench and bury the entire line in Option 3B or to remove the problem areas in Option 4C and the much greater scope to fully remove the line in Option 2A. There is also a much greater onshore scope associated with the returned line in Option 2A.

Against the Other Users criterion, again all partial removal options are equally preferred over the full removal option. This is due the impact on the safety of other users expected to be marginally higher for the full removal option than the partial removal options. This marginally higher impact is due to the much higher number of days of vessel operations and higher number of transits to / from the field to execute the full removal option. The safety impact on other users is similar across the partial removal options.

Against the High Consequence Events criterion, Option 3B (trench entirety of line) and Option 4A (rock cover over problem areas) are equally preferred. This is due to these options having limited / no offshore lifting whereas Option 4C (remove problem areas) has as a large number of offshore lifting operations associated with the deployment and recovery of cutting equipment and the recovery of sections of the line. Option 2A is the least preferred option due to the very high number of offshore lifting operations (when compared to the other options) associated with the deployment and recovery of the cutting equipment and the recovery of approximately 29 km of lines in 10 m sections.

Against the Legacy Risk criterion, the full removal option is preferred over Option 3B (trench entirety of line) as, while both options effectively leave a clear seabed, the line does remain in-situ in Option 3B and there is the legacy risk exposure from the future survey and monitoring to mitigate future snag risk of the lines left in-situ. These options are significantly preferred over Option 4C (remove problem areas) as the majority of the lines will remain on the seabed, albeit with existing areas of spans removed and Option 4A, where the majority of the lines will also remain on the seabed with rock berms over areas existing areas of spans. Again, each of these options has an associated legacy risk exposure from the future survey and monitoring to mitigate future snag risk of the lines left in-situ.

Option 4A is the preferred option from an Operations Personnel perspective and equally preferred from an impact on Other Users and High Consequence Events perspective. It is less preferred from a Legacy Risk perspective however, overall, there remains a preference for Option 4A from a Safety perspective.

15.6.2 Environment

Against the Operational Marine Impact criterion, all partial removal options are equally preferred over Option 2A (full removal). This is due to the greater noise impact from the longer durations that vessels are on-site and the longer duration cutting operations (with diamond wire) to fully remove the lines. There is an additional preference for the partial removal options due to the discharges of line contents that occur at each cut location in the full removal option. The preference for the partial removal options over the full removal option is marginal as the environmental impacts associated with the full removal are minor.

Against the Atmospheric Emissions and Fuel Use criterion, all partial removal options are equally preferred over Option 2A (full removal). This is due to the increased emissions generated and fuel used from the extended offshore scope in the full removal option. There are differences in the emission generated and fuel used across the partial removal options, however these differences are considered minor and insufficient to express a preference within these options.

Against the Other Consumptions criterion, Option 2A (full removal) is marginally preferred over Option 3B (trench entirety of lines) and Option 4C (remove problem areas) as the environmental impact from recycling returned material in Option 2A is smaller than the impact associated with generating replacement material for the lines left in-situ and, both options require more rock resource than Option 2A. Option 4A (rock cover over problem areas) is marginally less preferred again due to the quantity of rock required to deliver Option 4A is much greater than the other options, where the rock required is less significant.

Against the Seabed Disturbance criterion, Option 2A (full removal) and Option 4C (remove problem areas) are equally preferred as there is negligible seabed disturbance associated with the cut and lift of these surface laid lines and a small area impacted by the rock cover over the cut line ends in Option 4C. Option 3B is less preferred due to the large area of seabed impacted by trenching operations to bury the lines. While the area impacted is large, the impact is temporary in nature, with the seabed habitat recovering quickly. Option 4A is the least preferred option due to it having the largest area of permanent habitat change from rock covering the problem areas on these lines.

Against the Legacy Marine Impact criterion, Option 2A is preferred as there are no legacy marine impacts associated with these lines being fully removed. All partial removal options are considered to present a similar and minor legacy marine impact.

Option 4C is equally preferred from an Operational Marine Impact, Atmospheric Emissions and Fuel Use and Seabed Disturbance perspective, and only marginally less preferred from an Other Consumptions perspective. While it is less preferred from a Legacy Marine Impact perspective, overall, there remains a preference for Option 4C from an Environmental perspective.

15.6.3 Technical

Against the Technical criterion, Option 4A (rock placement over problem areas) and Option 4C (remove problem areas) are equally preferred. While all options employ relatively routine operations such as line cutting, trenching and rock cover, there are challenges associated with Option 3B (trench entirety of line) due to the geotechnical

conditions in this location and the limited track record of trenching rigid lines of this diameter (16-inch and 20-inch). There are also challenges associated with Option 2A (cut and lift) due to the likely spalling of the aging concrete coating on these lines.

15.6.4 Societal

Against the Societal – Fishing criterion, Option 2A (full removal) is preferred over Option 3B (trench entirety of lines) as, while both options effectively leave a clear seabed, the line does remain in-situ in Option 3B. These options are significantly preferred over Option 4C (remove problem areas) as the majority of the lines will remain on the seabed, albeit with existing areas of spans removed and Option 4A (rock placement over problem areas), where the majority of the lines will also remain on the seabed with rock berms over areas existing areas of spans.

Against the Societal – Other Users criterion, Option 2A is less preferred than the other options as, while there are societal benefits of returning the steel for recycling in the full removal option, this is offset by the seawater contaminated concrete, which is likely to take up limited landfill capacity on shore. The other options were assessed to have similar, minimal societal benefits / impacts.

As Option 2A (full removal) is preferred over the other options from a Fishing perspective but only marginally less preferred than the other options from an Other Users perspective, overall, there is a moderate preference for Option 2A from a Societal perspective.

15.6.5 Economic

Against the Short-term Costs criterion, Option 4A (rock placement over problem areas) is preferred over the other options. This is due to the costs to execute this option (£1.2 million) being almost a quarter of the cost of next lowest option (Option 4C – remove problem areas - £4.6 million) and less again than the other options.

Against the Long-term Costs criterion, all options are equally preferred. While there are no long-term costs associated with the full removal option, the long-term costs associated with the survey and monitoring of the line left in-situ in the partial removal options are minor (around £1 million) and would be spread out over many years. As such, the differences between the options are insufficient to express a preference.

As Option 4A is preferred from a Short-term Costs perspective and equally preferred from a Long-term Costs perspective, overall, Option 4A is preferred from an Economic perspective.

15.6.6 Group 7 Recommendations

The recommended decommissioning option for Group 7 – Rigid Pipelines (Surface Laid, Exposed and Concrete Coated) is Option 4A – Rock Placement over areas of Spans / Exposures / Shallow Burial. This option involves the following key activities:

- Pipelines will be disconnected
- Removal and recovery of line ends

- Rock placement to remediate snag risk from cut ends
- Rock placement at all areas of spans to an appropriate depth of cover
- Future survey & monitoring programme

15.7 Group 8 Discussion

The following sections provide a discussion of the evaluation of the three most viable Group 8 – Rigid Pipelines (Surface Laid and Rock Covered) decommissioning options (Option 2C – Full Removal by Reverse Installation (Reeling) with De-burial, Option 4A – Rock Placement over areas of Spans / Exposure / Shallow Burial and Option 5 – Remove Line Ends and Remediate Snag Risk) against the five criteria.

15.7.1 Safety

Against the Operations Personnel criterion, all partial removal options are equally preferred over Option 2C (full removal). This is due to the greater risk exposure associated with the greater scope to fully remove the line and the greater onshore scope associated with the returned line. There are differences in the risk exposure associated with the partial removal options, but these differences are considered minor and insufficient to express a preference within these options.

Against the Other Users criterion, all options are equally preferred as, while there are differences in the number of days of vessel operations and transits to / from the field across the options, these differences are considered insufficient to express a preference from a safety impact on other users' perspective.

Against the High Consequence Events criterion, Option 4A (rock placement over problem areas) and Option 5 (remove line ends only) are equally preferred over Option 2C (full removal) as the potential for High Consequence Events from dropped object from the limited offshore lifting in Option 4A and Option 5 to deploy and recover cutting equipment and line ends is considered lower than the potential from the residual torsion in the line during offloading (reeling) to the quayside.

Against the Legacy Risk criterion, the full removal option is preferred over the other options as there is no legacy risk associated with the full removal of the line. Option 4A is less preferred as the line remains in-situ, albeit with the problem areas rock covered. Option 5 is the least preferred option due to existing areas of spans, exposure and shallow burial remaining. All partial removal options also have an associated legacy risk exposure from the future survey and monitoring to mitigate future snag risk of the lines left in-situ.

Option 4A is equally preferred from an Operations Personnel, impact on Other Users and High Consequence Events perspective. It is marginally less preferred from a Legacy Risk perspective however, overall, there remains a preference for Option 4A from a Safety perspective.

15.7.2 Environment

Against the Operational Marine Impact criterion, all options are equally preferred as the differences in the environmental impacts across the options are minor, and insufficient to express a preference.

Against the Atmospheric Emissions and Fuel Use criterion, all options are equally preferred. There are differences in the emissions generated and fuel used across the options, however these differences are considered minor and insufficient to express a preference within these options.

Against the Other Consumptions criterion, all options are equally preferred as, while there are differences in environmental impact from recycling returned material or generating replacement material for the lines left in-situ, and in the rock consumed across the options, these differences are considered minor and insufficient to express a preference within these options.

Against the Seabed Disturbance criterion, Option 4A (rock cover over problem areas and Option 5 (remove line ends only) are equally preferred over Option 2C (full removal). This is due to the limited area impacted by the small amount of rock cover introduced in Option 4A and Option 5 versus the much larger area of seabed impacted by the de-burial operations to enable the line to be fully removed in Option 2C, although it is recognised that the impact will be temporary in nature.

Against the Legacy Marine Impact criterion, Option 2C (full removal) is preferred as there are no legacy marine impacts associated with these lines being fully removed. All partial removal options are considered to present a similar and minor legacy marine impact.

Option 2C is the preferred option from a Legacy Marine Impact perspective and equally preferred from an Operational Marine Impact, Atmospheric Emissions and Fuel Use and Other Users perspective. It is marginally less preferred that the other options from a Seabed Disturbance perspective but overall, there remains a preference for Option 2C from an Environmental perspective. This preference is very marginal over the other options.

15.7.3 Technical

Against the Technical criterion, Option 4A (rock placement over problem areas) and Option 5 (remove line ends only) are equally preferred. While all options employ relatively routine operations such as de-burial, line cutting and rock cover, there are challenges associated with Option 2C (reverse reeling) due to the de-burial of the existing rock cover to enable full removal along 22 km of line.

15.7.4 Societal

Against the Societal – Fishing criterion, Option 2C (full removal) is preferred over the other options as, while there will be disruption to fishing operations from the removal of the line, a clear seabed is preferred from a fishing operations perspective.

Against the Societal – Other Users criterion, all options are equally preferred as the positive and negative societal impacts are largely insignificant across all options due to the limited scope of returned material associated with the single, 10-inch, 22 km line in this group.

As Option 2C (full removal) is preferred over the other options from a Fishing perspective and equally preferred from an Other Users perspective, overall, there is a preference for Option 2C from a Societal perspective.

15.7.5 Economic

Against the Short-term Costs criterion, Option 4A (rock placement over problem areas) and Option 4C (remove problem areas) are equally preferred over the other options. This is due to the costs to execute these options being similar (£1.5 million and £1.2 million respectively) and much less than Option 2C (full removal - £6.6 million).

Against the Long-term Costs criterion, all options are equally preferred. While there are no long-term costs associated with the full removal option, the long-term costs associated with the survey and monitoring of the line left in-situ in the partial removal options are minor (less than £1 million) and would be spread out over many years. As such, the differences between the options are insufficient to express a preference.

As Option 4A and Option 4C are equally preferred from both a Short-term Costs and Long-term Costs perspective, overall, Option 4A and Option 4C are equally preferred from an Economic perspective.

15.7.6 Group 8 Recommendations

The recommended decommissioning option for Group 8 – Rigid Pipelines (Surface Laid and Rock Covered) is Option 4A – Rock Placement over areas of Spans / Exposures / Shallow Burial. This option involves the following key activities:

- Pipeline will be disconnected
- Removal and recovery of exposed line ends to existing rock cover
- Rock placement to remediate snag risk from cut ends
- Rock placement at all areas of spans, exposure and shallow burial to an appropriate depth of cover
- Future survey & monitoring programme

15.8 Group 9 Discussion

The following sections provide a discussion of the evaluation of the five most viable Group 9 – Rigid Pipelines (Trenched and Buried) decommissioning options (Option 2C – Full Removal by Reverse Installation (Reeling) with De-burial, Option 4A – Rock Placement over areas of Spans / Exposure / Shallow Burial, Option 4B – Trench and Bury areas of Spans / Exposure / Shallow Burial, Option 4C – Remove areas of Spans / Exposure / Shallow Burial) and Option 5 – Remove Line Ends and Remediate Snag Risk) against the five criteria.

15.8.1 Safety

Against the Operations Personnel criterion, Option 5 (remove line ends only) is preferred over the other options as it has the lowest offshore and onshore scope of all options and hence the lowest risk exposure. The other partial removal options are equally less preferred as, while there are differences in the scope and risk exposure across these options, the differences are considered minor and insufficient to express a preference within these options. Option 2C (full removal) is the least preferred option as the offshore and onshore scope to fully remove these lines is the greatest of all the options and hence carries the highest risk exposure.

Against the Other Users criterion, all partial removal options are equally preferred over the full removal option. This is due to the impact on the safety of other users expected to be marginally higher for the full removal option than the partial removal options. This marginally higher impact is due to the higher number of days of vessel operations and higher number of transits to / from the field to execute the full removal option. The safety impact on other users is similar across the partial removal options.

Against the High Consequence Events criterion, Option 2C (full removal, Option 4A (rock placement over problem areas), Option 4B (trench and bury problem areas) and Option 5 (remove line ends only) are equally preferred over Option 4C (remove problem areas). This is due to Option 4C having more offshore lifting operations to cut and recover the problem areas of the lines presenting the greatest potential for dropped object. The offshore lifting is similar in Option 4A, Option 4B and Option 5. There is less offshore lifting associated with Option 2C as the full removal of the lines is performed using reverse reeling techniques, however there is the potential for High Consequence associated with the potential residual torsion in the rigid lines during offloading (reeling) to the quayside.

Against the Legacy Risk criterion, the full removal option is preferred over the other options as there is no legacy risk associated with the full removal of the line. Option 4B (trench and bury problem areas) and Option 4C (remove problem areas) are less preferred as the lines remain in-situ, albeit with the problem areas trenched or removed thus presenting a largely clear seabed. Option 4A (rock placement over problem areas) is less preferred again as the lines remain in-situ, albeit with the problem areas rock covered. Option 5 is the least preferred option due to existing areas of spans, exposure and shallow burial remaining. All partial removal options also have an associated legacy risk exposure from the future survey and monitoring to mitigate future snag risk of the lines left in-situ.

Option 4B is the equally preferred option from an impact on Other Users and High Consequence Events perspective. It is marginally less preferred from an Operations Personnel and Legacy Risk perspective however, overall, there remains a preference for Option 4B from a Safety perspective.

15.8.2 Environment

Against the Operational Marine Impact criterion, all partial removal options are equally preferred over Option 2C (full removal). This is due to the greater noise impact from the longer durations that vessels are on-site and the de-burial operations. It is noted that, while there is a preference for the partial removal operations, that preference is marginal as the greater noise impact is minor. There is an additional preference for the partial removal options due to the discharge of line contents in one location from reverse reeling. Again, the preference is minor as the lines are cleaned and flushed prior to removal meaning any discharges will have a minor environmental impact.

Against the Atmospheric Emissions and Fuel Use criterion, all partial removal options are equally preferred over Option 2C (full removal). This is due to the increased emissions generated and fuel used from the extended offshore scope in the full removal option. There are differences in the emission generated and fuel used across the partial removal options, however these differences are considered minor and insufficient to express a preference within these options.

Against the Other Consumptions criterion, Option 2C (full removal), Option 4B (trench and bury problem areas), Option 4C (remove problem areas) and Option 5 (remove line ends only) are equally preferred. While there are differences in the impact associated with recycling material returned or generating replacement material for the lines left in-situ, these differences are insufficient to express a preference within these options. Option 4A (rock cover over problem areas) is the least preferred option due to the greater quantity of rock required in this option.

Against the Seabed Disturbance criterion, Option 4B (trench and bury problem areas) and Option 5 (remove line ends only) are equally preferred as, while there is a moderate area of seabed impacted by the trenching operations, the impact is temporary in nature. There is also a minor area of seabed disturbance associated with the rock cover introduced in these options over cut line ends which is a permanent habitat change. Option 4C (remove problem areas) is less preferred due to the larger area of permanent habitat change from the rock cover introduced over cut locations when removing problem areas. Option 2C (full removal) is marginally less preferred again as the area impacted from the de-burial operations over these lines is much greater although, again, this is temporary in nature. Finally, Option 4A (rock placement over problem areas) is the least preferred option as the area of permanent habitat change from rock covering problem areas has the greatest impact of all options.

Against the Legacy Marine Impact criterion, Option 2C (full removal) is preferred as there are no legacy marine impacts associated with these lines being fully removed. Option 4A (rock cover over problem areas), Option 4B (trench and bury problem areas) and Option 4C (remove problem areas) are less preferred as there will be slow discharges and degradation products from these lines remaining in-situ, although these will occur over a long time period and as such, their legacy environmental impact is expected to be minor, especially given these lines will be isolated from the marine environment. Option 5 (remove line ends only) is the least preferred option as any discharges and degradation products will occur over a shorter time period than the other options as the areas of existing spans and exposure will remain and are exposed to the marine environment. The legacy environmental impact is still expected to be minor.

Option 4B is the equally preferred option from an Operational Marine Impact, Atmospheric Emissions and Fuel Use, Other Consumptions and Seabed Disturbance perspective. It is less preferred than the full removal option from a

Legacy Marine Impact perspective but overall, there remains a preference for Option 4B from an Environmental perspective.

15.8.3 Technical

Against the Technical criterion, Option 4A (rock placement over problem areas), Option 4C (remove problem areas) and Option 5 (remove line ends only) are equally preferred. While all options employ relatively routine operations such as de-burial, line cutting, trenching and rock cover, there are challenges associated with Option 4B (trench and bury of problem areas) due to the geotechnical conditions in this location and challenges in successfully trenching areas of spans, exposure and shallow burial. There are also challenges associated with Option 2C (reverse reeling) due to de-burial and reeling required on the 115 km of lines in this group presenting technical challenges on a cumulative basis.

15.8.4 Societal

Against the Societal – Fishing criterion, Option 2C (full removal) is preferred over the other options as, while there will be significant disruption to fishing operations from the removal of the lines, a clear seabed is preferred from a fishing operations perspective.

Against the Societal – Other Users criterion, all options are equally preferred as, while there are societal benefits of returning the steel for recycling in the full removal option, this is offset by the quantity of polymer returned, which is likely to take up limited landfill capacity on shore.

As Option 2C (full removal) is preferred over the other options from a Fishing perspective and equally preferred from an Other Users perspective, overall, there is a preference for Option 2C from a Societal perspective.

15.8.5 Economic

Against the Short-term Costs criterion, all partial removal options are equally preferred over the full removal option as, while there are differences in the costs to execute these options (ranging from £3.7 million to £6 million), these differences are considered insufficient to express a preference. The full removal option (£29.9 million) is significantly more expensive.

Against the Long-term Costs criterion, Option 2C is marginally preferred as there are no long-term costs associated with the full removal option whereas all partial removal options have long-term costs associated with the survey and monitoring of the lines left in-situ. While these costs are relatively modest (between £1.6 million and £1.9 million) and would be spread over many years, they are sufficient to express a small preference for the full removal option.

As all partial removal options are equally preferred from a Short-term Costs and only marginally less preferred from a Long-term Costs perspective, overall, all removal options are equally preferred from an Economic perspective.

15.8.6 Group 9 Recommendations

The recommended decommissioning option for Group 9 – Rigid Pipelines (Trenched and Buried) is Option 4C – Removal of areas of Spans / Exposures / Shallow Burial. This option involves the following key activities:

- Pipelines will be disconnected
- Removal and recovery of line ends including trench transitions
- Removal (by cut and lift) of all areas of spans, exposure and shallow burial
- Rock placement to remediate snag risk from cut ends
- Future survey & monitoring programme

15.9 Group 16 Discussion

The following sections provide a discussion of the evaluation of the two most viable Group 16 – Blocked Rigid Pipeline (Trenched and Buried) decommissioning options (Option 2A – Full Removal by Cut and Lift and Option 5 – Remove Line Ends and Remediate Snag Risk) against the five criteria.

15.9.1 Safety

Against the Operations Personnel criterion, Option 5 (remove line ends only) is preferred over Option 2A (full removal) due to the greater risk exposure associated with the greater scope to fully remove the line and the greater onshore scope associated with the returned line.

Against the Other Users criterion, both options are equally preferred as, while there are differences in the number of days of vessel operations and transits to / from the field across the options, these differences are considered insufficient to express a preference from a safety impact on other users' perspective.

Against the High Consequence Events criterion, Option 5 (remove line ends only) is preferred over Option 2A (full removal) due to the higher number of offshore lifting operations to recover the full line.

Against the Legacy Risk criterion, the full removal option is preferred over Option 5 (remove line ends only) as there is no legacy risk associated with the full removal of the line whereas the line will remain in-situ in Option 5, albeit fully trenched and buried. Option 5 also have an associated legacy risk exposure from the future survey and monitoring to mitigate future snag risk of the lines left in-situ.

Option 5 is the preferred option from an Operations Personnel and High Consequence Events perspective. It is equally preferred from an impact on Other Users perspective. It is less preferred from a Legacy Risk perspective however, overall, there remains a preference for Option 5 from a Safety perspective.

15.9.2 Environment

Against the Operational Marine Impact criterion, Option 5 (remove line ends only) is preferred over Option 2A (full removal). This is due to the greater noise impact from the longer durations that vessels are on-site and the de-burial and cutting operations. There is an additional preference for Option 5 due to the discharges of line contents at each cut location in Option 2A. As the line in this group is blocked, it will not be able to be flushed and cleaned prior to removal. As such, the discharges at each cut location will have a greater impact, with the maximum residual contents being identified as 0.4 m^3 of oil, 10.3 m^3 of water and 17.9 m^3 of gas totalling 28.3 m^3 of discharges. The environmental impact of these discharges will be minor but are sufficient to express a preference for Option 5.

Against the Atmospheric Emissions and Fuel Use criterion, both options are equally preferred as, while there are differences in the emission generated and fuel used across the options, these differences are considered minor and insufficient to express a preference within these options.

Against the Other Consumptions criterion, both option are equally preferred as the differences in the impact associated with recycling material returned or generating replacement material for the line left in-situ and any rock required are negligible.

Against the Seabed Disturbance criterion, Option 5 (remove line ends only) is marginally preferred over the full removal option. There is a small area of permanent habitat change from the rock introduced over the cut line ends in Option 5, however the larger area of, albeit temporary impact, from the de-burial operations in Option 2A is less preferred.

Against the Legacy Marine Impact criterion, Option 2A (full removal) is preferred as there are no legacy marine impacts associated with the line being fully removed. Option 5 (remove line ends only) is less preferred as there will be discharges and degradation products from these lines left in-situ, although these will occur over a long time period. Again, as the line in this group is blocked, it will not be able to be flushed and cleaned prior to removal. As such, the discharges that occur will be the maximum residual contents which are identified as 0.4 m^3 of oil, 10.3 m^3 of water and 17.9 m^3 of gas totalling 28.3 m. The legacy environmental impact is still expected to be minor.

Option 5 is the preferred option from an Operational Marine Impact and Seabed Disturbance perspective and equally preferred from an Atmospheric Emissions and Fuel Use and Other Consumptions perspective. It is less preferred than the full removal option from a Legacy Marine Impact perspective but overall, there remains a preference for Option 5 from an Environmental perspective.

15.9.3 Technical

Against the Technical criterion, both options are equally preferred as they employ relatively routine operations and the scale of operations, while greater for Option 2A (full removal) is not sufficiently greater on this 1.6 km line to express a preference from a potential for greater technical risk on a cumulative basis perspective.

15.9.4 Societal

Against the Societal – Fishing criterion, both options are equally preferred, while the line is removed in Option 2A (full removal) the line that remains in-situ in Option 5 (remove line ends only) will be fully trenched and buried and as such, both options present a clear seabed. In addition, the line is this group is short (1.6 km) thus any line left in-situ will present a minimal impact on fishing operations, should it become de-buried in the future.

Against the Societal – Other Users criterion, both options are equally preferred as they are assessed to have similar, minimal societal benefits / impacts.

As both options are equally preferred from a Fishing perspective and an Other Users perspective, overall, both options are preferred from a Societal perspective.

15.9.5 Economic

Against the Short-term Costs criterion, both options are equally preferred as, while there are differences in the costs to execute these options (ranging from £1 million to £1.8 million), these differences are considered insufficient to express a preference.

Against the Long-term Costs criterion, both options are equally preferred. While there are no long-term costs associated with the full removal option, the long-term costs associated with the survey and monitoring of the line left in-situ in the partial removal option are minor (less than £1 million) and would be spread out over many years. As such, the differences between the options are insufficient to express a preference.

As both options are equally preferred from both a Short-term Costs and Long-term Costs perspective, overall, both options are equally preferred from an Economic perspective.

15.9.6 Group 16 Recommendations

The recommended decommissioning option for Group 16 – Blocked Rigid Pipeline (Trenched and Buried) is Option 5 – Remove Line Ends Only and Remediate Snag Risk. This option involves the following key activities:

- Pipeline will be disconnected
- Removal and recovery of line ends including trench transition
- Rock placement to remediate snag risk from cut ends
- Future survey & monitoring programme

15.10 Group 17 Discussion

The following sections provide a discussion of the evaluation of the four most viable Group 17 – In-Use Rigid Pipelines (Trenched and Partially Buried) decommissioning options (Option 2A – Full Removal by Cut and Lift, Option 3A – Rock Cover Entire Lines, Option 3B – Trench and Bury Entire Line) and Option 5 – Remove Line Ends and Remediate Snag Risk) against the five criteria.

15.10.1 Safety

Against the Operations Personnel criterion, Option 3B (trench and bury problem areas) is preferred over the other options as it has the lowest offshore and onshore scope of all options and hence the lowest risk exposure. The other partial removal options are less preferred as the offshore scope to rock cover the entirety of the lines in Option 3A or to remove line ends only in Option 5 is greater. Option 2A (full removal) is the least preferred option as the offshore and onshore scope to fully remove these lines is the greatest of all the options and hence carried the highest risk exposure.

Against the Other Users criterion, Option 3B (trench and bury problem areas) and Option 5 (remove line ends only) are equally preferred. This is due the impact on the safety of other users expected to be marginally higher for the Option 2A (full removal) and Option 3A (rock placement over entirety of lines) due to the higher number of days of vessel operations and higher number of transits to / from the field to execute these options.

Against the High Consequence Events criterion, Option 3A (rock placement over entirety of lines) and Option 3B (trench entirety of lines) are equally preferred as Option 3A has no offshore lifting operations and Option 3B has limited offshore lifting relating to deployment and recovery of trenching equipment to perform trenching and burial of the lines. Option 5 is marginally less preferred as the is greater offshore lifting and hence potential for dropped object from the deployment and recovery of cutting equipment and recovery of the line ends. Option 2A is the least preferred option due to the high number of offshore lifting operations associated with the deployment and recovery of the cutting equipment and the recovery of approximately 22 km of lines in 10 m sections.

Against the Legacy Risk criterion, the full removal option is preferred over the other options as there is no legacy risk associated with the full removal of the line. Option 3A (rock placement over entirety of lines) and Option 3B (trench entirety of lines) are equally less preferred as the lines remain in-situ, albeit with rock cover over the lines to the top of the existing trench or lines fully trenched and buried. Option 5 is the least preferred option due to existing areas of spans, exposure and shallow burial remaining. All partial removal options also have an associated legacy risk exposure from the future survey and monitoring to mitigate future snag risk of the lines left in-situ.

Option 3B is the preferred option from an Operations Personnel perspective and equally preferred from an impact on Other Users and High Consequence Events perspective. It is marginally less preferred from a Legacy Risk perspective however, overall, there remains a preference for Option 3B from a Safety perspective.

15.10.2 Environment

Against the Operational Marine Impact criterion, all partial removal options are equally preferred over Option 2A (full removal). This is due to the greater noise impact from the longer durations that vessels are on-site and the longer duration de-burial and cutting (with DWC) operations. It is noted that, while there is a preference for the partial removal operations, that preference is marginal as the greater noise impact is minor. There is an additional preference for the partial removal options due to the discharges of line contents that occur at each cut location in the full removal option, but again, the impacts are minor.

Against the Atmospheric Emissions and Fuel Use criterion, all partial removal options are equally preferred over Option 2A. This is due to the increased emissions generated and fuel used from the extended offshore scope in the full removal option. There are differences in the emission generated and fuel used across the partial removal options, however these differences are considered minor and insufficient to express a preference within these options.

Against the Other Consumptions criterion, Option 3A (rock placement over entirety of lines) is less preferred than all other options, which are equally preferred. This is due to the large quantity of rock required to deliver Option 3A whereas the rock required in the other options is either negligible or zero. The environmental impact from recycling returned material or generating replacement material for the lines left in-situ is largely similar across all options.

Against the Seabed Disturbance criterion, Option 5 (remove line ends only) is preferred as there is small area of seabed disturbance associated with the rock cover introduced over the cut line ends in this option, which is a permanent habitat change. Option 2A (full removal) and Option 3B (trench entirety of lines) are less preferred due to much larger area impacted by de-burial operations in Option 2A and trenching operations in Option 3B, although these impacts are temporary in nature. Option 3A (rock placement over entirety of lines) is the least preferred option as the area of permanent habitat change from rock covering the lines has the greatest impact of all options.

Against the Legacy Marine Impact criterion, Option 2A (full removal) is preferred as there are no legacy marine impacts associated with these lines being fully removed. Option 3A (rock placement over entirety of lines) and Option 3B (trench entirety of lines) are less preferred as there will be slow discharges and degradation products from these lines remaining in-situ, although these will occur over a long time period and as such, their legacy environmental impact is expected to be minor, especially given these lines will be isolated from the marine environment. Option 5 (remove line ends only) is the least preferred option as any discharges and degradation products will occur over a shorter time period than the other options as the areas of existing spans and exposure will remain and are exposed to the marine environment. The legacy environmental impact is still expected to be minor.

Option 5 (remove line ends only) is the equally preferred option from an Operational Marine Impact, Atmospheric Emissions and Fuel Use, Other Consumptions and Seabed Disturbance perspective. It is the least preferred option from a Legacy Marine Impact perspective however, overall, there remains a preference for Option 5 from an Environmental perspective.

15.10.3 Technical

Against the Technical criterion, Option 3A (rock placement over entirety of lines), Option 3B (trench entirety of lines) and Option 5 (remove line ends only) are equally preferred. While all options employ relatively routine operations such as de-burial, line cutting, trenching and rock cover, there are challenges associated with Option 2A (cut and lift) due to de-burial, cut and lift operations over the 20 km of lines in this group presenting technical challenges on a cumulative basis.

15.10.4 Societal

Against the Societal – Fishing criterion, Option 2A (full removal) is preferred over the other options as, while there will be significant disruption to fishing operations from the removal of the lines, a clear seabed is preferred from a fishing operations perspective.

Against the Societal – Other Users criterion, all options are equally preferred as the positive and negative societal impacts are largely insignificant across all options due to the limited scope of returned material associated with the two lines (6-inch, 10 km and 8-inch, 10 km) in this group.

As Option 2A (full removal) is preferred over the other options from a Fishing perspective and equally preferred from an Other Users perspective, overall, there is a preference for Option 2A from a Societal perspective.

15.10.5 Economic

Against the Short-term Costs criterion, Option 3B (trench entirety of lines) and Option 5 (remove line ends only) are equally preferred over the other options. This is due to the costs to execute these options being similar (£2.5 million and £1.6 million respectively) and around half the cost of Option 3A (rock placement over entirety of lines - £4.8 million). They are also much less than Option 2A (full removal - £12.8 million).

Against the Long-term Costs criterion, all options are equally preferred. While there are no long-term costs associated with the full removal option, the long-term costs associated with the survey and monitoring of the line left in-situ in the partial removal options are minor (less than £1 million) and would be spread out over many years. As such, the differences between the options are insufficient to express a preference.

As Option 3B and Option 5 are equally preferred from both a Short-term Costs and Long-term Costs perspective, overall, Option 3B and Option 5 are equally preferred from an Economic perspective.

15.10.6 Group 17 Recommendations

The recommended decommissioning option for Group 17 – In-Use Rigid Pipelines (Trenched and Partially Buried) is Option 3B – Trench and Bury Entirety of Line. This option involves the following key activities:

- Pipelines will be disconnected

- Trench / re-trench and bury full length of the lines to remove areas of spans, exposure and shallow burial
- Future survey & monitoring programme

15.11 Group 18 Discussion

The following sections provide a discussion of the evaluation of the five most viable Group 18 – Uncertain Integrity and Concrete Coated Rigid Pipelines (Trenched and Buried) decommissioning options (Option 2A – Full Removal by Cut and Lift, Option 4A – Rock Placement over areas of Spans / Exposure / Shallow Burial, Option 4B – Trench and Bury areas of Spans / Exposure / Shallow Burial, Option 4C – Remove areas of Spans / Exposure / Shallow Burial) and Option 5 – Remove Line Ends and Remediate Snag Risk) against the five criteria.

15.11.1 Safety

Against the Operations Personnel criterion, Option 5 (remove line ends only) is the preferred option. It is marginally preferred over Option 4B (trench and bury problem areas) as the scope to trench the problem areas is higher and therefor presents a marginally higher risk exposure. Option 5 is further preferred over Option 4A (rock placement over problem areas) as the scope to rock cover the problem areas and recover line ends is higher again. Option 4C (remove problem areas) is less preferred again due to the further increase in scope and risk exposure to remove the problem areas of the lines. Option 2A (full removal) is the least preferred option as the scope to fully remove these lines is the greatest and thus has the highest risk exposure of all options. There is also a greater onshore scope associated with the returned lines.

Against the Other Users criterion, Option 4B (trench and bury problem areas) and Option 5 (remove line ends only) are equally preferred over the other options. This is due the impact on the safety of other users expected to be lower in these options as they have a lower number of days of vessel operations and transits to / from the field than the other options. Option 4A (rock placement over problem areas) is less preferred due the higher number of days of vessel operations and transits to / from the field. Option 4C (remove problem areas) is less preferred again due to the much higher number of vessel days of operations. Option 2A (full removal) is the least preferred option as there are a much higher number of vessel days of operations and transits to / from the field in the full removal option.

Against the High Consequence Events criterion, Option 4A (rock placement over problem areas), Option 4B (trench and bury problem areas) and Option 5 (remove line ends only) are equally preferred as there are less offshore lifting operations (deployment and recovery of cutting and trenching equipment and recovery of line end sections) than the other options. Option 4C (removal of problem areas) is less preferred as there is a large number (thousands) of offshore lifting operations associated with the deployment and recovery of cutting equipment and the recovery of sections of the lines. Option 2A is the least preferred option due to the very high number of offshore lifting operations (tens of thousands) associated with the deployment and recovery of the cutting equipment and the recovery of approximately 189 km of lines in 10 m sections.

Against the Legacy Risk criterion, the full removal option is preferred over the other options as there is no legacy risk associated with the full removal of the lines. All other options are less preferred as the lines remain in-situ, albeit with the problem areas rock covered in Option 4A, trenched in Option 4B or removed in Option 4C. Option 5 is the least preferred option due to existing areas of spans, exposure and shallow burial remaining. All partial removal options also have an associated legacy risk exposure from the future survey and monitoring to mitigate future snag risk of the lines left in-situ.

Option 4B is the equally preferred option from an Other Users and High Consequence Events perspective. It is marginally less preferred (to Option 5) from an Operations Personnel perspective. While it is less preferred from a Legacy Risk perspective, overall, there remains a preference for Option 4B from a Safety perspective.

15.11.2 Environment

Against the Operational Marine Impact criterion, Option 4A (rock placement over problem areas), Option 4B (trench and bury problem areas) and Option 5 (remove line ends only) are equally preferred. Option 4C (remove problem areas) is less preferred due to the greater noise impact from the longer durations that vessels are on-site and the longer duration cutting operations (with DWC) to remove the problem areas. Option 2A (full removal is less preferred again due to the impact from the even longer durations that vessels are on-site and the longer duration de-burial and cutting operations (with DWC) to fully remove the lines.

Against the Atmospheric Emissions and Fuel Use criterion, Option 4A (rock placement over problem areas), Option 4B (trench and bury problem areas) and Option 5 (remove line ends only) are equally preferred. Again, Option 4C remove problem areas) is less preferred as the longer duration operations results in greater emissions. Option 2A (full removal) is least preferred as the even longer duration operations results in the greatest emissions of all options.

Against the Other Consumptions criterion, Option 2A (full removal) is marginally preferred over Option 4B (trench and bury problem areas) as the environmental impact from recycling returned material in Option 2A is smaller than the impact associated with generating replacement material for the lines left in-situ in Option 4B. Option 5 (remove line ends only) is less preferred for similar reasons and incudes a requirement for a moderate quantity of rock. Option 4C (remove problem areas) is less preferred again, due to the greater quantity of rock required over the cut ends when removing problem areas. Option 4A (rock placement over problem areas) is the least preferred option as it has a much higher rock requirement than any of the other options.

Against the Seabed Disturbance criterion, Option 5 (remove line ends only) is the preferred option as it has the smallest area of seabed impact, although, as this is from rock introduced over cut line ends, this represents a permanent habitat change. Option 4B (trench and bury problem areas) is less preferred as there is a much larger area impacted by the trenching operations, although this is offset by the impact being temporary in nature. Option 2A (full removal) is less preferred again, due to it having the largest area of impact from the de-burial operations to allow full removal of the lines. Again, this impact is offset by it being temporary in nature. Option 4C (remove problem areas) is less preferred again, as while the area impacted is smaller than in Option 4B and Option 2A, it is a significant area of permanent habitat change. Option 4A (rock placement over problem areas) is the least preferred option as it has significant area of permanent habitat change from the rock cover introduced.

Against the Legacy Marine Impact criterion, Option 2A (full removal) is preferred as there are no legacy marine impacts associated with these lines being fully removed. All other options are less preferred as there will be slow discharges and degradation products from these lines remaining in-situ, although these will occur over a long time period and as such, their legacy environmental impact is expected to be minor, especially given these lines will be isolated from the marine environment. Option 5 (remove line ends only) is the least preferred option as any discharges and degradation products will occur over a shorter time period than the other options as the areas of existing spans and exposure will remain and are exposed to the marine environment. The legacy environmental impact is still expected to be minor.

Option 4B is the equally preferred option from an Operational Marine Impact and Atmospheric Emissions and Fuel Use perspective. While it is less preferred from an Other Consumptions, Seabed Disturbance Legacy Marine Impact perspective, overall, there remains a preference for Option 4B from an Environmental perspective.

15.11.3 Technical

Against the Technical criterion, Option 5 (remove line ends only) is preferred. While all options employ relatively routine operations such as de-burial, line cutting, trenching and rock cover, Option 4B (trenching of problem areas) and Option 4C are less preferred due to the increased scope over Option 5 leading to greater technical challenges on a cumulative basis. Option 2A (cut and lift) is least preferred due to de-burial, cut and lift operations over the 189 km of lines in this group presenting the greatest technical challenges on a cumulative basis.

15.11.4 Societal

Against the Societal – Fishing criterion, Option 2A (full removal) is preferred over the other options as, while there will be significant disruption to fishing operations from the removal of the lines, a clear seabed is preferred from a fishing operations perspective.

Against the Societal – Other Users criterion, Option 2A is also preferred over the partial removal options. This is due to the societal benefits of returning the steel for recycling in the full removal option. The benefit of this is tempered by the quantity of concrete and polymer returned which is likely to end up in landfill. All partial removal options have similar, minimal societal benefits / impacts.

As Option 2A (full removal) is preferred over the other options from both a Fishing perspective and from an Other Users perspective, overall, there is a preference for Option 2A from a Societal perspective.

15.11.5 Economic

Against the Short-term Costs criterion, Option 5 (remove line ends only) is preferred over the other options. This is due to the costs to execute this option (£8.9 million) being less than the cost of next lowest option (Option 4A – rock placement over problem areas - £21.2 million) and less again than the other options.

Against the Long-term Costs criterion, Option 2A is marginally preferred as there are no long-term costs associated with the full removal option whereas all partial removal options have long-term costs associated with the survey and monitoring of the lines left in-situ. While these costs are relatively modest (between £2.1 million and £2.7 million) and would be spread over many years, they are sufficient to express a small preference for the full removal option.

As Option 5 is preferred from a Short-term Costs and only marginally less preferred from a Long-term Costs perspective, overall, Option 5 is preferred from an Economic perspective.

15.11.6 Group 18 Recommendations

The recommended decommissioning option for Group 18 – Uncertain Integrity and Concrete Coated Rigid Pipelines (Trenched and Buried) is Option 5 – Remove Line Ends Only and Remediate Snag Risk. This option involves the following key activities:

- Pipelines will be disconnected
- Removal and recovery of line ends including trench transition
- Rock placement to remediate snag risk from cut ends
- Future survey & monitoring programme. 128 spans are identified across the group, of which only three are classed as FishSafe spans (exceeding 10 m long and 0.8 m high) and all of those are located at the pipelines ends which will be removed. The remaining mid-line exposures and spans will be surveyed and monitored on a regular basis. Should the survey and monitoring programme provide evidence of an increase in the level of potential risk (from snagging), the areas of concern shall be remediated on a case-by-case basis.

APPENDIX A EVALUATION METHODOLOGY

A.1 CA Evaluation Methodology

TAQA 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 The Analytical Hierarchy Process ref. [10]. 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 during 2019 and listed in Appendix A.2
- Define Options – completed as part of CA Screening.
- 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 criterion – the discussion was recorded 'live' during the workshop in order that informed opinion and experience was factored into the decision-making process.
- Perform scoring (see Appendix A.5).
- Perform sensitivity analyses to test the decision outcomes.
- Export 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.

The sections below describe how the MCDA methodology has been applied.

A.2 Differentiating Criteria

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 BEIS Guidelines for Decommissioning of Offshore Oil and Gas Installations and Pipelines which are as follows:

- Safety
- Environmental
- Economic
- Technical
- Societal

These differentiating criteria were found to be appropriate for the decommissioning options tabled 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 A.1 below.

CRITERIA	SUB-CRITERIA	DESCRIPTION	APPROACH TO ASSESSMENT
1. Safety	1.1 Operations Personnel	This sub-criterion considers elements that impact risk to offshore personnel and includes, project teams, project vessel crews, diving teams, and survey vessel crews. This sub-criterion also considers elements that impact risk to onshore personnel and includes, dismantling, recycling or disposal operations, material transfer, and onshore handling. It should be noted that crew changes are performed via port calls. Any requirement for handling HazMat / NORM shall also be addressed here.	Quantitative data is used to compare the decommissioning options against this criterion. Potential for Loss of Life (PLL) metrics are calculated based on the Fatal Accident Rate (FAR) x Hours of Exposure for each of the worker groups and is considered a suitable metric for Comparative Assessment purposes. The FAR is taken from the summary report of the Joint Industry Project investigating the Risk Analysis into Decommissioning Activities issued by Safetec ref. [9]. The Hours of Exposure is taken from the various studies / cost estimates developed to define the decommissioning options.
	1.2 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. Elements such as duration of vessel operations, number of operational vessel and their locations and number of transits to / from port may be considered.	A quantitative assessment is made based on the number of vessel days, durations and port transits associated with each of the decommissioning options. This is considered acceptable as the Safety impact on other users is a function of the operational vessel numbers / durations / movements.
	1.3 High Consequence Events	This sub-criterion relates to any inherent potential for high consequence events i.e. major accident hazard type events. It applies to all onshore and offshore personnel involved in the project. Considerations such as lifting operations, dropped object, operational vessel collision risks and back of deck working may be considered.	A HAZID ref. [7] is conducted to identify activities associated with the decommissioning options that have potential for High Consequence Events. This is a qualitative assessment.

CRITERIA	SUB-CRITERIA	DESCRIPTION	APPROACH TO ASSESSMENT
	1.4 Legacy Risk	This sub-criterion addresses residual safety risk to other sea users i.e. fishermen, military vessel crews, commercial vessel crews and passengers, other sea users, that remains after performing the decommissioning option. Issues such as residual snag risk, collision risk, etc. may be considered.	A HAZID ref. [7] is conducted to identify areas of potential legacy risk associated with the decommissioning options.
2. Environmental	2.1 Operational Marine Impact	This sub-criterion addresses the marine environmental impact caused by performing the decommissioning option. Covers both planned impacts (inherent to the option being assessed) and potential unplanned impacts (accidental releases, both large and small in scale and encompassing Major Environmental Incidents (MEIs)).Impacts may be from Project Vessels, Supply Boats, Survey vessels, etc. Examples include; Noise generated by vessels, cutting operations, any explosives, etc., discharges from vessels and from removing infrastructure such as residual pipeline contents.	Planned and unplanned marine impacts are narrative judgement informed by estimates of volumes (m^3) / composition of any releases. Impacts from vessels are qualitative in nature. Marine noise impact is calculated based on the vessel durations, subsea cutting operations and other operations that generate marine noise and is a qualitative measure of cumulative sound energy level. Impact on marine mammals is a key focus.
	2.2 Atmospheric Emissions & Fuel Consumption	This sub-criterion addresses the atmospheric emissions, fuel consumption and energy consumption from performing the decommissioning option. This may be from Project Vessels, Survey vessels, etc. Impacts may be greenhouse gas emissions such as CO_2, NOx, SO_2, etc. Fuel and energy consumption are included and are tightly correlated to atmospheric emissions. Not considered: Energy / emissions / resource consumption required to replace materials not recovered for re-use or recycling which is covered in 2.3 Other Consumptions.	Fuel use, emissions and energy consumption are calculated from vessel operations using IP2000 ref. [12] factors for vessel fuel use and emissions. Fuel use, and emissions provided in metric tonnes. Energy provided in joules.

CRITERIA	SUB-CRITERIA	DESCRIPTION	APPROACH TO ASSESSMENT
	2.3 Other Consumptions	This sub-criterion addresses the environmental impact caused by the amount of resource consumption associated with the option. It covers elements such as environmental impact from processing returned materials, the use of quarried rock or other new material and any production of replacement materials for equipment left in-situ.	Other consumptions such as rock / steel / other fabrications are quoted in metric tonnes. Impact of recycling / processing returned material and replacing leave-in-situ material is quoted in CO_2 in metric tonnes. The output CO_2 figures allow a direct, quantitative comparison between options.
	2.4 Seabed Disturbance	This sub-criterion addresses the direct and indirect seabed disturbance caused by performing the decommissioning option. Impacts that are both permanent and temporary in nature are considered. The level of impact caused and any specific seabed concerns, such as protected areas or habitat changes may be covered.	Assessment based on quantifying the area of disturbance by type of disturbance (dredging, rock dump, trenching, backfilling, mass flow excavation) in combination with an understanding of the baseline environment in the area as shown by the outputs from the environmental surveys.
	2.5 Legacy Marine Impacts	This sub-criterion addresses the marine environmental impact caused after the decommissioning option has been performed. Covers the long-term impact of any infrastructure left in-situ such as release of materials into the marine environment, environmental impact from legacy monitoring and remediation i.e. planned and unplanned releases from vessels, vessel noise, etc.	Marine impacts are narrative judgement informed by estimates of volumes (m^3) / composition of any releases and the duration these may occur over. Impacts from vessels are qualitative in nature. Marine noise is calculated based on the vessel durations, subsea cutting operations and is a qualitative measure of cumulative sound energy level.
3. Technical	3.1 Technical Risk	This sub-criterion relates to the various technical risks that could result in a major project failure i.e. failure to deliver the decommissioning option broadly within the timescale / budget / endorsed decommissioning programme. Consideration is given to: Technical Novelty / Track Record, Technical Challenges / Consequence of Failure to deliver the decommissioning option as defined.	Assessment based on definition of the decommissioning option provided in the method statements. Qualitative judgement is provided in areas of novelty / track record and risk and consequence of failure.

CRITERIA	SUB-CRITERIA	DESCRIPTION	APPROACH TO ASSESSMENT
4. Societal	4.1 Fishing	This sub-criterion addresses the impact of the decommissioning option on commercial fishing operations. It includes consideration of impacts from both the decommissioning activities themselves and any residual impacts post decommissioning such as reinstatement of access to area.	A qualitative judgement that provides a narrative (rather than quantification) regarding the positive and negative impacts of the decommissioning option on commercial fishing operations. Area of impact in m^2 may be included.
	4.2 Other Aspects	This sub-criterion addresses any positive or negative socio-economic impacts on other users, where the impact may be from dismantling, transporting, treating, recycling and land filling activities relating to the decommissioning option. Additionally, 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 decommissioning option which has a negative impact on communities, increased traffic disruption due to extra-large transport loads, etc.	Assessment of impact on other users is a qualitative narrative considering both positive and negative impacts of the decommissioning option on waste paths, recycling, employment and general community impacts. Tonnage and types of material returned may be included.
5. Economic	5.1 Short-term Costs	This sub-criterion addresses the cost of delivering the option as described. An assessment of cost risk or cost uncertainty may also be provided. Not considered: No long-term cost element is considered here.	The cost for delivering the decommissioning option, along with an indication of the cost risk / uncertainty is calculated in the method statements.
	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.	The long-term cost for the monitoring and potential remediation for the decommissioning option, along with an indication of the cost risk / uncertainty is calculated in the method statements.

Table A.1 - Criteria and Sub-criteria Definitions

A.3 Differentiator Weighting

The five differentiating criteria all carry a 20% weighting. That is, all criteria are neutral to each other. The figure below shows the pairwise comparison matrix. TAQA decided that equal weightings offer the most transparency and a balanced view from all perspectives.

Primary Criteria	1. Safety	2. Environmental	3. Technical	4. Societal	5. Economic	Weighting
1. Safety	N	N	N	N	N	20.0%
2. Environmental	N	N	N	N	N	20.0%
3. Technical	N	N	N	N	N	20.0%
4. Societal	N	N	N	N	N	20.0%
5. Economic	N	N	N	N	N	20.0%

Figure A.1 - Example Pairwise Comparison Matrix (N = Neutral)

A.4 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. Appendices C, D, E, F, G, H, I, J, K, L and M the completed Attributes Tables for Groups 1, 2, 3, 4, 6, 7, 8, 9, 16, 17 and 18 respectively.

Any additional discussion around the relative merits of the options was also recorded in the attributes table. A summary discussion of why options are considered more or less attractive with respect to each of the differentiating criteria was also recorded.

A.5 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, TAQA 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 Table below). It was agreed that three positions from equal (and their reciprocals) would be sufficient for this CA. These positions were:

TITLE	SCOPE	RELATIVE PREFERENCE RATIO
Neutral	Equal Importance, equivalent to 1 in the AHP importance scale.	50 / 50
Stronger (S) / Weaker (W)	Moderate importance of one criteria / option over the other, equivalent to 1.5 in the AHP importance scale.	60 / 40
Much Stronger (MS) / Much Weaker (MW)	Essential / strong importance of one criteria / option over the other equivalent to 5 or 6 in the AHP importance scale.	75 / 25
Very Much Stronger (VMS) / Very Much Weaker (VMW)	Extreme importance of one criteria / option over the other equivalent to 8 or 9 in the AHP importance scale.	90 / 10

Figure A.2 - Explanation of Phrasing Adopted for Pairwise Comparison

It should be noted that the relative preference ratios depicted above relate to a two option example. Where there are more than two options being compared, the relative preference ratios vary according to the preferences selected but will always be a share of the 100% available for that judgement. For the relative preferences derived for each option within each group against each criterion, see the pairwise matrices in Appendix C through M.

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.

A summary example of the completed pair-wise comparisons for differentiating criteria versus options are shown in the Figure below.

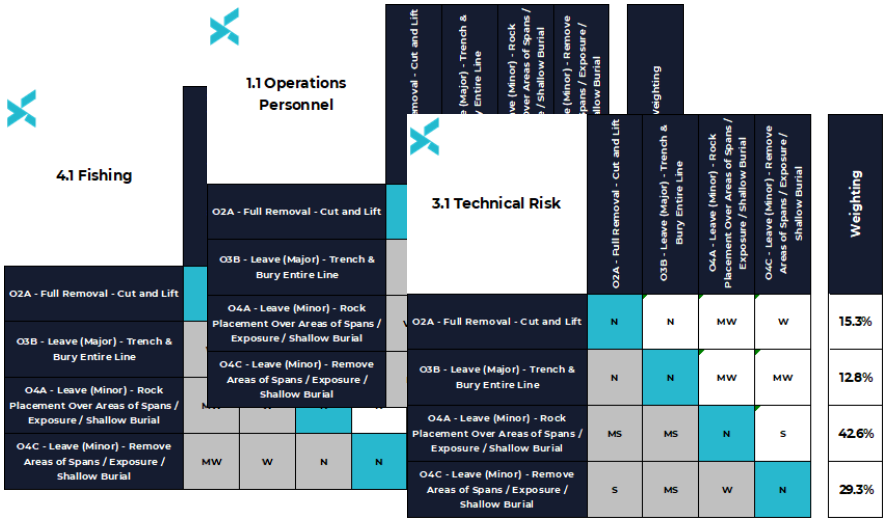


Figure A.3 - Example Option Pairwise Comparison

A.6 Visual Output and Sensitivities

The decision-making tool used the above pairwise comparisons 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 Appendices C, D, E, F, G, H, I, J, K, L and M. An example of the visual output obtained is shown in the Figure below.

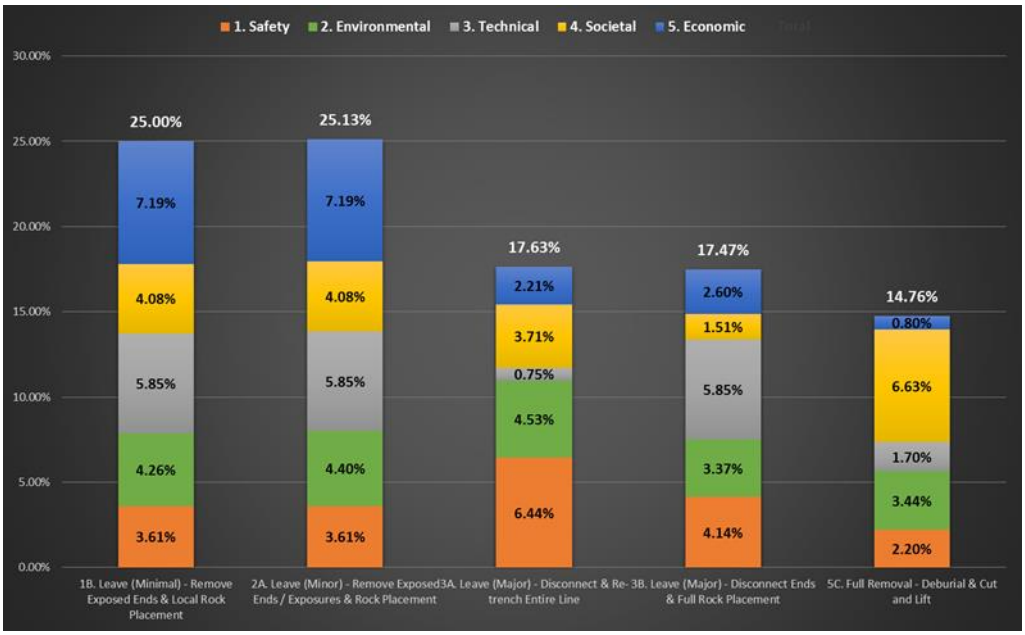


Figure A.4 - Visual Output Example

The CA output can then easily be stress tested by the workshop attendees by undertaking a sensitivity analysis:

- By applying a modification to the weighting of the criteria – bearing in mind that the base case for this assessment is to have all criteria equally weighted, and / or
- Modifying the pair-wise comparison of the options against each other within the criteria where appropriate.

These sensitivities will help inform workshop attendees as to whether a particular aspect is driving a preferred option, or indeed if the preferred option remains the same when the sensitivities are applied.

APPENDIX B EVALUATION STAKEHOLDER WORKSHOP MINUTES

Subject: TAQA Northern North Sea Subsea Comparative Assessment Evaluation Workshop

Location: Video Conference

Date: 30th June 2021

Reference: A-30259-S00-MINS-001

Minuted By: Nic Duncan

Issued On: 5th July 2021

Attending:

Andrew Third	SFF	Offshore Industry Liaison
Ruth Ledingham	BEIS	Senior Decommissioning Manager
Caitlyn Cox	BEIS	Decommissioning Manager
Sam Pattie	BEIS	Assistant Decommissioning Manager
Hywel Williams	HSE	Pipelines Inspector
Niki Piesinger	JNCC	Offshore Industry Advisor
Tetrienne Kerswell-Box	JNCC	Offshore Industries Advisor
Peter Cacela	OGA	Decommissioning Engineer (Strategy)
Louise Brown	SEPA	Principle Decommissioning Officer
Peter Lee	Fairfield	Decommissioning Manager
James Blackburn	Shell	UK Decom BOM
Allen Deans	BP	Commercial Advisor
Caroline Lawford	CNRL	Project Lead - Decommissioning
Alastair McLean	TAQA	Decommissioning Program Manager
Steve Sapp	TAQA	Decommissioning Manager – Subsea and Wells
Katie Lilford	TAQA	Decommissioning Stakeholder & Compliance Analyst
Robin Ritchie	TAQA	Decommissioning Subsea Engineer
Mik Crosby	TAQA	Senior Pipeline Engineer
David Holland	TAQA	HSE Manager
Alan Campbell	TAQA	Area Manager Tern, Eider and North Cormorant
John Taylor	TAQA	Subsea TA
Kevin Barrie	TAQA	Production Optimisation Lead
Robbie Jones	TAQA	Senior Environmental Advisor
Iain Milne	TAQA	Marine Focal Point
Martin Rae	TAQA	Subsea Inspection Engineer
Nic Duncan	Xodus Group	Project Manager
John Foreman	Xodus Group	Senior Risk Analyst
Gareth Jones	Xodus Group	Decommissioning Manager
Jeff McCleary	Xodus Group	Senior Decommissioning Consultant

Distribution: Attendees

ITEM	COMMENT	ACTION
1.0	**Pre-Workshop Discussion**	
1.1	Due to time limitations, it has been proposed that a live review of five groups only would be conducted. The groups selected are considered to be representative of all of the infrastructure, these are: • Group 2 Trunk Line – this line is unique within the infrastructure, and therefore will be reviewed within the workshop. • Group 1 Pipe in Pipe Hybrids – the lines are a unique configuration within the infrastructure, and therefore will be reviewed within the workshop. • Group 3 Flexibles and Umbilicals, Trenched and Buried – this is a large group considered to be representative of the flexibles and umbilicals across the infrastructure. • Group 16 Blocked Rigid Pipeline, Trenched and Buried – this line is unique as it is the only blocked line within the infrastructure. • Group 18 Uncertain Integrity or Concrete Coated Trenched and Buried Rigid Pipelines – this is a large group considered to be representative of the rigid pipelines within the infrastructure.	Info
2.0	**Introductions and Background**	
2.1	The session was opened by Alastair MacLean, TAQA Decommissioning Program Manager and Katie Lilford, TAQA Stakeholder and Compliance Analyst, who thanked the attendees for attending.	Info
2.2	Steve Sapp, TAQA Subsea and Wells Decommissioning Manager, provided an overview to the assets to be evaluated and the indicative scale of the lines under review.	Info
3.0	**Environmental and Societal Baseline**	
3.1	Gareth Jones, Xodus Decommissioning Manager, provided an overview of the environmental and societal base line against which the decommissioning shall be conducted. Details of the benthic environment, threatened and/or declining habitats and species as well as relevant conservation sites were described.	Info
3.2	The proximity of Special Protected Areas (SPAs) was explained, there are no SPAs directly affected by the infrastructure except for the inshore section of the PL4 trunk line which runs through the East Coast Mainland, Shetland SPA.	Info
4.0	**Comparative Assessment**	
4.1	Nic Duncan, Xodus Project Manager, provided the background to the CA process conducted to date, including the scoping and screening process, the means by which the data was developed within the preparation phase to inform the evaluation and a summary of the options which would be considered within evaluation. Hywel Williams, HSE, re-iterated that the Pipeline Safety Regulations (PSR) should be followed with any decommissioning option considered. Specifically, the statement from Regulation 14: *"(1) The operator shall ensure that a pipeline which has ceased to be used for the conveyance of any fluid is left in a safe condition.*	Info

ITEM	COMMENT	ACTION
	(2) The operator of a pipeline shall ensure that work done in discharge of the duty contained in paragraph (1) is performed safely."	
4.2	John Foreman, Xodus Senior Risk Analyst, explained the methodology behind the evaluation process.	Info
4.3	Information provided to inform workshop attendees was as follows: • Terms of Reference including the definition of sub-criteria applied within the evaluation; • NNS Subsea Comparative Assessment Briefing Pack; • Presentation slides (appended to these minutes).	Info
5.0	**Group 2: Trunk Line**	
5.1	Infrastructure details…	

Field / Platform	Description	From	To	Pipeline No.	Pipeline NB / OD (inches)	Length (km)
Cormorant Alpha	36" Oil Pipeline	Cormorant A	Sullom Voe	PL4	36	153.300

5.2	Options under consideration…
	Three options were evaluated for this group:
	• Full Removal
	  • Option 2A – Cut and Lift with De-burial
	• Leave *In Situ* with Minor Intervention
	  • Option 4A – Rock Placement over Spans
	  • Option 4C – Remove Spans
		Info

5.3	Evaluation	
5.3.1	Safety	
5.3.1.1	Operational Personnel – The assessment conducted was presented with no challenge raised. It was clarified that this was only the first of four Safety sub-criteria that will be considered for each group.	
5.3.1.2	Other Users – The assessment conducted was presented with no challenge raised. David Holland, TAQA HSE Manager, queried whether Legacy Risk is covered elsewhere, clarification was provided that yes, Legacy Risk is covered separately.	
5.3.1.3	High Consequence Events (HCE) – The assessment conducted was presented with no challenge raised. HCE were addressed via a HAZID process. Steve Sapp, TAQA, clarified that the HAZID used TAQA's corporate risk matrix to inform outcomes.	
5.3.1.4	Legacy Risk – The assessment conducted was presented. A challenge was raised regards the preference to minimise further rock installation. Option 4A was changed from Weaker to Much Weaker against Option 4C.	Info
	A query was raised by Andrew Third, SFF, regarding the potential height of rock berms over mid-line spans associated within Option 4A. This could be in the region of 2.5m above mean seabed level although a minimum of 3:1 berm gradient would be applied.	Info
	Hywel Williams, HSE, pointed out that this evaluation is still very early in the approvals process and further safety assessments would be conducted before approval for the specific decommissioning solution would be granted.	Info

ITEM	COMMENT	ACTION
	Details of the spans on PL4 were requested by OPRED – this will be provided following the workshop.	TAQA
5.3.2	Environment	
5.3.2.1	Operational Marine Impacts – The assessment conducted was presented with no challenge raised. Gareth Jones, Xodus, noted that operations within the near shore area may impact on seal haul out and that this should be considered within the assessment.	Info Info
5.3.2.2	Atmospheric Emissions and Fuel Consumption – The assessment conducted was presented with no challenge raised.	Info
5.3.2.3	Other Consumptions – The assessment conducted was presented with no challenge raised. Clarification was requested by David Holland, TAQA, as to whether the CO_2 associated with quarrying rock is included here. It is not, the boundaries stated are rock and CO_2 associated with returned or replaced material.	Info
5.3.2.4	Seabed Disturbance – The assessment conducted was presented with no challenge raised. For Options 4A and 4C the quantity of rock associated with the East Coast Mainland SPA were provided.	Info
5.3.2.5	Legacy Marine Impacts – The assessment conducted was presented with no challenge raised.	Info
5.3.3	Technical	
5.3.3.1	Technical Risk – The assessment conducted was presented with no challenge raised.	Info
5.3.4	Societal	
5.3.4.1	Fishing – The assessment conducted was presented. In line with the Legacy Safety challenge regards the preference to minimise further rock installation. Option 4A was changed from Weaker to Much Weaker against Option 4C.	Info
5.3.4.2	Other Users – The assessment conducted was presented with no challenge raised.	Info
5.3.5	Economic	
5.3.5.1	Short Term Costs – The assessment conducted was presented with no challenge raised.	Info
5.3.5.2	Long Term Costs – The assessment conducted was presented with no challenge raised. A query was raised by David Holland, TAQA, regarding how long the operator retains liability for infrastructure left *in situ*. It was clarified that this is in perpetuity. However, for the purposes of the CA a 30 year time horizon has been considered.	Info
5.3.6	Results	
5.3.6.1	Option 4A was identified as the emerging recommendation. It has received positive contributions from 1.1 – Operational Personnel, 1.2 – Other Users and 1.3 – HCE, 2.1 – Operational Marine Impact, 2.2 – Atmospheric Emissions and Fuel Consumption, 3.1 – Technical Risk, 4.2 – Other Users and 5.1 – Short Term	Info

ITEM	COMMENT	ACTION
	Costs and is diminished by 1.4 – Legacy Risk, 2.3 – Other Consumptions, 2.4 – Seabed Disturbance, 2.5 – Legacy Marine Impacts, 4.1 – Fishing and 5.2 – Long Term Costs. Steve Sapp, TAQA, stated that consideration will be given to taking a different approach for the near shore section given the difference from the offshore deeper section of the pipeline. John Foreman, Xodus, agreed that this result is only the emerging recommendation, and that further assessment will likely take place.	
5.3.6.2	A request was made by Ruth Ledingham, OPRED, for a copy of the Screening Report.	TAQA
5.3.6.3	The PL4 trunk line has been identified as having potential for re-use. The expectation is that the CA Report will fully document the consideration given to re-use options for PL4.	TAQA
6.0	**Group 1: Trunk Pipe in Pipe Hybrids**	
6.1	Infrastructure details…	

Field / Platform	Description	From	To	Pipeline No.	Pipeline NB / OD (inches)	Length (km)
Central Cormorant UMC	26" Oil Pipe-in-Pipe Hybrid - East [1]	UMC	Cormorant A	PL167 (N1208)	26" (8")	3.345
Central Cormorant UMC	26" Oil Pipe-in-Pipe Hybrid - East [2]	UMC	Cormorant A	PL167 (N1208)	26" (8")	3.345
Central Cormorant UMC	26" Oil Pipe-in-Pipe Hybrid - West [1]	UMC	Cormorant A	PL210 (N1209)	26" (8")	3.343
Central Cormorant UMC	26" Oil Pipe-in-Pipe Hybrid - West [2]	UMC	Cormorant A	PL210 (N1209)	26" (8")	3.343
Central Cormorant UMC	24" Oil Pipe-in-Pipe Hybrid [1]	UMC	Cormorant A	PL168 (N1207)	24" (2 x 3")	3.345
Central Cormorant UMC	24" Oil Pipe-in-Pipe Hybrid [2]	UMC	Cormorant A	PL168 (N1207)	24" (2 x 3")	3.345

6.2	Options under consideration…
	Four options were evaluated for this group:
	• Full Removal
	  • Option 2A – Cut and Lift with De-burial
	• Leave *In Situ* with Major Intervention
	  • Option 3B – Trench and Bury Entire Line
	• Leave *In Situ* with Minor Intervention
	  • Option 4A – Rock Placement over Spans
	  • Option 4C – Remove Spans
		Info

6.3	Evaluation	
6.3.1	Safety	
6.3.1.1	Operational Personnel – The assessment conducted was presented with no challenge raised. A requirement was identified to account for removal of venting appurtenances	Info TAQA
6.3.1.2	Other Users – The assessment conducted was presented with no challenge raised.	Info
6.3.1.3	High Consequence Events – The assessment conducted was presented with no challenge raised.	Info

ITEM	COMMENT	ACTION
6.3.1.4	Legacy Risk – The assessment conducted was presented. In line with the challenge raised for Group 2 the preference for Option 3B over 4A and 4C was increased from Stronger to Much Stronger and for Option 4A against Option 4C from Neutral to Much Weaker.	Info
6.3.2	Environment	
6.3.2.1	Operational Marine Impacts – The assessment conducted was presented with no challenge raised.	Info
6.3.2.2	Atmospheric Emissions and Fuel Consumption – The assessment conducted was presented with no challenge raised.	Info
6.3.2.3	Other Consumptions – The assessment conducted was presented with no challenge raised. The challenges associated with trenching large diameter lines was raised. It was clarified that this would be factored into the assessment under 3.1 Technical Risk.	Info
6.3.2.4	Seabed Disturbance – The assessment conducted was presented with no challenge raised.	Info
6.3.2.5	Legacy Marine Impacts – The assessment conducted was presented with no challenge raised.	Info
6.3.3	Technical	
6.3.3.1	Technical Risk – The assessment conducted was presented with no challenge raised. Further discussion regarding the challenges of trenching both large diameter lines and in this area where the soils have a significant clay content. A query was raised by David Holland, TAQA, regarding the feasibility of using hydraulic shears for cutting the lines. Steve Sapp, TAQA, responded that consideration had been given to the technology available and that suitably large shears are available from a number of suppliers. A query was raised regarding the integrity of the carrier pipe to retain the inner pipes even with crimping of the ends by shear cutting. Ruth Ledingham, OPRED, highlighted that the expected base case is for a clear seabed to be left. The discussion would be taken off-line where more detail can be provided. An action was taken to set up a meeting with OPRED to discuss further.	Info Info Info Info TAQA
6.3.4	Societal	
6.3.4.1	Fishing – The assessment conducted was presented. In line with the challenge raised for Group 2 the preference for Option 3B over 4A and 4C was increased from Stronger to Much Stronger and for Option 4A against Option 4C from Neutral to Much Weaker. Andrew Third, SFF, advised that venting appurtenances as exist on the pipe in pipe hybrids were shown not to be over-trawlable via trials performed on a bundle. Hywel Williams, HSE, highlighted that 'structures' would expect to be looked at closely. Ruth Ledingham, OPRED, requested more information on such structures if they are not being left for pipeline stabilisation purposes. Hywel Williams, HSE, noted that TAQA has some very large structures.	Info Info Info Info Info

ITEM	COMMENT	ACTION
	An action was taken to update the method statements incorporating removal of the venting appurtenances for Options 4A and 4C.	TAQA
6.3.4.2	Other Users – The assessment conducted was presented with no challenge raised.	Info
6.3.5	Economic	
6.3.5.1	Short Term Costs – The assessment conducted was presented with no challenge raised.	Info
6.3.5.2	Long Term Costs – The assessment conducted was presented with no challenge raised.	Info
6.3.6	Results	
6.3.6.1	Option 4A was identified as the emerging recommendation. It has received positive contributions from 1.1 – Operational Personnel, 1.3 – Other Users, 3.1 – Technical Risk and 5.1 – Short-Term Costs and is diminished by 1.4 – Legacy Risk, 2.3 – Other Consumptions, 2.4 – Seabed Disturbance, 2.5 – Legacy Marine Impacts and 4.2 – Other Users. It is equally preferred for 1.2 – Other Users, 2.1 – Operational Marine Impact, 2.2 – Atmospheric Emissions and Fuel Consumption and 5.2 – Long Term Costs.	Info
7.0	**Group 3: Flexibles and Umbilicals, Trenched and Buried**	
7.1	Infrastructure details…	

Field / Platform	Description	From	To	Pipeline No.	Pipeline NB / OD (inches)	Length (km)
Central Cormorant UMC	3" Oil 2 - TFL	Well P1	Cormorant A	PL118 (N0701)	3	5.6
Central Cormorant UMC	3" Oil 1 - TFL	Well P1	Cormorant A	PL118 (N0702)	3	5.6
Central Cormorant UMC	6" Water Injection Pipeline	UMC	Well W4	PL1558 (N0927)	6	3.537
Central Cormorant UMC	3" Umbilical - East	Cormorant A	UMC	PL169 (N0803)	3	7.669
Central Cormorant UMC	3" Umbilical - West	Cormorant A	UMC	PL169 (N0804)	3	7.962
Central Cormorant UMC	Umbilical	UMC	Well P5	PL308/PL309 (N0805)	4.9	3.3
Central Cormorant UMC	Umbilical	UMC	Well W4	PLU6227 (N0806)	4.9	3.845
Central Cormorant UMC	Replacement Umbilical	Cormorant A	UMC	PL1165 (N0874)	4.4	7.2
Pelican	Control Umbilical	Cormorant A	Pelican	PL1088/89/90 (N0843)	5.4	8.542
Pelican	4" Replacement Control Umbilical	Cormorant A	Pelican	PLU1944 (N1862)	4	8.434
North Cormorant	Power Cable	North Cormorant	Eider	PL3815 (N0809)	4	13.11
Otter	Control Umbilical	Eider	Otter	PLU1870 (T0127)	6.4	21
Otter	Power Cable 1 (MPP Supply)	Eider	Otter	PL4438 (T0126)	2.2	21.6
Otter	Power Cable 2 (MPP Supply)	Eider	Otter	PL4439	2.2	21.6
Otter	Power Cable 3 (Manifold Supply)	Eider	Otter	PL4440	2.2	21.6

ITEM	COMMENT	ACTION

Cladhan	Control Umbilical	Tern	Cladhan	PLU3575 (N1869)	5.7	16.6
Kestrel	8.5" Oil Flexible Pipeline	Kestrel P1	SSIV	PL1851 (N0791)	8.5	7.796
Kestrel	4" Gas Lift Flexible Pipeline	Tern	Kestrel	PL1852 (N1128)	4	7.737
Kestrel	8.5" Umbilical	Tern	Kestrel P2	PLU1854 (N1827)	8.5	7.9
Hudson	Hudson Main Umbilical	Tern Alpha	Hudson Manifold	PL1023	5.8	11

7.2	Options under consideration…
	Five options were evaluated for this group:
	• Full Removal
	  • Option 2B – Reverse Installation without De-burial
	• Leave *In Situ* with Minor Intervention
	  • Option 4A – Rock Placement over Spans / Exposures / Shallow Burial
	  • Option 4B – Trench and Bury Spans / Exposures / Shallow Burial
	  • Option 4C – Remove Spans / Exposures / Shallow Burial
	• Leave *In Situ* with Minimal Intervention
	  • Option 5 – Remove Line Ends and Remediate Snag Hazards
		Info

7.3	Evaluation	
7.3.1	Safety	
7.3.1.1	Operational Personnel – The assessment conducted was presented with no challenge raised.	Info
7.3.1.2	Other Users – The assessment conducted was presented with no challenge raised.	Info
7.3.1.3	High Consequence Events – The assessment conducted was presented with no challenge raised.	Info
7.3.1.4	Legacy Risk – The assessment conducted was presented. The Neutral preference between Option 4C and 5 was changed to a Stronger preference for Option 4C. Steve Sapp, TAQA, noted that spans in flexibles are not equivalent to spans in rigid pipelines. Andrew Third, SFF, responded that remediation of trenched spans where the rock is flush with the seabed is less of an issue than with surface laid lines and also clarified the preference for free rock placement over use of rock bags.	Info
7.3.2	Environment	
7.3.2.1	Operational Marine Impacts – The assessment conducted was presented with no challenge raised.	Info
7.3.2.2	Atmospheric Emissions and Fuel Consumption – The assessment conducted was presented with no challenge raised.	Info
7.3.2.3	Other Consumptions – The assessment conducted was presented with no challenge raised.	Info
7.3.2.4	Seabed Disturbance – The assessment conducted was presented with no challenge raised.	Info

ITEM	COMMENT	ACTION
	The preference was for less rock, i.e. larger but temporary seabed disturbance caused by line removal or trenching operations was preferred to a permanent change in habitat associated with rock placement. JNCC concurred with that sentiment.	
7.3.2.5	Legacy Marine Impacts – The assessment conducted was presented with no challenge raised.	Info
7.3.3	Technical	
7.3.3.1	Technical Risk – The assessment conducted was presented with no challenge raised.	Info
7.3.4	Societal	
7.3.4.1	Fishing – The assessment conducted was presented with no challenge raised.	Info
7.3.4.2	Other Users – The assessment conducted was presented with no challenge raised.	Info
7.3.5	Economic	
7.3.5.1	Short Term Costs – The assessment conducted was presented with no challenge raised.	Info
7.3.5.2	Long Term Costs – The assessment conducted was presented with no challenge raised.	Info
7.3.6	Results	
7.3.6.1	Option 2B was identified as the emerging recommendation. It has received positive contributions from 1.3 – High Consequence Events, 1.4 – Legacy Risk, 2.5 – Legacy Marine Impacts, 4.1 – Fishing, 4.2 – Other Users and 5.2 – Long-term Costs, and is diminished by 1.1 – Operations Personnel, 2.4 – Seabed Disturbance. It is equally preferred for 1.2 – Other Users, 2.1 – Operational Marine Impacts, 2.2 – Atmospheric Emissions and Fuel Consumption, 2.3 – Other Consumptions, 3.1 – Technical Risk and 5.1 – Short-term Costs.	Info
7.3.6.2	A query was raised by David Holland, TAQA, whether sufficient integrity of the lines to accommodate reverse reeling was confirmed. It was clarified that this had not been confirmed and was assumed at this time. However, as stated within the HAZID Report (77IFS-154925-H27-0001_01) personnel would be kept clear from sections of lines under tension during catenary recovery. The track record of reverse reeling flexibles was discussed, and it was noted that Maersk has had success with this process. Hywel Williams, HSE, stated that it would be down to the individual condition of the product whether it was suitable for reverse reeling.	Info
8.0	**Group 16: Blocked Rigid Pipeline, Trenched and Buried**	
8.1	Infrastructure details…	

Field / Platform	Description	From	To	Pipeline No.	Pipeline NB / OD (inches)	Length (km)
Hudson	L1 Production/Test Pipeline	Well L1	Hudson Manifold	PL1024/A	6	1.631

Steve Sapp, TAQA, provided the background on the L1 pipeline blockage issue. The well was originally a test well which was subsequently tied back. Potentially hydrates formed following a scale squeeze, there have been ongoing problems with the line throughout operation. Robin Ritchie, TAQA, also noted issues associated with the well's tree valves.

ITEM	COMMENT	ACTION

8.2	Options under consideration…
	Five options were evaluated for this group:
	• Full Removal
	  • Option 2A – Cut and Lift
	• Leave *In Situ* with Minimal Intervention
	  • Option 5 – Remove Line Ends and Remediate Snag Hazards
		Info

8.3	Evaluation	
8.3.1	Safety	
8.3.1.1	Operational Personnel – The assessment conducted was presented with no challenge raised.	Info
8.3.1.2	Other Users – The assessment conducted was presented with no challenge raised.	Info
8.3.1.3	High Consequence Events – The assessment conducted was presented with no challenge raised.	Info
8.3.1.4	Legacy Risk – The assessment conducted was presented with no challenge raised.	Info
8.3.2	Environment	
8.3.2.1	Operational Marine Impacts – The assessment conducted was presented with no challenge raised. An enquiry was made as to whether the contents of this blocked line were already permitted for release. Gareth Jones, Xodus, confirmed that this was the case.	Info
8.3.2.2	Atmospheric Emissions and Fuel Consumption – The assessment conducted was presented with no challenge raised.	Info
8.3.2.3	Other Consumptions – The assessment conducted was presented with no challenge raised.	Info
8.3.2.4	Seabed Disturbance – The assessment conducted was presented with no challenge raised.	Info
8.3.2.5	Legacy Marine Impacts – The assessment conducted was presented with no challenge raised.	Info
8.3.3	Technical	
8.3.3.1	Technical Risk – The assessment conducted was presented with no challenge raised.	Info
8.3.4	Societal	
8.3.4.1	Fishing – The assessment conducted was presented. The equal preference for Option 2A and Option 5 was initially amended to a Stronger preference for full removal, however, given the burial status of this line Andrew Third, SFF, advised that the Neutral assessment was valid.	Info
8.3.4.2	Other Users – The assessment conducted was presented with no challenge raised.	Info
8.3.5	Economic	
8.3.5.1	Short Term Costs – The assessment conducted was presented with no challenge raised.	Info

ITEM	COMMENT	ACTION
8.3.5.2	Long Term Costs – The assessment conducted was presented with no challenge raised.	Info
8.3.6	Results	
8.3.6.1	Option 5 was identified as the emerging recommendation; however, the result was close. From a safety perspective, positive contributions from 1.1 – Operations Personnel and 1.3 – High Consequence Events were enough to counter the negative contribution from 1.4 – Legacy Risk. Similarly, positive contributions for 2.1 – Operational Marine Impact and 2.4 – Seabed Disturbance countered the negative contribution from 2.5 – Legacy Marine Impacts. All other assessments were equally preferred.	Info
9.0	**Group 18: Uncertain Integrity or Concrete Coated Rigid Pipelines, Trenched and Buried**	
9.1	Infrastructure details…	

Field / Platform	Description	From	To	Pipeline No.	Pipeline NB / OD (inches)	Length (km)
Central Cormorant UMC	8" Water Injection Pipeline - New	Cormorant A	UMC	PL184 (N0901)	8"	7.200
Central Cormorant UMC	8" Water Injection Pipeline - Old	Cormorant A	UMC	PL184 (N0930)	8"	7.500
Central Cormorant UMC	2 x 3" Well Injection Flowlines	UMC	Well W4	PL304 (N0902)	3"	3.524
Central Cormorant UMC	2 x 3" Well Injection Flowlines	UMC	Well W4	PL305 (N0903)	3"	3.524
Central Cormorant UMC	3" Oil - TFL	Well P5	UMC	PL306 (N0707)	3"	3.142
Central Cormorant UMC	3" Oil - TFL	Well P5	UMC	PL307 (N0708)	3"	3.100
Eider	12" Oil Pipeline	Eider (Oil Production Tee)	North Cormorant	PL475 (N0506)	12"	13.145
Eider	12" Water Injection Pipeline - Disused	Tern	Eider	PL476 (N1001)	12"	16.400
Otter	10" Water Injection Pipeline	Eider (Water Injection Tee)	Otter	PL3132 (T0129)	10"	21.100
Otter	10" Water Injection Pipeline - Disused	Eider	Otter	PL1869 (T0124)	10"	21.100
Otter	10" Multiphase Pipeline	Otter	Eider	PL1868 (T0123)	10"	21.200
Otter	10" Multiphase Pipeline - Replacement	Otter	Eider (Oil Production Tee)	PL1868a (T0123a)	10"	6.000
Tern	8" Gas Pipeline	North Cormorant	Tern	PL478 (N0604)	8"	13.000
Hudson	2" L1 Gas Lift Pipeline	Hudson Manifold	Well L1	PL1022.1	2"	1.641
Hudson	2" L2 Gas Lift Pipeline	Hudson Manifold	Well L2	PL1022.2	2"	1.761
Hudson	10" Production Pipeline (disused)	Hudson Manifold	Tern Alpha	PL1018	10"	10.410
Hudson	10" Production Pipeline (disused)	Hudson Manifold	Tern Alpha	PL1019	10"	10.410
Hudson	8" Production/Test Pipeline (disused)	Hudson Manifold	Tern Alpha	PL1020	8"	10.410

ITEM	COMMENT	ACTION
	Hudson 8" L1 Production/Test Pipeline (disused) Well L1 Hudson Manifold PL1024 8" 1.761 Hudson 8" L2 Production/Test Pipeline (disused) Well L2 Hudson Manifold PL1025 8" 1.761 Hudson 8" Water Injection Pipeline (disused) Tern Alpha Hudson Manifold PL1021 8" 10.410	

9.2	Options under consideration…
	Five options were evaluated for this group:
	• Full Removal
	  • Option 2A – Cut and Lift with De-burial
	• Leave *In Situ* with Minor Intervention
	  • Option 4A – Rock Placement over Spans / Exposures / Shallow Burial
	  • Option 4B – Trench and Bury Spans / Exposures / Shallow Burial
	  • Option 4C – Remove Spans / Exposures / Shallow Burial
	• Leave In Situ with Minimal Intervention
	  • Option 5 – Remove Line Ends and Remediate Snag Hazards
		Info

9.3	Evaluation	
9.3.1	Safety	
9.3.1.1	Operational Personnel – The assessment conducted was presented with no challenge raised. Hywel Williams, HSE, highlighted the PSR Regulation 14, Para 2, "*The operator of a pipeline shall ensure that work done in discharge of the duty contained in paragraph (1) is performed safely*" Ruth Ledingham, OPRED, noted that placing lines into the Interim Pipeline Regime does not preclude the need to decommission the lines. Steve Sapp, TAQA, explained that that was understood. The reason these lines were placed into this group is because reverse installation is not applicable for these lines, removal will require the cut and lift technique due to uncertainties around pipeline and/or weight coating integrity.	Info
9.3.1.2	Other Users – The assessment conducted was presented with no challenge raised.	Info
9.3.1.3	High Consequence Events – The assessment conducted was presented with no challenge raised.	Info
9.3.1.4	Legacy Risk – The assessment conducted was presented with no challenge raised. Ruth Ledingham, OPRED, requested additional characterisation of this group. Action to provide this information to OPRED.	Info TAQA
9.3.2	Environment	
9.3.2.1	Operational Marine Impacts – The assessment conducted was presented with no challenge raised.	Info
9.3.2.2	Atmospheric Emissions and Fuel Consumption – The assessment conducted was presented with no challenge raised.	Info
9.3.2.3	Other Consumptions – The assessment conducted was presented with no challenge raised.	Info

ITEM	COMMENT	ACTION
9.3.2.4	Seabed Disturbance – The assessment conducted was presented with no challenge raised.	Info
9.3.2.5	Legacy Marine Impacts – The assessment conducted was presented with no challenge raised.	Info
9.3.3	Technical	
9.3.3.1	Technical Risk – The assessment conducted was presented with no challenge raised.	Info
9.3.4	Societal	
9.3.4.1	Fishing – The assessment conducted was presented with no challenge raised.	Info
9.3.4.2	Other Users – The assessment conducted was presented with no challenge raised.	Info
9.3.5	Economic	
9.3.5.1	Short Term Costs – The assessment conducted was presented with no challenge raised.	Info
9.3.5.2	Long Term Costs – The assessment conducted was presented with no challenge raised.	Info
9.3.6	Results	
9.3.6.1	Option 4B was identified as the emerging recommendation. The option did not receive any particular positive contributions; however, it was equally favourable across a number of sub-criteria; 1.2 – Other Users, 1.3 – High Consequence Events, 2.1 – Operational Marine Impact and 2.2 – Atmospheric Emissions and Fuel Consumption. It received negative contributions from 1.1 – Operations Personnel, 1.4 – Legacy Risk, 2.3 – Other Consumption, 2.4 – Seabed Disturbance, 2.5 – Legacy Marine Impacts, 3.1 – Technical Risk, 4.1 - Fishing, 4.2 – Other Users, 5.1 – Short-term Costs and 5.2 – Long-term Costs, however these were not sufficient to prevent it becoming the emerging recommendation. Andrew Third, SFF, stated that from a fishing perspective Option 4B is preferable to the second place option, Option 5.	Info
10.0	**Closing Statement**	
10.1	TAQA thanked all stakeholders for attending and participating and invited any further comments to be submitted to Katie.Lilford@taqaglobal.com.	Info
10.2	JNCC advised that they would share their notes with TAQA.	JNCC

APPENDIX C GROUP 1 – DETAILED EVALUATION RESULTS

C.1 Group 1 Attributes Table

Group 1: Pipe-in-Pipe Hybrids

PL167 (N1208) - 26" Oil Pipe-in-Pipe Hybrid - East [1] - 3.345 km | PL167 (N1208) - 26" Oil Pipe-in-Pipe Hybrid - East [2] - 3.345 km
PL210 (N1209) - 26" Oil Pipe-in-Pipe Hybrid - West [1] - 3.343 km | PL210 (N1209) - 26" Oil Pipe-in-Pipe Hybrid - West [2] - 3.343 km
PL168 (N1207) - 24" Oil Pipe-in-Pipe Hybrid [1] - 3.345 km | PL168 (N1207) - 24" Oil Pipe-in-Pipe Hybrid [2] - 3.345 km

	O2A - Full Removal - Cut and Lift	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial
	- Pipelines are disconnected - Surface laid lines are fully recovered by cut and lift - Shear cutting technique employed in order to crimp pipe ends	- Pipelines are disconnected - Trim chains are removed by divers - Vent appurtenances are removed by divers - Lines are trenched and backfilled to 0.6m DoC	- Pipeline is disconnected - Trim chains are removed by divers - Vent appurtenances are removed by divers - Rock placement over areas of spans	- Pipelines are disconnected - Trim chains are removed by divers - Vent appurtenances are removed by divers - Areas of spans are removed by cut and lift - Shear cutting technique employed in order to crimp pipe ends - Rock placement over cut ends to mitigate snag risk
1. Safety **1.1 Operations Personnel**	Vessel Type: PoB / Days / Hours / PLL CSV: 76 / 159.4 / 145,382 / 1.09E-02 Total offshore hours: 145,382 hrs Total offshore PLL: 1.09E-02 Resource Type: Days / Hours / PLL Engineering & Management: 1,976.5 / 15,812 / 6.32E-05 Project Management: 1,798.0 / 14,384 / 5.75E-05 Onshore Operations (includes Cleaning & Disposal): 222.0 / 14,208 / 1.75E-03 Total onshore hours: 44,404 hrs Total onshore PLL: 1.87E-03 Total operational hours: 189,786 hrs Total operational PLL: 1.28E-02	Vessel Type: PoB / Days / Hours / PLL CSV: 76 / 12.7 / 11,573 / 8.68E-04 Trenching Vessel: 55 / 15.1 / 9,940 / 7.45E-04 Total offshore hours: 21,513 hrs Total offshore PLL: 1.61E-03 Resource Type: Days / Hours / PLL Engineering & Management: 663.2 / 5,306 / 2.12E-05 Project Management: 616.0 / 4,928 / 1.97E-05 Onshore Operations (includes Cleaning & Disposal): 2.0 / 128 / 1.57E-05 Total onshore hours: 10,362 hrs Total onshore PLL: 5.67E-05 Total operational hours: 31,875 hrs Total operational PLL: 1.67E-03	Vessel Type: PoB / Days / Hours / PLL CSV: 76 / 12.7 / 11,573 / 8.68E-04 Rockdump Vessel: 20 / 6.4 / 1,543 / 1.16E-04 Total offshore hours: 13,116 hrs Total offshore PLL: 9.84E-04 Resource Type: Days / Hours / PLL Engineering & Management: 216.2 / 1,729 / 6.92E-06 Project Management: 206.0 / 1,648 / 6.59E-06 Total onshore hours: 3,377 hrs Total onshore PLL: 1.35E-05 Total operational hours: 16,494 hrs Total operational PLL: 9.97E-04	Vessel Type: PoB / Days / Hours / PLL CSV: 76 / 29.1 / 26,512 / 1.99E-03 Total offshore hours: 26,512 hrs Total offshore PLL: 1.99E-03 Resource Type: Days / Hours / PLL Engineering & Management: 345.6 / 2,765 / 1.11E-05 Project Management: 325.0 / 2,600 / 1.04E-05 Onshore Operations (includes Cleaning & Disposal): 8.0 / 512 / 6.30E-05 Total onshore hours: 5,877 hrs Total onshore PLL: 8.44E-05 Total operational hours: 32,389 hrs Total operational PLL: 2.07E-03
	MW / **MW** / **MW**	**W** / **N**	**S**	
	7.66467 / **12.8385** / **6.18357**	**1.67502508** / **0.80676329**	**0.481642512**	
Summary	The assessment of the Operations Personnel sub-criterion is as follows: Option 2A is assessed as being Much Weaker than Option 3B, Option 4A and Option 4C due to the risk exposure being higher in Option 2A due to the extended offshore scope for full removal and the onshore handling of the entirety of the lines. Option 3B is assessed as being Weaker than Option 4A due to the longer durations to trench and bury the entirety of the lines. Option 3B is assessed as being Neutral to Option 4C as the offshore and onshore scope and hence the risk exposure is similar. Option 4A is assessed as being Stornger than Option 4C as the offshore scope to rock cover problem areas is the smallest of all the options and hence has the lowest risk exposure. **Overall, Option 4A is preferred from a risk to Operations Personnel perspective.**			

		O2A - Full Removal - Cut and Lift	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial
1. Safety	1.2 Other Users	Vessel Days: CSV: 159.4 Total vessel days: 159.4 days Transits: 18	Vessel Days: CSV: 12.7 Trenching Vessel: 15.1 Total vessel days: 27.8 days Transits: 4	Vessel Days: CSV: 12.7 Rockdump Vessel: 6.4 Total vessel days: 19.1 days Transits: 4	Vessel Days: CSV: 29.1 Total vessel days: 29.1 days Transits: 4
		W W W	N N	N	
	Summary	The assessment of the Other Users sub-criterion is as follows: Option 2A is assessed as being Weaker than all other options due to the greater number of vessel days and transits compared to the other options presenting a small increase to the potential safety impact to other users of the sea. All other options are assessed as being Neutral to each other as, while there are differences in the vessel days and transits, these are insufficient to express a preference from a safety perspective. **Overall, Option 3B, Option 4A and Option 4C are equally preferred from a risk to Other Users perspective.**			
1. Safety	1.3 High Consequence Events	Routine cut and lift operations. High number of lifts (2025) through the water column to recover line sections. Additional lifting to transfer pipeline sections to quayside. Low number of lifting operations to deploy and recover cutting equipment.	Routine, low risk trenching operations. High number of lifting operations (125) through the water column to deploy and recover trenching equipment and cutting equipment (to remove chains).	Routine, low risk rock placement operations. High number of lifting operations (119) through the water column to deploy and recover cutting equipment (to remove chains & appurtenances).	High number of lifting operations (259) through the water column to recover line ends and to place rock bags. Additional lifting to transfer pipeline sections to quayside. Additional lifting operations to deploy and recover cutting equipment (to remove chains & appurtenances).
		W W W	N S	S	
	Summary	The assessment of the High Consequence Events sub-criterion is as follows: Option 2A is assessed as being Weaker than all other options as there are many more lifting operations and hence potential for high consequence events from dropped object, associated with Option 2A over the other options. Option 3B is assessed as being Neutral to Option 4A as the offshore lifting operations with potential for dropped object are similar in both options. Option 3B is assessed as being Stronger than Option 4C as there are around double the offshore lifting operations in Option 4C. Option 4A is assessed as being Stronger than Option 4C as there are around double the offshore lifting operations in Option 4C. It is noted that the lifts are likely to be challenging due to stability issues from potentially loose equipment within the pipe-in-pipe cut sections although the expectation is that the use of hydraulic shears should assist by 'crimping' of the lines at cut locations. **Overall, Option 3B and Option 4A are equally preferred from a High Consequence Events perspective.**			
1. Safety	1.4 Legacy Risk	No legacy risk from this full removal option.	The line would remain in-situ with this option although it would be fully trenched and buried under this option. The survey & monitoring programme is committed to ensuring that the potential snag hazard from left in-situ infrastructure continues to be managed & mitigated as appropriate. Vessel Type: PoB / Days / Hours / PLL Survey Vessel (Legacy): 44 / 29.0 / 15,323 / 1.15E-03	The line would remain in-situ with this option with the majority of its length remaining surface laid. Areas of spans will have rock placement to mitigate potential snag hazard. The survey & monitoring programme is committed to ensuring that the potential snag hazard from left in-situ infrastructure continues to be managed & mitigated as appropriate. Vessel Type: PoB / Days / Hours / PLL Survey Vessel (Legacy): 44 / 29.0 / 15,323 / 1.15E-03	The line would remain in-situ with this option with the majority of its length remaining surface laid. Areas of spans will be removed with rock cover to mitigate potential snag hazard from cut ends. The survey & monitoring programme is committed to ensuring that the potential snag hazard from left in-situ infrastructure continues to be managed & mitigated as appropriate. Vessel Type: PoB / Days / Hours / PLL Survey Vessel (Legacy): 44 / 29.0 / 15,323 / 1.15E-03
		S MS MS	MS MS	MW	
	Summary	The assessment of the Legacy Risk sub-criterion is as follows: Option 2A is assessed as being Stronger than Option 3B as while both options present a clear seabed, the lines are removed in Option 2A thus removing the potential for legacy risk. Option 2A is assessed as being Much Stronger than Option 4A and Option 4C as there is no legacy risk from the full removal option versus the lines remaining in-situ with problem areas rock covered, presenting surface laid lines with large rock berms or removed, presenting lines remaining surface laid with areas of spot rock cover. Option 3B is assessed as being Much Stronger than Option 4A and Option 4C as while the lines remain in-situ, they are fully trenched and buried thus presenting a clear seabed versus lines remaining in-situ with problem areas rock covered, presenting surface laid lines with large rock berms or removed, presenting lines remaining surface laid with areas of spot rock cover. Option 4A is assessed as being Much Weaker than Option 4C as while the lines remain in both cases, the large rock berms over problem areas in Option 4A present a greater legacy snag risk than the problem areas being removed in Option 4C. **Overall, 2A is preferred from a Legacy Risk perspective.**			

		O2A - Full Removal - Cut and Lift	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial
2. Environmental	2.1 Operational Marine Impact	Vessel Noise (days on-site): 131.4 days Tooling Noise (Hydraulic Shears) = 125.5 days Operation releases: Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush and releases to the marine environment during flushing activities. There will be potential for the release of residual contents at cut locations, however, given the prior cleaning of the lines, the concentration and quantity of release should still be low overall. Therefore, the related impact is also anticipated to be low. There will also be potential for release of small amounts of line insulation material at cut locations. Vessel releases: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore at 131.4 days is the highest of all the options. The environmental impact is considered to be negligible.	Vessel Noise (days on-site): 19.7 days Tooling Noise (Trenching) = 17.7 days Operation releases: Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush and releases to the marine environment during flushing activities. As line is being trenched there is negligible release from the lines. Vessel releases: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore at 19.7 days is not considered significant. The environmental impact is considered to be negligible.	Vessel Noise (days on-site): 11.1 days Tooling Noise = none Operation releases: Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush and releases to the marine environment during flushing activities. As line is being rock covered in areas of spans there is negligible release from the lines. Vessel releases: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore at 11.1 days is the lowest of the options. The environmental impact is considered to be negligible.	Vessel Noise (days on-site): 21.1 days Tooling Noise (Hydraulic Shears) = 9.4 days Operation releases: Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush and releases to the marine environment during flushing activities. Cutting of line ends would lead to an elevated release of fluids from within the line. However, given the prior cleaning of the line, the concentration and quantity of release should still be low overall. Therefore, the related impact is also anticipated to be low. There will also be potential for release of small amounts of line insulation material at cut locations. Vessel releases: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore at 21.1 days is not considered significant. The environmental impact is considered to be negligible.
		W W W	N N	N	
	Summary	The assessment of the Operational Marine Impact sub-criterion is as follows: Option 2A is assessed as being Weaker than all other options due to a combination of the noise impact from the longer vessel durations and tooling operations and the releases of pipeline contents and insulation material at all cut locations. Whilst the environmental impact is expected to be low, there is enough cumulative impact to express a small preference for all options over Option 2A. All other options are assessed as being Neutral to each other as, while there are differences in the vessel durations, tooling operations and potential for releases from cutting operations, these are considered insufficient to express a preference. **Overall, Option 3B, Option 4A and Option 4C are equally preferred from an Operational Marine Impact perspective.**			
2. Environmental	2.2 Atmospheric Emissions & Fuel Consumption	Vessel Emissions (in tonnes): Fuel: 4,421 CO2: 14,016 NOx: 262.64 SO2: 17.69 Vessel Energy Use: 190,124 GJ	Vessel Emissions (in tonnes): Fuel: 1,385 CO2: 4,390 NOx: 82.27 SO2: 5.54 Vessel Energy Use: 59,555 GJ	Vessel Emissions (in tonnes): Fuel: 1,236 CO2: 3,919 NOx: 73.43 SO2: 4.94 Vessel Energy Use: 53,154 GJ	Vessel Emissions (in tonnes): Fuel: 1,620 CO2: 5,135 NOx: 96.22 SO2: 6.48 Vessel Energy Use: 69,654 GJ
		W W W	N N	N	
	Summary	The assessment of the Atmospheric Emissions & Consumptions sub-criterion is as follows: Option 2A is assessed as being Weaker than all other options as the emissions and fuel use are around 3 to 4 times greater for Option 2A than the other options which is sufficient to express a small preference for the other options. All remaining options are assessed as being Neutral to each other as, while there are small differences in the emissions and fuel consumption, these are considered insufficient to express a preference. **Overall, Option 3B, Option 4A and Option 4C are equally preferred from an Atmospheric Emissions & Consumptions perspective.**			

		O2A - Full Removal - Cut and Lift			O3B - Leave (Major) - Trench & Bury Entire Line		O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial
2. Environmental	2.3 Other Consumptions	Material Emissions (CO2 in tonnes): Recovered Material: 6,335 Remaining Material: Total: 6,335 Rock: N/A tonnes			Material Emissions (CO2 in tonnes): Recovered Material: 57 Remaining Material: 11,748 Total: 11,805 Rock: N/A tonnes		Material Emissions (CO2 in tonnes): Recovered Material: Remaining Material: 11,854 Total: 11,854 Rock: 7,000 tonnes	Material Emissions (CO2 in tonnes): Recovered Material: 209 Remaining Material: 11,463 Total: 11,672 Rock: 224 tonnes
		N	S	N	N	N	N	
	Summary	The assessment of the Other Consumptions sub-criterion is as follows: Option 2A is assessed as being Neutral to Option 3B as, while there is a greater impact from replacing material left in-situ in Option 3B, this difference is considered insufficient to express a preference. Option 2A is assessed as being Stronger than Option 4A due to a combination of the lower impact from processing the returned material and there being no rock resource required versus the greater impact from generating replacement material and the rock resource required in Option 4A. Option 2A is assessed as being Neutral to Option 4C as, while there is a greater impact from replacing material left in-situ and the small amount of rock resource required in Option 4C, this difference is considered insufficient to express a preference. Option 3B is assessed as being Neutral to both Option 4A and Option 4C as the impact associated with the rock resource consumption is considered minimal and insufficient to express a preference. Option 4A is assessed as being Neutral to Option 4C with the difference in rock resource required being insufficient to express a preference. **Overall, Option 2A is preferred from an Other Consumptions perspective.**						
2. Environmental	2.4 Seabed Disturbance	Seabed Disturbance (m2): No rock cover in this option.			Seabed Disturbance (m2): Trenching: 202,460 No rock cover in this option.		Seabed Disturbance (m2): Rock Cover: 7,000 Habitat Loss / Change (m2): Rock Cover: 7,000	Seabed Disturbance (m2): Rock Cover: 350 Habitat Loss / Change (m2): Rock Bags: 350
		S	S	S	S	N	W	
	Summary	The assessment of the Seabed Disturbance sub-criterion is as follows: Option 2A is assessed as being Stronger than Option 3B as there is limited seabed disturbance associated with the full removal of the surface laid lines versus significant area of impact associated with the trenching of the lines, although the judgement is reduced as the trenching impact would be temporary in nature. Option 2A is assessed as being Stronger than Option 4A and Option 4C due to the limited impact versus the permanent habitat change associated with the small amount of rock cover in these options. Option 3B is assessed as being Stronger than Option 4A as the temporary nature of the larger area of impact in Option 3B is considered preferable to the permanent habitat change associated with the smaller area of rock cover in option 4A. Option 3B is assessed as being Neutral to Option 4C with the larger area of temporary impact versus the small area of permanent habitat change being largely similar. Option 4A is assessed as being Weaker than Option 4C due to the greater area of permanent habitat change in Option 4A. **Overall, Option 2A is preferred from a Seabed Disturbance perspective.**						
2. Environmental	2.5 Legacy Marine Impacts	No legacy marine impact from this full removal option.			Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush. The legacy marine impact from the slow release of these low concentration / quantity releases is therefore expected to be low overall.		Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush. The legacy marine impact from the slow release of these low concentration / quantity releases is therefore expected to be low overall.	Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush. The legacy marine impact from the slow release of these low concentration / quantity releases is therefore expected to be low overall.
		S	MS	MS	S	S	S	
	Summary	The assessment of the Legacy Marine Impacts sub-criterion is as follows: Option 2A is assessed as being Stronger than Option 3B as there is no legacy marine impacts associated with the full removal option whereas there will be slow degradation of the lines and releases over a long time period with Option 3B although this is reduced as the lines will be fully trenched and buried and as such, largely isolated from the marine environment. Option 2A is assessed as being Much Stronger than Option 4A and Option 4C as there is no legacy marine impacts associated with the full removal option whereas there will be slow degradation of the lines and releases over a long time period with Option 4A and Option 4C, both of which remain exposed to the marine environment. Option 3B is assessed as being Stronger than Option 4A and Option 4C as while the lines remain in all options, the lines are more isolated from the marine environment in Option 3B and the legacy impacts are expected to lower as a result. Option 4A is assessed as being Stronger than Option 4C as the legacy marine impact is expected to be marginally greater for Option 4C where there are multiple cut locations along the lines where areas of span have been removed resulting in potentially greater legacy marine impact. **Overall, Option 2A is preferred from a Legacy Marine Impacts perspective.**						

		O2A - Full Removal - Cut and Lift	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial
3. Technical	3.1 Technical Risk	Concept Maturity: Cut and lift techniques are well proven with multiple options available on the market. (Score 3) Technical Risks: Technical risks with this option are associated with the scale of the operation. (Score 2)	Concept Maturity: Trenching of large diameter surface lines has limited track record (Score 1) Technical Risks: A comparatively large scope. Geotechncial studies would be required to confirm if it is feasible. (Score 1)	Concept Maturity: Rock placement is a well proven process. (Score 3) Technical Risks: Limited technical risks associated with option (Score 3)	Concept Maturity: Cut and lift has a good track record (Score 3) Technical Risks: Limited technical risks associated with option (Score 3)
		N MW W	MW MW	S	
	Summary	The assessment of the Technical Risk sub-criterion is as follows: Option 2A is assessed as being Neutral to Option 3B as while both employ routine operations, there are significant challenges associated with both options. The challenges associated with Option 2A relate to cutting (with shears to provide 'crimping' effect) and lifting of the pipe-in-pipe hybrids with stability issues due to potential for loose equipment (loss of spider / centraliser support) within cut section during lift. The challenges associated with Option 3B relate to the geotechnical conditions of clays and 'shelly deposits' and the diameter of the lines. Option 2A is assessed as being Much Weaker than Option 4A due to the challenges of cutting and lifting the pipe-in-pipe hybrids versus the routine nature of rock covering spans in Option 4A. Option 2A is assessed as being Weaker than Option 4C as both options have similar challenges to cut and lift sections, however the scale of the operations and hence scope for challenges is much greater for Option 2A. Option 3B is assessed as being Much Weaker than both Option 4A and Option 4C due to the significant challenges trenching and burying lines of this type and diameter in the geotechnical conditions present. Option 4A is assessed as being Stronger than Option 4C due the routine nature of the rock cover operations versus the cut and lift challenges of the lines albeit smaller in scope as it relates to line ends only. **Overall, Option 4A is preferred from a Technical Risk perspective.**			
4. Societal	4.1 Fishing	Large scale disruption associated with the removal operation, however, infrastructure is removed long term, beneficial for the fishing industry. (Score 2)	Relatively short term operation, localised area of disturbance. If successful, the area would be clear for fishing operations to be conducted. (Score 3)	Short operation, small area of disturbance, however, rock berms would not be the fishing indutry's preference (Score 2)	Short operation, small area of disturbance. Rock bags will profile cut ends to mitigate snag hazard for fishing gear. (Score 2)
		S MS MS	MS MS	N	
	Summary	The assessment of the Societal impact on Fishing sub-criterion is as follows: Option 2A is assessed as being Stronger than Option 3B as, while both options present a clear seabed for commercial fishing operations, there is a preference for the lines to be removed. Option 2A is assessed as being Much Stronger than both Option 4A and Option 4C as the lines remain in these options (with rock cover over spans / spans removed) which presents an obstruction to fishing operations versus the lines being removed in Option 2A. Option 3B is assessed as being Much Stronger than both Option 4A and Option 4C as it presents a clear seabed versus the lines remaining on the seabed in Option 4A and Option 4C. Option 4A is assessed as being Neutral to Option 4C as the lines will remain on the seabed in both options. The differential between the spans being rock covered or removed is insufficient to express a preference. **Overall, Option 2A is preferred from a Societal impact on Fishing perspective.**			
4. Societal	4.2 Other Users	Significant amount of recyclable material returned. (Score 3) Materials Returned: Steel: 6,275 tonnes (recyclable) Polymer: 381 tonnes (landfill)	Minimal societal benefits / impacts with this option. (Score 3) Materials Returned: Steel: 57 tonnes (recyclable) Polymer: 4 tonnes (landfill)	Minimal societal benefits / impacts with this option. (Score 3) Materials Returned: None.	Minimal societal benefits / impacts with this option. (Score 3) Materials Returned: Steel: 208 tonnes (recyclable) Polymer: 13 tonnes (landfill)
		S S S	N N	N	
	Summary	The assessment of the Societal impact on Other Users sub-criterion is as follows: Option 2A is assessed as being Stronger than all other options as there is a significant quantity of useful, recyclable material returned (steel) with only a small proportion of material returned (polymer) that may end up in landfill versus limited / no material returned in the other options. In addition, there is the job creation / retention associated with the large offshore and onshore scope in Option 2A. This is deemed to present a small societal benefit over the other options. All other options are assessed as being Neutral to each other as the positive and negative societal impacts are considered largely similar for those options. It is noted that the extraction of the insulation material internal to the pipe-in-pipes may prove challenging, however assessed on the basis that separation could be achieved and that the useful recyclable steel could be obtained. **Overall, Option 2A is preferred from a Societal impact on Other Users perspective.**			

		O2A - Full Removal - Cut and Lift			O3B - Leave (Major) - Trench & Bury Entire Line		O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial
5. Economic	5.1 Short-term Costs	£17.73 Million			£6.2 Million		£2.268 Million	£3.428 Million
		W	MW	MW	W	W	N	
		11.53 million more	15.462 million more	14.302 million more	3.932 million more	2.772 million more	1.16 million less	
		186.0% higher	681.7% higher	417.2% higher	173.4% higher	80.9% higher	33.8% lower	
	Summary	The assessment of the Short-term Costs sub-criterion is as follows: Option 2A is assessed as being Weaker than Option 3B due to the costs to deliver this option being around 3 times higher (£11.5 million more) than Option 3B. Option 2A is assessed as being Much Weaker than Option 4A due to the costs being around 8 times higher (£15.5 million more) than Option 4A. Option 2A is assessed as being Much Weaker than Option 4C due to the costs being around 5 times higher (£14.3 million more). Option 3B is assessed as being Weaker than Option 4A due to the costs being around 2.5 times higher (£3.9 million more). Option 3B is assessed as being Weaker than Option 4C due to the costs being around double (£2.8 million more). Option 4A is assessed as being Neutral to Option 4C as, while there are differences in the costs to deliver these options, the differences are considered insufficient to express a preference. **Overall, Option 4A and Option 4C are equally preferred from a Short-term Cost perspective.**						
5. Economic	5.2 Long-term Costs	Surveys: N/A FLTC: N/A Total Legacy Cost: £0 Million			Surveys: £0.87 Million FLTC: N/A Total Legacy Cost: £0.87 Million		Surveys: £0.87 Million FLTC: £0.06 Million Total Legacy Cost: £0.931 Million	Surveys: £0.87 Million FLTC: £0.06 Million Total Legacy Cost: £0.931 Million
		N	N	N	N	N	N	
	Summary	The assessment of the Long-term Costs sub-criterion is as follows: All options are assessed as being Neutral to each other as, while there is no long-term costs associated with the full removal option versus long-term costs for survey and monitoring with the other options, these long-term costs are small and are considered insufficient to express a preference. **Overall, all options are equally preferred from a Long-term Cost perspective.**						

C.2 Group 1 Pairwise Comparison Matrices – Safety

1.1 Operations Personnel	O2A - Full Removal - Cut and Lift	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2A - Full Removal - Cut and Lift	N	MW	MW	MW	9.9%
O3B - Leave (Major) - Trench & Bury Entire Line	MS	N	W	N	26.9%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	MS	S	N	S	36.4%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	MS	N	W	N	26.9%

1.2 Other Users	O2A - Full Removal - Cut and Lift	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2A - Full Removal - Cut and Lift	N	W	W	W	18.2%
O3B - Leave (Major) - Trench & Bury Entire Line	S	N	N	N	27.3%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	S	N	N	N	27.3%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	S	N	N	N	27.3%

1.3 High Consequence Events	O2A - Full Removal - Cut and Lift	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2A - Full Removal - Cut and Lift	N	W	W	W	18.0%
O3B - Leave (Major) - Trench & Bury Entire Line	S	N	N	S	29.9%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	S	N	N	S	29.9%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	S	W	W	N	22.1%

1.4 Legacy Risk	O2A - Full Removal - Cut and Lift	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2A - Full Removal - Cut and Lift	N	S	MS	MS	41.0%
O3B - Leave (Major) - Trench & Bury Entire Line	W	N	MS	MS	33.4%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	MW	MW	N	MW	9.4%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	MW	MW	MS	N	16.2%

C.3 Group 1 Pairwise Comparison Matrices – Environment

2.1 Operational Marine Impact	O2A - Full Removal - Cut and Lift	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2A - Full Removal - Cut and Lift	N	W	W	W	18.2%
O3B - Leave (Major) - Trench & Bury Entire Line	S	N	N	N	27.3%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	S	N	N	N	27.3%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	S	N	N	N	27.3%

2.2 Atmospheric Emissions & Fuel Consumption	O2A - Full Removal - Cut and Lift	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2A - Full Removal - Cut and Lift	N	W	W	W	18.2%
O3B - Leave (Major) - Trench & Bury Entire Line	S	N	N	N	27.3%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	S	N	N	N	27.3%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	S	N	N	N	27.3%

2.3 Other Consumptions	O2A - Full Removal - Cut and Lift	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2A - Full Removal - Cut and Lift	N	N	S	N	27.6%
O3B - Leave (Major) - Trench & Bury Entire Line	N	N	N	N	24.9%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	W	N	N	N	22.5%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	N	N	N	N	24.9%

2.4 Seabed Disturbance	O2A - Full Removal - Cut and Lift	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2A - Full Removal - Cut and Lift	N	S	S	S	33.1%
O3B - Leave (Major) - Trench & Bury Entire Line	W	N	S	N	24.4%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	W	W	N	W	18.0%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	W	N	S	N	24.4%

2.5 Legacy Marine Impacts	O2A - Full Removal - Cut and Lift	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2A - Full Removal - Cut and Lift	N	S	MS	MS	43.5%
O3B - Leave (Major) - Trench & Bury Entire Line	W	N	S	S	25.1%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	MW	W	N	S	17.3%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	MW	W	W	N	14.1%

C.4 Group 1 Pairwise Comparison Matrices – Technical

3.1 Technical Risk	O2A - Full Removal - Cut and Lift	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2A - Full Removal - Cut and Lift	N	N	MW	W	15.3%
O3B - Leave (Major) - Trench & Bury Entire Line	N	N	MW	MW	12.8%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	MS	MS	N	S	42.6%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	S	MS	W	N	29.3%

C.5 Group 1 Pairwise Comparison Matrices – Societal

4.1 Fishing	O2A - Full Removal - Cut and Lift	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2A - Full Removal - Cut and Lift	N	S	MS	MS	41.3%
O3B - Leave (Major) - Trench & Bury Entire Line	W	N	MS	MS	33.8%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	MW	MW	N	N	12.5%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	MW	MW	N	N	12.5%

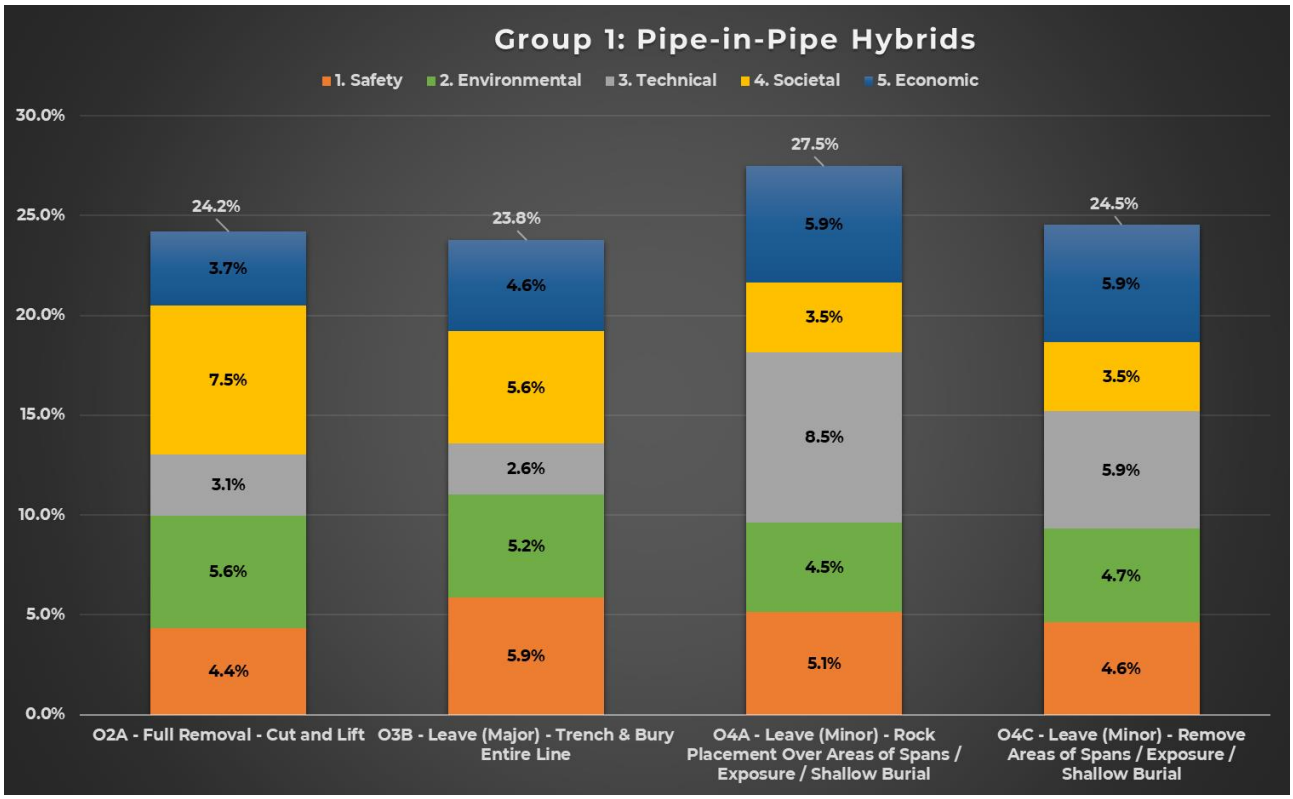
4.2 Other Users	O2A - Full Removal - Cut and Lift	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2A - Full Removal - Cut and Lift	N	S	S	S	33.3%
O3B - Leave (Major) - Trench & Bury Entire Line	W	N	N	N	22.2%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	W	N	N	N	22.2%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	W	N	N	N	22.2%

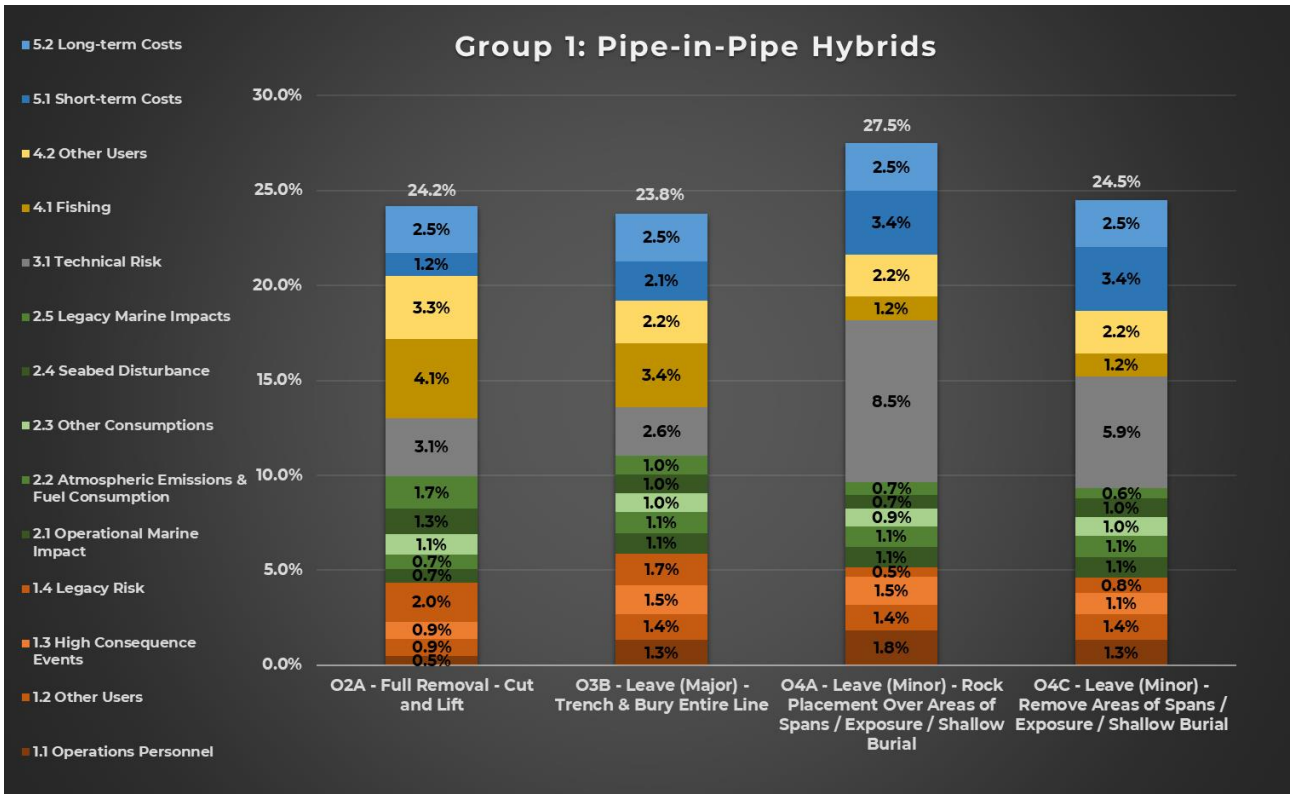
C.6 Group 1 Pairwise Comparison Matrices – Economic

5.1 Short-term Costs	O2A - Full Removal - Cut and Lift	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2A - Full Removal - Cut and Lift	N	W	MW	MW	12.0%
O3B - Leave (Major) - Trench & Bury Entire Line	S	N	W	W	20.8%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	MS	S	N	N	33.6%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	MS	S	N	N	33.6%

5.2 Long-term Costs	O2A - Full Removal - Cut and Lift	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2A - Full Removal - Cut and Lift	N	N	N	N	25.0%
O3B - Leave (Major) - Trench & Bury Entire Line	N	N	N	N	25.0%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	N	N	N	N	25.0%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	N	N	N	N	25.0%

C.7 Group 1 Results Charts





APPENDIX D GROUP 2 – DETAILED EVALUATION RESULTS

D.1 Group 2 Attributes Table

Group 2: Trunk Lines (Trenched and Buried)

PL4 (N0101) - 36" Oil Pipeline from Cormorant Alpha to Sullom Voe - 153.3 km

	O2A - Full Removal - Cut and Lift	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial
	- Pipeline is disconnected - Line is de-buried using MFE (65 km 1 pass, 85 km 2 passes) - Line is fully recovered by cut and lift - Concrete spalling debris is recovered by DSV (25% of cuts)	- Pipeline is disconnected - Rock placement over areas of spans	- Pipeline is disconnected - Areas of spans are removed by cut and lift - Rock placed over cut ends to mitigate snag risk
1.1 Operations Personnel	Vessel Type: PoB / Days / Hours / PLL DSV: 110 / 81.0 / 106,973 / 8.02E-03 Divers: 18 / 81.0 / 35,009 / 3.40E-02 CSV: 76 / 1,296.7 / 1,182,554 / 8.87E-02 Total offshore hours: 1,324,536 hrs Total offshore PLL: 1.31E-01 Resource Type: Days / Hours / PLL Engineering & Management: 17,408.8 / 139,271 / 5.57E-04 Project Management: 17,412.0 / 139,296 / 5.57E-04 Onshore Operations (includes Cleaning & Disposal): 4,752.0 / 304,128 / 3.74E-02 Total onshore hours: 582,695 hrs Total onshore PLL: 3.85E-02 Total operational hours: 1,907,231 hrs Total operational PLL: 1.69E-01	Vessel Type: PoB / Days / Hours / PLL Rockdump Vessel: 20 / 32.1 / 7,694 / 5.77E-04 Total offshore hours: 7,694 hrs Total offshore PLL: 5.77E-04 Resource Type: Days / Hours / PLL Engineering & Management: 232.4 / 1,859 / 7.44E-06 Project Management: 375.0 / 3,000 / 1.20E-05 Total onshore hours: 4,859 hrs Total onshore PLL: 1.94E-05 Total operational hours: 12,553 hrs Total operational PLL: 5.97E-04	Vessel Type: PoB / Days / Hours / PLL DSV: 110 / 8.2 / 10,811 / 8.11E-04 Divers: 18 / 8.2 / 3,538 / 3.43E-03 CSV: 76 / 133.2 / 121,451 / 9.11E-03 Rockdump Vessel: 20 / 29.7 / 7,121 / 5.34E-04 Total offshore hours: 142,921 hrs Total offshore PLL: 1.39E-02 Resource Type: Days / Hours / PLL Engineering & Management: 2,010.3 / 16,082 / 6.43E-05 Project Management: 1,940.0 / 15,520 / 6.21E-05 Onshore Operations (includes Cleaning & Disposal): 248.0 / 15,872 / 1.95E-03 Total onshore hours: 47,474 hrs Total onshore PLL: 2.08E-03 Total operational hours: 190,395 hrs Total operational PLL: 1.60E-02
	VMW / **MW**	**MS**	
	283.0820771 / **10.5625**	**0.0373125**	
	The assessment of the Operations Personnel sub-criterion is as follows: Option 2A is assessed as being Very Much Weaker than Option 4A due to the risk exposure being more than 200 times higher in Option 2A. This is due to the much greater offshore scope associated with the full removal of this 153 km trunk line in Option 2A versus the small scope and lower risk activities to perform rock placement over problem areas of the line in Option 4A. There is also greater risk exposure from the onshore handling and processing of the full length of the line in Option 2A versus no onshore handling / processing in Option 4A. Option 2A is assessed as being Much Weaker than Option 4C due to the risk exposure being around 10 times higher in Option 2A. This is due to the greater scope both offshore and onshore to remove the full 153 km trunk line in Option 2A versus the smaller offshore and onshore scope associated with removing problem areas only in Option 4C. Option 4A is assessed as being Much Stronger than Option 4C as the risk exposure is around 30 times lower in Option 4A. This is due to the smaller offshore scope to provide rock placement over the problem areas of the line (which are also lower risk activities) and there being no onshore handling / processing in Option 4A versus the greater offshore and onshore scopes associated with removing problem areas in Option 4C. **Overall, Option 4A is preferred from a risk to Operations Personnel perspective.**		
1.2 Other Users	Vessel Days: DSV: 81.0 CSV: 1,296.7 Total vessel days: 1,377.7 days Transits: 382	Vessel Days: Rockdump Vessel: 32.1 Total vessel days: 32.1 days Transits: 8	Vessel Days: DSV: 8.2 CSV: 133.2 Rockdump Vessel: 29.7 Total vessel days: 171.0 days Transits: 26
	VMW / **MW**	**S**	
	The assessment of the Other Users sub-criterion is as follows: Option 2A is assessed as being Very Much Weaker than Option 4A due to the thousands of vessel days and hundreds of transits required to execute Option 2A versus the low number of vessel days and transits to deliver Option 4A which is considered to present an increase in the safety risk to other users of the sea. Option 2A is assessed as being Much Weaker than Option 4C as, again there are thousands of days and hundreds of transits in Option 2A versus a lower number of vessel days and transits in Option 4C. Option 4A is assessed as being Stronger than Option 4C due to there being less vessel days and transits to execute Option 4A. **Overall, Option 4A is preferred from a risk to Other Users perspective.**		
1.3 High Consequence Events	Routine cut and lift operations. Very high number of lifts (15527) through the water column to recover line sections. Additional lifting to transfer pipeline sections to quayside. High number of lifting operations to deploy and recover deburial (MFE) and cutting equipment.	Routine, low risk rock placement operations. No offshore lifting.	High number of lifting operations (924) through the water column to recover areas of spans. Additional lifting to transfer pipeline sections to quayside. Small number of lifting operations to deploy and recover cutting equipment.
	VMW / **MW**	**MS**	
	The assessment of the High Consequence Events sub-criterion is as follows: Option 2A is assessed as being Very Much Weaker than Option 4A due to the very high number of offshore lifting operations (which have the potential for a High Consequence Event i.e. dropped object) required to deploy the subsea tooling to perform the cutting of the line and the recovery of the cut sections of line through the water column in Option 2A. There are also lifting operations associated with the deployment and recovery of the MFE for deburial operations. This is compared to no lifting operations associated with rock placement operations in Option 4A . Option 2A is assessed as being Much Weaker than Option 4C, again due to the very high number of offshore lifting operations in Option 2A. There are almost a thousand offshore lifting operations associated with equipment deployment / retrieval and line section recovery associated with Option 4C, however the potential for High Consequence Events from dropped objects is much smaller than Option 2A. Option 4A is assessed as being Much Stronger than Option 4C due to there being no lifting operations versus almost a thousand offshore lifting operations with Option 4C. **Overall, Option 4A is preferred from a High Consequence Events perspective.**		
1.4 Legacy Risk	No legacy risk from this full removal option.	The line would remain in-situ with this option although the majority of its length is already trenched and buried. Areas of spans will be rock covered to mitigate potential snag hazard. The survey & monitoring programme is committed to ensuring that the potential snag hazard from left in-situ infrastructure continues to be managed & mitigated as appropriate. Vessel Type: PoB / Days / Hours / PLL Survey Vessel (Legacy): 44 / 60.9 / 32,171 / 2.41E-03 Total offshore hours: 32,171 hrs Total offshore PLL: 2.41E-03	The line would remain in-situ with this option although the majority of its length is already trenched and buried. Areas of spans will be removed. The survey & monitoring programme is committed to ensuring that the potential snag hazard from left in-situ infrastructure continues to be managed & mitigated as appropriate. Vessel Type: PoB / Days / Hours / PLL Survey Vessel (Legacy): 44 / 60.9 / 32,171 / 2.41E-03 Total offshore hours: 32,171 hrs Total offshore PLL: 2.41E-03
	MS / **MS**	**MW**	
	The assessment of the Legacy Risk sub-criterion is as follows: Option 2A is assessed as being Much Stronger than both Option 4A and Option 4C as the line is fully removed and as such there is no legacy risk versus the line remaining with rock cover over areas of spans or the areas of spans removed in the other options, where the potential for snag hazard remains although this is mitigated by the survey and monitoring programme. Option 4A is assessed as being Much Weaker than Option 4C as while the majority of the trunk line is trenched and partially buried in both options, the rock cover over areas of spans in Option 4A would present a greater legacy risk from snagging potential than if the areas of spans were removed in Option 4C, hence the preference for Option 4C. **Overall, Option 2A is preferred from a Legacy Risk perspective.**		

	O2A - Full Removal - Cut and Lift	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial
2.1 Operational Marine Impact	Vessel Noise (days on-site): 802.7 days Tooling Noise (MFE and DWC) = 405.5 days Operation releases: Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush and releases to the marine environment during flushing activities. There will be potential for the release of residual contents during cutting operations. However, given the prior cleaning of the lines, the concentration and quantity of release should still be low overall. Therefore, the related impact is also anticipated to be low. Vessel releases: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore at around 802.7 days is the highest of all options and notable. The environmental impact is considered to be low.	Vessel Noise (days on-site): 19.1 days Tooling Noise = None Operation releases: Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush and releases to the marine environment during flushing activities. As line is being rock covered there is negligible release from the line. Vessel releases: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore at 19.1 days is the lowest of all options. The environmental impact is considered to be negligible.	Vessel Noise (days on-site): 116.2 days Tooling Noise (DWC) = 54.6 days Operation releases: Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush and releases to the marine environment during flushing activities. Cutting and removal of problem areas of line would lead to a release of fluids from within the line. However, given the prior cleaning of the line, the concentration and quantity of release should still be low overall. Therefore, the related impact is also anticipated to be low. Vessel releases: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore at 116.2 days not considered significant. The environmental impact is considered to be negligible.
	MW **W**	**S**	
	The assessment of the Operational Marine Impact sub-criterion is as follows: Option 2A is assessed as being Much Weaker than Option 4A due to the environmental impact associated with the much larger number of days of vessel operations and deburial (MFE) / cutting (DWC) operations. In addition, the impact from the releases at each cut location is greater than in Option 4A where there is no cutting of the line. Option 2A is assessed as being Weaker than Option 4C again, due to the larger number of vessel days, cutting operations and releases at cut locations. Option 4A is assessed as being Stronger than Option 4C due to the lower impact from the lower number of vessel days and there being no cutting operations and hence no releases in Option 4A. Note: impact on marine mammals and haul out area in near shore location dominates the judgement. **Overall, Option 4A is preferred from an Operational Marine Impact perspective.**		
2.2 Atmospheric Emissions & Fuel Consumption	Vessel Emissions (in tonnes): Fuel: 37,823 CO2: 119,898 NOx: 2,246.67 SO2: 151.29 Vessel Energy Use: 1,626,379 GJ	Vessel Emissions (in tonnes): Fuel: 2,394 CO2: 7,589 NOx: 142.21 SO2: 9.58 Vessel Energy Use: 102,943 GJ	Vessel Emissions (in tonnes): Fuel: 6,177 CO2: 19,582 NOx: 366.93 SO2: 24.71 Vessel Energy Use: 265,622 GJ
	MW **MW**	**S**	
	The assessment of the Atmospheric Emissions & Consumptions sub-criterion is as follows: Option 2A is assessed as being Much Weaker than both Option 4A and Option 4C as there is much greater atmospheric emissions and fuel use associated with the greater scopes in Option 2A. Option 4A is assessed as being Stronger than Option 4C as the emissions and fuel use for Option 4A is less than half that associated with Option 4C. **Overall, Option 4A is preferred from an Atmospheric Emissions & Consumptions perspective.**		
2.3 Other Consumptions	Material Emissions (CO2 in tonnes): Recovered Material: 146,238 Remaining Material: 189 Total: 146,427 Rock: 32 tonnes	Material Emissions (CO2 in tonnes): Recovered Material: Remaining Material: 200,420 Total: 200,420 Rock: 77,050 tonnes	Material Emissions (CO2 in tonnes): Recovered Material: 7,630 Remaining Material: 189,973 Total: 197,603 Rock: 15,600 tonnes
	MS **S**	**W**	
	The assessment of the Other Consumptions sub-criterion is as follows: Option 2A is assessed as being Much Stronger than Option 4A due to the large quantity of rock resource required in Option 4A coupled with the greater impact associated with producing replacement material for the infrastructure left in-situ. Option 2A is assessed as being Stronger than Option 4C due to the greater quantity of rock resource and greater impact associated with producing replacement material left in-situ. Option 4A is assessed as being Weaker than Option 4C due to the greater quantity of rock resource required in Option 4A. **Overall, Option 2A is preferred from an Other Consumptions perspective.**		
2.4 Seabed Disturbance	Seabed Disturbance (m2): Rock Cover: 50 MFE: 738,590 Habitat Loss / Change (m2): Rock Bags: 50	Seabed Disturbance (m2): Rock Cover: 77,400 Habitat Loss / Change (m2): Rock Cover: 77,400 Within East Mainland Coast Shetland SPA: 13,350 tonnes / 13,350 m2 (maximum) or 2,612 tonnes / 2,612 m2 (fishsafe only).	Seabed Disturbance (m2): Rock Cover: 15,600 Habitat Loss / Change (m2): Rock Cover: 15,600 Within East Mainland Coast Shetland SPA: 2,600 tonnes / 2,600 m2 (maximum) or 1,800 tonnes / 1,800 m2 (fishsafe only).
	S **MW**	**MW**	
	The assessment of the Seabed Disturbance sub-criterion is as follows: Option 2A is assessed as being Stronger than Option 4A as, while there is significant area of seabed disturbance from the deburial operations in Option 2A, this impact is temporary in nature whereas the area impacted in Option 4A is significant and represents a permanent habitat change with a notable proportion of that impact within the SPA. Option 2A is assessed as being Much Weaker than Option 4C as while there is a moderate area of seabed impact that is permanent in nature in Option 4C, only a small proportion of this impact is within the SPA and this is much more preferable to the large area of temporary disturbance associated with Option 2A. Option 4A is assessed as being Much Weaker than Option 4C due to the much larger area of permanent habitat change associated with Option 4A, particularly the proportion that is within the SPA. **Overall, Option 4C is preferred from a Seabed Disturbance perspective.**		
2.5 Legacy Marine Impacts	No legacy marine impact from this full removal option.	Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush. The legacy marine impact from the slow release of these low concentration / quantity releases is therefore expected to be low overall.	Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush. The legacy marine impact from the slow release of these low concentration / quantity releases is therefore expected to be low overall.
	MS **MS**	**N**	
	The assessment of the Legacy Marine Impacts sub-criterion is as follows: Option 2A is assessed as being Much Stronger than Option 4A and Option 4C as there are no legacy environmental impacts associated with the full removal option versus the impact associated with the slow degradation of the line and slow release of residual contents in Option 4A and Option 4C. Option 4A is assessed as being Neutral to Option 4C as the legacy impact from these options are considered largely similar. **Overall, Option 2A is preferred from a Legacy Marine Impacts perspective.**		

	O2A - Full Removal - Cut and Lift		O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial
3.1 Technical Risk	Concept Maturity: Cut and lift techniques are well proven with multiple options available on the market. (Score 3) Technical Risks: Technical risks with this option are associated with the scale of the operation. (Score 1)		Concept Maturity: Rock placement from a fall pipe vessel is a well proven technique. (Score 3) Technical Risks: Limited technical risks associated with option (Score 3)	Concept Maturity: Cut and lift has a good track record (Score 3) Technical Risks: Technical risk with this option is related to scale, i.e managing logistics. (Score 3)
	MW	**W**	**N**	
	The assessment of the Technical Risk sub-criterion is as follows: Option 2A is assessed as being Much Weaker than Option 4A as while cut and lift operations associated with Option 2A are relatively routine, as are the rock placement operations associated with Option 4A, the scale of the cut and lift operations over hundreds of days and along 153 km of line is likely to present significant, cumulative technical challenges. Option 2A is assessed as being Weaker than Option 4C as, again, the operations are largely routine but the much greater scale on Option 2A leads to greater potential for technical challenges and hence a preference for Option 4C. Option 4A is assessed as being Neutral to Option 4C due to the routine nature of the operations in both options with the differences in scale being insufficient to express a preference. Note: for all options the limit of the CA scope is the Low Water mark at shore. This results in some shallow water operations and tidal impact on operations need to be considered. This adds to the challenges associated with the full removal option. **Overall, Option 4A is preferred from a Technical Risk perspective.**			
4.1 Fishing	Large scale disruption associated with the removal operation, however, infrastructure is removed long term, beneficial for the fishing industry. (Score 2)		Short operation, small area of disturbance during operation. However, rock berms are not preferred option from the fishing industry's perspective. (Score 1)	Significant operation, spread over a large area. Rock cover intended to be installed flush with seabed to avoid impact on fishing operations. (Score 2)
	MS	**MS**	**MW**	
	The assessment of the Societal impact on Fishing sub-criterion is as follows: Option 2A is assessed as being Much Stronger than Option 4A and Option 4C as the line is removed in Option 2A. Although there would be significant disruption in removing the line, a clear seabed is the preferred outcome from a commercial fishing operations perspective. Option 4A is assessed as being Weaker than Option 4C due to the large rock berms created in Option 4A which are less preferred than the section removal and spot rock cover associated with Option 4C. **Overall, Option 2A is preferred from a Societal impact on Fishing perspective.**			
4.2 Other Users	Significant amount of recyclable material returned. (Score 3) Materials Returned: Steel: 74,122 tonnes (recyclable) Concrete: 68,428 tonnes (landfill)		Minimal societal benefits / impacts with this option. (Score 3) Materials Returned: None.	Minimal societal benefits / impacts with this option. (Score 3) Materials Returned: Steel: 3,868 tonnes (recyclable) Concrete: 3,571 tonnes (landfill)
	W	**W**	**N**	
	The assessment of the Societal impact on Other Users sub-criterion is as follows: Option 2A is assessed as being Weaker than Option 4A and Option 4C as while there is good job creation / retention in this large scope option and there is benefit in the large quantity of steel returned in Option 2A, this is offset by the large quantity of concrete returned which is likely to end up in landfill. Both the steel and the concrete will present processing / waste segregation challenges due to the use of coal tar layer between the steel and the concrete and the age / design of the concrete layer on this line being of the 'chicken wire' type rather than the more recent 'rebar' type design. Option 4A is assessed as being Neutral to Option 4C as while there are differences in the societal impacts, with Option 4C returning a moderate quantity of steel which is offset by the concrete returned going to landfill, these differences are insufficient to express a preference. **Overall, Option 4A and Option 4C are equally preferred from a Societal impact on Other Users perspective.**			
5.1 Short-term Costs	£169.957 Million		£4.291 Million	£19.557 Million
	VMW	**VMW**	**MS**	
	165.66 million more	**150.4 million more**	**15.27 million more**	
	3860.6% higher	**769.0% higher**	**355.8% higher**	
	The assessment of the Short-term Costs sub-criterion is as follows: Option 2A is assessed as being Very Much Weaker than Option 4A due the to costs to deliver this option being around 40 times higher (£165 million more) than Option 4A. Option 2A is assessed as being Very Much Weaker than Option 4C due to the costs being more than 8 times higher (£150 million more) than Option 4C. Option 4A is assessed as being Much Stronger than Option 4C due to the costs being almost five times higher (£15 million more) for Option 4C. **Overall, Option 4A is preferred from a Short-term Cost perspective.**			
5.2 Long-term Costs	Surveys: N/A FLTC: N/A Total Legacy Cost: £0 Million		Surveys: £1.828 Million FLTC: £0.443 Million Total Legacy Cost: £2.271 Million	Surveys: £1.828 Million FLTC: £0.443 Million Total Legacy Cost: £2.271 Million
	S	**S**	**N**	
	The assessment of the Long-term Costs sub-criterion is as follows: Option 2A is assessed as being Stronger than Option 4A and Option 4C due to there being no legacy costs associated with Option 2A versus the costs associated with the surveying and monitoring of the infrastructure left in-situ in Option 4A and Option 4C. Option 4A is assessed as being Neutral to Option 4C as the long-term costs are the same in both cases. **Overall, Option 2A is preferred from a Long-term Cost perspective.**			

D.2 Group 2 Pairwise Comparison Matrices – Safety

1.1 Operations Personnel	O2A - Full Removal - Cut and Lift	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2A - Full Removal - Cut and Lift	N	VMW	MW	7.7%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	VMS	N	MS	69.2%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	MS	MW	N	23.1%

1.2 Other Users	O2A - Full Removal - Cut and Lift	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2A - Full Removal - Cut and Lift	N	VMW	MW	8.4%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	VMS	N	S	59.9%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	MS	W	N	31.7%

1.3 High Consequence Events	O2A - Full Removal - Cut and Lift	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2A - Full Removal - Cut and Lift	N	VMW	MW	7.7%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	VMS	N	MS	69.2%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	MS	MW	N	23.1%

1.4 Legacy Risk	O2A - Full Removal - Cut and Lift	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2A - Full Removal - Cut and Lift	N	MS	MS	58.4%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	MW	N	MW	13.5%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	MW	MS	N	28.1%

D.3 Group 2 Pairwise Comparison Matrices – Environment

2.1 Operational Marine Impact	O2A - Full Removal - Cut and Lift	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2A - Full Removal - Cut and Lift	N	MW	W	18.6%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	MS	N	S	50.7%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	S	W	N	30.7%

2.2 Atmospheric Emissions & Fuel Consumption	O2A - Full Removal - Cut and Lift	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2A - Full Removal - Cut and Lift	N	MW	MW	14.2%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	MS	N	S	48.7%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	MS	W	N	37.1%

2.3 Other Consumptions	O2A - Full Removal - Cut and Lift	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2A - Full Removal - Cut and Lift	N	MS	S	50.7%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	MW	N	W	18.6%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	W	S	N	30.7%

2.4 Seabed Disturbance	O2A - Full Removal - Cut and Lift	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2A - Full Removal - Cut and Lift	N	S	MW	22.8%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	W	N	MW	17.4%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	MS	MS	N	59.8%

2.5 Legacy Marine Impacts	O2A - Full Removal - Cut and Lift	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2A - Full Removal - Cut and Lift	N	MS	MS	60.0%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	MW	N	N	20.0%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	MW	N	N	20.0%

D.4 Group 2 Pairwise Comparison Matrices – Technical

3.1 Technical Risk	O2A - Full Removal - Cut and Lift	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2A - Full Removal - Cut and Lift	N	MW	W	19.0%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	MS	N	N	45.2%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	S	N	N	35.9%

D.5 Group 2 Pairwise Comparison Matrices – Societal

4.1 Fishing	O2A - Full Removal - Cut and Lift	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2A - Full Removal - Cut and Lift	N	MS	MS	58.4%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	MW	N	MW	13.5%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	MW	MS	N	28.1%

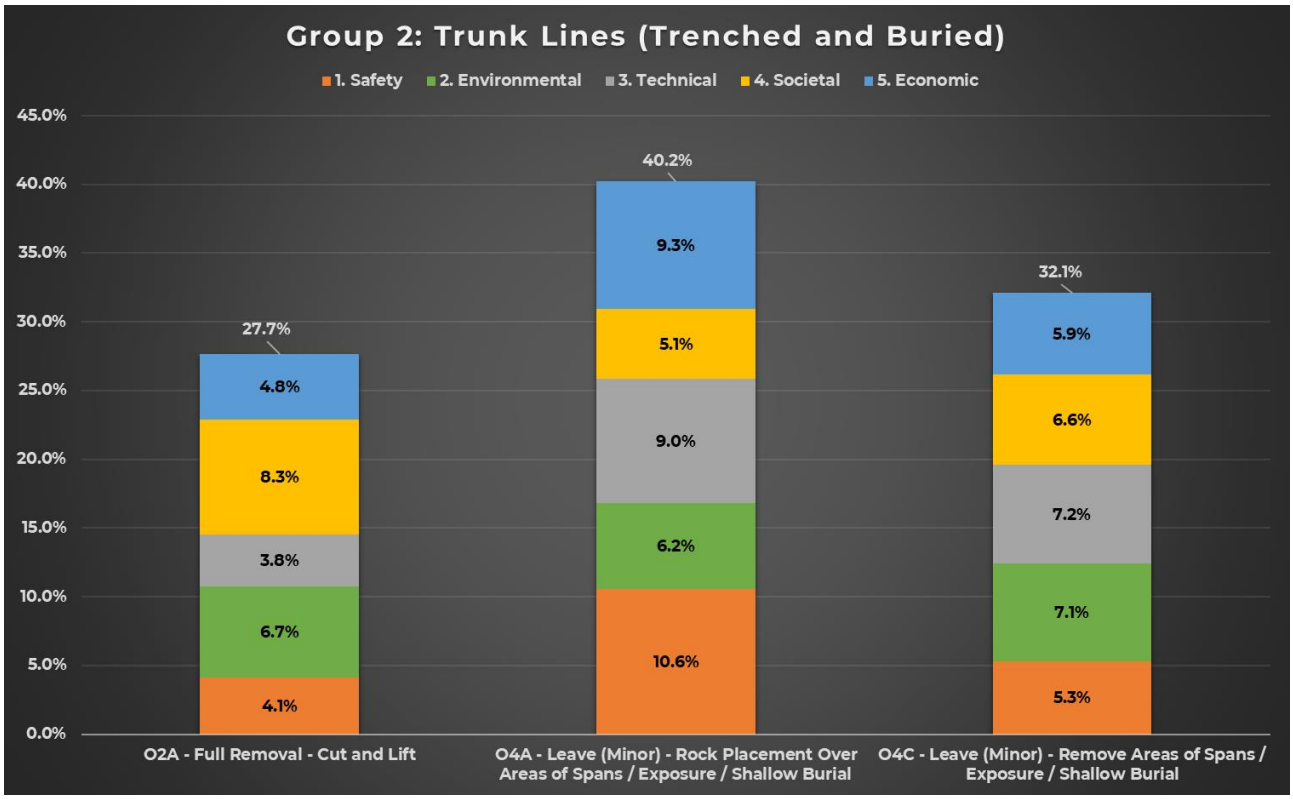
4.2 Other Users	O2A - Full Removal - Cut and Lift	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2A - Full Removal - Cut and Lift	N	W	W	25.0%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	S	N	N	37.5%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	S	N	N	37.5%

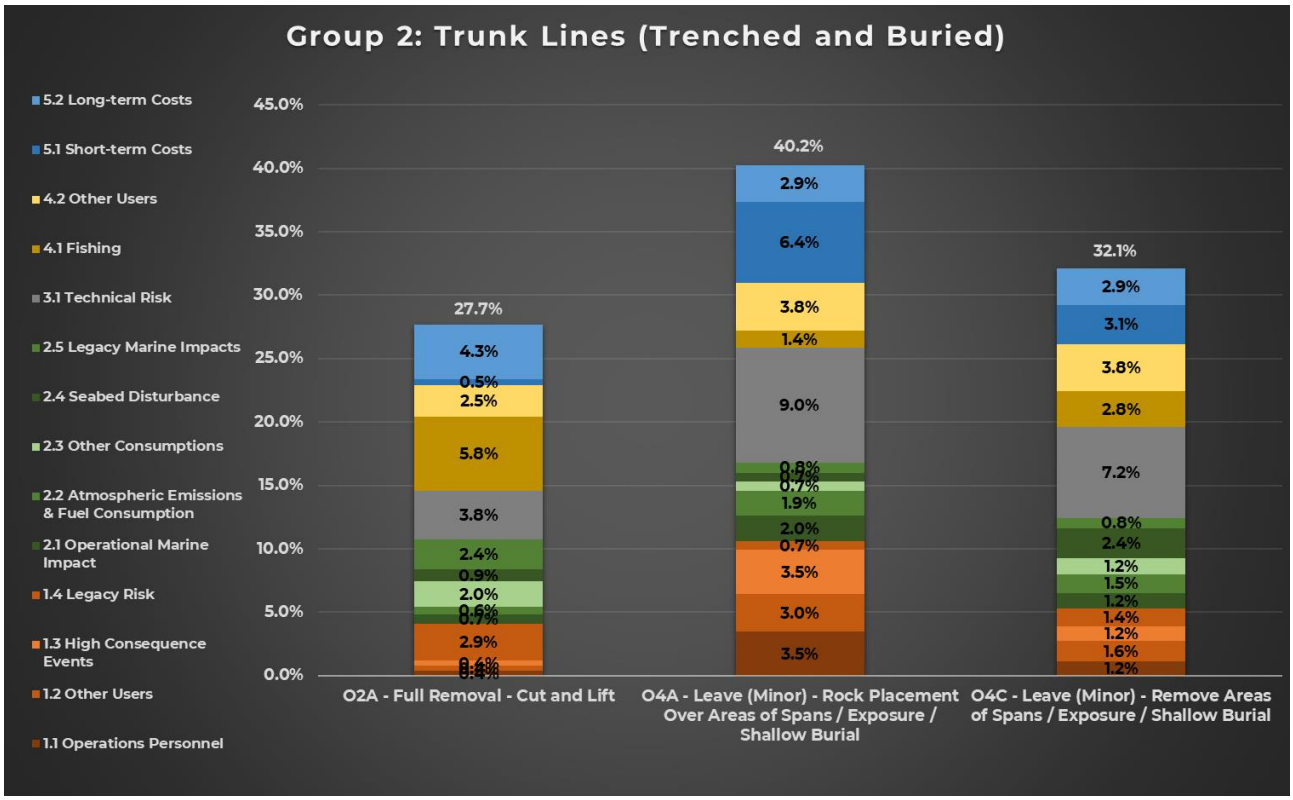
D.6 Group 2 Pairwise Comparison Matrices – Economic

5.1 Short-term Costs	O2A - Full Removal - Cut and Lift	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2A - Full Removal - Cut and Lift	N	VMW	VMW	4.9%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	VMS	N	MS	64.2%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	VMS	MW	N	30.9%

5.2 Long-term Costs	O2A - Full Removal - Cut and Lift	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2A - Full Removal - Cut and Lift	N	S	S	42.9%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	W	N	N	28.6%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	W	N	N	28.6%

D.7 Group 2 Results Charts





APPENDIX E GROUP 3 – DETAILED EVALUATION RESULTS

E.1 Group 3 Attributes Table

Group 3: Flexible Pipelines & Umbilicals (Trenched & Buried)

PL118 (N0701) 3" Oil 2 - TFL 5.6 km | PL118 (N0702) 3" Oil 1 - TFL 5.6 km | PL1558 (N0927) 6" Water Injection Pipeline 3.537 km | PL169 (N0803) 3" Umbilical - East 7.669 km | PL169 (N0804) 3" Umbilical - West 7.962 km | PL308 (N0805) Umbilical 3.3 km | PL309 (N0806) Umbilical 3.845 km | PL1165 (N0874) Replacement Umbilical 7.2 km | PL1088/89/90 (N0843) Control Umbilical 8.542 km | PLU1944 (N1862) 4" Replacement Control Umbilical 8.434 km | PL3815 (N0809) Power Cable 13.11 km | PLU1870 (T0127) Control Umbilical 21 km | PL4438 (T0126) Power Cable 1 (MPP Supply) 21.6 km | PL4439 Power Cable 2 (MPP Supply) 21.6 km | PL4440 Power Cable 3 (Manifold Supply) 21.6 km | PLU3575 (N1869) Control Umbilical 16.6 km | PL1851 (N0791) 8.5" Oil Flexible Pipeline 7.796 km | PL1852 (N1128) 4" Gas Lift Flexible Pipeline 7.737 km | PLU1854 (N1827) 8.5" Umbilical 7.9 km | PL1023 Hudson Main Umbilical 11 km

		O2A - Full Removal - Cut and Lift	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk
		- Flowlines / umbilicals are disconnected - De-burial of lines by MFE - Lines are fully recovered by cut and lift	- Flowlines / umbilicals are disconnected - Flowlines / umbilicals end transitions cut and recovered in 10m sections - Rock placement over areas of spans / exposures / shallow burial	- Flowlines / umbilicals are disconnected - Flowlines / umbilicals end transitions cut and recovered in 10m sections - Re-trench and bury areas of spans / exposures / shallow burial	- Flowlines / umbilicals are disconnected - Flowlines / umbilicals end transitions cut and recovered in 10m sections - Remove areas of spans / exposures / shallow burial by cut and lift - Remediate cut ends with rock	- Flowlines / umbilicals are disconnected - Remove flowlines / umbilicals ends by cut and lift - Remediate cut ends with rock
1. Safety	1.1 Operations Personnel	Vessel Type: PoB / Days / Hours / PLL CSV: 76 / 1,241.8 / 1,132,522 / 8.49E-02 Total offshore hours: 1,132,522 hrs Total offshore PLL: 8.49E-02 Resource Type: Days / Hours / PLL Engineering & Management: 15,485.3 / 123,882 / 4.96E-04 Project Management: 14,402.0 / 115,216 / 4.61E-04 Onshore Operations (includes Cleaning & Disposal): 178.0 / 11,392 / 1.40E-03 Total onshore hours: 250,490 hrs Total onshore PLL: 2.36E-03 Total operational hours: 1,383,012 hrs Total operational PLL: 8.73E-02	Vessel Type: PoB / Days / Hours / PLL CSV: 76 / 55.8 / 50,908 / 3.82E-03 Rockdump Vessel: 20 / 59.9 / 14,369 / 1.08E-03 Total offshore hours: 65,277 hrs Total offshore PLL: 4.90E-03 Resource Type: Days / Hours / PLL Engineering & Management: 1,722.1 / 13,776 / 5.51E-05 Project Management: 1,571.0 / 12,568 / 5.03E-05 Onshore Operations (includes Cleaning & Disposal): 4.0 / 256 / 3.15E-05 Total onshore hours: 26,600 hrs Total onshore PLL: 1.37E-04 Total operational hours: 91,877 hrs Total operational PLL: 5.03E-03	Vessel Type: PoB / Days / Hours / PLL CSV: 76 / 55.0 / 50,151 / 3.76E-03 Trenching Vessel: 55 / 61.0 / 40,273 / 3.02E-03 Total offshore hours: 90,424 hrs Total offshore PLL: 6.78E-03 Resource Type: Days / Hours / PLL Engineering & Management: 2,407.4 / 19,259 / 7.70E-05 Project Management: 2,224.0 / 17,792 / 7.12E-05 Onshore Operations (includes Cleaning & Disposal): 4.0 / 256 / 3.15E-05 Total onshore hours: 37,307 hrs Total onshore PLL: 1.80E-04 Total operational hours: 127,731 hrs Total operational PLL: 6.96E-03	Vessel Type: PoB / Days / Hours / PLL CSV: 76 / 152.7 / 139,217 / 1.04E-02 Rockdump Vessel: 20 / 9.7 / 2,323 / 1.74E-04 Total offshore hours: 141,540 hrs Total offshore PLL: 1.06E-02 Resource Type: Days / Hours / PLL Engineering & Management: 1,985.3 / 15,882 / 6.35E-05 Project Management: 1,920.0 / 15,360 / 6.14E-05 Onshore Operations (includes Cleaning & Disposal): 21.0 / 1,344 / 1.65E-04 Total onshore hours: 32,586 hrs Total onshore PLL: 2.90E-04 Total operational hours: 174,126 hrs Total operational PLL: 1.09E-02	Vessel Type: PoB / Days / Hours / PLL CSV: 76 / 47.8 / 43,630 / 3.27E-03 Total offshore hours: 43,630 hrs Total offshore PLL: 3.27E-03 Resource Type: Days / Hours / PLL Engineering & Management: 795.6 / 6,365 / 2.55E-05 Project Management: 738.0 / 5,904 / 2.36E-05 Onshore Operations (includes Cleaning & Disposal): 4.0 / 256 / 3.15E-05 Total onshore hours: 12,525 hrs Total onshore PLL: 8.06E-05 Total operational hours: 56,155 hrs Total operational PLL: 3.35E-03
		VMW	MW	MW	VMW	N	S	N	N	W	W
		17.3559	12.5431	8.009174	26.0597	0.72270115	0.46146789	1.50149254	0.63853211	2.07761194	3.253731343
Summary		The assessment of the Operations Personnel sub-criterion is as follows: Option 2A is assessed as being Very Much Weaker than Option 4A and Option 5 due to the risk exposure being 17 times higher than Option 4A and 26 times higher than Option 5. This is due to the significantly greater offshore and onshore scope associated with the full removal of the lines by cut and lift. Option 2A is assessed as being Much Weaker than Option 4A and Option 4C due to the risk exposure being around 10 times higher than these options. This is due to the significantly greater offshore and onshore scope associated with the full removal of the lines by cut and lift. Option 4A is assessed as being Neutral to Option 4B and Option 5 as, while there are differences in the risk exposure due to differences in offshore scope, these are considered insufficient to express a preference. Option 4A is assessed as being Stronger than Option 4C as the risk exposure is around double in Option 4C due to the greater scope associated with removing the problem areas of the lines in Option 4C. Option 4B is assessed as being Neutral to Option 4C as, while there are differences in the risk exposure due to differences in offshore scope, these are considered insufficient to express a preference. Option 4B is assessed as being Weaker than Option 5 as the risk exposure is around double in Option 4C due to the greater scope associated with removing the problem areas of the lines in Option 4C. Option 4C is assessed as being Weaker than Option 5 as the risk exposure is around 3 times higher in Option 4C due to the greater scope associated with removing the problem areas of the lines in Option 4C. **Overall, Option 5 is preferred from a risk to Operations Personnel perspective.**					
1. Safety	1.2 Other Users	Vessel Days: CSV: 1,241.8 Total vessel days: 1,241.8 days Transits: 120	Vessel Days: CSV: 55.8 Rockdump Vessel: 59.9 Total vessel days: 115.7 days Transits: 20	Vessel Days: CSV: 55.0 Trenching Vessel: 61.0 Total vessel days: 116.0 days Transits: 6	Vessel Days: CSV: 152.7 Rockdump Vessel: 9.7 Total vessel days: 162.3 days Transits: 8	Vessel Days: CSV: 47.8 Total vessel days: 47.8 days Transits: 4
		MW	MW	MW	MW	N	N	W	N	W	W
Summary		The assessment of the Other Users sub-criterion is as follows: Option 2A is assessed as being Much Weaker than all other options due to the much higher number of vessel transits requiured to execute this option compared to the others. There a a much higher number of vessel days at the various offshore locations although this is a less significant contributer to the potential safety impact to other users of the sea. Option 4A is assessed as being Neutral to Option 4B and Option 4C as, while there are differences in the vessel days and transits, these are considered insufficient to express a preference. Option 4A is assessed as being Weaker than Option 5 as there are fewer vessel days and transits in Option 5. Option 4B is assessed as being Neutral to Option 4C as, while there are differences in the vessel days and transits, these are considered insufficient to express a preference. Option 4B is assessed as being Weaker than Option 5 as there are fewer vessel days and transits in Option 5. Option 4C is assessed as being Weaker than Option 5 as there are fewer vessel days and transits in Option 5. **Overall, Option 5 is preferred from a risk to Other Users perspective.**					

		O2A - Full Removal - Cut and Lift	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk
1. Safety	1.3 High Consequence Events	Very high number of lifting operations (20445) to recover the lines. Small number of lifting operations through the water column to deploy and recover cutting equipment. In addition there is the potential for dropped object associated with the offloading of the cut line sections to the quayside.	Routine, low risk rock placement operations. High number of lifting operations (480) to recover the line ends. Small number of lifting operations through the water column to deploy and recover cutting equipment. In addition there is the potential for dropped object associated with the offloading of the cut line sections to the quayside.	Routine, low risk trenching operations. High number of lifting operations (810) to recover the line ends. Moderate number of lifting operations through the water column to deploy and recover trenching and cutting equipment. In addition there is the potential for dropped object associated with the offloading of the cut line sections to the quayside.	Very high number of lifting operations (4020) to recover the line ends and areas of spans / exposure / shallow burial. Small number of lifting operations through the water column to deploy and recover cutting equipment. In addition there is the potential for dropped object associated with the offloading of the cut line sections to the quayside.	High number of lifting operations (640) to recover the line ends and to place rock bags. Small number of lifting operations through the water column to deploy and recover cutting equipment. In addition there is the potential for dropped object associated with the offloading of the cut line sections to the quayside.
		MW MW W MW	N S N	S N	W	
	Summary	The assessment of the High Consequence Events sub-criterion is as follows: Option 2A is assessed as being Much Weaker than Option 4A, Option 4B and Option 5 as there are around 20,000 lifts associated with option 2A versus hundreds with the other options. Option 2A is assessed as being Weaker than Option 4C as there are around 20,000 lifts associated with option 2A versus around 4,000 in Option 4C. Option 4A is assessed as being Neutral to Option 4B and Option 5 as, while there are differences in the number of lifts across these option, the differences are deemed insufficient to express a preference. Option 4A is assessed as being Stronger than Option 4C as there are a much higher number of lifts associated with Option 4C. Option 4B is assessed as being Stronger than Option 4C as there are a much higher number of lifts associated with Option 4C. Option 4B is assessed as being Neutral to Option 5 as, while there are differences in the number of lifts across these option, the differences are deemed insufficient to express a preference. Option 4C is assessed as being Weaker than Option 5 as there are a much higher number of lifts associated with Option 4C. **Overall, Option 4A, Option 4B and Option 5 are equally preferred from a High Consequence Events perspective.**				
1. Safety	1.4 Legacy Risk	No legacy risk from this full removal option although the under crossings will remain.	The lines would remain in-situ with this option although the majority of their length would be trenched and buried with rock placement over areas of exposures \ shallow burial. The survey & monitoring programme is committed to ensuring that the potential snag hazard from left in-situ infrastructure continues to be managed & mitigated as appropriate. Vessel Type: PoB / Days / Hours / PLL Survey Vessel (Legacy): 44 / 76.9 / 40,608 / 3.05E-03	The lines would remain in-situ with this option although would be fully trenched and buried. The survey & monitoring programme is committed to ensuring that the potential snag hazard from left in-situ infrastructure continues to be managed & mitigated as appropriate. Vessel Type: PoB / Days / Hours / PLL Survey Vessel (Legacy): 44 / 76.9 / 40,608 / 3.05E-03	The lines would remain in-situ with this option although would be fully trenched and buried as areas of exposures / shallow burial are removed. The survey & monitoring programme is committed to ensuring that the potential snag hazard from left in-situ infrastructure continues to be managed & mitigated as appropriate. Vessel Type: PoB / Days / Hours / PLL Survey Vessel (Legacy): 44 / 76.9 / 40,608 / 3.05E-03	The lines would remain in-situ with this option although the majority of their length would be trenched and buried. The line ends will be removed with small areas of rock cover to mitigate potential snag hazard from cut ends. Spans and exposures will remain. The survey & monitoring programme is committed to ensuring that the potential snag hazard from left in-situ infrastructure continues to be managed & mitigated as appropriate. Vessel Type: PoB / Days / Hours / PLL Survey Vessel (Legacy): 44 / 76.9 / 40,608 / 3.05E-03
		S S S MS	W W S	N S	S	
	Summary	The assessment of the Legacy Risk sub-criterion is as follows: Option 2A is assessed as being Stronger than Option 4A, Option 4B and Option 4C as the lines are fully removed and as such there is no legacy risk versus the lines remaining largely trenched and buried with problem areas addressed by rock cover / trenching / removal in the other options, where the potential for snag hazard remains although this is mitigated by the survey and monitoring programme. Option 2A is assessed as being Much Stronger than Option 5 as there is no legacy risk as the lines are removed versus the lines remaining, largely trenched and buried albeit with areas of spans remaining in Option 5. Option 4A is assessed as being Weaker than Option 4B and Option 4C as, while the lines remain in all three options, Option 4B and Option 4C present more of a clear seabed due to the problem areas being trenched or removed versus being rock covered in Option 4A. Option 4A is assessed as being Stronger than Option 5 as while the lines remain in both options, problem areas are rock covered in Option 4A whereas the problem areas would remain in Option 5. Option 4B is assessed as being Neutral to Option 4C as both options present a clear seabed. Option 4B is assessed as being Stronger than Option 5 as while the lines remain in both options, problem areas are trenched in Option 4A whereas the problem areas would remain in Option 5. Option 4C is assessed as being Stronger than Option 5 as while the lines remain in both options, problem areas are removed in Option 4A whereas the problem areas would remain in Option 5. **Overall, Option 2A is preferred from a Legacy Risk perspective.**				
2. Environmental	2.1 Operational Marine Impact	Vessel Noise (days on-site): 1063 days Tooling Noise (MFE) = 169 days Tooling Noise (Hydraulic Shears) = 426 days Operation releases: Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush and releases to the marine environment during flushing activities. Cutting of line into sections would lead to an elevated release of fluids from within the line. However, given the prior cleaning of the line, the concentration and quantity of release should still be low overall. Therefore, the related impact is also anticipated to be low. Vessel releases: This includes Ballast, Grey and Black Water and the potential for accidental discharges. It is driven by duration of vessel operations and therefore at over 1000 days is the most significant of the options.	Vessel Noise (days on-site): 82.5 days Tooling Noise (Hydraulic Shears) = 19.2 days Operation releases: Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush and releases to the marine environment during flushing activities. Cutting of line ends would lead to an elevated release of fluids from within the line. However, given the prior cleaning of the line, the concentration and quantity of release should still be low overall. Therefore, the related impact is also anticipated to be low. Vessel releases: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore at 82.5 days is the lowest of the options.	Vessel Noise (days on-site): 103.8 days Tooling Noise (Hydraulic Shears) = 57.6 days Operation releases: Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush and releases to the marine environment during flushing activities. Cutting of line ends would lead to an elevated release of fluids from within the line. However, given the prior cleaning of the line, the concentration and quantity of release should still be low overall. Therefore, the related impact is also anticipated to be low. Vessel releases: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore at 103.8 days is not considered significant. The environmental impact is considered to be negligible.	Vessel Noise (days on-site): 146.3 days Tooling Noise (Hydraulic Shears) = 70.3 days Operation releases: Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush and releases to the marine environment during flushing activities. Cutting of line ends and midline cuts would lead to an elevated release of fluids from within the line. However, given the prior cleaning of the line, the concentration and quantity of release should still be low overall. Therefore, the related impact is also anticipated to be low. Vessel releases: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore at 146.3 days is the highest of the options. The environmental impact is considered to be negligible.	Vessel Noise (days on-site): 39.8 days Tooling Noise (Hydraulic Shears) = 18.3 days Operation releases: Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush and releases to the marine environment during flushing activities. Cutting of line ends would lead to an elevated release of fluids from within the line. However, given the prior cleaning of the line, the concentration and quantity of release should still be low overall. Therefore, the related impact is also anticipated to be low. Vessel releases: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore at 39.8 days is lowest of the options. The environmental impact is considered to be negligible.
		W W W MW	N N W	N W	W	
	Summary	The assessment of the Operational Marine Impact sub-criterion is as follows: Option 2A is assessed as being Weaker than Option 4A, Option 4B and Option 4C due to the higher vessel and tooling noise, increased potential for releases from the pipeline cutting operations and increased vessel releases associated with the greater scope for Option 2A. Option 2A is assessed as being Much Weaker than Option 5 as there are less vessel days associated with Option 5. Option 4A is assessed as being Neutral to Option 4B and Option 4C as the impacts from vessel noise and potential releases are similar for all options. Option 4A is assessed as being Weaker than Option 5 as there are less vessel days associated with Option 5. Option 4B is assessed as being Neutral to Option 4C as the impacts from vessel noise and potential releases are similar for both options. Option 4B is assessed as being Weaker than Option 5 as there are less vessel days associated with Option 5. Option 4C is assessed as being Weaker than Option 5 as there are less vessel days associated with Option 5. **Overall, Option 5 is preferred from an Operational Marine Impact perspective.**				

		O2A - Full Removal - Cut and Lift				O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial			O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial		O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk
2. Environmental	2.2 Atmospheric Emissions & Fuel Consumption	Vessel Emissions (in tonnes): Fuel: 34,728 CO2: 110,089 NOx: 2,062.87 SO2: 138.91 Vessel Energy Use: 1,493,321 GJ				Vessel Emissions (in tonnes): Fuel: 4,910 CO2: 15,565 NOx: 291.66 SO2: 19.64 Vessel Energy Use: 211,133 GJ			Vessel Emissions (in tonnes): Fuel: 4,907 CO2: 15,554 NOx: 291.46 SO2: 19.63 Vessel Energy Use: 210,986 GJ		Vessel Emissions (in tonnes): Fuel: 6,756 CO2: 21,415 NOx: 401.28 SO2: 27.02 Vessel Energy Use: 290,488 GJ	Vessel Emissions (in tonnes): Fuel: 3,690 CO2: 11,697 NOx: 219.18 SO2: 14.76 Vessel Energy Use: 158,664 GJ
		MW	MW	MW	MW	N	N	N	N	N	W	
	Summary	The assessment of the Atmospheric Emissions & Consumptions sub-criterion is as follows: Option 2A is assessed as being Much Weaker than all other options as the emissions and fuel use for Option 2A is significantly higher than all other options. Option 4A is assessed as being Neutral to Option 4A, Option 4B and Option 5 as, while there are differences in the emissions and fuel use across these options, the differences are considered insufficient to express a preference. Option 4B is assessed as being Neutral to Option 4C and Option 5 as, while there are differences in the emissions and fuel use across these options, the differences are considered insufficient to express a preference. Option 4C is assessed as being Weaker than Option 5 as the fuel use and emissions are almost double for Option 4C. **Overall, Option 5 is preferred from an Atmospheric Emissions & Consumptions perspective.**										
2. Environmental	2.3 Other Consumptions	Material Emissions (CO2 in tonnes): Recovered Material: 3,554 Remaining Material: Total: 3,554 Rock: 3,600 tonnes				Material Emissions (CO2 in tonnes): Recovered Material: 68 Remaining Material: 10,966 Total: 11,034 Rock: 165,697 tonnes			Material Emissions (CO2 in tonnes): Recovered Material: 68 Remaining Material: 10,966 Total: 11,034 Rock: N/A tonnes		Material Emissions (CO2 in tonnes): Recovered Material: 344 Remaining Material: 10,097 Total: 10,441 Rock: 44,250 tonnes	Material Emissions (CO2 in tonnes): Recovered Material: 68 Remaining Material: 10,966 Total: 11,034 Rock: 640 tonnes
		MS	N	S	N	MW	W	MW	S	N	W	
	Summary	The assessment of the Other Consumptions sub-criterion is as follows: Option 2A is assessed as being Much Stronger than Option 4A due to the large quantity of rock resource required in Option 4A. Option 2A is assessed as being Neutral to Option 4B and Option 5 as there is no / minimal rock resource required in these options. Option 2A is assessed as being Stronger than Option 4C due to the notable quantity of rock resource required in Option 4A. Option 4A is assessed as being Much Weaker than Option 4B and Option 5 due to the much larger quantity of rock resource required in Option 4A. Option 4A is assessed as being Weaker than Option 4C due to the larger quantity of rock resource used in Option 4A. Option 4B is assessed as being Stronger than Option 4C as there is no rock resource required in this option versus a notable quantity required in Option 4C. Option 4B is assessed as being Neutral to Option 5 as there is no / minimal rock resource required in these options. Option 4C is assessed as being Weaker than Option 5 due to the higher quantity of rock resource required in Option 4C. **Overall, Option 2A, Option 4B and Option 5 are equally preferred from an Other Consumptions perspective.**										
2. Environmental	2.4 Seabed Disturbance	Seabed Disturbance (m2): MFE: 1,022,160 Habitat Loss / Change (m2): Rock Cover: 12,500				Seabed Disturbance (m2): Rock Cover: 168,697 Habitat Loss / Change (m2): Rock Cover: 165,697			Seabed Disturbance (m2): Trenching: 184,697 No rock cover in this option.		Seabed Disturbance (m2): Rock Cover: 177,000 Habitat Loss / Change (m2): Rock Cover: 177,000	Seabed Disturbance (m2): Rock Cover: 1,000 Habitat Loss / Change (m2): Rock Bags: 1,000
		S	MW	S	MW	MW	N	MW	MS	W	MW	
	Summary	The assessment of the Seabed Disturbance sub-criterion is as follows: Option 2A is assessed as being Stronger than Option 4A as, while there is significant area of seabed disturbance from the deburial operations in Option 2A, this impact is temporary in nature whereas the area impacted in Option 4A is significant and represents a permanent habitat change. Option 2A is assessed as being Much Weaker than Option 4B as there is a larger area of temporary seabed impact in Option 2A and an area of permanent habit change from the rock cover. Option 2A is assessed as being Stronger than Option 4C as, while there is significant area of seabed disturbance from the deburial operations in Option 2A, this impact is temporary in nature whereas the area impacted in Option 4C is significant and represents a permanent habitat change. Option 2A is assessed as being Much Weaker than Option 5 as the large area of temporary seabed impact and area of rock cover in Option 2A is considered to have a greater impact than the small area of rock cover in Option 5. Option 4A is assessed as being Much Weaker than Option 4B and Option 5 due to the large area of permanent habitat change introduced in this option. Option 4A is assessed as being Neutral to Option 4C as the area of permanent habitat change is similar in both options. Option 4B is assessed as being Much Stronger than Option 4C as, while there is significant area of seabed disturbance from the deburial operations in Option 4B, this impact is temporary in nature whereas the area impacted in Option 4C is significant and represents a permanent habitat change. Option 4B is assessed as being Weaker than Option 5 as the large area of temporary seabed impact in Option 4B is considered to have a greater impact than the small area of rock cover despite this being a permanent habitat change. Option 4C is assessed as being Much Weaker than Option 5 due to the large area of permanent habitat change introduced in this option. **Overall, Option 5 is preferred from a Seabed Disturbance perspective.**										

		O2A - Full Removal - Cut and Lift	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk
2. Environmental	2.5 Legacy Marine Impacts	No legacy marine impact from this full removal option.	Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush. The legacy marine impact from the slow release of these low concentration / quantity releases is therefore expected to be low overall.	Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush. The legacy marine impact from the slow release of these low concentration / quantity releases is therefore expected to be low overall.	Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush. The legacy marine impact from the slow release of these low concentration / quantity releases is therefore expected to be low overall.	Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush. The legacy marine impact from the slow release of these low concentration / quantity releases is therefore expected to be low overall.
		S S S MS	N N S	N S	S	
	Summary	The assessment of the Legacy Marine Impacts sub-criterion is as follows: Option 2A is assessed as being Stronger than Option 4A, Option 4B and Option 4C as there is no legacy marine impacts associated with the full removal option whereas there will be slow degradation of the lines and releases over a long time period with the other options although this is reduced as the lines will be fully / largely trenched and buried with rock cover trenching / removal of problem areas. As such, the lines left in-situ will be largely isolated from the marine environment. Option 2A is assessed as being Much Stronger than Option 5 as there is no legacy marine impacts associated with the full removal option whereas there will be slow degradation of the lines and releases over a long time period with Option 5 where sections of the lines remain exposed to the marine environment. Option 4A is assessed as being Neutral to both Option 4B and Option 4C as the lines remain in all options and are largely isolated from the marine environment. Option 4A is assessed as being Stronger than Option 5 as the legacy marine impact is expected to be marginally greater for Option 5 where sections of the lines remain exposed to the marine environment. Option 4B is assessed as being Neutral to Option 4C as the lines remain in both options and are largely isolated from the marine environment. Option 4B is assessed as being Stronger than Option 5 as the legacy marine impact is expected to be marginally greater for Option 5 where sections of the lines remain exposed to the marine environment. Option 4C is assessed as being Stronger than Option 5 as the legacy marine impact is expected to be marginally greater for Option 5 where sections of the lines remain exposed to the marine environment. **Overall, Option 2A is preferred from a Legacy Marine Impacts perspective.**				
3. Technical	3.1 Technical Risk	Concept Maturity: Cut and lift techniques are well proven with multiple options available on the market. (Score 3) Technical Risks: Technical risks with this option are associated with the scale of the operation. (Score 2)	Concept Maturity: Cut and lift and rock placement are well proven techniques. (Score 3) Technical Risks: Limited technical risks associated with option (Score 3)	Concept Maturity: Group is trenched and buired therefore trenching is assumed to be feasible. (Score 3) Technical Risks: Minimal technical risk assumed, however, an appropriate geotechnical study should be performed to properly assess feasibility. (Score 3)	Concept Maturity: Cut and lift has a good track record (Score 3) Technical Risks: Technical risk with this option is related to scale, i.e managing logistics. (Score 1)	Concept Maturity: Minimal operations, well proven techniques. (Score 3) Technical Risks: Limited technical risks associated with option (Score 3)
		W W W MW	S S N	N W	W	
	Summary	The assessment of the Technical Risk sub-criterion is as follows: Option 2A is assessed as being weaker than Option 4A, Option 4B and Option 4C as, will they all employ routine operations, there is greater potential for technical risk from the scale of the removal of the 216 km of lines. Option 2A is assessed as Much Weaker than Option 5 as the scope of operations in Option 5 is smaller than the other options. Option 4A is assessed as being Stronger than Option 4B and Option 4C as there are challenges associated with the trenching opertaions in Option 4B and the scale of the removal opetions in Option 4C. Option 4A is assessed as being Neutral to Option 5 due to the routine nature and similar sclae of operations with these options. Option 4B is assessed as being Neutral to Option 4C as the technical challenges associated with the trenching operations in Option 4B and the scale of the removal operations in Option 4C are considered similar. Option 4B is assessed as being Weaker than Option 5 as the challenges associated with the trenching operations in Option 4B are considered greater than the small scale of routine operations in Option 5. Option 4C is assessed as being Weaker than Option 5 due to the potetial challenges associated with the scale of the removal operations in Option 4C versus the smaller scale of opertaions in Option 5. **Overall, Option 5 is preferred from a Technical Risk perspective.**				
4. Societal	4.1 Fishing	Significant short term disturbance, however, infrastructure is removed, positive for fishing in the long term. (Score 2)	Medium operation, some short term disturbance during operation. Rock berms are not preferred option from the fishing industry's perspective. (Score 1)	Relatively short term operation, localised areas of disturbance. If successful, the areas would be clear for fishing operations to be conducted. (Score 3)	Significant operation, spread over a large area. Rock bags intended to be installed flush with seabed to avoid impact on fishing operations. However, use of rock bags needs to be considerd whether fall pipe vessel would be more efficient but potentially more impactful to fishing operations. (Score 2)	Short operation, small area of localised disturbance. Rock used to remediate cut ends should be profiled with seabed to avoid impacts for the fishing industry. (Score 2)
		S S S MS	W W S	N S	S	
	Summary	The assessment of the Societal impact on Fishing sub-criterion is as follows: Option 2A is assessed as being Stronger than Option 4A, Option 4B and Option 4C as the full removal of the lines in Option 2A is preferred to lines remaining trenched and buried with problem areas addressed by rock cover / trenching or removal respectively. Option 2A is assessed as being Much Stronger than Option 5 as the lines are removed versus lines remaining largely trenched and buried with problem areas remaining. Option 4A is assessed as being Weaker than Option 4B and Option 4C as, while the lines remain in all three options, Option 4B and Option 4C present more of a clear seabed due to the problem areas being trenched or removed versus being rock covered in Option 4A. Option 4A is assessed as being Stronger than Option 5 as while the lines remain in both options, problem areas are rock covered in Option 4A whereas the problem areas would remain in Option 5. Option 4B is assessed as being Neutral to Option 4C as both options present a clear seabed. Option 4B is assessed as being Stronger than Option 5 as while the lines remain in both options, problem areas are trenched in Option 4A whereas the problem areas would remain in Option 5. Option 4C is assessed as being Stronger than Option 5 as while the lines remain in both options, problem areas are removed in Option 4A whereas the problem areas would remain in Option 5. **Overall, Option 2A is preferred from a Societal impact on Fishing perspective.**				
4. Societal	4.2 Other Users	Significant quantity of recyclable material returned, however, also large amount of polymer that may require to go to limited land fill site(s). (Score 2) Materials Returned: Steel: 3,065 tonnes (recyclable) Copper: 1 tonnes (recyclable) Polymer: 2,276 tonnes (landfill)	Minimal societal benefits / impacts with this option. (Score 3) Materials Returned: Steel: 60 tonnes (recyclable) Copper: 14 tonnes (recyclable) Polymer: 45 tonnes (landfill)	Minimal societal benefits / impacts with this option. (Score 3) Materials Returned: Steel: 60 tonnes (recyclable) Copper: 14 tonnes (recyclable) Polymer: 45 tonnes (landfill)	Minimal societal benefits / impacts with this option. (Score 3) Materials Returned: Steel: 307 tonnes (recyclable) Copper: 70 tonnes (recyclable) Polymer: 228 tonnes (landfill)	Minimal societal benefits / impacts with this option. (Score 3) Materials Returned: Steel: 60 tonnes (recyclable) Copper: 14 tonnes (recyclable) Polymer: 45 tonnes (landfill)
		S S S S	N N N	N N	N	
	Summary	The assessment of the Societal impact on Other Users sub-criterion is as follows: Option 2A is assessed as being Stronger than all other options due to the significant quantity of useful, recyclable material returned (steel and copper) and the job creation / retention associated with the large offshore and onshore scope in Option 2A. This is offset somewhat by the significant quantity of material (polymer) that is likely to end up in landfill. Overall, Option 2A is deemed to present a small societal benefit over the other options. All other options are assessed as being Neutral to each other as the positive and negative societal impacts are considered largely similar for those options. **Overall, Option 2A is preferred from a Societal impact on Other Users perspective.**				

		O2A - Full Removal - Cut and Lift				O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial			O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial		O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk
5. Economic	5.1 Short-term Costs	£140.619 Million				£15.513 Million			£21.877 Million		£18.917 Million	£8.023 Million
		MW	MW	MW	MW	S	N	W	N	MW	W	
		125.097 million more	118.733 million more	121.693 million more	132.587 million more	6.364 million less	3.404 million less	7.49 million more	2.96 million more	13.854 million more	10.894 million more	
		806.4% higher	542.7% higher	643.3% higher	1652.6% higher	29.1% lower	18.0% lower	93.4% higher	15.6% higher	172.7% higher	135.8% higher	
	Summary	The assessment of the Short-term Costs sub-criterion is as follows: Option 2A is assessed as being Much Weaker than all other options due to the costs being around 7 times higher than the closest option. Option 4A is assessed as being Stronger than Option 4B due to the costs being around 40% higher (£6.4 million more) for Option 4B. Option 4A is assessed as being Neutral to Option 4C as, while there is a difference in cost, this is considered insufficient to express a preference. Option 4A is assessed as being Weaker than Option 5 due to the costs being almost double (£7.5 million more) than Option 5. Option 4B is assessed as being Neutral to Option 4C as, while there is a difference in cost, this is considered insufficient to express a preference. Option 4B is assessed as being Much Weaker than Option 5 due to the costs being almost 3 times higher (£13.9 million more) than Option 5. Option 4C is assessed as being Weaker than Option 5 due to the costs being more than double (£10.9 million more) than Option 5. **Overall, Option 5 is preferred from a Short-term Cost perspective.**										
5. Economic	5.2 Long-term Costs	Surveys: N/A FLTC: N/A Total Legacy Cost: £0 Million				Surveys: £2.31 Million FLTC: N/A Total Legacy Cost: £2.31 Million			Surveys: £2.31 Million FLTC: N/A Total Legacy Cost: £2.31 Million		Surveys: £2.31 Million FLTC: N/A Total Legacy Cost: £2.31 Million	Surveys: £2.31 Million FLTC: £0.635 Million Total Legacy Cost: £2.94 Million
		S	S	S	S	N	N	N	N	N	N	
	Summary	The assessment of the Long-term Costs sub-criterion is as follows: Option 2A is assessed as being Stronger than all other options due to there being no legacy costs associated with Option 2A versus the costs associated with the surveying and monitoring of the infrastructure left in-situ in the other options. All other options are assessed as being Neutral to each other as the long-term costs are largely similar for these options. **Overall, Option 2A is preferred from a Long-term Cost perspective.**										

E.2 Group 3 Pairwise Comparison Matrices – Safety

1.1 Operations Personnel	O2A - Full Removal - Cut and Lift	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	VMW	MW	MW	VMW	4.5%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	VMS	N	N	S	N	28.1%
O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	MS	N	N	N	W	19.2%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	MS	W	N	N	W	17.7%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	VMS	N	S	S	N	30.5%

1.2 Other Users	O2A - Full Removal - Cut and Lift	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	MW	MW	MW	MW	7.6%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	MS	N	N	N	W	21.1%
O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	MS	N	N	N	W	21.1%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	MS	N	N	N	W	21.1%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	MS	S	S	S	N	29.2%

1.3 High Consequence Events	O2A - Full Removal - Cut and Lift	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	MW	MW	W	MW	8.9%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	MS	N	N	S	N	25.1%
O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	MS	N	N	S	N	25.1%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	S	W	W	N	W	15.8%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	MS	N	N	S	N	25.1%

1.4 Legacy Risk	O2A - Full Removal - Cut and Lift	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	S	S	S	MS	30.3%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	W	N	W	W	S	16.2%
O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	W	S	N	N	S	20.7%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	W	S	N	N	S	20.7%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	MW	W	W	W	N	12.0%

E.3 Group 3 Pairwise Comparison Matrices – Environment

2.1 Operational Marine Impact	O2A - Full Removal - Cut and Lift	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	W	W	W	MW	12.1%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	S	N	N	N	W	19.2%
O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	S	N	N	N	W	19.2%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	S	N	N	N	W	19.2%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	MS	S	S	S	N	30.4%

2.2 Atmospheric Emissions & Fuel Consumption	O2A - Full Removal - Cut and Lift	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	MW	MW	MW	MW	7.7%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	MS	N	N	N	N	23.0%
O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	MS	N	N	N	N	23.0%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	MS	N	N	N	W	21.2%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	MS	N	N	S	N	25.0%

2.3 Other Consumptions	O2A - Full Removal - Cut and Lift	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	MS	N	S	N	25.1%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	MW	N	MW	W	MW	8.9%
O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	N	MS	N	S	N	25.1%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	W	S	W	N	W	15.8%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	N	MS	N	S	N	25.1%

2.4 Seabed Disturbance	O2A - Full Removal - Cut and Lift	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	S	MW	S	MW	13.0%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	W	N	MW	N	MW	10.2%
O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	MS	MS	N	MS	W	30.6%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	W	N	MW	N	MW	10.2%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	MS	MS	S	MS	N	36.0%

2.5 Legacy Marine Impacts	O2A - Full Removal - Cut and Lift	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	S	S	S	MS	30.4%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	W	N	N	N	S	19.2%
O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	W	N	N	N	S	19.2%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	W	N	N	N	S	19.2%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	MW	W	W	W	N	12.1%

E.4 Group 3 Pairwise Comparison Matrices – Technical

3.1 Technical Risk	O2A - Full Removal - Cut and Lift	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	W	W	W	MW	12.1%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	S	N	S	S	N	24.5%
O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	S	W	N	N	W	17.7%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	S	W	N	N	W	17.7%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	MS	N	S	S	N	28.1%

E.5 Group 3 Pairwise Comparison Matrices – Societal

4.1 Fishing	O2A - Full Removal - Cut and Lift	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	S	S	S	MS	30.3%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	W	N	W	W	S	16.2%
O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	W	S	N	N	S	20.7%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	W	S	N	N	S	20.7%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	MW	W	W	W	N	12.0%

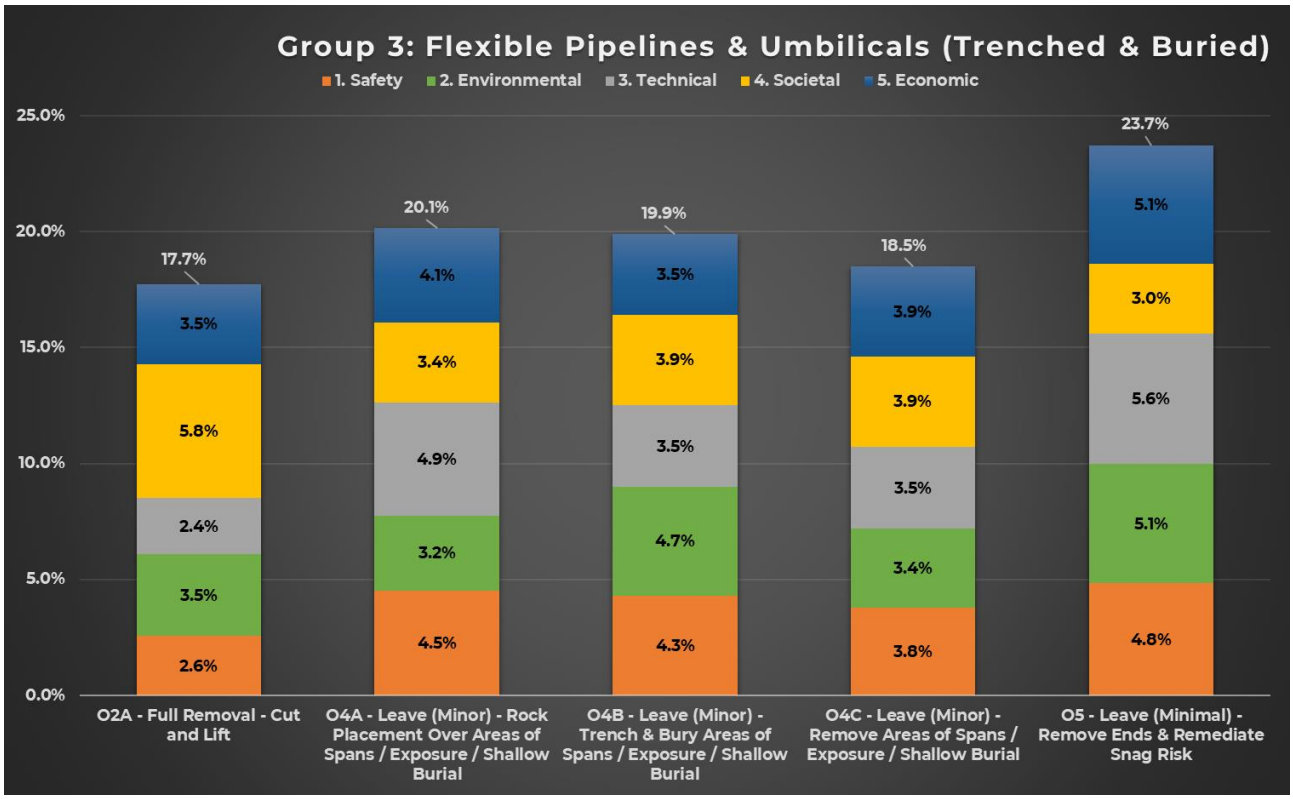
4.2 Other Users	O2A - Full Removal - Cut and Lift	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	S	S	S	S	27.3%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	W	N	N	N	N	18.2%
O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	W	N	N	N	N	18.2%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	W	N	N	N	N	18.2%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	W	N	N	N	N	18.2%

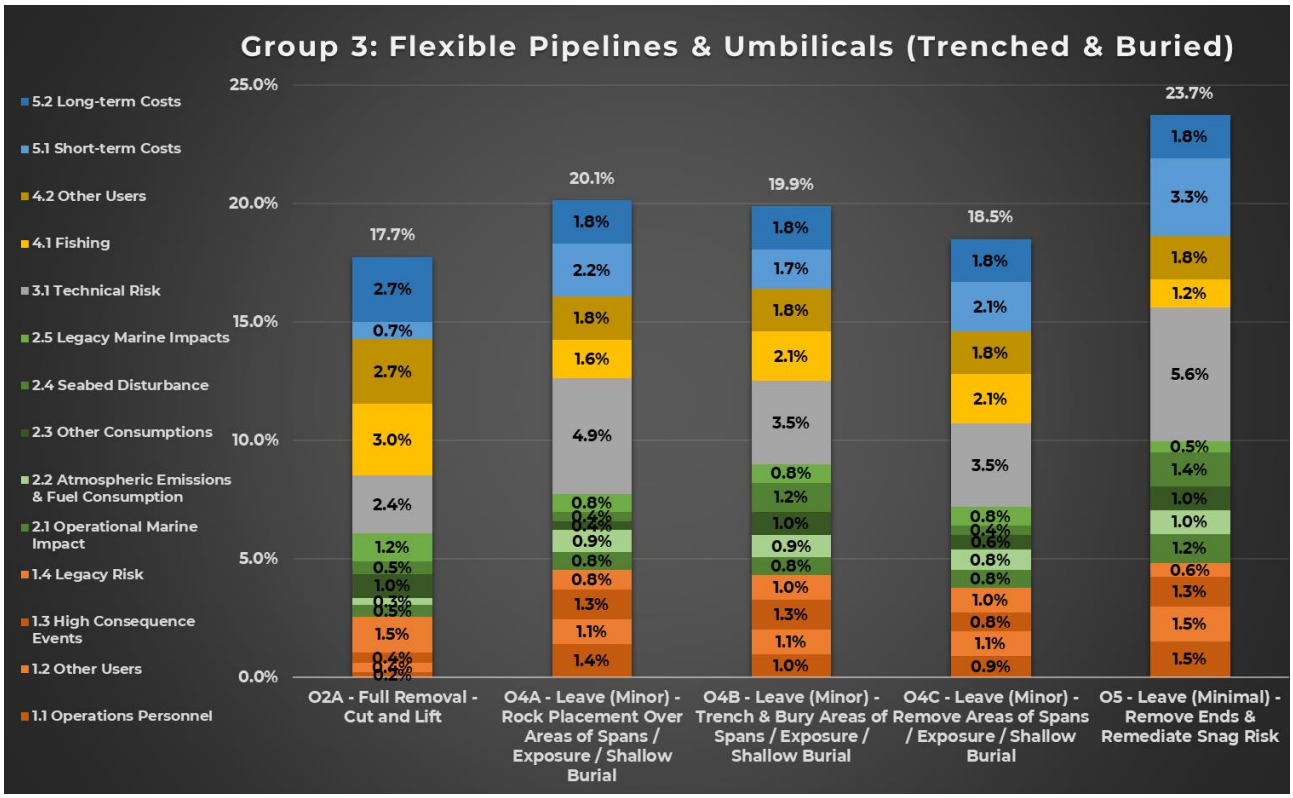
E.6 Group 3 Pairwise Comparison Matrices – Economic

5.1 Short-term Costs	O2A - Full Removal - Cut and Lift	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	MW	MW	MW	MW	7.5%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	MS	N	S	N	W	22.4%
O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	MS	W	N	N	MW	16.6%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	MS	N	N	N	W	20.7%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	MS	S	MS	S	N	32.8%

5.2 Long-term Costs	O2A - Full Removal - Cut and Lift	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	S	S	S	S	27.3%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	W	N	N	N	N	18.2%
O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	W	N	N	N	N	18.2%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	W	N	N	N	N	18.2%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	W	N	N	N	N	18.2%

E.7 Group 3 Results Charts





APPENDIX F GROUP 4 – DETAILED EVALUATION RESULTS

Given the similarity between the equipment in Group 3, where the flexible flowlines and umbilicals are trenched and buried and Group 4 where the flexible flowlines are trenched and rock covered, the outcome of the evaluation for Group 4 is in line with the outcome obtained during the evaluation of Group 3 as described in Section 6.4. On this basis, the preferred decommissioning option for Group 4 is Option 5, Remove Ends and Remediate Snag Risk.

APPENDIX G GROUP 6 – DETAILED EVALUATION RESULTS

G.1 Group 6 Attributes Table

Group 6: Rigid Pipelines (Surface Laid, Exposed and Non-concrete Coated)

PL1317 (N1002) - 16" Water Injection Pipeline from Tern to Eider (Water Injection Tee) - 16.104 km

	O2B - Full Removal - Reverse Installlation Without Deburial	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial
	- Pipeline is disconnected - Diver initiation preparation - Section between Falcon/Kestrel crossing is removed by cut and lift - Reverse reel remaining pipeline	- Pipeline is disconnected - Entire line is trenched and backfilled to 0.6m DoC - Remedial rock cover installed over trench transitions	- Pipeline is disconnected - Rock placement over free spans	- Pipeline is disconnected - Remove pipeline at free span locations by cut and lift
1. Safety **1.1 Operations Personnel**	Vessel Type: PoB / Days / Hours / PLL DSV: 110 / 7.9 / 10,362 / 7.77E-04 Divers: 18 / 7.9 / 3,391 / 3.29E-03 Reel Vessel: 76 / 12.3 / 11,208 / 8.41E-04 Total offshore hours: 24,962 hrs Total offshore PLL: 4.91E-03 Resource Type: Days / Hours / PLL Engineering & Management: 433.8 / 3,471 / 1.39E-05 Project Management: 507.0 / 4,056 / 1.62E-05 Onshore Operations (includes Cleaning & Disposal): 124.0 / 7,936 / 9.76E-04 Total onshore hours: 15,463 hrs Total onshore PLL: 1.01E-03 Total operational hours: 40,424 hrs Total operational PLL: 5.91E-03	Vessel Type: PoB / Days / Hours / PLL Rockdump Vessel: 20 / 4.3 / 1,025 / 7.69E-05 Trenching Vessel: 55 / 12.4 / 8,171 / 6.13E-04 Total offshore hours: 9,196 hrs Total offshore PLL: 6.90E-04 Resource Type: Days / Hours / PLL Engineering & Management: 333.8 / 2,671 / 1.07E-05 Project Management: 319.0 / 2,552 / 1.02E-05 Total onshore hours: 5,223 hrs Total onshore PLL: 2.09E-05 Total operational hours: 14,418 hrs Total operational PLL: 7.11E-04	Vessel Type: PoB / Days / Hours / PLL Rockdump Vessel: 20 / 6.5 / 1,558 / 1.17E-04 Total offshore hours: 1,558 hrs Total offshore PLL: 1.17E-04 Resource Type: Days / Hours / PLL Engineering & Management: 75.0 / 600 / 2.40E-06 Project Management: 80.0 / 640 / 2.56E-06 Total onshore hours: 1,240 hrs Total onshore PLL: 4.96E-06 Total operational hours: 2,798 hrs Total operational PLL: 1.22E-04	Vessel Type: PoB / Days / Hours / PLL CSV: 76 / 18.5 / 16,899 / 1.27E-03 Total offshore hours: 16,899 hrs Total offshore PLL: 1.27E-03 Resource Type: Days / Hours / PLL Engineering & Management: 236.8 / 1,894 / 7.58E-06 Project Management: 236.0 / 1,888 / 7.55E-06 Onshore Operations (includes Cleaning & Disposal): 9.0 / 576 / 7.08E-05 Total onshore hours: 4,358 hrs Total onshore PLL: 8.60E-05 Total operational hours: 21,257 hrs Total operational PLL: 1.35E-03
	W 8.31224	VMW 48.4426	W 4.37778	W 5.82786885	S 0.52666667	MS 0.09037037
Summary	The assessment of the Operations Personnel sub-criterion is as follows: Option 2B is assessed as being Weaker than Option 3B due to the risk exposure being around 8 times higher in Option 2B. This is due to the greater offshore scope (with diver support) associated with the full removal of the line versus the smaller scope and lower risk activities to trench the entire line in Option 3B. Option 2B is assessed as being Very Much Weaker than Option 4A due to the risk exposure being around 48 times higher in Option 2B. This is due to the greater offshore scope (with diver support) associated with the full removal of the line versus the smaller scope and lower risk activities to perform rock placement over problem areas of the line in Option 4A. Option 2B is assessed as being Weaker than Option 4C due to the risk exposure being around 4 times higher in Option 2B. This is due to the greater offshore scope (with diver support) associated with the full removal of the line versus the smaller scope and lower risk activities to remove problem areas of the line in Option 4A. Option 3B is assessed as being Weaker than Option 4A due to the risk exposure being around 6 times higher in Option 3B. This is due to the greater scope associated with trenching the entire line in Option 3B versus the smaller scope to provide rock placement over problem areas of the line in Option 4A. Option 3B is assessed as being Stronger than Option 4C due to the risk exposure being around double in Option 4C. This is due to the smaller scope associated with trenching the entire line in Option 3B versus the greater scope to remove problem areas of the line in Option 4C. Option 4A is assessed as being Much Stronger than Option 4C due to the risk exposure being around 11 times higher in Option 4C. This is due to the smaller scope associated with rock placement over problem areas of the line in Option 4A versus the greater scope to remove problem areas of the line in Option 4C. **Overall, Option 4A is preferred from a risk to Operations Personnel perspective.**			

		O2B - Full Removal - Reverse Installlation Without Deburial	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial
1. Safety	1.2 Other Users	Vessel Days: DSV: 7.9 Reel Vessel: 12.3 Total vessel days: 20.1 days Transits: 4	Vessel Days: Rockdump Vessel: 4.3 Trenching Vessel: 12.4 Total vessel days: 16.7 days Transits: 4	Vessel Days: Rockdump Vessel: 6.5 Total vessel days: 6.5 days Transits: 2	Vessel Days: CSV: 18.5 Total vessel days: 18.5 days Transits: 2
		N N N	N N	N	
	Summary	The assessment of the Other Users sub-criterion is as follows: All options are assessed as being Neutral to each other as, while there are small differences in the number of vessel days and transits, the impact on the safety of other users is expected to be similar (and low) across all options. **Overall, all options are equally preferred from a risk to Other Users perspective.**			
1. Safety	1.3 High Consequence Events	Routine, low risk reeling operations. There are 2 lifts of the line ends through the water column to initiate reeling. There are an additional 4 lifts associated recovering the cut sections around the crossing and placing rock bags. In addition there is the potential for dropped object associated with the offloading of the reels and cut line sections to the quayside. Small number of lifting operations to deploy and recover cutting equipment.	Routine, low risk trenching operations. Small number of lifting operations (8) through the water column to deploy and recover trenching equipment.	Routine, low risk rock placement operations with no lifting operations.	High number of lifting operations (240) through the water column to recover line ends and to place rock bags. Additional lifting to transfer pipeline sections to quayside. Small number of lifting operations to deploy and recover cutting equipment.
		MW MW N	N S	S	
	Summary	The assessment of the High Consequence Events sub-criterion is as follows: Option 2B is assessed as being Much Weaker than Option 3B and Option 4A due to the potential for high consequence events during the offloading / unspooling of rigid line at the quayside. Option 2B is assessed as being Neutral to Option 4C as the potential for high consequence events is considered similar from the offloading operations in Option 2B and the numerous offshore lifting operations in Option 4C. Option 3B is assessed as being Neutral to Option 4A as there is limited potential for high consequence events as there is limited / no offshore lifting in these options. Option 3B is assessed as being Stronger than Option 4C due the potential for dropped object associated with the numerous offshore lifting operations in Option 4C. Option 4A is assessed as being Stronger than Option 4C due the potential for dropped object associated with the numerous offshore lifting operations in Option 4C. **Overall, Option 3B and Option 4A are equally preferred from a High Consequence Events perspective.**			
1. Safety	1.4 Legacy Risk	No legacy risk from this full removal option.	The line would remain in-situ with this option although it would be fully trenched and buried under this option. The survey & monitoring programme is committed to ensuring that the potential snag hazard from left in-situ infrastructure continues to be managed & mitigated as appropriate. Vessel Type: PoB / Days / Hours / PLL Survey Vessel (Legacy): 44 / 28.0 / 14,763 / 1.11E-03	The line would remain in-situ with this option with the majority of its length remaining surface laid. Areas of spans will have rock placement to mitigate potential snag hazard. The survey & monitoring programme is committed to ensuring that the potential snag hazard from left in-situ infrastructure continues to be managed & mitigated as appropriate. Vessel Type: PoB / Days / Hours / PLL Survey Vessel (Legacy): 44 / 28.0 / 14,763 / 1.11E-03	The line would remain in-situ with this option with the majority of its length remaining surface laid. Areas of spans will be removed with rock cover to mitigate potential snag hazard from cut ends. The survey & monitoring programme is committed to ensuring that the potential snag hazard from left in-situ infrastructure continues to be managed & mitigated as appropriate. Vessel Type: PoB / Days / Hours / PLL Survey Vessel (Legacy): 44 / 28.0 / 14,763 / 1.11E-03
		S MS MS	MS MS	N	
	Summary	The assessment of the Legacy Risk sub-criterion is as follows: Option 2B is assessed as being Stronger than Option 3B as there is no legacy risk with the full removal option versus the line being trenched and buried which, while presenting a clear seabed, the line does remain. Option 2B is assessed as being Much Stronger than Option 4A and Option 4C as there is no legacy risk with the full removal option versus the line remaining surface laid with problem areas rock covered or removed in the other options leaving a potential snag risk. Option 3B is assessed as being Much Stronger than Option 4A and Option 4C as there is limited legacy risk with the line being fully trenched and buried in Option 3B versus the line remaining surface laid with problem areas rock covered or removed in the other options leaving a potential snag risk. Option 4A is assessed as being Neutral to Option 4C as the line remaining surface laid with problem areas rock covered or removed presents a similar potential snag risk. **Overall, Option 2B is preferred from a Legacy Risk perspective.**			

		O2B - Full Removal - Reverse Installlation Without Deburial	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial
2. Environmental	2.1 Operational Marine Impact	Vessel Noise (days on-site): 6.1 days Tooling Noise (Hydraulic Shears) = 1.2 days Operation releases: Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush and releases to the marine environment during flushing activities. There will be potential for the release of all residual contents in one location at one time during the reverse reeling operations. However, given the prior cleaning of the lines, the concentration and quantity of release should still be low overall. Therefore, the related impact is also anticipated to be low. Vessel releases: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore at 6.1 days is not considered significant. The environmental impact is considered to be negligible.	Vessel Noise (days on-site): 8.6 days Tooling Noise (Trenching) = 6.9 days Operation releases: Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush and releases to the marine environment during flushing activities. As line is being trenched there is negligible release from the line. Vessel releases: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore at 8.6 days is not considered significant. The environmental impact is considered to be negligible.	Vessel Noise (days on-site): 2.5 days Tooling Noise = none Operation releases: Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush and releases to the marine environment during flushing activities. Cutting of line ends and midline cuts would lead to an elevated release of fluids from within the line. However, given the prior cleaning of the line, the concentration and quantity of release should still be low overall. Therefore, the related impact is also anticipated to be low. Vessel releases: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore at 2.5 days is the lowest of the options. The environmental impact is considered to be negligible.	Vessel Noise (days on-site): 14.5 days Tooling Noise (Hydraulic Shears) = 6.0 days Operation releases: Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush and releases to the marine environment during flushing activities. Cutting of line ends would lead to an elevated release of fluids from within the line. However, given the prior cleaning of the line, the concentration and quantity of release should still be low overall. Therefore, the related impact is also anticipated to be low. Vessel releases: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore at 14.5 days is the highest of all options but not considered significant. The environmental impact is considered to be negligible.
		N N N	N N	N	
	Summary	The assessment of the Operational Marine Impact sub-criterion is as follows: All options are assessed as being Neutral to each other as the marine environmental impact from vessel noise, tooling noise and releases is similar across all options. It is noted that the impact from releases from the line are insignificant as this line was used for water injection. **Overall, all options are equally preferred from an Operational Marine Impact perspective.**			
2. Environmental	2.2 Atmospheric Emissions & Fuel Consumption	Vessel Emissions (in tonnes): Fuel: 498 CO2: 1,579 NOx: 29.59 SO2: 1.99 Vessel Energy Use: 21,417 GJ	Vessel Emissions (in tonnes): Fuel: 1,029 CO2: 3,262 NOx: 61.12 SO2: 4.12 Vessel Energy Use: 44,244 GJ	Vessel Emissions (in tonnes): Fuel: 890 CO2: 2,820 NOx: 52.85 SO2: 3.56 Vessel Energy Use: 38,255 GJ	Vessel Emissions (in tonnes): Fuel: 1,291 CO2: 4,091 NOx: 76.66 SO2: 5.16 Vessel Energy Use: 55,494 GJ
		N N N	N N	N	
	Summary	The assessment of the Atmospheric Emissions & Consumptions sub-criterion is as follows: All options are assessed as being Neutral to each other as, while there are differences in the atmospheric emissions generated across the options, these differences are considered insufficient to express a preference from an environmental impact perspective. **Overall, all options are equally preferred from an Atmospheric Emissions & Consumptions perspective.**			

		O2B - Full Removal - Reverse Installlation Without Deburial	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial
2. Environmental	2.3 Other Consumptions	Material Emissions (CO2 in tonnes): Recovered Material: 3,447 Remaining Material: 117 Total: 3,564 Rock: 256 tonnes	Material Emissions (CO2 in tonnes): Recovered Material: Remaining Material: 6,559 Total: 6,559 Rock: 2,000 tonnes	Material Emissions (CO2 in tonnes): Recovered Material: Remaining Material: 6,559 Total: 6,559 Rock: 12,000 tonnes	Material Emissions (CO2 in tonnes): Recovered Material: 250 Remaining Material: 6,092 Total: 6,342 Rock: 384 tonnes
		N N N	N N	N	
	Summary	The assessment of the Other Consumptions sub-criterion is as follows: All options are assessed as being Neutral to each other as the impacts associated with returned / replaced material and rock consumption is similar across all options. **Overall, all options are equally preferred from an Other Consumptions perspective.**			
2. Environmental	2.4 Seabed Disturbance	Seabed Disturbance (m2): Rock Cover: 50 Habitat Loss / Change (m2): Rock Bags: 50	Seabed Disturbance (m2): Rock Cover: 2,000 Trenching: 156,950 Habitat Loss / Change (m2): Rock Cover: 2,000	Seabed Disturbance (m2): Rock Cover: 12,000 Habitat Loss / Change (m2): Rock Cover: 12,000	Seabed Disturbance (m2): Rock Cover: 600 Habitat Loss / Change (m2): Rock Bags: 600
		S MS S	S N	MW	
	Summary	The assessment of the Seabed Disturbance sub-criterion is as follows: Option 2B is assessed as being Stronger than Option 3B as there is limited temporary seabed disturbance from removing this surface laid line versus a significant area of seabed disturbance from the trenching of the line, although this impact is temporary in nature. Option 2B is assessed as being Much Stronger than Option 4A due to the limited disturbance versus a significant area of permanent habitat change from the introduction of rock cover in Option 4A. Option 2B is assessed as being Stronger than Option 4C due to small area of permanent habitat change from the rock cover over the cut locations in Option 4C. Option 3B is assessed as being Stronger than Option 4A as, while there is a large area of impact from the trenching operations in Option 3B this has less impact than the smaller area of permanent habitat change from the rock cover in Option 4A. Option 3B is assessed as being Neutral to Option 4C as the large area of temporary impact from trenching has similar impact as the small area of permanent habitat change in Option 4C. Option 4A is assessed as being Much Weaker than Option 4C due to the larger area of permanent habitat change in Option 4A. **Overall, Option 2B is preferred from a Seabed Disturbance perspective.**			
2. Environmental	2.5 Legacy Marine Impacts	No legacy marine impact from this full removal option.	Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush. The legacy marine impact from the slow release of these low concentration / quantity releases is therefore expected to be low overall.	Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush. The legacy marine impact from the slow release of these low concentration / quantity releases is therefore expected to be low overall.	Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush. The legacy marine impact from the slow release of these low concentration / quantity releases is therefore expected to be low overall.
		S MS MS	S S	N	
	Summary	The assessment of the Legacy Marine Impacts sub-criterion is as follows: Option 2B is assessed as being Stronger than Option 3B as there is no legacy marine impact from the full removal option versus the line remaining in Option 3B although, as the line is fully trenched and buried in Option 3B so is isolated from the marine environment reducing its impact. Option 2B is assessed as being Much Stronger than Option 4A and Option 4C as the line is fully removed versus the line remaining exposed to the marine environment. Option 3B is assessed as being Stronger than Option 4A and Option 4C as the line remains but is isolated from marine environment as it is fully trenched and buried versus the line remaining and exposed to the marine environment. Option 4A is assessed as being Neutral to Option 4C as the line remains and is exposed to the marine environment in both options. Note: it is recognised that the releases from this line over a long time period will negligible given its service as a water line. The line has a polymer liner which will be left in-situ and will introduce degradation products into the marine environment although this will occur slowly over a long time frame. **Overall, Option 2B is preferred from a Legacy Marine Impacts perspective.**			

		O2B - Full Removal - Reverse Installlation Without Deburial	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial
3. Technical	3.1 Technical Risk	Concept Maturity: Reverse reel of rigid pipelines has a limited track record. (Score 2) Technical Risks: Relatively small scale scope, limited technical risks associated with the scale / logistics of this option. (Score 3)	Concept Maturity: Trenching of surface lines has good track record (Score 1) Technical Risks: Geotechncial studies would be required to confirm if it is feasible. (Score 2)	Concept Maturity: Rock placement is a well proven technique. (Score 3) Technical Risks: Limited technical risks associated with option (Score 3)	Concept Maturity: Cut and lift has a good track record (Score 3) Technical Risks: No significant technical risk with this option. (Score 3)
		W / MW / MW	W / W	N	
	Summary	The assessment of the Technical Risk sub-criterion is as follows: Option 2B is assessed as being Weaker than Option 3B as reverse reeling of rigid lines, certainly at this diameter, has a limited track record and near the limit of capability versus trenching of the line which, while still having challenges relating to geotechnical conditions is expected to carry less technical risk (Kestrel line in area has been trenched). Option 2B is assessed as being Much Weaker than Option 4A and Option 4C due to the limited track record versus largely routine operations in the other options. Option 3B is assessed as being Weaker than Option 4A and Option 4C due to the geotechnical challenges in trenching and being at the limit of trenching plough capability the entire line versus largely routine operations in the other options. Option 4A is assessed as being Neutral to Option 4C as both options employ largely routine operations. **Overall, Option 4A and Option 4C are equally preferred from a Technical Risk perspective.**			
4. Societal	4.1 Fishing	Limited short term disturbance, infrastructure is removed, positive for fishing in the long term. (Score 2)	Single line, relatively short term operation, localised area of disturbance. If successful, the area would be clear for fishing operations to be conducted. (Score 3)	Minimal operation, a small amount of short term disturbance during operation. However, rock berms are not preferred option from the fishing industry's perspective. (Score 1)	Rock bags intended to be installed with a suitable gradient to minimise impact on fishing operations. (Score 3)
		S / MS / MS	S / S	N	
	Summary	The assessment of the Societal impact on Fishing sub-criterion is as follows: Option 2B is assessed as being Stronger than Option 3B as the line is removed versus remaining in-situ albeit fully trenched and buried in Option 3B. Option 2B is assessed as being Much Stronger than Option 4A and Option 4C as the line is removed versus the line remaining in-situ (surface laid) with problem areas rock covered or removed in the other options. Option 3B is assessed as being Stronger than Option 4A and Option 4C as the while the line remains in-situ in all options, it is fully trenched and buried thus presenting a clear seabed in Option 3B versus the line remaining surface laid with rock cover over problem areas / problem areas removed in the other options. Option 4A is assessed as being Neutral to Option 4C as the line remains surface laid with either rock cover over problem areas / problem areas removed. **Overall, Option 2B is preferred from a Societal impact on Fishing perspective.**			
4. Societal	4.2 Other Users	Significant quantity of recyclable material returned, however, also large amount of polymer that may require to go to limited land fill site(s). (Score 2) Materials Returned: Steel: 3,410 tonnes (recyclable) Polymer: 295 tonnes (landfill)	Minimal societal benefits / impacts with this option. (Score 3) Materials Returned: None.	Minimal societal benefits / impacts with this option. (Score 3) Materials Returned: None.	Minimal societal benefits / impacts with this option. (Score 3) Materials Returned: Steel: 247 tonnes (recyclable) Polymer: 22 tonnes (landfill)
		N / N / N	N / N	N	
	Summary	The assessment of the Societal impact on Other Users sub-criterion is as follows: All options are assessed as Neutral to each other as the positive and negative societal impacts are considered largely insignificant across all options. It is noted that a greater quantity of useful, recyclable material (steel) is returned in Option 2B, however the societal benefit of this is offset by the larger quantity of polymer returned which is likely to end up in landfill. **Overall, all options are equally preferred from a Societal impact on Other Users perspective.**			

		O2B - Full Removal - Reverse Installlation Without Deburial			O3B - Leave (Major) - Trench & Bury Entire Line		O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial
5. Economic	5.1 Short-term Costs	£5.138 Million			£3.306 Million		£1.019 Million	£2.539 Million
		N	W	N	W	N	N	
		1.832 million more	4.119 million more	2.599 million more	2.287 million more	0.767 million more	1.52 million less	
		55.4% higher	404.2% higher	102.4% higher	224.4% higher	30.2% higher	59.9% lower	
	Summary	The assessment of the Short-term Costs sub-criterion is as follows: Option 2B is assessed as being Neutral to Option 3B as, while the costs to deliver Option 2B are £1.8 million more, this is considered insufficient to express a preference. Option 2B is assessed as being Weaker than Option 4A due to the costs to deliver this option being more than 5 times higher (around £4 million more) than Option 4A. Option 2B is assessed as being Neutral to Option 4C as, while the costs to deliver Option 2B are £2.6 million more, this is considered insufficient to express a preference. Option 3B is assessed as being Weaker than Option 4A due to the costs to deliver this option being more than 3 times higher (around £2.3 million more) than Option 4A. Option 3B is assessed as being Neutral to Option 4C as, while the costs to deliver Option 3B are £800k more, this is considered insufficient to express a preference. Option 4A is assessed as being Neutral to Option 4C as, while the costs to deliver Option 4C are £1.5 million more, this is considered insufficient to express a preference. **Overall, Option 4A is preferred from a Short-term Cost perspective.**						
5. Economic	5.2 Long-term Costs	Surveys: £0 Million FLTC: N/A Total Legacy Cost: £0 Million			Surveys: £0.839 Million FLTC: N/A Total Legacy Cost: £0.839 Million		Surveys: £0.839 Million FLTC: £0.048 Million Total Legacy Cost: £0.886 Million	Surveys: £0.839 Million FLTC: £0.048 Million Total Legacy Cost: £0.886 Million
		N	N	N	N	N	N	
	Summary	The assessment of the Long-term Costs sub-criterion is as follows: All options are assessed as being Neutral to each other as, while there are no long-term costs associated with the full removal option, the costs associated with the monitoring and surveying of the lines remaining in-situ are relatively minor and insufficient to express a preference. **Overall, all options are equally preferred from a Long-term Cost perspective.**						

G.2 Group 6 Pairwise Comparison Matrices – Safety

1.1 Operations Personnel	O2B - Full Removal - Reverse Installlation Without Deburial	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2B - Full Removal - Reverse Installlation Without Deburial	N	W	VMW	W	9.7%
O3B - Leave (Major) - Trench & Bury Entire Line	S	N	W	S	22.8%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	VMS	S	N	MS	51.9%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	S	W	MW	N	15.6%

1.2 Other Users	O2B - Full Removal - Reverse Installlation Without Deburial	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2B - Full Removal - Reverse Installlation Without Deburial	N	N	N	N	25.0%
O3B - Leave (Major) - Trench & Bury Entire Line	N	N	N	N	25.0%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	N	N	N	N	25.0%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	N	N	N	N	25.0%

1.3 High Consequence Events	O2B - Full Removal - Reverse Installlation Without Deburial	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2B - Full Removal - Reverse Installlation Without Deburial	N	MW	MW	N	13.4%
O3B - Leave (Major) - Trench & Bury Entire Line	MS	N	N	S	33.8%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	MS	N	N	S	33.8%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	N	W	W	N	19.0%

1.4 Legacy Risk	O2B - Full Removal - Reverse Installlation Without Deburial	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2B - Full Removal - Reverse Installlation Without Deburial	N	S	MS	MS	41.3%
O3B - Leave (Major) - Trench & Bury Entire Line	W	N	MS	MS	33.8%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	MW	MW	N	N	12.5%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	MW	MW	N	N	12.5%

G.3 Group 6 Pairwise Comparison Matrices – Environment

2.1 Operational Marine Impact	O2B - Full Removal - Reverse Installlation Without Deburial	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2B - Full Removal - Reverse Installlation Without Deburial	N	N	N	N	25.0%
O3B - Leave (Major) - Trench & Bury Entire Line	N	N	N	N	25.0%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	N	N	N	N	25.0%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	N	N	N	N	25.0%

2.2 Atmospheric Emissions & Fuel Consumption	O2B - Full Removal - Reverse Installlation Without Deburial	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2B - Full Removal - Reverse Installlation Without Deburial	N	N	N	N	25.0%
O3B - Leave (Major) - Trench & Bury Entire Line	N	N	N	N	25.0%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	N	N	N	N	25.0%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	N	N	N	N	25.0%

2.3 Other Consumptions	O2B - Full Removal - Reverse Installlation Without Deburial	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2B - Full Removal - Reverse Installlation Without Deburial	N	N	N	N	25.0%
O3B - Leave (Major) - Trench & Bury Entire Line	N	N	N	N	25.0%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	N	N	N	N	25.0%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	N	N	N	N	25.0%

2.4 Seabed Disturbance	O2B - Full Removal - Reverse Installlation Without Deburial	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2B - Full Removal - Reverse Installlation Without Deburial	N	S	MS	S	37.3%
O3B - Leave (Major) - Trench & Bury Entire Line	W	N	S	N	23.1%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	MW	W	N	MW	12.1%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	W	N	MS	N	27.5%

2.5 Legacy Marine Impacts	O2B - Full Removal - Reverse Installlation Without Deburial	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2B - Full Removal - Reverse Installlation Without Deburial	N	S	MS	MS	43.6%
O3B - Leave (Major) - Trench & Bury Entire Line	W	N	S	S	25.2%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	MW	W	N	N	15.6%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	MW	W	N	N	15.6%

G.4 Group 6 Pairwise Comparison Matrices – Technical

3.1 Technical Risk	O2B - Full Removal - Reverse Installlation Without Deburial	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2B - Full Removal - Reverse Installlation Without Deburial	N	W	MW	MW	12.0%
O3B - Leave (Major) - Trench & Bury Entire Line	S	N	W	W	20.8%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	MS	S	N	N	33.6%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	MS	S	N	N	33.6%

G.5 Group 6 Pairwise Comparison Matrices – Societal

4.1 Fishing	O2B - Full Removal - Reverse Installlation Without Deburial	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2B - Full Removal - Reverse Installlation Without Deburial	N	S	MS	MS	43.6%
O3B - Leave (Major) - Trench & Bury Entire Line	W	N	S	S	25.2%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	MW	W	N	N	15.6%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	MW	W	N	N	15.6%

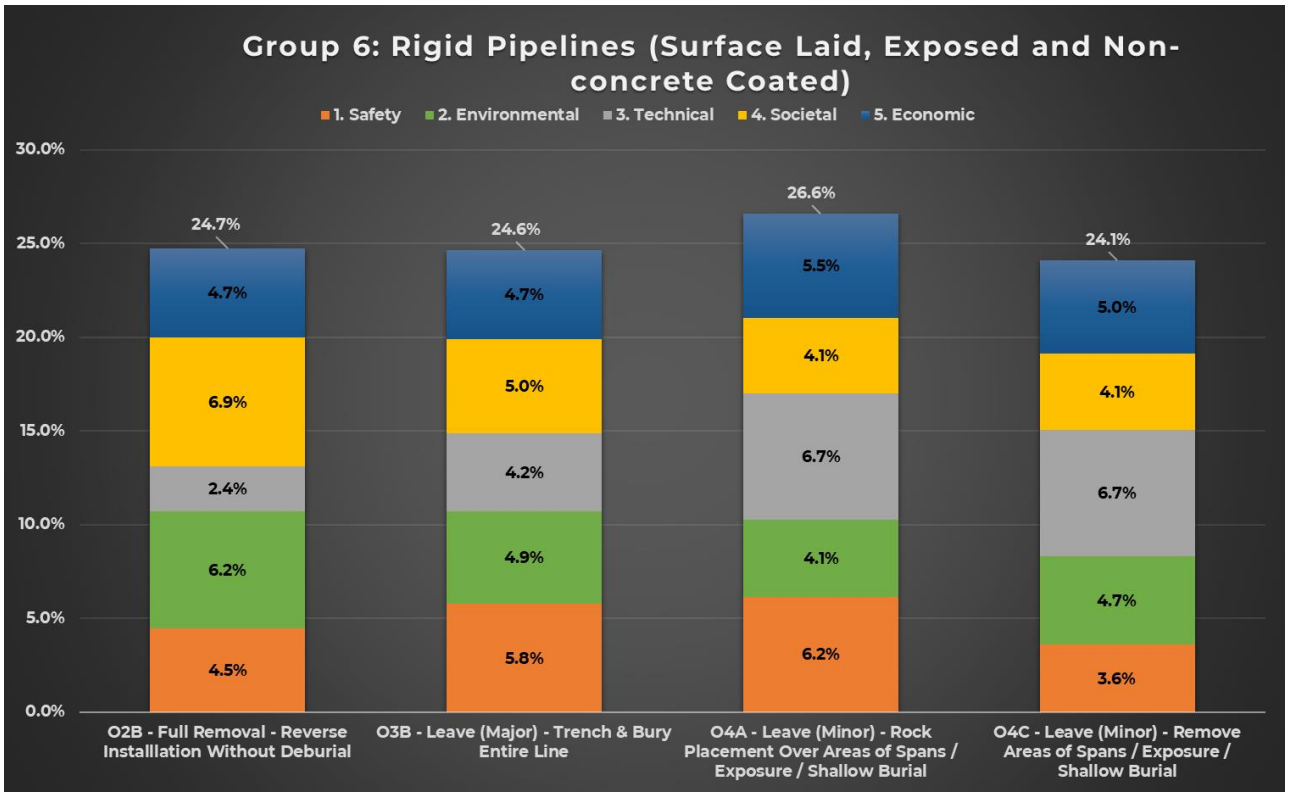
4.2 Other Users	O2B - Full Removal - Reverse Installlation Without Deburial	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2B - Full Removal - Reverse Installlation Without Deburial	N	N	N	N	25.0%
O3B - Leave (Major) - Trench & Bury Entire Line	N	N	N	N	25.0%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	N	N	N	N	25.0%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	N	N	N	N	25.0%

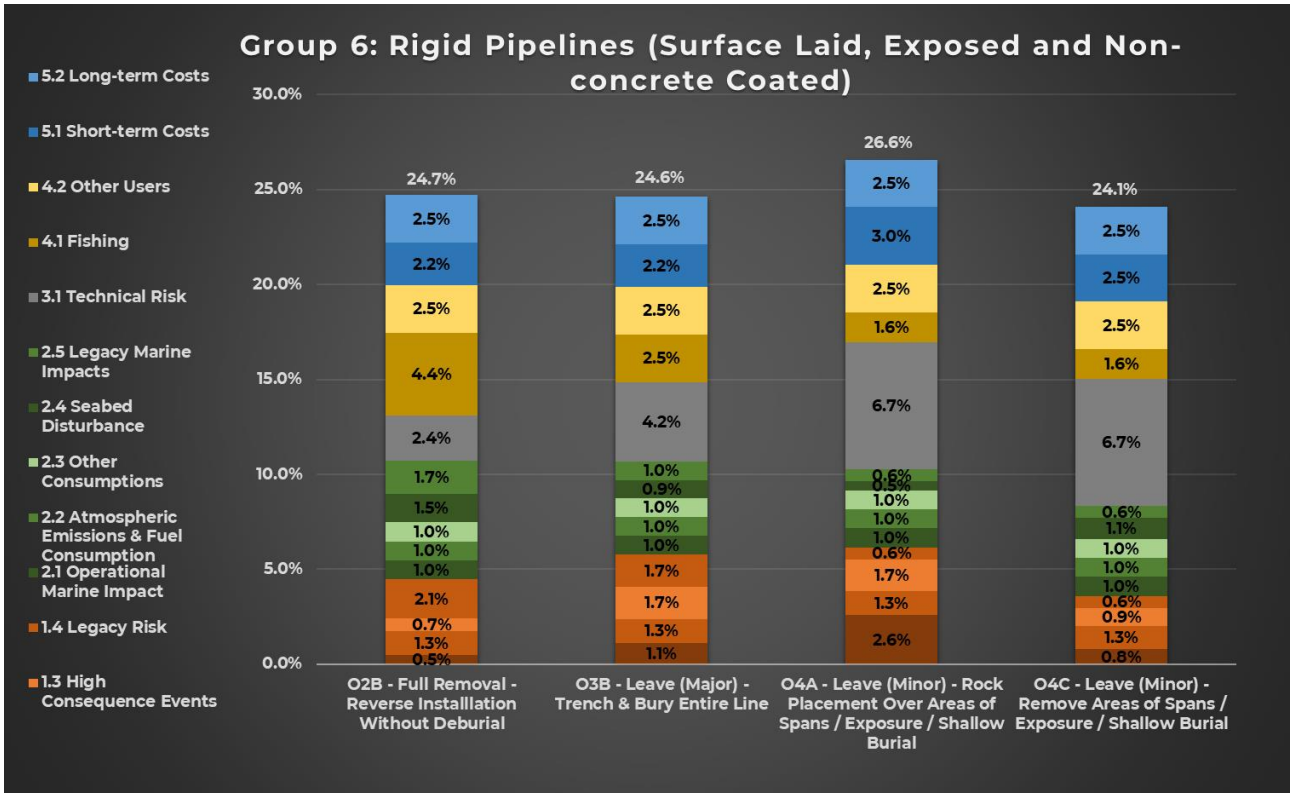
G.6 Group 6 Pairwise Comparison Matrices – Economic

5.1 Short-term Costs	O2B - Full Removal - Reverse Installlation Without Deburial	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2B - Full Removal - Reverse Installlation Without Deburial	N	N	W	N	22.4%
O3B - Leave (Major) - Trench & Bury Entire Line	N	N	W	N	22.4%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	S	S	N	N	30.4%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	N	N	N	N	24.8%

5.2 Long-term Costs	O2B - Full Removal - Reverse Installlation Without Deburial	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2B - Full Removal - Reverse Installlation Without Deburial	N	N	N	N	25.0%
O3B - Leave (Major) - Trench & Bury Entire Line	N	N	N	N	25.0%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	N	N	N	N	25.0%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	N	N	N	N	25.0%

G.7 Group 6 Results Charts





APPENDIX H GROUP 7 – DETAILED EVALUATION RESULTS

H.1 Group 7 Attributes Table

Group 7: Rigid Lines (Surface Laid, Exposed and Concrete Coated)

PL113 (N0305) - 20" Oil Pipeline from North Cormorant to Cormorant Alpha - 16.586 km | PL477 (N0505) - 16" Oil Pipeline from Tern to North Cormorant - 12.957 km

	O2A - Full Removal - Cut and Lift	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial
	- Pipelines are disconnected - Surface laid lines are fully recovered by cut and lift - Concrete spalling debris is recovered by DSV (25% of cuts)	- Pipelines are disconnected - Entirety of lines are trenched and backfilled to 0.6m DoC - Remedial rock cover installed over trench transitions	- Pipelines are disconnected - Rock placement over areas of spans	- Pipelines are disconnected - Areas of spans are removed by cut and lift - Rock placement over cut ends to mitigate snag risk
1. Safety **1.1 Operations Personnel**	Vessel Type: PoB / Days / Hours / PLL DSV: 110 / 19.5 / 25,674 / 1.93E-03 Divers: 18 / 19.5 / 8,402 / 8.15E-03 CSV: 76 / 154.7 / 141,114 / 1.06E-02 Total offshore hours: 175,190 hrs Total offshore PLL: 2.07E-02 Resource Type: Days / Hours / PLL Engineering & Management: 2,366.2 / 18,929 / 7.57E-05 Project Management: 2,285.0 / 18,280 / 7.31E-05 Onshore Operations (includes Cleaning & Disposal): 376.0 / 24,064 / 2.96E-03 Total onshore hours: 61,273 hrs Total onshore PLL: 3.11E-03 Total operational hours: 236,464 hrs Total operational PLL: 2.38E-02	Vessel Type: PoB / Days / Hours / PLL Rockdump Vessel: 20 / 5.0 / 1,210 / 9.07E-05 Trenching Vessel: 55 / 19.0 / 12,566 / 9.42E-04 Total offshore hours: 13,776 hrs Total offshore PLL: 1.03E-03 Resource Type: Days / Hours / PLL Engineering & Management: 504.4 / 4,035 / 1.61E-05 Project Management: 486.0 / 3,888 / 1.56E-05 Total onshore hours: 7,923 hrs Total onshore PLL: 3.17E-05 Total operational hours: 21,699 hrs Total operational PLL: 1.06E-03	Vessel Type: PoB / Days / Hours / PLL Rockdump Vessel: 20 / 8.6 / 2,052 / 1.54E-04 Total offshore hours: 2,052 hrs Total offshore PLL: 1.54E-04 Resource Type: Days / Hours / PLL Engineering & Management: 61.8 / 494 / 1.98E-06 Project Management: 90.0 / 720 / 2.88E-06 Total onshore hours: 1,214 hrs Total onshore PLL: 4.86E-06 Total operational hours: 3,266 hrs Total operational PLL: 1.59E-04	Vessel Type: PoB / Days / Hours / PLL DSV: 110 / 5.2 / 6,824 / 5.12E-04 Divers: 18 / 5.2 / 2,233 / 2.17E-03 CSV: 76 / 27.3 / 24,861 / 1.86E-03 Total offshore hours: 33,919 hrs Total offshore PLL: 4.54E-03 Resource Type: Days / Hours / PLL Engineering & Management: 461.8 / 3,694 / 1.48E-05 Project Management: 440.0 / 3,520 / 1.41E-05 Onshore Operations (includes Cleaning & Disposal): 24.0 / 1,536 / 1.89E-04 Total onshore hours: 8,750 hrs Total onshore PLL: 2.18E-04 Total operational hours: 42,669 hrs Total operational PLL: 4.76E-03
Summary	MW: 22.4528 VMW: 149.686 W: 5	W: 6.66666667 S: 0.22268908	MS: 0.033403361	
	The assessment of the Operations Personnel sub-criterion is as follows: Option 2A is assessed as being Much Weaker than Option 3B due to the risk exposure being around 22 times higher in Option 2A due to the greater offshore scope (with diver support) associated with the full removal of these lines versus the smaller scope to perform trenching of the lines in Option 3B. Option 2A is assessed as being Very Much Weaker than Option 4A due to the risk exposure being around 150 times higher in Option 2B. This is due to the greater offshore scope (with diver support) associated with the full removal of the lines versus the smaller scope and lower risk activities to perform rock placement over problem areas of the lines in Option 4A. Option 2A is assessed as being Weaker than Option 4C due to the risk exposure being around 5 times higher in Option 2B. This is due to the greater offshore scope (with diver support) associated with the full removal of the lines versus the smaller scope and lower risk activities to remove problem areas of the lines in Option 4A.. Option 3B is assessed as being Weaker than Option 4A due to the risk exposure being around 7 times higher in Option 3B. This is due to the greater scope associated with trenching the lines in Option 3B versus the smaller scope to provide rock placement over problem areas of the lines in Option 4A. Option 3B is assessed as being Stronger than Option 4C due to the risk exposure being around 5 times higher in Option 4C. This is due to the smaller scope associated with trenching the entire line in Option 3B versus the greater scope to remove problem areas of the line in Option 4C. Option 4A is assessed as being Much Stronger than Option 4C due to the risk exposure being around 30 times higher in Option 4C. This is due to the smaller scope associated with rock placement over problem areas of the line in Option 4A versus the greater scope to remove problem areas of the line in Option 4C. **Overall, Option 4A is preferred from a risk to Operations Personnel perspective.**			

		O2A - Full Removal - Cut and Lift	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial
1. Safety	1.2 Other Users	Vessel Days: DSV: 19.5 CSV: 154.7 Total vessel days: 174.2 days Transits: 16	Vessel Days: Rockdump Vessel: 5.0 Trenching Vessel: 19.0 Total vessel days: 24.1 days Transits: 4	Vessel Days: Rockdump Vessel: 8.6 Total vessel days: 8.6 days Transits: 2	Vessel Days: DSV: 5.2 CSV: 27.3 Total vessel days: 32.4 days Transits: 4
		W W W	N N	N	
	Summary	The assessment of the Other Users sub-criterion is as follows: Option 2A is assessed as being Weaker than all other options due to the greater number of vessel days and transits compared to the other options presenting a small increase to the potential safety impact to other users of the sea. All other options are assessed as being Neutral to each other as, while there are differences in the vessel days and transits, these are insufficient to express a preference from a safety perspective. **Overall, Option 3B, Option 4A and Option 4C are equally preferred from a risk to Other Users perspective.**			
1. Safety	1.3 High Consequence Events	Routine cut and lift operations. Very high number of lifts (2976) through the water column to recover line sections. Additional lifting to transfer pipeline sections to quayside. Low number of lifting operations to deploy and recover cutting equipment.	Routine, low risk trenching operations. Small number of lifting operations (4) through the water column to deploy and recover trenching equipment.	Routine, low risk rock placement operations with no lifting operations.	High number of lifting operations (380) through the water column to recover areas of spans and to place rock bags. Additional lifting to transfer pipeline sections to quayside. Small number of lifting operations to deploy and recover cutting equipment.
		MW MW W	N S	S	
	Summary	The assessment of the High Consequence Events sub-criterion is as follows: Option 2A is assessed as being Much Weaker than Option 3B and Option 4A as there are many more lifting operations and hence potential for high consequence events from dropped objects, associated with Option 2A over minimal / no lifting operations with the other options. Option 2A is assessed as being Weaker than Option 4C as while there is offshore lifting associated with both options, there are many more lifting operations and hence greater potential for high consequence events from dropped object, associated with Option 2A. Option 3B is assessed as being Neutral to Option 4A as there is minimal / no lifting operations with these options. Option 3B is assessed as being Stronger than Option 4C as there is significant offshore lifting scope associated with Option 4C versus limited lifting in Option 4A. Option 4A is assessed as being Stronger than Option 4C as there is significant offshore lifting scope associated with Option 4C versus no lifting operations in Option 4A. **Overall, Option 4A is preferred from a High Consequence Events perspective.**			
1. Safety	1.4 Legacy Risk	No legacy risk from this full removal option.	The line would remain in-situ with this option although it would be fully trenched and buried under this option. The survey & monitoring programme is committed to ensuring that the potential snag hazard from left in-situ infrastructure continues to be managed & mitigated as appropriate. Vessel Type: PoB / Days / Hours / PLL Survey Vessel (Legacy): 44 / 31.4 / 16,574 / 1.24E-03	The line would remain in-situ with this option with the majority of its length remaining surface laid. Areas of spans will have rock placement to mitigate potential snag hazard. The survey & monitoring programme is committed to ensuring that the potential snag hazard from left in-situ infrastructure continues to be managed & mitigated as appropriate. Vessel Type: PoB / Days / Hours / PLL Survey Vessel (Legacy): 44 / 31.4 / 16,574 / 1.24E-03	The line would remain in-situ with this option with the majority of its length remaining surface laid. Areas of spans will be removed with rock cover to mitigate potential snag hazard from cut ends. The survey & monitoring programme is committed to ensuring that the potential snag hazard from left in-situ infrastructure continues to be managed & mitigated as appropriate. Vessel Type: PoB / Days / Hours / PLL Survey Vessel (Legacy): 44 / 31.4 / 16,574 / 1.24E-03
		S MS MS	MS MS	W	
	Summary	The assessment of the Legacy Risk sub-criterion is as follows: Option 2A is assessed as being Stronger than Option 3B as while both options present a clear seabed, the lines are removed in Option 2A thus removing any potential for legacy risk. Option 2A is assessed as being Much Stronger than Option 4A and Option 4C as there is no legacy risk from the full removal option versus the lines remaining in-situ with problem areas rock covered, presenting surface laid lines with large rock berms or removed, presenting lines remaining surface laid with areas of spot rock cover. Option 3B is assessed as being Much Stronger than Option 4A and Option 4C as while the lines remain in-situ, they are fully trenched and buried thus presenting a clear seabed versus lines remaining in-situ with problem areas rock covered, presenting surface laid lines with large rock berms or removed, presenting lines remaining surface laid with areas of spot rock cover. Option 4A is assessed as being Weaker than Option 4C as while the lines remain in both cases, the large rock berms over problem areas in Option 4A present a greater legacy snag risk than the problem areas being removed in Option 4C. **Overall, Option 2A is preferred from a Legacy Risk perspective.**			

		O2A - Full Removal - Cut and Lift	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial
2. Environmental	2.1 Operational Marine Impact	Vessel Noise (days on-site): 142.2 days Tooling Noise (DWC) = 122.3 days Operation releases: Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush and releases to the marine environment during flushing activities. Cutting of line ends and midline cuts would lead to an elevated release of fluids from within the line. However, given the prior cleaning of the line, the concentration and quantity of release should still be low overall. Therefore, the related impact is also anticipated to be low. Vessel releases: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore at 142.2 days is the highest of all options. The environmental impact is considered to be low.	Vessel Noise (days on-site): 16.1 days Tooling Noise (Trenching) = 12.4 days Operation releases: Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush and releases to the marine environment during flushing activities. As line is being trenched there is negligible release from the line. Vessel releases: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore at 16.1 days is not considered significant. The environmental impact is considered to be negligible.	Vessel Noise (days on-site): 4.6 days Tooling Noise = none Operation releases: Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush and releases to the marine environment during flushing activities. As line is being rock covered there is negligible release from the line. Vessel releases: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore at 4.6 days is the lowest of the options. The environmental impact is considered to be negligible.	Vessel Noise (days on-site): 24.4 days Tooling Noise (Hydraulic Shears) = 9.5 days Operation releases: Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush and releases to the marine environment during flushing activities. Cutting of line ends and midline cuts would lead to an elevated release of fluids from within the line. However, given the prior cleaning of the line, the concentration and quantity of release should still be low overall. Therefore, the related impact is also anticipated to be low. Vessel releases: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore at 24.4 days is not considered significant. The environmental impact is considered to be negligible.
		W W W	N N	N	
	Summary	The assessment of the Operational Marine Impact sub-criterion is as follows: Option 2A is assessed as being Weaker than all other options due to a combination of the noise impact from the longer vessel durations and tooling operations and the releases of pipeline contents at all cut locations. Whilst the environmental impact is expected to be low, there is enough cumulative impact to express a small preference for all options over Option 2A. All other options are assessed as being Neutral to each other as, while there are differences in the vessel durations, tooling operations and potential for releases from cutting operations, these are considered insufficient to express a preference. **Overall, Option 3B, Option 4A and Option 4C are equally preferred from an Operational Marine Impact perspective.**			
2. Environmental	2.2 Atmospheric Emissions & Fuel Consumption	Vessel Emissions (in tonnes): Fuel: 4,648 CO2: 14,733 NOx: 276.07 SO2: 18.59 Vessel Energy Use: 199,852 GJ	Vessel Emissions (in tonnes): Fuel: 1,268 CO2: 4,019 NOx: 75.30 SO2: 5.07 Vessel Energy Use: 54,511 GJ	Vessel Emissions (in tonnes): Fuel: 1,036 CO2: 3,284 NOx: 61.53 SO2: 4.14 Vessel Energy Use: 44,540 GJ	Vessel Emissions (in tonnes): Fuel: 1,724 CO2: 5,466 NOx: 102.43 SO2: 6.90 Vessel Energy Use: 74,150 GJ
		W W W	N N	N	
	Summary	The assessment of the Atmospheric Emissions & Consumptions sub-criterion is as follows: Option 2A is assessed as being Weaker than all other options as the emissions and fuel use are around 3 to 5 times greater for Option 2A than the other options which is sufficient to express a small preference for the other options. All remaining options are assessed as being Neutral to each other as, while there are small differences in the emissions and fuel consumption, these are considered insufficient to express a preference. **Overall, Option 3B, Option 4A and Option 4C are equally preferred from an Atmospheric Emissions & Consumptions perspective.**			

		O2A - Full Removal - Cut and Lift	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial
2. Environmental	2.3 Other Consumptions	Material Emissions (CO2 in tonnes): Recovered Material: 11,594 Remaining Material: 110 Total: 11,704 Rock: 160 tonnes	Material Emissions (CO2 in tonnes): Recovered Material: Remaining Material: 14,663 Total: 14,663 Rock: 5,000 tonnes	Material Emissions (CO2 in tonnes): Recovered Material: Remaining Material: 14,663 Total: 14,663 Rock: 23,000 tonnes	Material Emissions (CO2 in tonnes): Recovered Material: 732 Remaining Material: 13,745 Total: 14,477 Rock: 608 tonnes
		S S N	S N	W	
	Summary	The assessment of the Other Consumptions sub-criterion is as follows: Option 2A is assessed as being Stronger than Option 3B and Option 4A due to a combination of the lower impact from processing the returned material and there being minimal rock resource required versus the greater impact from generating replacement material and the rock resource required in Option 3b and Option 4A. Option 2A is assessed as being Neutral to Option 4C as, while there is a greater impact from replacing material left in-situ and the higher amount of rock resource required in Option 4C, this difference is considered insufficient to express a preference. Option 3B is assessed as being Stronger than Option 4A as there is significantly less rock resource required in Option 3B. Option 3B is assessed as being Neutral to Option 4C as, while there is more rock resource required in Option 3B, the difference is considered insufficient to express a preference. Option 4A is assessed as being Weaker than Option 4C due to the much greater rock resource required in Option 4A. **Overall, Option 2A is preferred from an Other Consumptions perspective.**			
2. Environmental	2.4 Seabed Disturbance	Seabed Disturbance (m2): Rock Cover: 250 Habitat Loss / Change (m2): Rock Bags: 250	Seabed Disturbance (m2): Rock Cover: 5,000 Trenching: 292,030 Habitat Loss / Change (m2): Rock Cover: 5,000	Seabed Disturbance (m2): Rock Cover: 19,000 Habitat Loss / Change (m2): Rock Cover: 19,000	Seabed Disturbance (m2): Rock Cover: 950 Habitat Loss / Change (m2): Rock Bags: 950
		S MS N	S W	MW	
	Summary	The assessment of the Seabed Disturbance sub-criterion is as follows: Option 2A is assessed as being Stronger than Option 3B as there is minimal seabed disturbance associated with the full removal of these surface laid lines versus a significant area of temporary impact from trenching the lines and permanent habitat change from the rock cover in Option 3B. Option 2A is assessed as being Much Stronger than Option 4A as there is minimal seabed disturbance associated with the full removal of these surface laid lines versus a significant area of permanent habitat change from the rock cover in Option 4A. Option 2A is assessed as being Neutral to Option 4C as there is minimal seabed disturbance in both options with the small area of permanent habitat change in Option 4C being insufficient to express a preference. Option 3B is assessed as being Stronger than Option 4A due to the smaller area of permanent habitat change in Option 3B. The significant area of impact from the trenching operations is less important as the impact is temporary in nature. Option 3B is assessed as being Weaker than Option 4C as there is a greater area of permanent habitat change from the rock cover in Option 3B. Option 4A is assessed as being Much Weaker than Option 4C due to the significant area of permanent habitat change from the rock cover in Option 4A. **Overall, Option 2A and Option 4C are equally preferred from a Seabed Disturbance perspective.**			
2. Environmental	2.5 Legacy Marine Impacts	No legacy marine impact from this full removal option.	Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush. The legacy marine impact from the slow release of these low concentration / quantity releases is therefore expected to be low overall.	Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush. The legacy marine impact from the slow release of these low concentration / quantity releases is therefore expected to be low overall.	Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush. The legacy marine impact from the slow release of these low concentration / quantity releases is therefore expected to be low overall.
		S S S	N N	N	
	Summary	The assessment of the Legacy Marine Impacts sub-criterion is as follows: Option 2A is assessed as being Stronger than all other options as the lines are fully removed hence there is no legacy environmental impact. All other options are assessed as being Neutral to each other as the lines remain in each of the options with the legacy impact from slow releases of residual (minimal) contents and degradation products is expected to be similar for all options presenting a similar (minor) legacy environmental impact. **Overall, Option 2A is preferred from a Legacy Marine Impacts perspective.**			

		O2A - Full Removal - Cut and Lift	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial
3. Technical	3.1 Technical Risk	Concept Maturity: Cut and lift techniques are well proven with multiple options available on the market. (Score 3) Technical Risks: Technical risks with this option are associated with the scale of the operation. (Score 2)	Concept Maturity: Trenching of large diameter surface lines has limited track record (Score 1) Technical Risks: A comparatively large scope. Geotechnical studies would be required to confirm if it is feasible. (Score 1)	Concept Maturity: Rock placement is a well proven technique. (Score 3) Technical Risks: Limited technical risks associated with option (Score 3)	Concept Maturity: Cut and lift has a good track record (Score 3) Technical Risks: No significant technical risk with this option. (Score 3)
		N W W	W W	N	
	Summary	The assessment of the Technical Risk sub-criterion is as follows: Option 2A is assessed as being Neutral to Option 3B as the challenges associated with cutting and lifting lines with aging concrete coatings on this scale and trenching of these large diameter lines are expected to provide a similar level of technical challenges. Option 2A is assessed as being Weaker than Option 4A and Option 4C as these options employ largely routine operations. Option 3B is assessed as being Weaker than Option 4A and Option 4C as there are challenges associated with trenching lines of this diameter versus largely routine operations in the other options. Option 4A is assessed as being Neutral to Option 4C as these option both employ largely routine operations. **Overall, Option 4A and Option 4C are equally preferred from a Technical Risk perspective.**			
4. Societal	4.1 Fishing	Large scale disruption associated with the removal operation, however, infrastructure is removed long term, beneficial for the fishing industry. (Score 2)	Two pipelines only, a relatively short term operation, with a localised area of disturbance. If successful, the area would be clear for fishing operations to be conducted. (Score 3)	Minimal operation, a small amount of short term disturbance during operation. However, rock berms are not preferred option from the fishing industry's perspective. (Score 1)	Rock bags intended to be installed with a suitable gradient to minimise impact on fishing operations. (Score 3)
		S MS MS	S S	N	
	Summary	The assessment of the Societal impact on Fishing sub-criterion is as follows: Option 2A is assessed as being Stronger than Option 3B as the lines are removed versus remaining in-situ albeit fully trenched and buried in Option 3B. Option 2A is assessed as being Much Stronger than Option 4A and Option 4C as the lines are removed versus the lines remaining in-situ (surface laid) with problem areas rock covered or removed in the other options. Option 3B is assessed as being Stronger than Option 4A and Option 4C as the while the lines remain in-situ in all options, they are fully trenched and buried thus presenting a clear seabed in Option 3B versus the lines remaining surface laid with rock cover over problem areas / problem areas removed in the other options. Option 4A is assessed as being Neutral to Option 4C as the lines remain surface laid with either rock cover over problem areas / problem areas removed. **Overall, Option 2A is preferred from a Societal impact on Fishing perspective.**			
4. Societal	4.2 Other Users	Significant amount of recyclable material returned, however, there is also a very large amount of concrete returned which will likely have to go to land fill. (Score 1) Materials Returned: Steel: 4,610 tonnes (recyclable) Concrete: 6,645 tonnes (landfill)	Minimal societal benefits / impacts with this option. (Score 3) Materials Returned: None.	Minimal societal benefits / impacts with this option. (Score 3) Materials Returned: None.	Minimal societal benefits / impacts with this option. (Score 3) Materials Returned: Steel: 291 tonnes (recyclable) Concrete: 419 tonnes (landfill)
		W W W	N N	N	
	Summary	The assessment of the Societal impact on Other Users sub-criterion is as follows: Option 2A is assessed as being Weaker than all other options as while there is benefit in the large quantity of steel returned in Option 2A, this is offset by the large quantity of concrete returned which is likely to end up in landfill. All other options are assessed as being Neutral to each other as while there are differences in the societal impacts, with Option 4C returning a moderate quantity of steel which is offset by the concrete returned going to landfill, these differences are insufficient to express a preference. **Overall, Option 3B, Option 4A and Option 4C are equally preferred from a Societal impact on Other Users perspective.**			

		O2A - Full Removal - Cut and Lift			O3B - Leave (Major) - Trench & Bury Entire Line		O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial
5. Economic	5.1 Short-term Costs	£22.47 Million			£4.931 Million		£1.164 Million	£4.572 Million
		MW	MW	MW	W	N	S	
		17.539 million more	21.306 million more	17.898 million more	3.767 million more	0.359 million more	3.408 million less	
		355.7% higher	1830.4% higher	391.5% higher	323.6% higher	7.9% higher	74.5% lower	
	Summary	The assessment of the Short-term Costs sub-criterion is as follows: Option 2A is assessed as being Weaker than Option 3B due to the costs to deliver this option being around 4 times higher (£17.5 million more) than Option 3B. Option 2A is assessed as being Much Weaker than Option 4A due to the costs being around 19 times higher (£21.3 million more) than Option 4A. Option 2A is assessed as being Much Weaker than Option 4C due to the costs being around 5 times higher (£17.9 million more). Option 3B is assessed as being Weaker than Option 4A due to the costs being around 4 times higher (£3.8 million more). Option 3B is assessed as being Neutral to Option 4C due to the costs being similar. Option 4A is assessed as being Stronger than Option 4C due to the costs being more than 4 times higher (£3.4 million more) for Option 4C. **Overall, Option 4A is preferred from a Short-term Cost perspective.**						
5. Economic	5.2 Long-term Costs	Surveys: N/A FLTC: N/A Total Legacy Cost: £0 Million			Surveys: £0.942 Million FLTC: N/A Total Legacy Cost: £0.942 Million		Surveys: £0.942 Million FLTC: £0.089 Million Total Legacy Cost: £1.03 Million	Surveys: £0.942 Million FLTC: £0.089 Million Total Legacy Cost: £1.03 Million
		N	N	N	N	N	N	
	Summary	The assessment of the Long-term Costs sub-criterion is as follows: All options are assessed as being Neutral to each other as, while there are no long-term costs associated with the full removal option, the costs associated with the monitoring and surveying of the lines remaining in-situ are relatively minor and insufficient to express a preference. **Overall, all options are equally preferred from a Long-term Cost perspective.**						

H.2 Group 7 Pairwise Comparison Matrices – Safety

1.1 Operations Personnel	O2A - Full Removal - Cut and Lift	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2A - Full Removal - Cut and Lift	N	MW	VMW	W	7.9%
O3B - Leave (Major) - Trench & Bury Entire Line	MS	N	W	S	26.3%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	VMS	S	N	MS	50.5%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	S	W	MW	N	15.2%

1.2 Other Users	O2A - Full Removal - Cut and Lift	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2A - Full Removal - Cut and Lift	N	W	W	W	18.2%
O3B - Leave (Major) - Trench & Bury Entire Line	S	N	N	N	27.3%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	S	N	N	N	27.3%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	S	N	N	N	27.3%

1.3 High Consequence Events	O2A - Full Removal - Cut and Lift	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2A - Full Removal - Cut and Lift	N	MW	MW	W	12.0%
O3B - Leave (Major) - Trench & Bury Entire Line	MS	N	N	S	33.6%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	MS	N	N	S	33.6%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	S	W	W	N	20.8%

1.4 Legacy Risk	O2A - Full Removal - Cut and Lift	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2A - Full Removal - Cut and Lift	N	S	MS	MS	41.3%
O3B - Leave (Major) - Trench & Bury Entire Line	W	N	MS	MS	33.7%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	MW	MW	N	W	11.2%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	MW	MW	S	N	13.8%

H.3 Group 7 Pairwise Comparison Matrices – Environment

2.1 Operational Marine Impact	O2A - Full Removal - Cut and Lift	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2A - Full Removal - Cut and Lift	N	W	W	W	18.2%
O3B - Leave (Major) - Trench & Bury Entire Line	S	N	N	N	27.3%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	S	N	N	N	27.3%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	S	N	N	N	27.3%

2.2 Atmospheric Emissions & Fuel Consumption	O2A - Full Removal - Cut and Lift	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2A - Full Removal - Cut and Lift	N	W	W	W	18.2%
O3B - Leave (Major) - Trench & Bury Entire Line	S	N	N	N	27.3%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	S	N	N	N	27.3%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	S	N	N	N	27.3%

2.3 Other Consumptions	O2A - Full Removal - Cut and Lift	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2A - Full Removal - Cut and Lift	N	S	S	N	30.1%
O3B - Leave (Major) - Trench & Bury Entire Line	W	N	S	N	24.6%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	W	W	N	W	18.1%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	N	N	S	N	27.2%

2.4 Seabed Disturbance	O2A - Full Removal - Cut and Lift	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2A - Full Removal - Cut and Lift	N	S	MS	N	33.6%
O3B - Leave (Major) - Trench & Bury Entire Line	W	N	S	W	20.8%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	MW	W	N	MW	12.0%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	N	S	MS	N	33.6%

2.5 Legacy Marine Impacts	O2A - Full Removal - Cut and Lift	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2A - Full Removal - Cut and Lift	N	S	S	S	33.3%
O3B - Leave (Major) - Trench & Bury Entire Line	W	N	N	N	22.2%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	W	N	N	N	22.2%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	W	N	N	N	22.2%

H.4 Group 7 Pairwise Comparison Matrices – Technical

3.1 Technical Risk	O2A - Full Removal - Cut and Lift	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2A - Full Removal - Cut and Lift	N	N	W	W	20.0%
O3B - Leave (Major) - Trench & Bury Entire Line	N	N	W	W	20.0%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	S	S	N	N	30.0%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	S	S	N	N	30.0%

H.5 Group 7 Pairwise Comparison Matrices – Societal

4.1 Fishing	O2A - Full Removal - Cut and Lift	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2A - Full Removal - Cut and Lift	N	S	MS	MS	43.6%
O3B - Leave (Major) - Trench & Bury Entire Line	W	N	S	S	25.2%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	MW	W	N	N	15.6%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	MW	W	N	N	15.6%

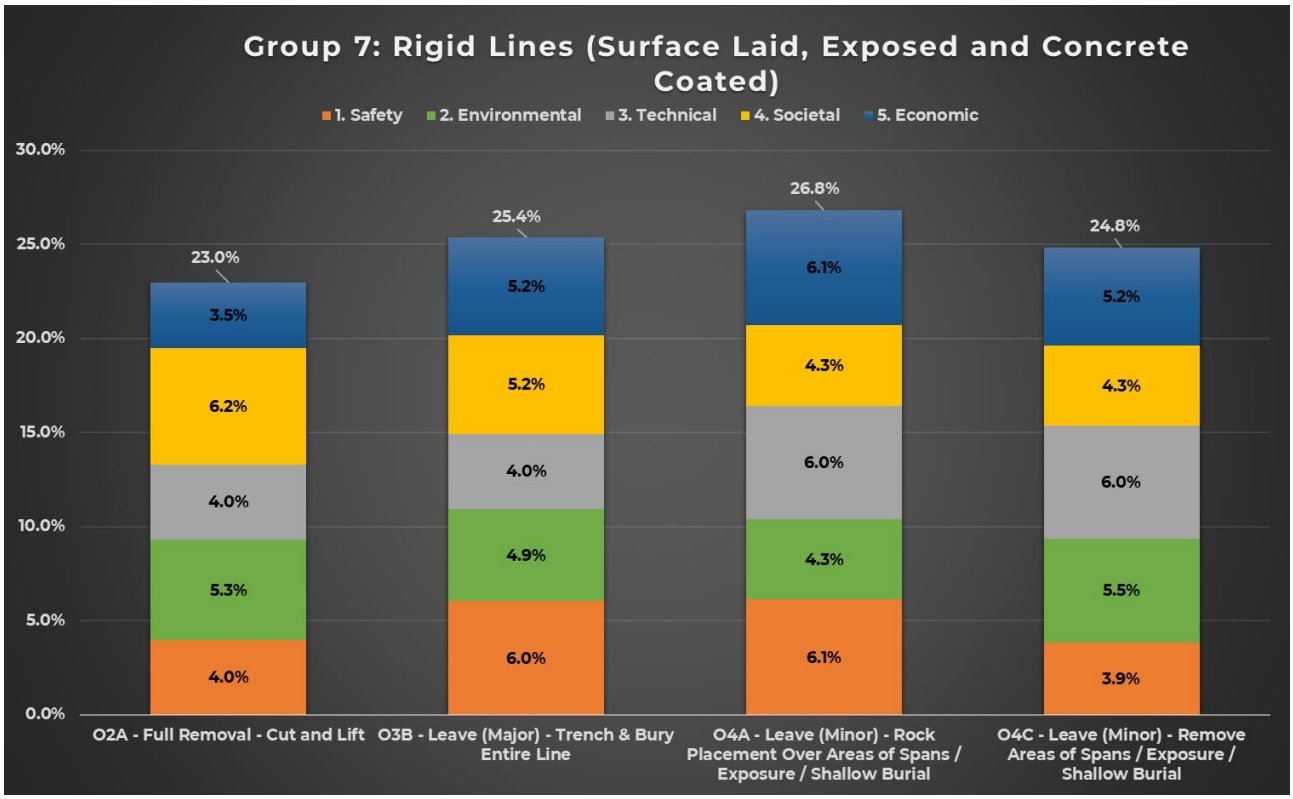
4.2 Other Users	O2A - Full Removal - Cut and Lift	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2A - Full Removal - Cut and Lift	N	W	W	W	18.2%
O3B - Leave (Major) - Trench & Bury Entire Line	S	N	N	N	27.3%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	S	N	N	N	27.3%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	S	N	N	N	27.3%

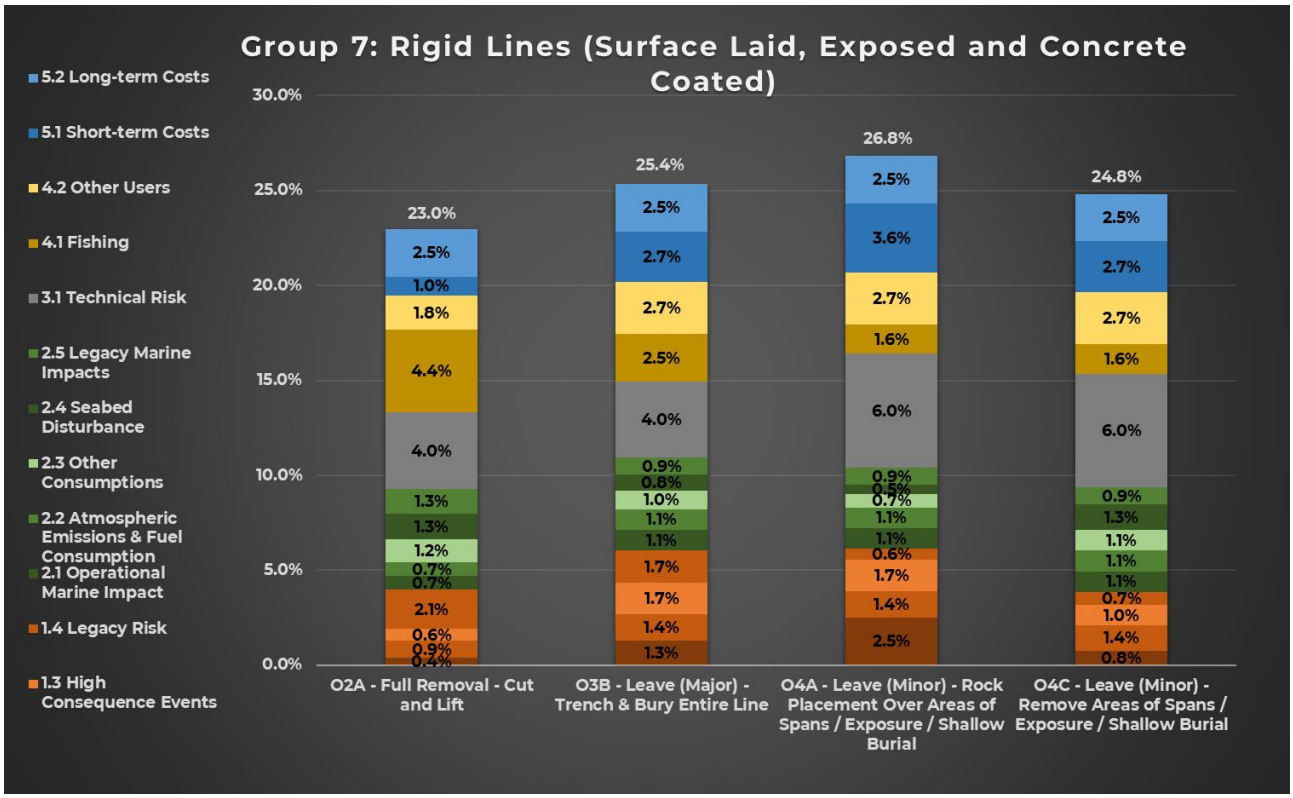
H.6 Group 7 Pairwise Comparison Matrices – Economic

5.1 Short-term Costs	O2A - Full Removal - Cut and Lift	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2A - Full Removal - Cut and Lift	N	MW	MW	MW	9.9%
O3B - Leave (Major) - Trench & Bury Entire Line	MS	N	W	N	26.9%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	MS	S	N	S	36.4%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	MS	N	W	N	26.9%

5.2 Long-term Costs	O2A - Full Removal - Cut and Lift	O3B - Leave (Major) - Trench & Bury Entire Line	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	Weighting
O2A - Full Removal - Cut and Lift	N	N	N	N	25.0%
O3B - Leave (Major) - Trench & Bury Entire Line	N	N	N	N	25.0%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	N	N	N	N	25.0%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	N	N	N	N	25.0%

H.7 Group 7 Results Charts





APPENDIX I GROUP 8 – DETAILED EVALUATION RESULTS

I.1 Group 8 Attributes Table

Group 8: Rigid Pipelines (Surface Laid and Rock Covered)

PL114 (N0602) - 10" Gas Pipeline from North Cormorant to Western Leg Tee - 22.245 km

		O2C - Full Removal - Reverse Installlation With Deburial		O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk
		- Pipeline disconnected - Line de-buried using MFE - Line cut around crossing - Line recovered to reel vessel (reverse installation)		- Pipeline disconnected - Pipeline end transitions cut and recovered in 10m sections - Rock placed over areas of span / exposure / shallow burial	- Pipeline disconnected - Pipeline end transitions cut and recovered in 10m sections - Rock bags placed over cut ends only to mitigate snag hazard
1. Safety	1.1 Operations Personnel	Vessel Type: PoB / Days / Hours / PLL DSV: 110 / 14.2 / 18,731 / 1.40E-03 Divers: 18 / 14.2 / 6,130 / 5.95E-03 Reel Vessel: 76 / 11.0 / 10,068 / 7.55E-04 Total offshore hours: 34,929 hrs Total offshore PLL: 8.11E-03 Resource Type: Days / Hours / PLL Engineering & Management: 545.6 / 4,365 / 1.75E-05 Project Management: 656.0 / 5,248 / 2.10E-05 Onshore Operations (includes Cleaning & Disposal): 53.0 / 3,392 / 4.17E-04 Total onshore hours: 13,005 hrs Total onshore PLL: 4.56E-04 Total operational hours: 47,934 hrs Total operational PLL: 8.56E-03		Vessel Type: PoB / Days / Hours / PLL CSV: 76 / 7.0 / 6,402 / 4.80E-04 Rockdump Vessel: 20 / 6.4 / 1,529 / 1.15E-04 Total offshore hours: 7,931 hrs Total offshore PLL: 5.95E-04 Resource Type: Days / Hours / PLL Engineering & Management: 136.8 / 1,094 / 4.38E-06 Project Management: 138.0 / 1,104 / 4.42E-06 Onshore Operations (includes Cleaning & Disposal): 1.0 / 64 / 7.87E-06 Total onshore hours: 2,262 hrs Total onshore PLL: 1.67E-05 Total operational hours: 10,193 hrs Total operational PLL: 6.11E-04	Vessel Type: PoB / Days / Hours / PLL CSV: 76 / 7.3 / 6,612 / 4.96E-04 Total offshore hours: 6,612 hrs Total offshore PLL: 4.96E-04 Resource Type: Days / Hours / PLL Engineering & Management: 95.6 / 765 / 3.06E-06 Project Management: 101.0 / 808 / 3.23E-06 Onshore Operations (includes Cleaning & Disposal): 1.0 / 64 / 7.87E-06 Total onshore hours: 1,637 hrs Total onshore PLL: 1.42E-05 Total operational hours: 8,249 hrs Total operational PLL: 5.10E-04
		MW	**MW**	**N**	
		14.00982	**16.7843137**	**1.198039216**	
	Summary	The assessment of the Operations Personnel sub-criterion is as follows: Option 2C is assessed as being Much Weaker than Option 4A due to the risk exposure being around 14 times higher in Option 2C due to the greater offshore scope (with diver support) associated with the full removal of the line versus the smaller scope to perform rock cover over the problem areas. Option 2C is assessed as being Much Weaker than Option 5 due to the risk exposure being around 17 times higher in Option 2C. This is due to the greater offshore scope (with diver support) associated with the full removal of the line versus the smaller scope to recover the line ends only. Option 4A is assessed as being Neutral to Option 5 as the risk exposure for these options is largely similar. **Overall, Option 4A and Option 5 are equally preferred from a risk to Operations Personnel perspective.**			
1. Safety	1.2 Other Users	Vessel Days: DSV: 14.2 Reel Vessel: 11.0 Total vessel days: 25.2 days Transits: 6		Vessel Days: CSV: 7.0 Rockdump Vessel: 6.4 Total vessel days: 13.4 days Transits: 4	Vessel Days: CSV: 7.3 Total vessel days: 7.3 days Transits: 2
		N	**N**	**N**	
	Summary	The assessment of the Other Users sub-criterion is as follows: All options are assessed as being Neutral to each other as, while there are small differences in the number of vessel days and transits, the impact on the safety of other users is expected to be similar (and low) across all options. **Overall, all options are equally preferred from a risk to Other Users perspective.**			
1. Safety	1.3 High Consequence Events	Routine, low risk reeling operations. There are 7 lifts of the line ends through the water column to initiate reeling. In addition there is the potential for dropped object associated with the offloading of the reels to the quayside. Small number of lifting operations to deploy and recover deburial equipment (MFE).		Routine, low risk rock placement operations. Small number of lifting operations (24) through the water column to recover line ends. Additional lifting to transfer pipeline sections to quayside. Small number of lifting operations to deploy and recover cutting equipment.	Small number of lifting operations (32) through the water column to recover line ends. Additional lifting to transfer pipeline sections to quayside. Small number of lifting operations to deploy and recover cutting equipment.
		MW	**MW**	**N**	
	Summary	The assessment of the High Consequence Events sub-criterion is as follows: Option 2C is assessed as being Much Weaker than Option 4A and Option 5 due to the potential for high consequence events from the residual torsion in the line when offloading (reeling) to the quayside versus the limited offshore lifting operations in the other options. Option 4A is assessed as being Neutral to Option 5 as the potential for high consequence events from the offshore lifting operations is similar for both options. **Overall, Option 4A and Option 5 are equally preferred from a High Consequence Events perspective.**			
1. Safety	1.4 Legacy Risk	No legacy risk from this full removal option.		The line would remain in-situ with this option although the majority of its length is already rock covered. Areas of spans / exposure will be rock covered to mitigate potential snag hazard. The survey & monitoring programme is committed to ensuring that the potential snag hazard from left in-situ infrastructure continues to be managed & mitigated as appropriate. Vessel Type: PoB / Days / Hours / PLL Survey Vessel (Legacy): 44 / 29.5 / 15,560 / 1.17E-03 Total offshore hours: 15,560 hrs Total offshore PLL: 1.17E-03	The line would remain in-situ with this option although the majority of its length is already rock covered. Areas of spans / exposure will remain The survey & monitoring programme is committed to ensuring that the potential snag hazard from left in-situ infrastructure continues to be managed & mitigated as appropriate. Vessel Type: PoB / Days / Hours / PLL Survey Vessel (Legacy): 44 / 29.5 / 15,560 / 1.17E-03 Total offshore hours: 15,560 hrs Total offshore PLL: 1.17E-03
		MS	**MS**	**S**	
	Summary	The assessment of the Legacy Risk sub-criterion is as follows: Option 2C is assessed as being Much Stronger than Option 4A and Option 5 as there is no legacy risk with the full removal option versus the line remaining surface laid with rock cover over problem areas or (limited) problem areas remaining. Option 4A is assessed as being Stronger than Option 5 as, while the line remains in both options, the problem areas are rock covered in Option 4A while they remain in Option 5. **Overall, Option 2C is preferred from a Legacy Risk perspective.**			

		O2C - Full Removal - Reverse Installlation With Deburial	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk
2. Environmental	2.1 Operational Marine Impact	Vessel Noise (days on-site): 15.2 days Tooling Noise (MFE) = 9.4 days Operation releases: Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush and releases to the marine environment during flushing activities. There will be potential for the release of all residual contents in one location at one time during the reverse reeling operations. However, given the prior cleaning of the lines, the concentration and quantity of release should still be low overall. Therefore, the related impact is also anticipated to be low. Vessel releases: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore at around 15.2 days is the highest of all options but not considred significant. The environmental impact is considered to be negligible.	Vessel Noise (days on-site): 5.0 days Tooling Noise (Hydraulic Shears) = 0.9 days Operation releases: Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush and releases to the marine environment during flushing activities. Cutting of line ends would lead to an elevated release of fluids from within the line. However, given the prior cleaning of the line, the concentration and quantity of release should still be low overall. Therefore, the related impact is also anticipated to be low. Vessel releases: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore at 5 days is not considered significant. The environmental impact is considered to be negligible.	Vessel Noise (days on-site): 3.0 days Tooling Noise (Hydraulic Shears) = 0.9 days Operation releases: Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush and releases to the marine environment during flushing activities. Cutting of line ends would lead to an elevated release of fluids from within the line. However, given the prior cleaning of the line, the concentration and quantity of release should still be low overall. Therefore, the related impact is also anticipated to be low. Vessel releases: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore at 3 days is the lowest of the options. The environmental impact is considered to be negligible.
		N N	N	
	Summary	The assessment of the Operational Marine Impact sub-criterion is as follows: All options are assessed as being Neutral to each other as, while the the marine environmental impact from vessel noise, tooling noise and releases higher for Option 2C than the other options, this is considered insufficient to express a preference. It is noted that the impact from releases from the line are insignificant as this line was used for gas injection. **Overall, all options are equally preferred from an Operational Marine Impact perspective.**		
2. Environmental	2.2 Atmospheric Emissions & Fuel Consumption	Vessel Emissions (in tonnes): Fuel: 659 CO2: 2,089 NOx: 39.15 SO2: 2.64 Vessel Energy Use: 28,340 GJ	Vessel Emissions (in tonnes): Fuel: 1,091 CO2: 3,458 NOx: 64.80 SO2: 4.36 Vessel Energy Use: 46,907 GJ	Vessel Emissions (in tonnes): Fuel: 1,023 CO2: 3,244 NOx: 60.79 SO2: 4.09 Vessel Energy Use: 44,007 GJ
		N N	N	
	Summary	The assessment of the Atmospheric Emissions & Consumptions sub-criterion is as follows: All options are assessed as being Neutral to each other as, while there are differences in the atmospheric emissions generated across the options, these differences are considered insufficient to express a preference from an environmental impact perspective. **Overall, all options are equally preferred from an Atmospheric Emissions & Consumptions perspective.**		
2. Environmental	2.3 Other Consumptions	Material Emissions (CO2 in tonnes): Recovered Material: 1,598 Remaining Material: Total: 1,598 Rock: N/A tonnes	Material Emissions (CO2 in tonnes): Recovered Material: 14 Remaining Material: 2,970 Total: 2,984 Rock: 320 tonnes	Material Emissions (CO2 in tonnes): Recovered Material: 14 Remaining Material: 2,970 Total: 2,984 Rock: 32 tonnes
		N N	N	
	Summary	The assessment of the Other Consumptions sub-criterion is as follows: All options are assessed as being Neutral to each other as the impacts associated with returned / replaced material and rock consumption is similar across all options. **Overall, all options are equally preferred from an Other Consumptions perspective.**		
2. Environmental	2.4 Seabed Disturbance	Seabed Disturbance (m2): MFE: 109,500 No rock cover in this option. Additional disturbance plume associated with disturbing sediment during MFE operations, although temporary in nature - a greater consideration especially in areas local to platform end of line.	Seabed Disturbance (m2): Rock Cover: 470 Habitat Loss / Change (m2): Rock Cover: 470 The impact from the introduced rock cover is less significant as there is already rock in location.	Seabed Disturbance (m2): Rock Cover: 50 Habitat Loss / Change (m2): Rock Bags: 50
		W W	N	
	Summary	The assessment of the Seabed Disturbance sub-criterion is as follows: Option 2C is assessed as being Weaker than Option 4C and Option 5 due to the larger area of temporary seabed impacted by the deburial operations required to enable the full removal of the lines versus the small areas of permanent habitat change from rock placement in the other options. This assessment is influenced by the rock placement being applied in areas where the lines are already rock covered thus having lower impact. Option 4A is assessed as being Neutral to Option 5 as, while there are differences in the area of seabed impacted by rock placement, these differences are considered insufficient to express a preference. **Overall, Option 4A and Option 5 are equally preferred from a Seabed Disturbance perspective.**		
2. Environmental	2.5 Legacy Marine Impacts	No legacy marine impact from this full removal option.	Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush. The legacy marine impact from the slow release of these low concentration / quantity releases is therefore expected to be low overall.	Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush. The legacy marine impact from the slow release of these low concentration / quantity releases is therefore expected to be low overall.
		S S	N	
	Summary	The assessment of the Legacy Marine Impacts sub-criterion is as follows: Option 2C is assessed as being Stronger than Option 4A and Option 5 as the line is removed leaving no legacy impact. Option 4A is assessed as being Neutral to Option 5 as the line remains in both options with the legacy impact from degradation products is expected to be similar presenting a similar (minor) legacy environmental impact. **Overall, Option 2C is preferred from a Legacy Marine Impacts perspective.**		

		O2C - Full Removal - Reverse Installlation With Deburial		O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk
3. Technical	3.1 Technical Risk	Concept Maturity: Reverse reel of rigid pipelines has a limited track record. (Score 2) Technical Risks: Some technical risks associated with the scale / logistics of this option. (Score 2)		Concept Maturity: Cut and lift and rock placement are well proven techniques. (Score 3) Technical Risks: Limited technical risks associated with option (Score 3)	Concept Maturity: Minimal operations, well proven techniques. (Score 3) Technical Risks: Limited technical risks associated with option (Score 3)
		W	**W**	**N**	
	Summary	The assessment of the Technical Risk sub-criterion is as follows: Option 2C is assessed as being Weaker than Option 4A and Option 5 as, while all options employ largely routine operations, the scale of operations to fully recover the line is expected to encounter greater technical challenges than the smaller scope rock cover / cut and lift line ends operations. Option 4A is assessed as being Neutral to Option 5 as the routine operations and scope are similar. **Overall, Option 4A and Option 5 are equally preferred from a Technical Risk perspective.**			
4. Societal	4.1 Fishing	Significant short term disturbance, infrastructure is removed although rock will remain, positive for fishing in the long term. (Score 2)		Minimal operation, a small amount of short term disturbance during operation. However, rock berms are not preferred option from the fishing industry's perspective. (Score 1)	Short operation, small area of localised disturbance. Rock used to remediate cut ends should be profiled with a suitable gradient to avoid impacts for the fishing industry. (Score 2)
		S	**S**	**S**	
	Summary	The assessment of the Societal impact on Fishing sub-criterion is as follows: Option 2C is assessed as being Stronger than Option 4A and Option 5 as the line is removed presenting a clear seabed versus the line remaining surface laid with problem areas rock covered or problem areas remaining. Option 4A is assessed as being Stronger than Option 5 as while the line remains in both options, the problem areas are rock covered in Option 4A but remain in Option 5. **Overall, Option 2C is preferred from a Societal impact on Fishing perspective.**			
4. Societal	4.2 Other Users	Significant quantity of recyclable material returned. (Score 3) Materials Returned: Steel: 1,588 tonnes (recyclable)		Minimal societal benefits / impacts with this option. (Score 3) Materials Returned: Steel: 15 tonnes (recyclable)	Minimal societal benefits / impacts with this option. (Score 3) Materials Returned: Steel: 15 tonnes (recyclable)
		N	**N**	**N**	
	Summary	The assessment of the Societal impact on Other Users sub-criterion is as follows: All options are assessed as Neutral to each other as, while there is greater useful material (steel) returned in Option 2C, the quantity is considered insufficient to express a preference. **Overall, all options are equally preferred from a Societal impact on Other Users perspective.**			
5. Economic	5.1 Short-term Costs	£6.59 Million		£1.538 Million	£1.243 Million
		MW	**MW**	**N**	
		5.06 million more	**5.35 million more**	**0.3 million more**	
		328.5% higher	**430.2% higher**	**23.7% higher**	
	Summary	The assessment of the Short-term Costs sub-criterion is as follows: Option 2C is assessed as being Much Weaker than Option 4A due to the costs to deliver this option being around 4 times higher (£5.1 million more) than Option 4A. Option 2C is assessed as being Much Weaker than Option 5 due to the costs being around 5 times higher (£5.6 million more) than Option 5. Option 4A is assessed as being Neutral to Option 5 due to the costs being similar. **Overall, Option 4A and Option 5 are equally preferred from a Short-term Cost perspective.**			
5. Economic	5.2 Long-term Costs	Surveys: N/A FLTC: N/A Total Legacy Cost: £0 Million		Surveys: £0.884 Million FLTC: N/A Total Legacy Cost: £0.884 Million	Surveys: £0.884 Million FLTC: £0.066 Million Total Legacy Cost: £0.95 Million
		N	**N**	**N**	
	Summary	The assessment of the Long-term Costs sub-criterion is as follows: All options are assessed as being Neutral to each other as, while there are no long-term costs associated with the full removal option, the costs associated with the monitoring and surveying of the line remaining in-situ are relatively minor and insufficient to express a preference. **Overall, all options are equally preferred from a Long-term Cost perspective.**			

I.2 Group 8 Pairwise Comparison Matrices – Safety

1.1 Operations Personnel	O2C - Full Removal - Reverse Installlation With Deburial	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2C - Full Removal - Reverse Installlation With Deburial	N	MW	MW	14.3%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	MS	N	N	42.9%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	MS	N	N	42.9%

1.2 Other Users	O2C - Full Removal - Reverse Installlation With Deburial	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2C - Full Removal - Reverse Installlation With Deburial	N	N	N	33.3%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	N	N	N	33.3%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	N	N	N	33.3%

1.3 High Consequence Events	O2C - Full Removal - Reverse Installlation With Deburial	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2C - Full Removal - Reverse Installlation With Deburial	N	MW	MW	14.3%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	MS	N	N	42.9%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	MS	N	N	42.9%

1.4 Legacy Risk	O2C - Full Removal - Reverse Installlation With Deburial	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2C - Full Removal - Reverse Installlation With Deburial	N	MS	MS	59.8%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	MW	N	S	22.8%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	MW	W	N	17.4%

I.3 Group 8 Pairwise Comparison Matrices – Environment

2.1 Operational Marine Impact	O2C - Full Removal - Reverse Installlation With Deburial	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2C - Full Removal - Reverse Installlation With Deburial	N	N	N	33.3%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	N	N	N	33.3%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	N	N	N	33.3%

2.2 Atmospheric Emissions & Fuel Consumption	O2C - Full Removal - Reverse Installlation With Deburial	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2C - Full Removal - Reverse Installlation With Deburial	N	N	N	33.3%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	N	N	N	33.3%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	N	N	N	33.3%

2.3 Other Consumptions	O2C - Full Removal - Reverse Installlation With Deburial	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2C - Full Removal - Reverse Installlation With Deburial	N	N	N	33.3%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	N	N	N	33.3%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	N	N	N	33.3%

2.4 Seabed Disturbance	O2C - Full Removal - Reverse Installlation With Deburial	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2C - Full Removal - Reverse Installlation With Deburial	N	W	W	25.0%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	S	N	N	37.5%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	S	N	N	37.5%

2.5 Legacy Marine Impacts	O2C - Full Removal - Reverse Installlation With Deburial	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2C - Full Removal - Reverse Installlation With Deburial	N	S	S	42.9%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	W	N	N	28.6%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	W	N	N	28.6%

I.4 Group 8 Pairwise Comparison Matrices – Technical

3.1 Technical Risk	O2C - Full Removal - Reverse Installlation With Deburial	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2C - Full Removal - Reverse Installlation With Deburial	N	W	W	25.0%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	S	N	N	37.5%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	S	N	N	37.5%

I.5 Group 8 Pairwise Comparison Matrices – Societal

4.1 Fishing	O2C - Full Removal - Reverse Installlation With Deburial	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2C - Full Removal - Reverse Installlation With Deburial	N	S	S	42.6%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	W	N	S	32.5%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	W	W	N	24.8%

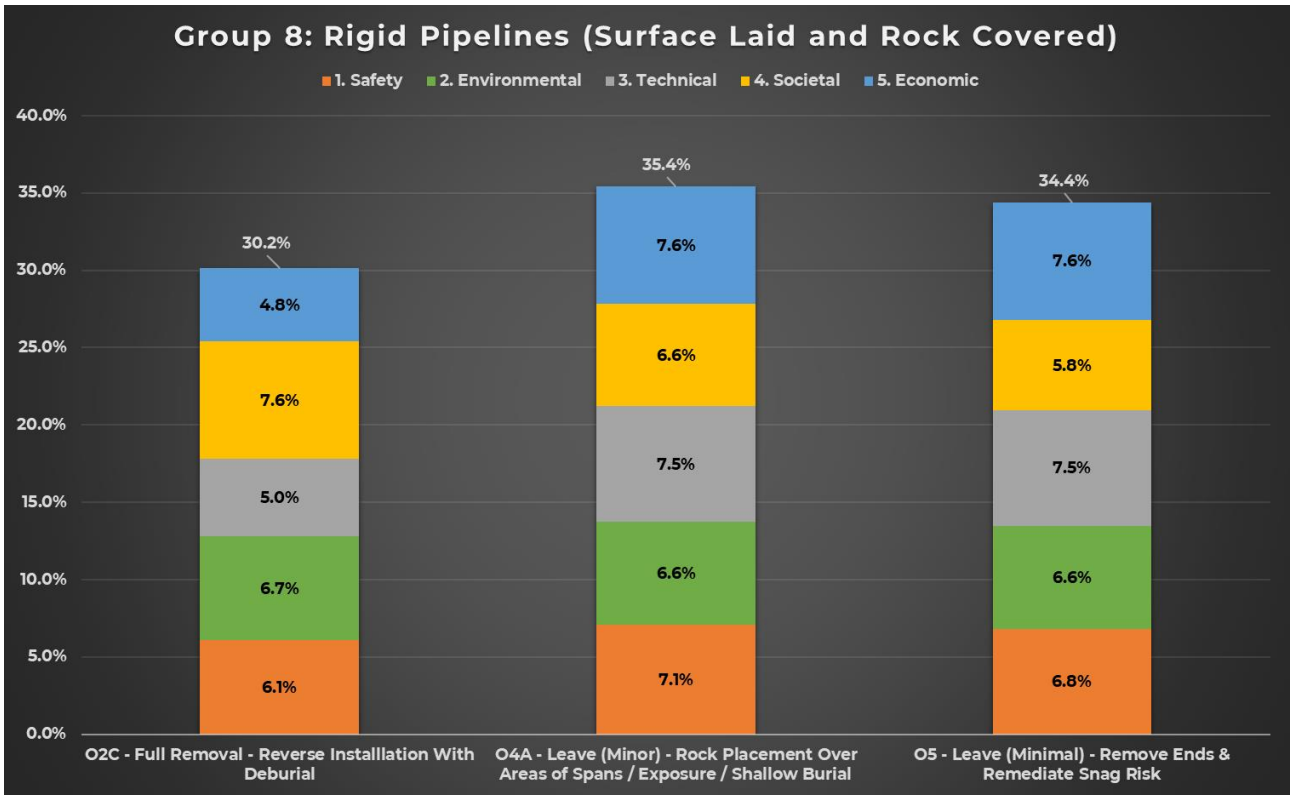
4.2 Other Users	O2C - Full Removal - Reverse Installlation With Deburial	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2C - Full Removal - Reverse Installlation With Deburial	N	N	N	33.3%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	N	N	N	33.3%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	N	N	N	33.3%

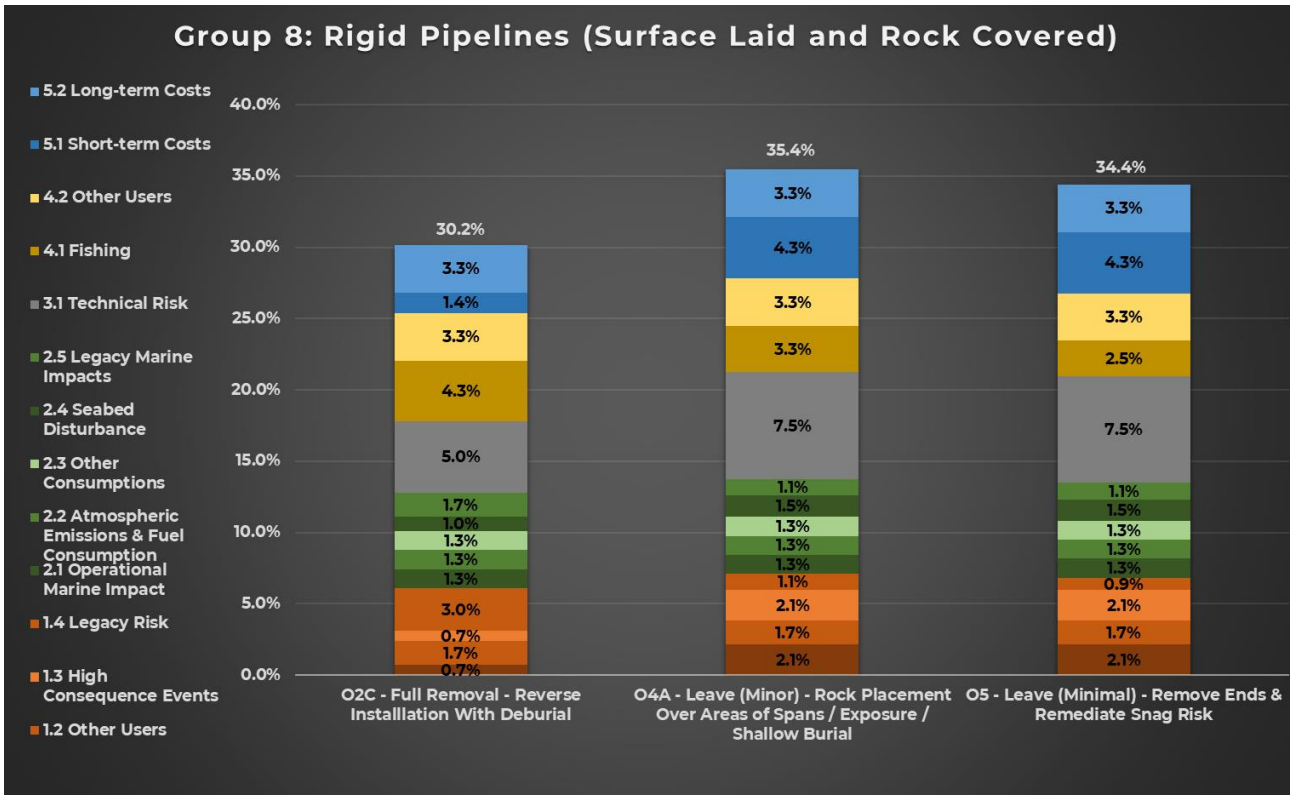
I.6 Group 8 Pairwise Comparison Matrices – Economic

5.1 Short-term Costs	O2C - Full Removal - Reverse Installlation With Deburial	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2C - Full Removal - Reverse Installlation With Deburial	N	MW	MW	14.3%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	MS	N	N	42.9%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	MS	N	N	42.9%

5.2 Long-term Costs	O2C - Full Removal - Reverse Installlation With Deburial	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2C - Full Removal - Reverse Installlation With Deburial	N	N	N	33.3%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	N	N	N	33.3%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	N	N	N	33.3%

I.7 Group 8 Results Charts





APPENDIX J GROUP 9 – DETAILED EVALUATION RESULTS

J.1 Group 9 Attributes Table

Group 9: Rigid Pipelines (Trenched and Buried)

PL1084 (N0740) - 8" Oil Pipeline 1 from Pelican to Cormorant Alpha - 8.467 km | PL1085 (N0741) - 8" Oil Pipeline 2 from Pelican to Cormorant Alpha - 8.338 km | PL1086 (N1121) 6" Gas Lift Pipeline from Cormorant Alpha to Pelican - 8.387 km | PL1087 (N0915) - 8" Water Injection Pipeline from Cormorant Alpha to Pelican 8.337 km
PL3572 (N0605) - 10" Production Pipeline from Cladhan to Tern - 16.8 km | PL3573 (N1149) - 4" Gas Lift Pipeline - Piggybacked to PL3572 from Tern to Cladhan - 16.866 km | PL3574 (N0942) - 10" Water Injection Pipeline from Tern to Cladhan - 16.6 km
PL1018/A - 10" Production Pipeline from Hudson to Tern - 10.167 km | PL1019/A - 10" Production Pipeline from Hudson to Tern - 10.150 km | PL1020/A - 8" Production/Test Line from Hudson to Tern - 10.134 km | PL1025/A - 6" L2 Production/Test Pipeline from Well L2 to Hudson Manifold - 1.61 km

	O2C - Full Removal - Reverse Installlation With Deburial	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk
	- Pipeline is disconnected - Diver initiation preparation - Line deburied using MFE - Cut pipeline around crossing locations - Reverse reel pipelines and return to shore	- Pipeline is disconnected - Rock placement over areas of spans / exposures / shallow burial	- Pipeline is disconnected - Re-trench and bury areas of spans / exposures / shallow burial - Removal of line ends outwith existing trench - Placement of rock bags to mitigate snag risk from cut ends	- Pipeline is disconnected - Remove areas of spans / exposures / shallow burial by cut and lift - Removal of line ends outwith existing trench - Remediate cut ends with rock	- Pipeline is disconnected - Remove pipeline ends by cut and lift - Remediate cut ends with rock
1. Safety **1.1 Operations Personnel**	Vessel Type: PoB / Days / Hours / PLL DSV: 110 / 7.6 / 10,072 / 7.55E-04 Divers: 18 / 7.6 / 3,296 / 3.20E-03 CSV: 76 / 118.1 / 107,680 / 8.08E-03 Reel Vessel: 76 / 55.4 / 50,516 / 3.79E-03 Total offshore hours: 171,563 hrs Total offshore PLL: 1.58E-02 Resource Type: Days / Hours / PLL Engineering & Management: 3,225.0 / 25,800 / 1.03E-04 Project Management: 3,041.0 / 24,328 / 9.73E-05 Onshore Operations (includes Cleaning & Disposal): 238.0 / 15,232 / 1.87E-03 Total onshore hours: 65,360 hrs Total onshore PLL: 2.07E-03 Total operational hours: 236,923 hrs Total operational PLL: 1.79E-02	Vessel Type: PoB / Days / Hours / PLL CSV: 76 / 22.8 / 20,803 / 1.56E-03 Rockdump Vessel: 20 / 13.7 / 3,278 / 2.46E-04 Total offshore hours: 24,081 hrs Total offshore PLL: 1.81E-03 Resource Type: Days / Hours / PLL Engineering & Management: 425.0 / 13,600 / 5.44E-05 Project Management: 430.0 / 6,880 / 2.75E-05 Total onshore hours: 20,480 hrs Total onshore PLL: 8.19E-05 Total operational hours: 24,081 hrs Total operational PLL: 1.81E-03	Vessel Type: PoB / Days / Hours / PLL CSV: 76 / 22.8 / 20,803 / 1.56E-03 Trenching Vessel: 55 / 12.6 / 8,329 / 6.25E-04 Total offshore hours: 29,132 hrs Total offshore PLL: 2.18E-03 Resource Type: Days / Hours / PLL Engineering & Management: 630.9 / 5,047 / 2.02E-05 Project Management: 600.0 / 4,800 / 1.92E-05 Onshore Operations (includes Cleaning & Disposal): 5.0 / 320 / 3.94E-05 Total onshore hours: 10,167 hrs Total onshore PLL: 7.87E-05 Total operational hours: 39,299 hrs Total operational PLL: 2.26E-03	Vessel Type: PoB / Days / Hours / PLL CSV: 76 / 32.2 / 29,330 / 2.20E-03 Rockdump Vessel: 20 / 6.2 / 1,486 / 1.11E-04 Total offshore hours: 30,816 hrs Total offshore PLL: 2.31E-03 Resource Type: Days / Hours / PLL Engineering & Management: 444.1 / 3,553 / 1.42E-05 Project Management: 415.0 / 3,320 / 1.33E-05 Onshore Operations (includes Cleaning & Disposal): 9.0 / 576 / 7.08E-05 Total onshore hours: 7,449 hrs Total onshore PLL: 9.83E-05 Total operational hours: 38,264 hrs Total operational PLL: 2.41E-03	Vessel Type: PoB / Days / Hours / PLL CSV: 76 / 21.0 / 19,134 / 1.44E-03 Rockdump Vessel: 20 / 6.7 / 1,601 / 1.20E-04 Total offshore hours: 20,735 hrs Total offshore PLL: 1.56E-03 Resource Type: Days / Hours / PLL Engineering & Management: 350.0 / 2,800 / 1.12E-05 Project Management: 328.0 / 2,624 / 1.05E-05 Onshore Operations (includes Cleaning & Disposal): 5.0 / 320 / 3.94E-05 Total onshore hours: 5,744 hrs Total onshore PLL: 6.11E-05 Total operational hours: 26,479 hrs Total operational PLL: 1.62E-03
Summary	**MW** **MW** **MW** **MW**	**N** **N** **N**	**N** **W**	**W**	
	9.8895 **7.92035** **7.42739** **11.0494**	**0.80088496** **0.75103734** **1.11728395**	**0.937759336** **1.395061728**	**1.487654321**	
	The assessment of the Operations Personnel sub-criterion is as follows: Option 2C is assessed as being Much Weaker than Option 4A due to the risk exposure being around 10 times higher in Option 2C. This is due to the greater offshore scope (with diver support) associated with the full removal of these lines versus the smaller scope and lower risk activities to perform rock placement over problem areas of the lines in Option 4A. Option 2C is assessed as being Much Weaker than Option 4B due to the risk exposure being around 8 times higher in Option 2C again, due to the greater full removal scope. Option 2C is assessed as being Much Weaker than Option 4C due to the risk exposure being around 7 times higher in Option 2C again, due to the greater full removal scope. Option 2C is assessed as being Much Weaker than Option 5 due to the risk exposure being around 11 times higher in Option 2C again, due to the greater full removal scope. Option 4A is assessed as being Neutral to all other options as, while there are small differences in the risk exposure across these options, these differences are considered insufficient to express a preference. Option 4B is assessed as being Neutral to Option 4C as, while there are small differences in the risk exposure across these options, these differences are considered insufficient to express a preference. Option 4B is assessed as being Weaker than Option 5 due to the risk exposure being around 40% higher in Option 4B from the longer duration offshore operations to trench and bury the problem areas of the lines versus line end removal only. Option 4C is assessed as being Weaker than Option 5 due to the risk exposure being around 50% higher in Option 4C from the longer duration offshore operations to remove the problem areas of the lines versus line end removal only. **Overall, Option 5 is preferred from a risk to Operations Personnel perspective.**				
1. Safety **1.2 Other Users**	Vessel Days: DSV: 7.6 CSV: 118.1 Reel Vessel: 55.4 Total vessel days: 181.1 days Transits: 34	Vessel Days: CSV: 22.8 Rockdump Vessel: 13.7 Total vessel days: 36.5 days Transits: 4	Vessel Days: CSV: 22.8 Trenching Vessel: 12.6 Total vessel days: 35.4 days Transits: 4	Vessel Days: CSV: 32.2 Rockdump Vessel: 6.2 Total vessel days: 38.4 days Transits: 4	Vessel Days: CSV: 21.0 Rockdump Vessel: 6.7 Total vessel days: 27.7 days Transits: 4
Summary	**W** **W** **W** **W**	**N** **N** **N**	**N** **N**	**N**	
	The assessment of the Other Users sub-criterion is as follows: Option 2C is assessed as being Weaker than all other options due to the higher number of vessel days and transits required in the full removal option. All other options are assessed as being Neutral to each other as the number of vessel days and transits are largely similar across these options. **Overall, Option 4A, Option 4B, Option 4C and Option 5 are equally preferred from a risk to Other Users perspective.**				

	O2C - Full Removal - Reverse Installlation With Deburial	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk
1. Safety – 1.3 High Consequence Events	Routine, low risk reeling operations. There are 30 lifts of the line ends through the water column to initiate reeling. There are an additional 38 lifts associated recovering the cut sections around the crossing locations. In addition there is the potential for dropped object associated with the offloading of the reels and cut line sections to the quayside. Small number of lifting operations to deploy and recover cutting equipment.	Routine, low risk rock cover operations. High number of lifting operations (264) to recover the line ends. Small number of lifting operations through the water column to deploy and recover cutting equipment. In addition there is the potential for dropped object associated with the offloading of the cut line sections to the quayside.	Routine, low risk trenching operations. High number of lifting operations (302) to recover the line ends and to place rock bags. Small number of lifting operations through the water column to deploy and recover trenching and cutting equipment. In addition there is the potential for dropped object associated with the offloading of the cut line sections to the quayside.	High number of lifting operations (445) to recover the line ends and areas of spans / exposure / shallow burial. Small number of lifting operations through the water column to deploy and recover cutting equipment. In addition there is the potential for dropped object associated with the offloading of the cut line sections to the quayside.	High number of lifting operations (264) to recover the line ends and to place rock bags. Small number of lifting operations through the water column to deploy and recover cutting equipment. In addition there is the potential for dropped object associated with the offloading of the cut line sections to the quayside.
	N N S N	N S N	S N	W	
Summary	The assessment of the High Consequence Events sub-criterion is as follows: Option 2C is assessed as being Neutral to Option 4A, Option 4B and Option 5 as potential for high consequence from the offloading (reeling) at the quayside in Option 2C is considered similar to the potential for high consequence events from a dropped object in the (around 300) offshore lifting operations in the other options. Option 2C is assessed as being Stronger than Option 4C as there are more (around 450) offshore lifting operations in Option 4C. Option 4A is assessed as being Neutral to Option 4B and Option 5 as the potential for high consequence events from a dropped object in the (around 300) offshore lifting operations in these options is similar. Option 4A is assessed as being Stronger than Option 4C as there are more (around 450) offshore lifting operations in Option 4C. Option 4B is assessed as being Stronger than Option 4C as there are more (around 450) offshore lifting operations in Option 4C. Option 4B is assessed as being Neutral to Option 5 as the potential for high consequence events from a dropped object in the (around 300) offshore lifting operations in these options is similar. Option 4C is assessed as being Weaker than Option 5 as there are more (around 450) offshore lifting operations in Option 4C. **Overall, Option 2C, Option 4A, Option 4B and Option 5 are equally preferred from a High Consequence Events perspective.**				
1. Safety – 1.4 Legacy Risk	No legacy risk from this full removal option.	The lines would remain in-situ with this option although the majority of their length would be trenched and buried with rock placement over areas of spans \ exposures \ shallow burial. The survey & monitoring programme is committed to ensuring that the potential snag hazard from left in-situ infrastructure continues to be managed & mitigated as appropriate. Vessel Type: PoB / Days / Hours / PLL Survey Vessel (Legacy): 44 / 53.0 / 27,968 / 2.10E-03	The lines would remain in-situ with this option although would be fully trenched and buried. The survey & monitoring programme is committed to ensuring that the potential snag hazard from left in-situ infrastructure continues to be managed & mitigated as appropriate. Vessel Type: PoB / Days / Hours / PLL Survey Vessel (Legacy): 44 / 53.0 / 27,968 / 2.10E-03	The lines would remain in-situ with this option although would be fully trenched and buried as areas of spans / exposures / shallow burial are removed. The survey & monitoring programme is committed to ensuring that the potential snag hazard from left in-situ infrastructure continues to be managed & mitigated as appropriate. Vessel Type: PoB / Days / Hours / PLL Survey Vessel (Legacy): 44 / 53.0 / 27,968 / 2.10E-03	The lines would remain in-situ with this option although the majority of their length would be trenched and buried. The line ends will be removed with small areas of rock cover to mitigate potential snag hazard from cut ends. Spans and exposures will remain. The survey & monitoring programme is committed to ensuring that the potential snag hazard from left in-situ infrastructure continues to be managed & mitigated as appropriate. Vessel Type: PoB / Days / Hours / PLL Survey Vessel (Legacy): 44 / 53.0 / 27,968 / 2.10E-03
	S S S MS	W W S	N MS	MS	
Summary	The assessment of the Legacy Risk sub-criterion is as follows: Option 2C is assessed as being Stronger than Option 4A, Option 4B and Option 4C as the lines are fully removed and as such there is no legacy risk versus the lines remaining largely trenched and buried with problem areas addressed by rock cover / trenching / removal in the other options, where the potential for snag hazard remains although this is mitigated by the survey and monitoring programme. Option 2C is assessed as being Much Stronger than Option 5 as there is no legacy risk as the lines are removed versus the lines remaining, largely trenched and buried albeit with areas of spans remaining in Option 5. Option 4A is assessed as being Weaker than Option 4B and Option 4C as, while the lines remain in all three options, Option 4B and Option 4C present more of a clear seabed due to the problem areas being trenched or removed versus being rock covered in Option 4A. Option 4A is assessed as being Stronger than Option 5 as while the lines remain in both options, problem areas are rock covered in Option 4A whereas the problem areas would remain in Option 5. Option 4B is assessed as being Neutral to Option 4C as both options present a clear seabed. Option 4B is assessed as being Stronger than Option 5 as while the lines remain in both options, problem areas are trenched in Option 4B whereas the problem areas would remain in Option 5. Option 4C is assessed as being Stronger than Option 5 as while the lines remain in both options, problem areas are removed in Option 4C whereas the problem areas would remain in Option 5. **Overall, Option 2C is preferred from a Legacy Risk perspective.**				

	O2C - Full Removal - Reverse Installlation With Deburial	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk
2. Environmental — **2.1 Operational Marine Impact**	Vessel Noise (days on-site): 134.3 days Tooling Noise (MFE & Hydraulic Shears) = 101.1 days Operation releases: Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush and releases to the marine environment during flushing activities. There will be potential for the release of all residual contents in one location at one time during the reverse reeling operations. However, given the prior cleaning of the lines, the concentration and quantity of release should still be low overall. Therefore, the related impact is also anticipated to be low. Vessel releases: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore at 134.3 days is the highest of all options. The environmental impact is considered to be negligible.	Vessel Noise (days on-site): 25.0 days Tooling Noise (Hydraulic Shears) = 5.9 days Operation releases: Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush and releases to the marine environment during flushing activities. As line is being rock covered there is negligible release from the line. Vessel releases: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore at 25 days is not considered significant. The environmental impact is considered to be negligible.	Vessel Noise (days on-site): 26.9 days Tooling Noise (Trenching & Hydraulic Shears) = 9.5 days Operation releases: Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush and releases to the marine environment during flushing activities. Cutting of line ends would lead to an elevated release of fluids from within the line. However, given the prior cleaning of the line, the concentration and quantity of release should still be low overall. Therefore, the related impact is also anticipated to be low. Vessel releases: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore at 26.9 days is not considered significant. The environmental impact is considered to be negligible.	Vessel Noise (days on-site): 29.8 days Tooling Noise (MFE & Hydraulic Shears) = 18.3 days Operation releases: Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush and releases to the marine environment during flushing activities. Cutting of line ends and midline cuts would lead to an elevated release of fluids from within the line. However, given the prior cleaning of the line, the concentration and quantity of release should still be low overall. Therefore, the related impact is also anticipated to be low. Vessel releases: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore at 29.8 days is not considered significant. The environmental impact is considered to be negligible.	Vessel Noise (days on-site): 18.3 days Tooling Noise (Hydraulic Shears) = 5.9 days Operation releases: Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush and releases to the marine environment during flushing activities. Cutting of line ends would lead to an elevated release of fluids from within the line. However, given the prior cleaning of the line, the concentration and quantity of release should still be low overall. Therefore, the related impact is also anticipated to be low. Vessel releases: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore at 18.3 days is not considered significant. The environmental impact is considered to be negligible.
	W **W** **W** **W**	**N** **N** **N**	**N** **N**	**N**	
Summary	The assessment of the Operational Marine Impact sub-criterion is as follows: Option 2C is assessed as being Weaker than all other options as there are many more vessel days and days of tooling operations associated with Option 2C which generate a greater noise impact than the other options. Other impacts are negligible. All other options are assessed as being Neutral to each other as the marine impacts are largely similar (and negligible) for these options. **Overall, Option 4A, Option 4B, Option 4C and Option 5 are equally preferred from an Operational Marine Impact perspective.**				
2. Environmental — **2.2 Atmospheric Emissions & Fuel Consumption**	Vessel Emissions (in tonnes): Fuel: 5,580 CO2: 17,689 NOx: 331.46 SO2: 22.32 Vessel Energy Use: 239,948 GJ	Vessel Emissions (in tonnes): Fuel: 2,417 CO2: 7,661 NOx: 143.55 SO2: 9.67 Vessel Energy Use: 103,914 GJ	Vessel Emissions (in tonnes): Fuel: 2,399 CO2: 7,604 NOx: 142.48 SO2: 9.59 Vessel Energy Use: 103,142 GJ	Vessel Emissions (in tonnes): Fuel: 2,550 CO2: 8,082 NOx: 151.44 SO2: 10.20 Vessel Energy Use: 109,630 GJ	Vessel Emissions (in tonnes): Fuel: 2,245 CO2: 7,116 NOx: 133.34 SO2: 8.98 Vessel Energy Use: 96,526 GJ
	W **W** **W** **W**	**N** **N** **N**	**N** **N**	**N**	
Summary	The assessment of the Atmospheric Emissions & Consumptions sub-criterion is as follows: Option 2C is assessed as being Weaker than all other options as the emissions and fuel use is around double that of the other options. All other options are assessed as being Neutral to each other as, while there are differences in the emissions and fuel use across these options, the differences are considered insufficient to express a preference. **Overall, Option 4A, Option 4B, Option 4C and Option 5 are equally preferred from an Atmospheric Emissions & Consumptions perspective.**				
2. Environmental — **2.3 Other Consumptions**	Material Emissions (CO2 in tonnes): Recovered Material: 6,049 Remaining Material: Total: 6,049 Rock: N/A tonnes	Material Emissions (CO2 in tonnes): Recovered Material: 115 Remaining Material: 11,032 Total: 11,147 Rock: 18,512 tonnes	Material Emissions (CO2 in tonnes): Recovered Material: 115 Remaining Material: 11,032 Total: 11,147 Rock: 352 tonnes	Material Emissions (CO2 in tonnes): Recovered Material: 212 Remaining Material: 10,852 Total: 11,064 Rock: 2,450 tonnes	Material Emissions (CO2 in tonnes): Recovered Material: 115 Remaining Material: 11,032 Total: 11,147 Rock: 550 tonnes
	S **N** **N** **N**	**W** **W** **W**	**N** **N**	**N**	
Summary	The assessment of the Other Consumptions sub-criterion is as follows: Option 2C is assessed as being Stronger than Option 4A due to greater impact from the replacing material left in-situ versus recycling the material returned in Option 2C and the consumption of a moderate quantity of rock resource in Option 4A. Option 2C is assessed as being Neutral to Option 4B, Option 4C and Option 5 as, while there is greater impact from replacing material left in-situ in these options versus recycling the material returned in Option 2C, this difference is considered insufficient to express a preference. The varying quantities of rock consumed are also considered insufficient to express a preference. Option 4A is assessed as being Weaker than all other options due to greater quantity of rock consumption in Option 4A. All remaining options are assessed as being Neutral to each other as while there are differences in the rock consumption, these are considered insufficient to express a preference. **Overall, Option 2C, Option 4B, Option 4C and Option 5 are equally preferred from an Other Consumptions perspective.**				

		O2C - Full Removal - Reverse Installlation With Deburial	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk
2. Environmental	2.4 Seabed Disturbance	Seabed Disturbance (m2): MFE: 579,280 No rock cover in this option.	Seabed Disturbance (m2): Rock Cover: 22,612 Habitat Loss / Change (m2): Rock Cover: 22,612	Seabed Disturbance (m2): Rock Cover: 550 Trenching: 29,619 Habitat Loss / Change (m2): Rock Bags: 550	Seabed Disturbance (m2): Rock Cover: 9,800 Habitat Loss / Change (m2): Rock Cover: 9,800	Seabed Disturbance (m2): Rock Cover: 2,200 Habitat Loss / Change (m2): Rock Cover: 2,200
		S W W W	W W W	S N	W	
	Summary	The assessment of the Seabed Disturbance sub-criterion is as follows: Option 2C is assessed as being Stronger than Option 4A as, while there is significant area of seabed disturbance from the deburial operations in Option 2C, this impact is temporary in nature whereas the area impacted in Option 4A represents a permanent habitat change. Option 2C is assessed as being Weaker than Option 4B, Option 4C and Option 5 as the large area of albeit temporary impact in Option 2C is considered less preferred than the varying but small areas of permanent habitat change across the other options. Option 4A is assessed as being Weaker than Option 4B, Option 4C and Option 5 as, while all options have varying areas of temporary and permanent impacts, Option 4A has the greatest area of permanent habitat change from the rock cover introduced. Option 4B is assessed as being Stronger than Option 4C as, while there is a moderate area of temporary impact from the trenching operations in Option 4B, the larger area of permanent habitat change from the rock cover in Option 4C is considered to have greater impact. Option 4B is assessed as being Neutral to Option 5 as the impact from the larger area of temporary seabed disturbance from the trenching operations is considered to have a similar impact to the smaller area of permanent habitat change from the rock cover in Option 5. Option 4C is assessed as being Weaker than Option 5 due to the greater area of permanent habitat change from the rock cover in Option 4C. **Overall, Option 4B is preferred from a Seabed Disturbance perspective.**				
2. Environmental	2.5 Legacy Marine Impacts	No legacy marine impact from this full removal option.	Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush. The legacy marine impact from the slow release of these low concentration / quantity releases is therefore expected to be low overall.	Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush. The legacy marine impact from the slow release of these low concentration / quantity releases is therefore expected to be low overall.	Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush. The legacy marine impact from the slow release of these low concentration / quantity releases is therefore expected to be low overall.	Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush. The legacy marine impact from the slow release of these low concentration / quantity releases is therefore expected to be low overall.
		S S S MS	N N S	N S	S	
	Summary	The assessment of the Legacy Marine Impacts sub-criterion is as follows: Option 2C is assessed as being Stronger than Option 4A, Option 4B and Option 4C as there is no legacy marine impacts associated with the full removal option whereas there will be slow degradation of the lines and releases over a long time period with the other options although this is reduced as the lines will be fully trenched and buried with rock cover / trenching / removal of problem areas. As such, the lines left in-situ will be largely isolated from the marine environment. Option 2C is assessed as being Much Stronger than Option 5 as there is no legacy marine impacts associated with the full removal option whereas there will be slow degradation of the lines and releases over a long time period with Option 5 where sections of the lines remain exposed to the marine environment. Option 4B is assessed as being Neutral to Option 4C as the lines remain in both options and are largely isolated from the marine environment. Option 4B is assessed as being Stronger than Option 5 as the legacy marine impact is expected to be marginally greater for Option 5 where sections of the lines remain exposed to the marine environment. Option 4C is assessed as being Stronger than Option 5 as the legacy marine impact is expected to be marginally greater for Option 5 where sections of the lines remain exposed to the marine environment. **Overall, Option 2C is preferred from a Legacy Marine Impacts perspective.**				
3. Technical	3.1 Technical Risk	Concept Maturity: Limited track record. (Score 1) Technical Risks: Large scale scope. Success is dependant upon pipeline integrity. Medium potential for failure. (Score 2)	Concept Maturity: Rock placement is well proven with a good track record (Score 3) Technical Risks: Limited technical risks associated with this option (Score 3)	Concept Maturity: Post trenching of pipeline sections has a good track record. (Score 3) Technical Risks: The group represents trenched pipelines, therefore trenching should be feasible. However, areas of exposure may be associated with difficult to trench sections. (Score 2)	Concept Maturity: Pipe cutting operation is well proven with a good track record (Score 3) Technical Risks: Limited technical risks associated with this option (Score 3)	Concept Maturity: Pipe cutting operation is well proven with a good track record (Score 3) Technical Risks: Limited technical risks associated with this option (Score 3)
		W W W W	S N N	W W	N	
	Summary	The assessment of the Technical Risk sub-criterion is as follows: Option 2C is assessed as being Weaker than all other options as, while all operations are considered routine, there are challenges performing deburial and cutting / lifting at this scale (115 km of lines), whereas the scopes for the other options are smaller in scale. Option 4A is assessed as being Stronger than Option 4B as the simple rock cover operations are expected to present less challenges than the trenching of problem areas of the lines. Option 4A is assessed as being Neutral to Option 4C and Option 5 as the simple rock cover operations, problem area removal or line end removal are expected to present similar, low potential for technical challenges. Option 4B is assessed as being Weaker than Option 4C and Option 5 as the trenching operations are likely to present greater technical challenges than the problem area / line end removal. Option 4C is assessed as being Neutral to Option 5 as the problem area removal or line end removal are expected to present similar, low potential for technical challenges. **Overall, Option 4A, Option 4C and Option 5 are equally preferred from a Technical Risk perspective.**				
4. Societal	4.1 Fishing	Large operation with significant localised disruption. Infrastructure removed, seabed left clear for fishing. (Score 2)	Relatively short operation. Rock berms are not fishing industry's preferred decommissioning solution. (Score 1)	Medium duration operation in the short-term. If successful, seabed will be left clear for fishing operations. (Score 3)	Significant duration operation in the short-term. Rock to mitigate cut ends should be flush with seabed and not pose any obstacle to fishing operations. (Score 2)	Relatively short duration operation in the short-term. Rock to mitigate cut ends should be flush with seabed and not pose any obstacle to fishing operations. (Score 3)
		S S S MS	W W S	N MS	MS	
	Summary	The assessment of the Societal impact on Fishing sub-criterion is as follows: Option 2C is assessed as being Stronger than Option 4A, Option 4B and Option 4C as the full removal of the lines in Option 2C is preferred to lines remaining trenched and buried with problem areas addressed by rock cover / trenching or removal respectively. Option 2C is assessed as being Much Stronger than Option 5 as the lines are removed versus lines remaining largely trenched and buried with problem areas remaining. Option 4A is assessed as being Weaker than Option 4B and Option 4C as, while the lines remain in all three options, Option 4B and Option 4C present more of a clear seabed due to the problem areas being trenched or removed versus being rock covered in Option 4A. Option 4A is assessed as being Stronger than Option 5 as while the lines remain in both options, problem areas are rock covered in Option 4A whereas the problem areas would remain in Option 5. Option 4B is assessed as being Neutral to Option 4C as both options present a clear seabed. Option 4B is assessed as being Much Stronger than Option 5 as while the lines remain in both options, problem areas are trenched in Option 4B whereas the problem areas would remain in Option 5. Option 4C is assessed as being Much Stronger than Option 5 as while the lines remain in both options, problem areas are removed in Option 4C whereas the problem areas would remain in Option 5.. **Overall, Option 2C is preferred from a Societal impact on Fishing perspective.**				

	O2C - Full Removal - Reverse Installlation With Deburial				O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial			O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial		O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk
4. Societal – **4.2 Other Users**	Large amount of recyclable material returned. Large amount of material (polymer) that may have to go to land fill. (Score 2) Materials Returned: Steel: 5,954 tonnes (recyclable) Polymer: 1,177 tonnes (landfill)				Minimal societal benefits / impacts with this option. (Score 3) Materials Returned: Steel: 114 tonnes (recyclable) Polymer: 23 tonnes (landfill)			Minimal societal benefits / impacts with this option. (Score 3) Materials Returned: Steel: 114 tonnes (recyclable) Polymer: 23 tonnes (landfill)		Minimal societal benefits / impacts with this option. (Score 3) Materials Returned: Steel: 209 tonnes (recyclable) Polymer: 42 tonnes (landfill)	Minimal societal benefits / impacts with this option. (Score 3) Materials Returned: Steel: 114 tonnes (recyclable) Polymer: 23 tonnes (landfill)
	N	**N**	**N**	**N**	**N**	**N**	**N**	**N**	**N**	**N**	
Summary	The assessment of the Societal impact on Other Users sub-criterion is as follows: All options are assessed as Neutral to each other as the positive and negative societal impacts are considered largely insignificant across all options. It is noted that a greater quantity of useful, recyclable material (steel) is returned in Option 2C, however the societal benefit of this is offset by the larger quantity of polymer returned which is likely to end up in landfill. **Overall, all options are equally preferred from a Societal impact on Other Users perspective.**										
5. – **5.1 Short-term Costs**	£29.847 Million				£4.734 Million			£6.042 Million		£4.239 Million	£3.738 Million
	MW	**MW**	**MW**	**MW**	**N**	**N**	**N**	**N**	**N**	**N**	
	25.113 million more	**23.805 million more**	**25.608 million more**	**26.109 million more**	**1.308 million less**	**0.495 million more**	**0.996 million more**	**1.803 million more**	**2.304 million more**	**0.501 million more**	
	530.5% higher	**394.0% higher**	**604.1% higher**	**698.5% higher**	**21.6% lower**	**11.7% higher**	**26.6% higher**	**42.5% higher**	**61.6% higher**	**13.4% higher**	
Summary	The assessment of the Short-term Costs sub-criterion is as follows: Option 2C is assessed as being Much Weaker than Option 4A due to the costs being around 6 times higher (£25.1 million more) for Option 4A. Option 2C is assessed as being Much Weaker than Option 4B due to the costs being around 5 times higher (£23.8 million more) for Option 4B. Option 2C is assessed as being Much Weaker than Option 4C due to the costs being around 7 times higher (£25.6 million more) for Option 4C. Option 2C is assessed as being Much Weaker than Option 5 due to the costs being around 8 times higher (£26.1 million more) for Option 5. Option 4A is assessed as being Neutral to Option 4B, Option 4C and Option 5 as, while there are differences in the costs to deliver these options, they are insufficient to express a preference. Option 4B is assessed as being Neutral to Option 4C and Option 5 as, while there are differences in the costs to deliver these options, they are insufficient to express a preference.. Option 4C is assessed as being Neutral to Option 5 as, while there are differences in the costs to deliver these options, they are insufficient to express a preference.. **Overall, Option 4A, Option 4B, Option 4C and Option 5 are equally preferred from a Short-term Cost perspective.**										
5. Economic – **5.2 Long-term Costs**	Surveys: N/A FLTC: N/A Total Legacy Cost: £0 Million				Surveys: £1.59 Million FLTC: £0.348 Million Total Legacy Cost: £1.94 Million			Surveys: £1.59 Million FLTC: N/A Total Legacy Cost: £1.59 Million		Surveys: £1.59 Million FLTC: N/A Total Legacy Cost: £1.59 Million	Surveys: £1.59 Million FLTC: £0.348 Million Total Legacy Cost: £1.94 Million
	S	**S**	**S**	**S**	**N**	**N**	**N**	**N**	**N**	**N**	
Summary	The assessment of the Long-term Costs sub-criterion is as follows: Option 2C is assessed as being Stronger than all other options due to there being no legacy costs associated with Option 2C versus the costs associated with the surveying and monitoring of the infrastructure left in-situ in the other options. All other options are assessed as being Neutral to each other as the long-term costs are largely similar for these options. **Overall, Option 2C is preferred from a Long-term Cost perspective.**										

J.2 Group 9 Pairwise Comparison Matrices – Safety

1.1 Operations Personnel	O2C - Full Removal - Reverse Installlation With Deburial	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2C - Full Removal - Reverse Installlation With Deburial	N	MW	MW	MW	MW	7.7%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	MS	N	N	N	N	23.0%
O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	MS	N	N	N	W	21.2%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	MS	N	N	N	W	21.2%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	MS	N	S	S	N	27.0%

1.2 Other Users	O2C - Full Removal - Reverse Installlation With Deburial	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2C - Full Removal - Reverse Installlation With Deburial	N	W	W	W	W	14.3%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	S	N	N	N	N	21.4%
O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	S	N	N	N	N	21.4%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	S	N	N	N	N	21.4%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	S	N	N	N	N	21.4%

1.3 High Consequence Events	O2C - Full Removal - Reverse Installlation With Deburial	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2C - Full Removal - Reverse Installlation With Deburial	N	N	N	S	N	21.4%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	N	N	N	S	N	21.4%
O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	N	N	N	S	N	21.4%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	W	W	W	N	W	14.3%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	N	N	N	S	N	21.4%

1.4 Legacy Risk	O2C - Full Removal - Reverse Installlation With Deburial	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2C - Full Removal - Reverse Installlation With Deburial	N	S	S	S	MS	29.4%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	W	N	W	W	S	15.7%
O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	W	S	N	N	MS	23.0%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	W	S	N	N	MS	23.0%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	MW	W	MW	MW	N	8.8%

J.3 Group 9 Pairwise Comparison Matrices – Environment

2.1 Operational Marine Impact

	O2C - Full Removal - Reverse Installation With Deburial	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2C - Full Removal - Reverse Installation With Deburial	N	W	W	W	W	14.3%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	S	N	N	N	N	21.4%
O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	S	N	N	N	N	21.4%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	S	N	N	N	N	21.4%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	S	N	N	N	N	21.4%

2.2 Atmospheric Emissions & Fuel Consumption

	O2C - Full Removal - Reverse Installation With Deburial	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2C - Full Removal - Reverse Installation With Deburial	N	W	W	W	W	14.3%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	S	N	N	N	N	21.4%
O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	S	N	N	N	N	21.4%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	S	N	N	N	N	21.4%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	S	N	N	N	N	21.4%

2.3 Other Consumptions

	O2C - Full Removal - Reverse Installation With Deburial	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2C - Full Removal - Reverse Installation With Deburial	N	S	N	N	N	21.4%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	W	N	W	W	W	14.3%
O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	N	S	N	N	N	21.4%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	N	S	N	N	N	21.4%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	N	S	N	N	N	21.4%

2.4 Seabed Disturbance

	O2C - Full Removal - Reverse Installation With Deburial	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2C - Full Removal - Reverse Installation With Deburial	N	S	W	W	W	16.6%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	W	N	W	W	W	14.1%
O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	S	S	N	S	N	24.9%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	S	S	W	N	W	19.5%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	S	S	N	S	N	24.9%

2.5 Legacy Marine Impacts

	O2C - Full Removal - Reverse Installation With Deburial	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2C - Full Removal - Reverse Installation With Deburial	N	S	S	S	MS	30.4%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	W	N	N	N	S	19.2%
O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	W	N	N	N	S	19.2%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	W	N	N	N	S	19.2%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	MW	W	W	W	N	12.1%

J.4 Group 9 Pairwise Comparison Matrices – Technical

3.1 Technical Risk	O2C - Full Removal - Reverse Installation With Deburial	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2C - Full Removal - Reverse Installlation With Deburial	N	W	W	W	W	14.2%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	S	N	S	N	N	23.1%
O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	S	W	N	W	W	16.7%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	S	N	S	N	N	23.1%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	S	N	S	N	N	23.1%

J.5 Group 9 Pairwise Comparison Matrices – Societal

4.1 Fishing	O2C - Full Removal - Reverse Installlation With Deburial	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2C - Full Removal - Reverse Installlation With Deburial	N	S	S	S	MS	29.4%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	W	N	W	W	S	15.7%
O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	W	S	N	N	MS	23.0%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	W	S	N	N	MS	23.0%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	MW	W	MW	MW	N	8.8%

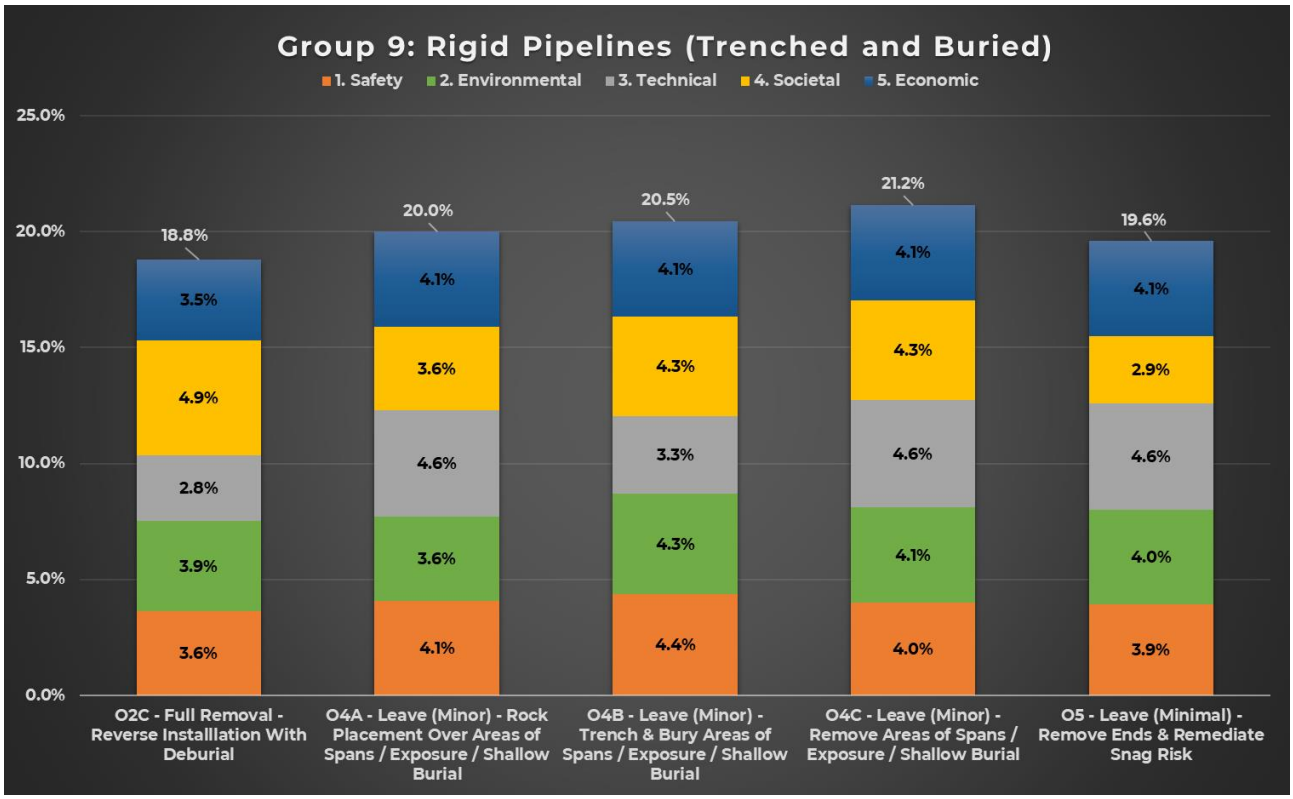
4.2 Other Users	O2C - Full Removal - Reverse Installlation With Deburial	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2C - Full Removal - Reverse Installlation With Deburial	N	N	N	N	N	20.0%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	N	N	N	N	N	20.0%
O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	N	N	N	N	N	20.0%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	N	N	N	N	N	20.0%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	N	N	N	N	N	20.0%

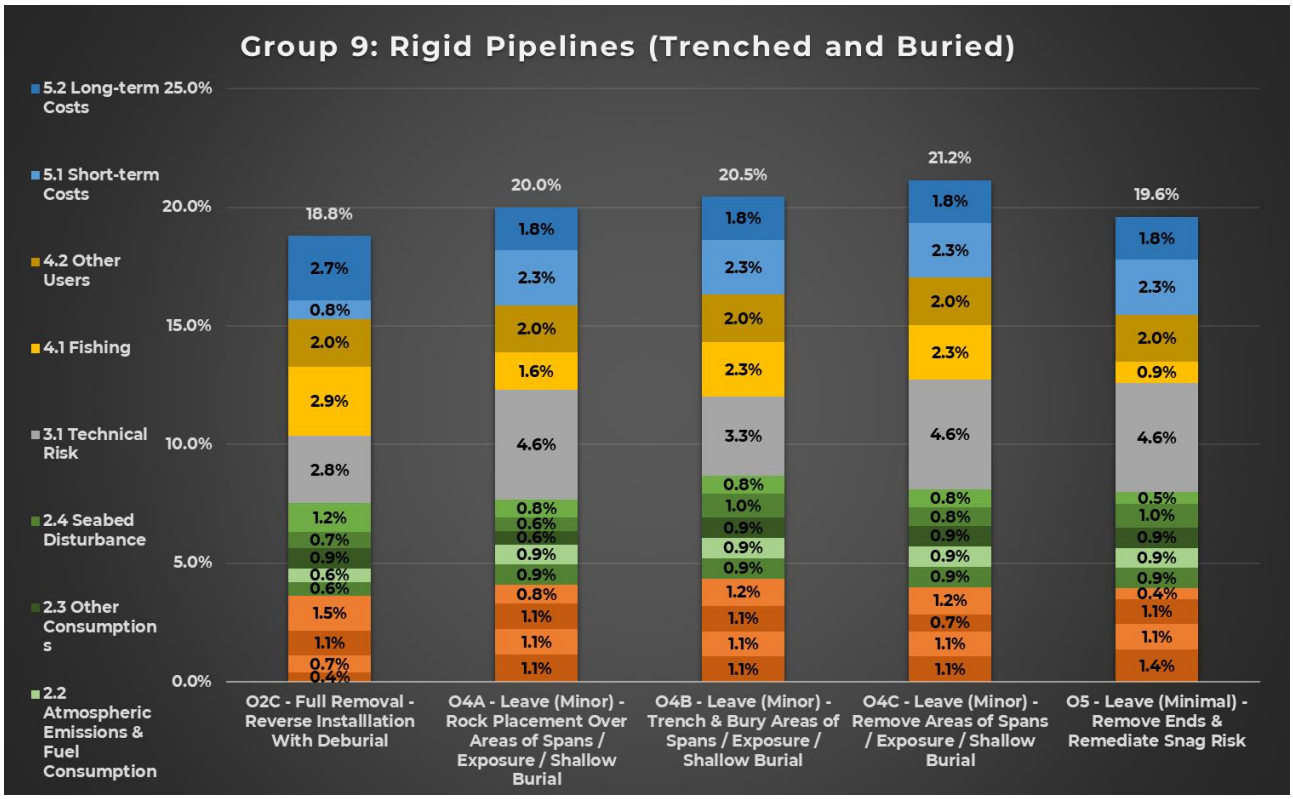
J.6 Group 9 Pairwise Comparison Matrices – Economic

5.1 Short-term Costs	O2C - Full Removal - Reverse Installiation With Deburial	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2C - Full Removal - Reverse Installiation With Deburial	N	MW	MW	MW	MW	7.7%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	MS	N	N	N	N	23.1%
O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	MS	N	N	N	N	23.1%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	MS	N	N	N	N	23.1%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	MS	N	N	N	N	23.1%

5.2 Long-term Costs	O2C - Full Removal - Reverse Installiation With Deburial	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2C - Full Removal - Reverse Installiation With Deburial	N	S	S	S	S	27.3%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	W	N	N	N	N	18.2%
O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	W	N	N	N	N	18.2%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	W	N	N	N	N	18.2%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	W	N	N	N	N	18.2%

J.7 Group 9 Results Charts





APPENDIX K GROUP 16 – DETAILED EVALUATION RESULTS

K.1 Group 16 Attributes Table

Group 16: Rigid Pipeline (Trenched & Buried, Blocked)

PL1024/A - 6" L1 Production / Test Pipeline from Well L1 to Hudson Manifold - 1.631 km

		O2A - Full Removal - Cut and Lift	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk
		- Pipeline safety venting operation is completed upfront - Pipeline is disconnected - De-burial of line by MFE (2 passes) - Line is fully recovered by cut and lift	- Pipeline safety venting operation is completed upfront - Pipeline is disconnected - Remove pipeline ends by cut and lift - Remediate cut ends with rock
1. Safety	1.1 Operations Personnel	Vessel Type: PoB / Days / Hours / PLL CSV: 76 / 12.7 / 11,537 / 8.65E-04 Total offshore hours: 11,537 hrs Total offshore PLL: 8.65E-04 Resource Type: Days / Hours / PLL Engineering & Management: 154.4 / 1,235 / 4.94E-06 Project Management: 161.0 / 1,288 / 5.15E-06 Onshore Operations (includes Cleaning & Disposal): 4.0 / 256 / 3.15E-05 Total onshore hours: 2,779 hrs Total onshore PLL: 4.16E-05 Total operational hours: 14,316 hrs Total operational PLL: 9.07E-04	Vessel Type: PoB / Days / Hours / PLL CSV: 76 / 6.1 / 5,536 / 4.15E-04 Total offshore hours: 5,536 hrs Total offshore PLL: 4.15E-04 Resource Type: Days / Hours / PLL Engineering & Management: 73.5 / 588 / 2.35E-06 Project Management: 84.0 / 672 / 2.69E-06 Onshore Operations (includes Cleaning & Disposal): 1.0 / 64 / 7.87E-06 Total onshore hours: 1,324 hrs Total onshore PLL: 1.29E-05 Total operational hours: 6,860 hrs Total operational PLL: 4.28E-04
		W	
		2.119158879	
	Summary	The assessment of the Operations Personnel sub-criterion is as follows: Option 2A is assessed as being Weaker than Option 5 due to the risk exposure being around double for Option 2A, driven by the longer offshore durations and the handling of more returned material. **Overall, Option 5 is preferred from a risk to Operations Personnel perspective.**	
1. Safety	1.2 Other Users	Vessel Days: CSV: 12.7 Total vessel days: 12.7 days Transits: 2	Vessel Days: CSV: 6.1 Total vessel days: 6.1 days Transits: 2
		N	
	Summary	The assessment of the Other Users sub-criterion is as follows: Option 2A is assessed as being Neutral to Option 5 as the transits are the same for both options and the differential in vessel days was considered insufficient to express a preference from a safety impact on other users perspective. **Overall, Option 2A and Option 5 are equally preferred from a risk to Other Users perspective.**	
1. Safety	1.3 High Consequence Events	Routine cut and lift operations. High number of lifts (168) through the water column to recover line sections. Additional lifting to transfer pipeline sections to quayside. Small number of lifting operations to deploy and recover deburial (MFE) and cutting equipment.	Routine cut and lift operations. Small number of lifting operations (30) through the water column to recover line ends. Additional lifting to transfer pipeline sections to quayside. Small number of lifting operations to deploy and recover cutting equipment.
		W	
	Summary	The assessment of the High Consequence Events sub-criterion is as follows: Option 2A is assessed as being Weaker than Option 5 due to the greater number of offshore lifting operations associated with Option 2A. **Overall, Option 5 is preferred from a High Consequence Events perspective.**	

		O2A - Full Removal - Cut and Lift	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk
1. Safety	1.4 Legacy Risk	No legacy risk from this full removal option.	The line would remain in-situ with this option although it is trenched and buried along its entire length. The survey & monitoring programme is committed to ensuring that the potential snag hazard from left in-situ infrastructure continues to be managed & mitigated as appropriate. Vessel Type: PoB / Days / Hours / PLL Survey Vessel (Legacy): 44 / 24.4 / 12,862 / 9.65E-04 Total offshore hours: 12,862 hrs Total offshore PLL: 9.65E-04
		S	
Summary		The assessment of the Legacy Risk sub-criterion is as follows: Option 2A is assessed as being Stronger than Option 5 as there is no legacy risk associated with the full removal option. The preference is small given the line remaining in-situ would be trenched and buried along its entire length. **Overall, Option 2A is preferred from a Legacy Risk perspective.**	
2. Environmental	2.1 Operational Marine Impact	Vessel Noise (days on-site): 8.6 days Tooling Noise (MFE & DWC) = 8.3 days Operation releases: Line cleaning and flushing operations are unable to be completed fully due to this line being blocked. The maximum residual contents are: Oil (0.4 m3) | Water (10.3 m3) | Gas (17.9 m3) | Total (28.6 m3) There will be potential for the release of the contents of the line during cutting operations. Worst-case composition and quantity of the line contents are known and their release is covered by a permit. Therefore, the related impact is anticipated to be low. Vessel releases: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore at around 8.6 days is the highest of all options but not considered significant. The environmental impact is considered to be negligible.	Vessel Noise (days on-site): 2.0 days Tooling Noise (Hydraulic Shears) = 0.6 days Operation releases: Line cleaning and flushing operations are unable to be completed fully due to this line being blocked. The maximum residual contents are: Oil (0.4 m3) | Water (10.3 m3) | Gas (17.9 m3) | Total (28.6 m3) There will be potential for limited release of the contents of the line during cutting operations at the line ends. Worst-case composition and quantity of the line contents are known and their release is covered by a permit. Therefore, the related impact is anticipated to be low. Vessel releases: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore at 2.0 days is the lowest of the options. The environmental impact is considered to be negligible.
		W	
Summary		The assessment of the Operational Marine Impact sub-criterion is as follows: Option 2A is assessed as being Weaker than Option 5 as, while the differences between the options are small, the potential impact of full release of line contents in Option 2A is sufficient to express a small preference for Option 5. **Overall, Option 5 is preferred from an Operational Marine Impact perspective.**	
2. Environmental	2.2 Atmospheric Emissions & Fuel Consumption	Vessel Emissions (in tonnes): Fuel: 312 CO2: 990 NOx: 18.54 SO2: 1.25 Vessel Energy Use: 13,425 GJ	Vessel Emissions (in tonnes): Fuel: 826 CO2: 2,617 NOx: 49.04 SO2: 3.30 Vessel Energy Use: 35,500 GJ
		N	
Summary		The assessment of the Atmospheric Emissions & Consumptions sub-criterion is as follows: Option 2A is assessed as being Neutral to Option 5 as while there differences between the emissions and fuel use for the options, these differences are considered insufficient to express a preference from an environmental impact perspective. **Overall, Option 2A and Option 5 are preferred from an Atmospheric Emissions & Consumptions perspective.**	

		O2A - Full Removal - Cut and Lift	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk
2. Environmental	2.3 Other Consumptions	Material Emissions (CO2 in tonnes): Recovered Material: 82 Remaining Material: Total: 82 Rock: N/A tonnes	Material Emissions (CO2 in tonnes): Recovered Material: 11 Remaining Material: 132 Total: 143 Rock: 32 tonnes
		N	
	Summary	The assessment of the Other Consumptions sub-criterion is as follows: Option 2A is assessed as being Neutral to Option 5 as, while there is a small amount of rock resource required in Option 5 and the emissions produced to replacement material left in-situ in Option 5 is greater, these differences are considered insufficient to express a preference from an environmental impact perspective. **Overall, Option 2A and Option 5 are equally preferred from an Other Consumptions perspective.**	
2. Environmental	2.4 Seabed Disturbance	Seabed Disturbance (m2): MFE: 8,155 No rock cover in this option.	Seabed Disturbance (m2): Rock Cover: 50 Habitat Loss / Change (m2): Rock Bags: 50
		W	
	Summary	The assessment of the Seabed Disturbance sub-criterion is as follows: Option 2A is assessed as being Weaker than Option 5 due to large area of seabed disturbed during the deburial operations in Option 2A versus the very small area of rock cover introduced in Option 5 despite the latter being a permanent habitat change . **Overall, Option 5 is preferred from a Seabed Disturbance perspective.**	
2. Environmental	2.5 Legacy Marine Impacts	No legacy marine impact from this full removal option.	Line cleaning and flushing operations are unable to be completed fully due to this line being blocked. The maximum residual contents are: Oil (0.4 m3) | Water (10.3 m3) | Gas (17.9 m3) | Total (28.6 m3) The legacy marine impact from the slow release of the residual contents (covered by a permit) is expected to be low overall.
		S	
	Summary	The assessment of the Legacy Marine Impacts sub-criterion is as follows: Option 2A is assessed as being Stronger than Option 5 as there is no legacy impact associated with the full removal option versus the impact associated with leaving the line in-situ in Option 5. This impact is expected to minimal given the slow degradation of the line / slow release of the residual contents. **Overall, Option 2A is preferred from a Legacy Marine Impacts perspective.**	
3. Technical	3.1 Technical Risk	Concept Maturity: Cut and lift techniques are well proven with multiple options available on the market. (Score 3) Technical Risks: Minimal technical risks with this option. (Score 3)	Concept Maturity: Minimal operations, well proven techniques. (Score 3) Technical Risks: Limited technical risks associated with option (Score 3)
		N	
	Summary	The assessment of the Technical Risk sub-criterion is as follows: Option 2A is assessed as being Neutral to Option 5 as both options employ routine operations with the length of the line (1.6 km) being insufficient to express a preference from a scale perspective. **Overall, Option 2A and Option 5 are equally preferred from a Technical Risk perspective.**	
4. Societal	4.1 Fishing	Minimal disruption associated with the removal operation, infrastructure is removed long term, beneficial for the fishing industry. (Score 3)	Short operation, small area of localised disturbance. Rock used to remediate cut ends should be profiled with a suitable gradient to avoid impacts for the fishing industry. (Score 2)
		N	
	Summary	The assessment of the Societal impact on Fishing sub-criterion is as follows: Option 2A is assessed as being Neutral to Option 5 as, while the line is removed in Option 2A, the line left in-situ in Option 5 will be fully trenched and buried. As such, the differences are insufficient to express a preference between the options from a commercial fishing operations perspective. **Overall, Option 2A and Option 5 are equally preferred from a Societal impact on Fishing perspective.**	

		O2A - Full Removal - Cut and Lift	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk
4. Societal	4.2 Other Users	Small amount of recyclable material returned. (Score 3) Materials Returned: Steel: 80 tonnes (recyclable) Polymer: 36 tonnes (landfill)	Minimal societal benefits / impacts with this option. (Score 3) Materials Returned: Steel: 10 tonnes (recyclable) Polymer: 5 tonnes (landfill)
		N	
Summary		The assessment of the Societal impact on Other Users sub-criterion is as follows: Option 2A is assessed as being Neutral to Option 5 as the societal benefits are considered minimal for both options. **Overall, Option 2A and Option 5 are equally preferred from a Societal impact on Other Users perspective.**	
5. Economic	5.1 Short-term Costs	£1.762 Million	£1.017 Million
		N	
		0.75 million more	
		73.3% higher	
Summary		The assessment of the Short-term Costs sub-criterion is as follows: Option 2A is assessed as being Neutral to Option 5 as the small differential in cost to execute the options is considered insufficient to express a preference. **Overall, Option 2A and Option 5 are equally preferred from a Short-term Cost perspective.**	
5. Economic	5.2 Long-term Costs	Surveys: N/A FLTC: N/A Total Legacy Cost: £0 Million	Surveys: £0.731 Million FLTC: N/A Total Legacy Cost: £0.731 Million
		N	
Summary		The assessment of the Long-term Costs sub-criterion is as follows: Option 2A is assessed as being Neutral to Option 5 as the difference between no long-term costs in Option 2A versus the small long-term costs in Option 5 is considered insufficient to express a preference. **Overall, Option 2A and Option 5 are equally preferred from a Long-term Cost perspective.**	

K.2 Group 16 Pairwise Comparison Matrices – Safety

1.1 Operations Personnel	O2A - Full Removal - Cut and Lift	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	W	40.0%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	S	N	60.0%

1.2 Other Users	O2A - Full Removal - Cut and Lift	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	N	50.0%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	N	N	50.0%

1.3 High Consequence Events	O2A - Full Removal - Cut and Lift	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	W	40.0%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	S	N	60.0%

1.4 Legacy Risk	O2A - Full Removal - Cut and Lift	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	S	60.0%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	W	N	40.0%

K.3 Group 16 Pairwise Comparison Matrices – Environment

2.1 Operational Marine Impact	O2A - Full Removal - Cut and Lift	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	W	40.0%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	S	N	60.0%

2.2 Atmospheric Emissions & Fuel Consumption	O2A - Full Removal - Cut and Lift	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	N	50.0%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	N	N	50.0%

2.3 Other Consumptions	O2A - Full Removal - Cut and Lift	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	N	50.0%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	N	N	50.0%

2.4 Seabed Disturbance	O2A - Full Removal - Cut and Lift	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	W	40.0%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	S	N	60.0%

2.5 Legacy Marine Impacts	O2A - Full Removal - Cut and Lift	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	S	60.0%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	W	N	40.0%

K.4 Group 16 Pairwise Comparison Matrices – Technical

3.1 Technical Risk	O2A - Full Removal - Cut and Lift	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	N	50.0%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	N	N	50.0%

K.5 Group 16 Pairwise Comparison Matrices – Societal

4.1 Fishing	O2A - Full Removal - Cut and Lift	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	N	50.0%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	N	N	50.0%

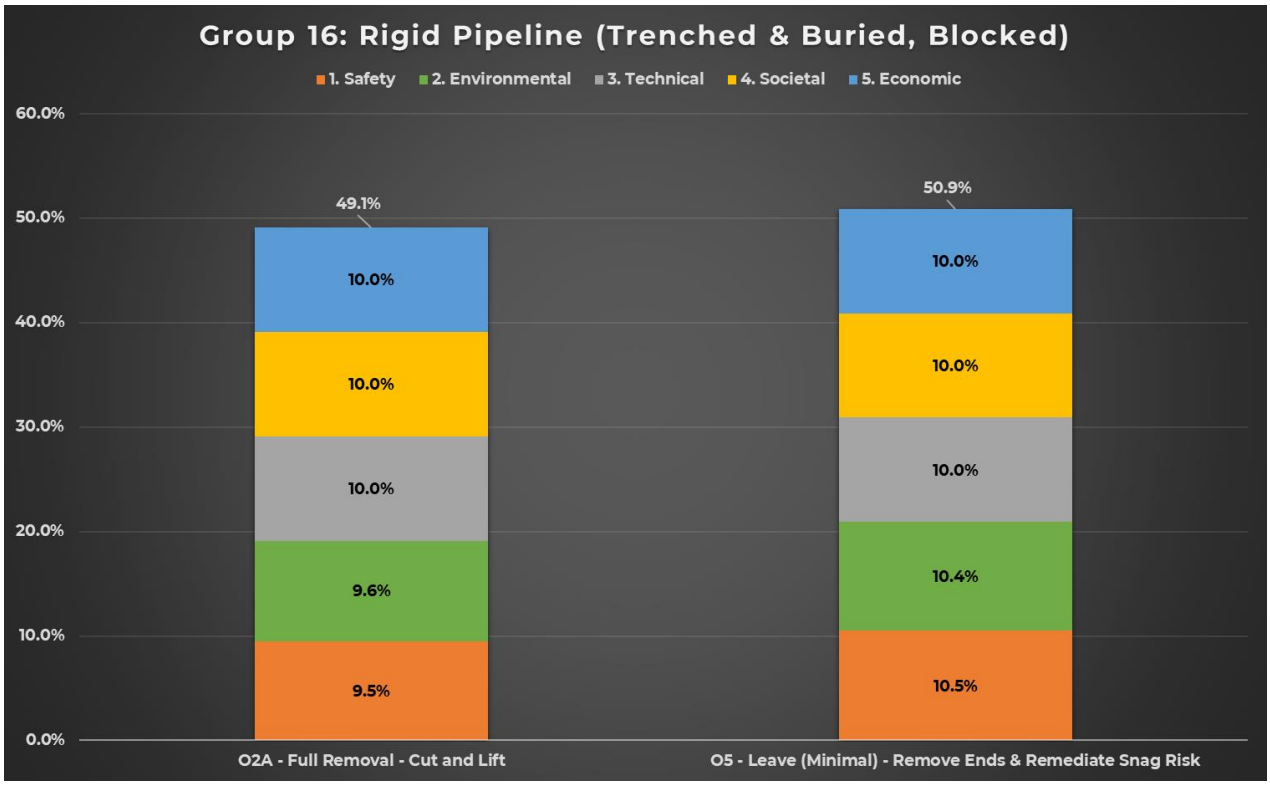
4.2 Other Users	O2A - Full Removal - Cut and Lift	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	N	50.0%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	N	N	50.0%

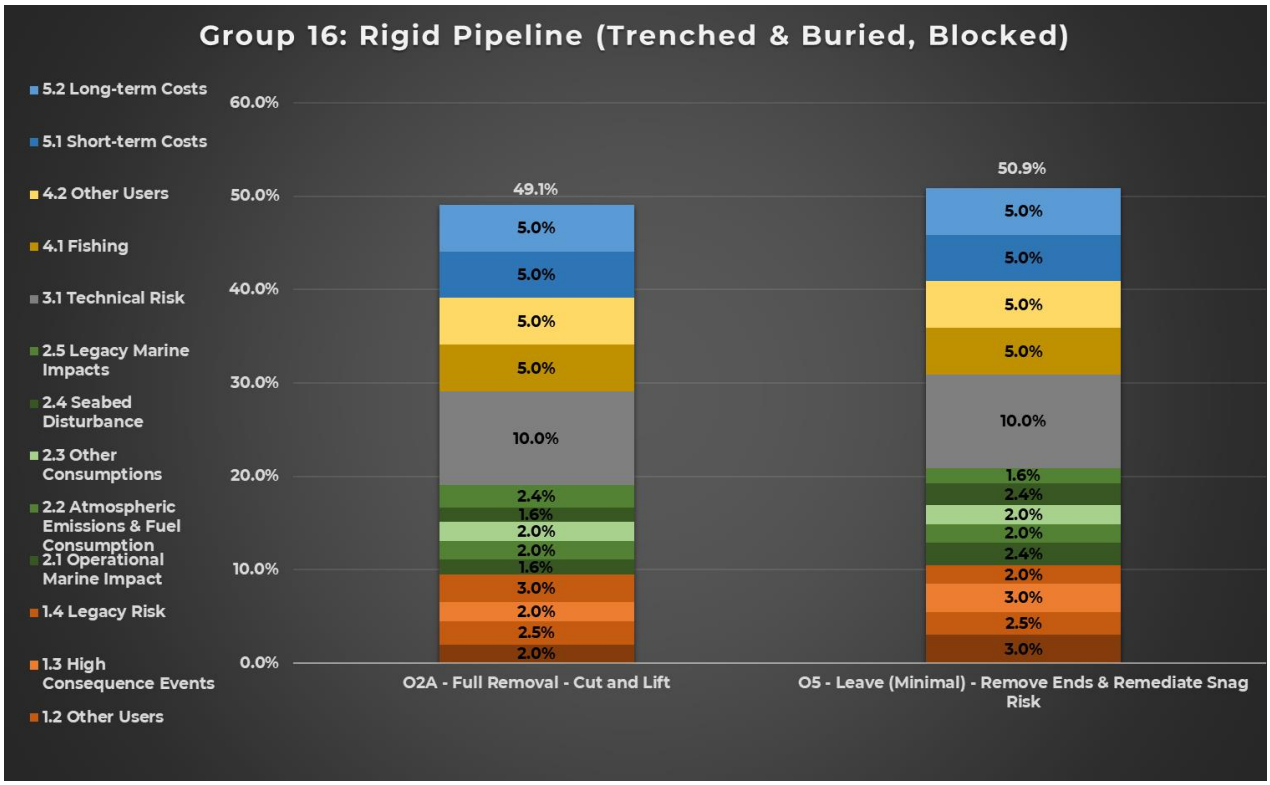
K.6 Group 16 Pairwise Comparison Matrices – Economic

5.1 Short-term Costs	O2A - Full Removal - Cut and Lift	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	N	50.0%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	N	N	50.0%

5.2 Long-term Costs	O2A - Full Removal - Cut and Lift	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	N	50.0%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	N	N	50.0%

K.7 Group 16 Results Charts





APPENDIX L GROUP 17 – DETAILED EVALUATION RESULTS

L.1 Group 17 Attributes Table

Group 17: Rigid Pipelines (Trenched and Partially Buried)

PL1022 - 6" Gas Lift Pipeline from Tern to Hudson Manifold - 10.161 km | PL1021/A - 8" Water Injection Pipeline from Tern to Hudson Manifold - 10.185 km

		O2A - Full Removal - Cut and Lift			O3A - Leave (Major) - Rock Placement Over Entire Line		O3B - Leave (Major) - Trench & Bury Entire Line	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk
		- Pipelines are disconnected - De-burial of lines by MFE (1 pass) - Lines are fully recovered by cut and lift			- Pipelines are disconnected - Entirety of lines are rock covered using a FPV		- Pipelines are disconnected - All lines in existing trench - Entirety of lines requires backfilled to 0.6m DoC	- Pipelines are disconnected - Remove pipeline ends by cut and lift - Remediate cut ends with rock
1. Safety	1.1 Operations Personnel	Vessel Type: PoB / Days / Hours / PLL CSV: 76 / 111.5 / 101,642 / 7.62E-03 Total offshore hours: 101,642 hrs Total offshore PLL: 7.62E-03 Resource Type: Days / Hours / PLL Engineering & Management: 1,388.2 / 11,106 / 4.44E-05 Project Management: 1,284.0 / 10,272 / 4.11E-05 Onshore Operations (includes Cleaning & Disposal): 37.0 / 2,368 / 2.91E-04 Total onshore hours: 23,746 hrs Total onshore PLL: 3.77E-04 Total operational hours: 125,388 hrs Total operational PLL: 8.00E-03			Vessel Type: PoB / Days / Hours / PLL Rockdump Vessel: 20 / 41.3 / 9,922 / 7.44E-04 Total offshore hours: 9,922 hrs Total offshore PLL: 7.44E-04 Resource Type: Days / Hours / PLL Engineering & Management: 283.8 / 2,271 / 9.08E-06 Project Management: 472.0 / 3,776 / 1.51E-05 Total onshore hours: 6,047 hrs Total onshore PLL: 2.42E-05 Total operational hours: 15,968 hrs Total operational PLL: 7.68E-04		Vessel Type: PoB / Days / Hours / PLL Trenching Vessel: 55 / 10.0 / 6,580 / 4.94E-04 Total offshore hours: 6,580 hrs Total offshore PLL: 4.94E-04 Resource Type: Days / Hours / PLL Engineering & Management: 239.7 / 1,918 / 7.67E-06 Project Management: 233.0 / 1,864 / 7.46E-06 Total onshore hours: 3,782 hrs Total onshore PLL: 1.51E-05 Total operational hours: 10,362 hrs Total operational PLL: 5.09E-04	Vessel Type: PoB / Days / Hours / PLL CSV: 76 / 9.9 / 9,038 / 6.78E-04 Total offshore hours: 9,038 hrs Total offshore PLL: 6.78E-04 Resource Type: Days / Hours / PLL Engineering & Management: 138.2 / 1,106 / 4.42E-06 Project Management: 141.0 / 1,128 / 4.51E-06 Onshore Operations (includes Cleaning & Disposal): 1.0 / 64 / 7.87E-06 Total onshore hours: 2,298 hrs Total onshore PLL: 1.68E-05 Total operational hours: 11,336 hrs Total operational PLL: 6.95E-04
		MW	**MW**	**MW**	**W**	**N**	**N**	
		10.4167	**15.7171**	**11.5108**	**1.50884086**	**1.10503597**	**0.732374101**	
	Summary	The assessment of the Operations Personnel sub-criterion is as follows: Option 2A is assessed as being Much Weaker than Option 3A due to the risk exposure being around 10 times higher in Option 2A due to the greater offshore scope associated with the full removal of these lines versus the smaller scope to perform rock cover over the lines in Option 3A. Option 2A is assessed as being Much Weaker than Option 3B due to the risk exposure being more around 16 times higher in Option 2A due to the greater offshore scope associated with the full removal of these lines versus the smaller scope to perform trenching of the lines in Option 3B. Option 2A is assessed as being Much Weaker than Option 5 due to the risk exposure being around 11 times higher in Option 2A due to the greater offshore scope associated with the full removal of these lines versus the smaller scope to recover line ends only in Option 5. Option 3A is assessed as being Weaker than Option 3B due to the risk exposure being around 50% higher from the longer duration activities to rock cover the lines. Option 3A is assessed as being Neutral to Option 5 as the risk exposure is largely similar. Option 3B is assessed as being Neutral to Option 5 as the risk exposure is largely similar. **Overall, Option 3B and Option 5 are equally preferred from a risk to Operations Personnel perspective.**						
1. Safety	1.2 Other Users	Vessel Days: CSV: 111.5 Total vessel days: 111.5 days Transits: 10			Vessel Days: Rockdump Vessel: 41.3 Total vessel days: 41.3 days Transits: 20		Vessel Days: Trenching Vessel: 10.0 Total vessel days: 10.0 days Transits: 2	Vessel Days: CSV: 9.9 Total vessel days: 9.9 days Transits: 2
		N	**W**	**W**	**W**	**W**	**N**	
	Summary	The assessment of the Other Users sub-criterion is as follows: Option 2A is assessed as being Neutral to Option 3A as, while there are more transits associated with Option 3A, there are more vessel days on-site with Option 2A and the impact on the safety of other users is considered similar across both options. Option 2A is assessed as being Weaker than Option 3B and Option 5 due to the greater number of vessel days and transits having greater impact on safety of other users. Option 3A is assessed as being Weaker than Option 3B and Option 5 due to the greater number of vessel days and transits having greater impact on safety of other users. Option 3B is assessed as being Neutral to Option 5 as the vessel days and transits are similar across these options. **Overall, Option 3B and Option 5 are equally preferred from a risk to Other Users perspective.**						

		O2A - Full Removal - Cut and Lift	O3A - Leave (Major) - Rock Placement Over Entire Line	O3B - Leave (Major) - Trench & Bury Entire Line	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk
1. Safety	1.3 High Consequence Events	Routine cut and lift operations. Very high number of lifts (2045) through the water column to recover line sections. Additional lifting to transfer pipeline sections to quayside. Low number of lifting operations to deploy and recover deburial equipment.	Routine, low risk rock placement operations with no lifting operations.	Routine, low risk trenching operations. Small number of lifting operations (4) through the water column to deploy and recover trenching equipment.	Small number of lifting operations (64) through the water column to recover line ends and to place rock bags. Additional lifting to transfer pipeline sections to quayside. Small number of lifting operations to deploy and recover cutting equipment.
		MW MW W	N S	S	
	Summary	The assessment of the High Consequence Events sub-criterion is as follows: Option 2A is assessed as being Much Weaker than Option 3A and Option 3B as there are 2,000 offshore lifts and hence potential for high consequence events from dropped object, associated with Option 2A versus limited / no lifting with Option 3A and Option 3B. Option 2A is assessed as being Weaker than Option 5 due to the much higher number of offshore lifting operations associated with Option 2A. Option 3A is assessed as being Neutral to Option 3B as there is limited potential for high consequence events in both options. Option 3A is assessed as being Stronger than Option 5 due to the potential for high consequence events from dropped object from the lifting operations associated with Option 5. Option 3B is assessed as being Stronger than Option 5 due to the potential for high consequence events from dropped object from the lifting operations associated with Option 5.. **Overall, Option 3A and Option 3B are equally preferred from a High Consequence Events perspective.**			
1. Safety	1.4 Legacy Risk	No legacy risk from this full removal option.	The line would remain in-situ with this option although it would be fully trenched and rock covered. The survey & monitoring programme is committed to ensuring that the potential snag hazard from left in-situ infrastructure continues to be managed & mitigated as appropriate. Vessel Type: PoB / Days / Hours / PLL Survey Vessel (Legacy): 44 / 29.1 / 15,360 / 1.15E-03	The line would remain in-situ with this option although it would be fully trenched and buried. The survey & monitoring programme is committed to ensuring that the potential snag hazard from left in-situ infrastructure continues to be managed & mitigated as appropriate. Vessel Type: PoB / Days / Hours / PLL Survey Vessel (Legacy): 44 / 29.1 / 15,360 / 1.15E-03	The line would remain in-situ with this option with the majority of its length within a trench but with light cover only. The line ends will be removed with rock cover to mitigate potential snag hazard from cut ends. The survey & monitoring programme is committed to ensuring that the potential snag hazard from left in-situ infrastructure continues to be managed & mitigated as appropriate. Vessel Type: PoB / Days / Hours / PLL Survey Vessel (Legacy): 44 / 29.0 / 15,307 / 1.15E-03
		S S MS	N S	S	
	Summary	The assessment of the Legacy Risk sub-criterion is as follows: Option 2A is assessed as being Stronger than Option 3A and Option 3B as there is no legacy risk associated with the full removal options versus the lines remaining in-situ either rock covered (to top of trench) or trenched and backfilled within existing trench. Option 2A is assessed as being Much Stronger than Option 5 as the line remains in-situ with areas of exposure (within existing trench) remaining. Option 3A is assessed as being Neutral to Option 3B as the lines remain in-situ in both options either rock covered (to top of trench) or trenched and backfilled within existing trench. Option 3A is assessed as being Stronger than Option 5 as, while the line remains in-situ in both options, it is fully rock covered in Option 3A whereas areas of exposure (within existing trench) remain in Option 5. Option 3B is assessed as being Stronger than Option 5 as, while the line remains in-situ in both options, it is fully trenched and buried in Option 3B whereas areas of exposure (within existing trench) remain in Option 5. **Overall, 2A is preferred from a Legacy Risk perspective.**			

		O2A - Full Removal - Cut and Lift	O3A - Leave (Major) - Rock Placement Over Entire Line	O3B - Leave (Major) - Trench & Bury Entire Line	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk
2. Environmental	2.1 Operational Marine Impact	Vessel Noise (days on-site): 95.4 days Tooling Noise (MFE & DWC) = 93.6 days Operation releases: Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush and releases to the marine environment during flushing activities. Cutting of line ends and midline cuts would lead to an elevated release of fluids from within the line. However, given the prior cleaning of the line, the concentration and quantity of release should still be low overall. Therefore, the related impact is also anticipated to be low. Vessel releases: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore at 95.4 days is the highest of all the options. The environmental impact is considered to be negligible.	Vessel Noise (days on-site): 10.3 days Tooling Noise = none Operation releases: Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush and releases to the marine environment during flushing activities. As lines are being rock covered there is negligible release from the line. Vessel releases: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore at 10.3 days is not considered significant. The environmental impact is considered to be negligible.	Vessel Noise (days on-site): 6.0 days Tooling Noise (Trenching) = 4.1 days Operation releases: Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush and releases to the marine environment during flushing activities. As lines are being trenched there is negligible release from the line. Vessel releases: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore at 6.0 days is not considered significant. The environmental impact is considered to be negligible.	Vessel Noise (days on-site): 5.7 days Tooling Noise (Hydraulic Shears) = 1.8 days Operation releases: Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush and releases to the marine environment during flushing activities. Cutting of line ends would lead to an elevated release of fluids from within the line. However, given the prior cleaning of the line, the concentration and quantity of release should still be low overall. Therefore, the related impact is also anticipated to be low. Vessel releases: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore at 5.7 days is the lowest of all options. The environmental impact is considered to be negligible.
		W W W	N N	N	
	Summary	The assessment of the Operational Marine Impact sub-criterion is as follows: Option 2A is assessed as being Weaker than Option 3A, Option 3B and Option 5 as there are many more vessel days and days of tooling operations associated with Option 2A which generate a greater noise impact than the other options. Other impacts are negligible. All other options are assessed as being Neutral to each other as the marine impacts are largely similar (and negligible) for these options. **Overall, Option 3A, Option 3B and Option 5 are equally preferred from an Operational Marine Impact perspective.**			
2. Environmental	2.2 Atmospheric Emissions & Fuel Consumption	Vessel Emissions (in tonnes): Fuel: 3,079 CO2: 9,759 NOx: 182.87 SO2: 12.31 Vessel Energy Use: 132,380 GJ	Vessel Emissions (in tonnes): Fuel: 1,527 CO2: 4,841 NOx: 90.72 SO2: 6.11 Vessel Energy Use: 65,673 GJ	Vessel Emissions (in tonnes): Fuel: 986 CO2: 3,126 NOx: 58.58 SO2: 3.94 Vessel Energy Use: 42,404 GJ	Vessel Emissions (in tonnes): Fuel: 1,082 CO2: 3,431 NOx: 64.30 SO2: 4.33 Vessel Energy Use: 46,544 GJ
		W W W	N N	N	
	Summary	The assessment of the Atmospheric Emissions & Consumptions sub-criterion is as follows: Option 2A is assessed as being Weaker than Option 3A as the emissions and fuel use are higher (between 2 and 3 times higher) for Option 2A due to the larger offshore scope for full removal. All other options are assessed as being Neutral to each other as, while there are differences in the emissions and fuel use, these are considered insufficient to express a preference. **Overall, Option 3A, Option 3B and Option 5 are equally preferred from an Atmospheric Emissions & Consumptions perspective.**			

		O2A - Full Removal - Cut and Lift	O3A - Leave (Major) - Rock Placement Over Entire Line	O3B - Leave (Major) - Trench & Bury Entire Line	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk
2. Environmental	2.3 Other Consumptions	Material Emissions (CO2 in tonnes): Recovered Material: 1,092 Remaining Material: Total: 1,092 Rock: N/A tonnes	Material Emissions (CO2 in tonnes): Recovered Material: Remaining Material: 2,048 Total: 2,048 Rock: 203,460 tonnes	Material Emissions (CO2 in tonnes): Recovered Material: Remaining Material: 2,048 Total: 2,048 Rock: N/A tonnes	Material Emissions (CO2 in tonnes): Recovered Material: 22 Remaining Material: 2,006 Total: 2,028 Rock: 64 tonnes
		S N N	W W	N	
	Summary	The assessment of the Other Consumptions sub-criterion is as follows: Option 2A is assessed as being Stronger than Option 3A due to the large quantity of rock resource required in Option 3A. Option 2A is assessed as being Neutral to Option 3B and Option 5 as the resource consumption from recycled / replacement material and rock consumption perspective are largely similar across these options. Option 3A is assessed as being Weaker than Option 3B and Option 5 due to the large quantity of rock resource required in Option 3A. Option 3B is assessed as being Neutral to Option 5 as the resource consumption from recycled / replacement material and rock consumption perspective are largely similar across these options. **Overall, Option 2A, Option 3B and Option 5 are equally preferred from an Other Consumptions perspective.**			
2. Environmental	2.4 Seabed Disturbance	Seabed Disturbance (m2): MFE: 101,730 No rock cover in this option.	Seabed Disturbance (m2): Rock Cover: 203,460 Habitat Loss / Change (m2): Rock Cover: 203,460	Seabed Disturbance (m2): Trenching: 203,460 No rock cover in this option.	Seabed Disturbance (m2): Rock Cover: 100 Habitat Loss / Change (m2): Rock Bags: 100
		MS N W	MW VMW	W	
	Summary	The assessment of the Seabed Disturbance sub-criterion is as follows: Option 2A is assessed as being Much Stronger than Option 3A as, while there is a large area of seabed impacted in Option 2A, the impact is temporary in nature so less significant than the much larger area of permanent impact (habitat change) from the rock cover introduced in Option 3A. Option 2A is assessed as being Neutral to Option 3B as, while the are of impact is greater in Option 3B, as these impacts are both temporary in nature, the difference is considered insufficient to express a preference. Option 2A is assessed as being Weaker than Option 5 as there is limited area of seabed impacted in Option 5. Option 3A is assessed as being Much Weaker than Option 3B due to the greater impact from the permanent habit change from the rock introduced in Option 3A. Option 3A is assessed as being Very Much Weaker than Option 5 due to the much greater impact from the permanent habitat change from the rock introduced in Option 3A. Option 3B is assessed as being Weaker than Option 5 as there is limited area of seabed impacted in Option 5. **Overall, Option 5 is preferred from a Seabed Disturbance perspective.**			
2. Environmental	2.5 Legacy Marine Impacts	No legacy marine impact from this full removal option.	Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush. The legacy marine impact from the slow release of these low concentration / quantity releases is therefore expected to be low overall.	Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush. The legacy marine impact from the slow release of these low concentration / quantity releases is therefore expected to be low overall.	Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush. The legacy marine impact from the slow release of these low concentration / quantity releases is therefore expected to be low overall.
		S S MS	N S	S	
	Summary	The assessment of the Legacy Marine Impacts sub-criterion is as follows: Option 2A is assessed as being Stronger than Option 3A and Option 3B as there is no legacy marine impacts associated with the full removal option whereas there will be slow degradation of the lines and releases over a long time period with the other options although this is reduced as the lines will be within a trench and either fully covered in rock or fully backfilled thus the lines left in-situ will be largely isolated from the marine environment. Option 2A is assessed as being Much Stronger than Option 5 as there is no legacy marine impacts associated with the full removal option whereas there will be slow degradation of the lines and releases over a long time period with Option 5 where sections of the lines remain exposed to the marine environment. Option 3A is assessed as being Neutral to Option 3B as the lines remain in-situ but isolated from marine environment so rate of degradation and release to marine environment will be similar (and slow) in both options. Option 3A is assessed as being Stronger than Option 5 as the lines are isolated from the marine environment in Option 3A versus sections of the lines remaining exposed to the marine environment in Option 5 which will result in degradation products impacting more quickly (but still slow / low impact). Option 3B is assessed as being Stronger than Option 5 again, as the lines are isolated from the marine environment in Option 3B versus sections of the lines remaining exposed to the marine environment in Option 5 which will result in degradation products impacting more quickly (but still slow / low impact). **Overall, Option 2A is preferred from a Legacy Marine Impacts perspective.**			

		O2A - Full Removal - Cut and Lift	O3A - Leave (Major) - Rock Placement Over Entire Line	O3B - Leave (Major) - Trench & Bury Entire Line	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk
3. Technical	3.1 Technical Risk	Concept Maturity: Cut and lift techniques are well proven with multiple options available on the market. (Score 3) Technical Risks: Technical risks with this option are associated with the scale of the operation. (Score 2)	Concept Maturity: Rock placement is a well proven process. (Score 3) Technical Risks: Limited technical risks associated with option (Score 3)	Concept Maturity: Trenching surface lines has a good track record (Score 3) Technical Risks: Geotechnical studies would be required to confirm if it is feasible. (Score 2)	Concept Maturity: Pipe cutting operation is well proven with a good track record (Score 3) Technical Risks: Limited technical risks associated with this option (Score 3)
		W W W	N N	N	
	Summary	The assessment of the Technical Risk sub-criterion is as follows: Option 2A is assessed as being Weaker than all other options as, while all operations are considered routine, there are challenges performing deburial and cutting / lifting at this scale (20 km of lines), whereas the scopes for the other options are smaller in scale. All other options are assessed as being Neutral to each other as the scope and potential for technical challenges are limited for these options. **Overall, Option 3A, Option 3B and Option 5 are equally preferred from a Technical Risk perspective.**			
4. Societal	4.1 Fishing	Large scale disruption associated with the removal operation, however, infrastructure is removed long term, beneficial for the fishing industry. (Score 2)	Rock berms designed to be over-trawlable, however, rock berms are not fishing industry's preference. (Score 1)	Two pipelines only, a relatively short term operation, with a localised area of disturbance. If successful, the area would be clear for fishing operations to be conducted. (Score 3)	Relatively short duration operation in the short-term. Rock to mitigate cut ends should be flush with seabed and not pose any obstacle to fishing operations. (Score 3)
		S S MS	N S	S	
	Summary	The assessment of the Societal impact on Fishing sub-criterion is as follows: Option 2A is assessed as being Stronger than Option 3A and Option 3B as the lines are removed versus being left in-situ albeit rock covered or backfilled to the top of the existing trench. Option 2A is assessed as being Much Stronger than Option 5 as the lines are fully removed versus remaining in the existing trench with exposures (within the trench) remaining. Option 3A is assessed as being Neutral to Option 3B as the as left condition of the lines presents a largely flat seabed and limited disruption to fishing operations in both cases. Option 3A is assessed as being Stronger than Option 5 as it presents a flat seabed versus the lines remaining in the existing trench with exposures (within the trench) remaining. Option 3B is assessed as being Stronger than Option 5 as it presents a flat seabed versus the lines remaining in the existing trench with exposures (within the trench) remaining.. **Overall, Option 2A is preferred from a Societal impact on Fishing perspective.**			
4. Societal	4.2 Other Users	Significant amount of recyclable material returned. (Score 3) Materials Returned: Steel: 1,084 tonnes (recyclable) Polymer: 24 tonnes (landfill)	Minimal societal benefits / impacts with this option. (Score 3) Materials Returned: None.	Minimal societal benefits / impacts with this option. (Score 3) Materials Returned: None.	Minimal societal benefits / impacts with this option. (Score 3) Materials Returned: Steel: 22 tonnes (recyclable) Polymer: 1 tonnes (landfill)
		N N N	N N	N	
	Summary	The assessment of the Societal impact on Other Users sub-criterion is as follows: All options are assessed as Neutral to each other as the positive and negative societal impacts are considered largely insignificant across all options. It is noted that a greater quantity of useful, recyclable material (steel) is returned in Option 2A, however the societal benefit of this is offset by the larger quantity of polymer returned which is likely to end up in landfill. **Overall, all options are equally preferred from a Societal impact on Other Users perspective.**			

		O2A - Full Removal - Cut and Lift			O3A - Leave (Major) - Rock Placement Over Entire Line		O3B - Leave (Major) - Trench & Bury Entire Line	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk
5. Economic	5.1 Short-term Costs	£12.714 Million			£4.793 Million		£2.467 Million	£1.633 Million
		MW	MW	MW	W	W	N	
		7.921 million more	10.247 million more	11.081 million more	2.326 million more	3.16 million more	0.834 million more	
		165.3% higher	415.4% higher	678.6% higher	94.3% higher	193.5% higher	51.1% higher	
	Summary	The assessment of the Short-term Costs sub-criterion is as follows: Option 2A is assessed as being Much Weaker than Option 3A due to the costs to deliver this option being almost 3 times higher (£7.9 million more) than Option 3A. Option 2A is assessed as being Much Weaker than Option 3B due to the costs to deliver this option being around 5 times higher (£10.2 million more) than Option 3B. Option 2A is assessed as being Much Weaker than Option 5 due to the costs to deliver this option being more than 6 times higher (£11.1 million more) than Option 5. Option 3A is assessed as being Weaker than Option 3B due to the costs to deliver this option being almost double (£2.3 million more) than Option 3B. Option 3A is assessed as being Weaker than Option 5 due to the costs to deliver this option being almost 3 times higher (£3.2 million more) than Option 5. Option 3B is assessed as being Neutral to Option 5 as while there is a difference in costs to deliver these options, the difference is insufficient to express a preference. **Overall, Option 3B and Option 5 are equally preferred from a Short-term Cost perspective.**						
5. Economic	5.2 Long-term Costs	Surveys: N/A FLTC: N/A Total Legacy Cost: £0 Million			Surveys: £0.873 Million FLTC: N/A Total Legacy Cost: £0.873 Million		Surveys: £0.873 Million FLTC: N/A Total Legacy Cost: £0.873 Million	Surveys: £0.87 Million FLTC: £0.061 Million Total Legacy Cost: £0.931 Million
		N	N	N	N	N	N	
	Summary	The assessment of the Long-term Costs sub-criterion is as follows: All options are assessed as being Neutral to each other as, while there are no long-term costs associated with the full removal option, the costs associated with the monitoring and surveying of the lines remaining in-situ are relatively minor and insufficient to express a preference. **Overall, all options are equally preferred from a Long-term Cost perspective.**						

L.2 Group 17 Pairwise Comparison Matrices – Safety

1.1 Operations Personnel	O2A - Full Removal - Cut and Lift	O3A - Leave (Major) - Rock Placement Over Entire Line	O3B - Leave (Major) - Trench & Bury Entire Line	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	MW	MW	MW	10.0%
O3A - Leave (Major) - Rock Placement Over Entire Line	MS	N	W	N	27.0%
O3B - Leave (Major) - Trench & Bury Entire Line	MS	S	N	N	33.1%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	MS	N	N	N	29.9%

1.2 Other Users	O2A - Full Removal - Cut and Lift	O3A - Leave (Major) - Rock Placement Over Entire Line	O3B - Leave (Major) - Trench & Bury Entire Line	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	N	W	W	20.0%
O3A - Leave (Major) - Rock Placement Over Entire Line	N	N	W	W	20.0%
O3B - Leave (Major) - Trench & Bury Entire Line	S	S	N	N	30.0%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	S	S	N	N	30.0%

1.3 High Consequence Events	O2A - Full Removal - Cut and Lift	O3A - Leave (Major) - Rock Placement Over Entire Line	O3B - Leave (Major) - Trench & Bury Entire Line	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	MW	MW	W	12.0%
O3A - Leave (Major) - Rock Placement Over Entire Line	MS	N	N	S	33.6%
O3B - Leave (Major) - Trench & Bury Entire Line	MS	N	N	S	33.6%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	S	W	W	N	20.8%

1.4 Legacy Risk	O2A - Full Removal - Cut and Lift	O3A - Leave (Major) - Rock Placement Over Entire Line	O3B - Leave (Major) - Trench & Bury Entire Line	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	S	S	MS	38.1%
O3A - Leave (Major) - Rock Placement Over Entire Line	W	N	N	S	23.6%
O3B - Leave (Major) - Trench & Bury Entire Line	W	N	N	S	23.6%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	MW	W	W	N	14.7%

L.3 Group 17 Pairwise Comparison Matrices – Environment

2.1 Operational Marine Impact	O2A - Full Removal - Cut and Lift	O3A - Leave (Major) - Rock Placement Over Entire Line	O3B - Leave (Major) - Trench & Bury Entire Line	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	W	W	W	18.2%
O3A - Leave (Major) - Rock Placement Over Entire Line	S	N	N	N	27.3%
O3B - Leave (Major) - Trench & Bury Entire Line	S	N	N	N	27.3%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	S	N	N	N	27.3%

2.2 Atmospheric Emissions & Fuel Consumption	O2A - Full Removal - Cut and Lift	O3A - Leave (Major) - Rock Placement Over Entire Line	O3B - Leave (Major) - Trench & Bury Entire Line	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	W	W	W	18.2%
O3A - Leave (Major) - Rock Placement Over Entire Line	S	N	N	N	27.3%
O3B - Leave (Major) - Trench & Bury Entire Line	S	N	N	N	27.3%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	S	N	N	N	27.3%

2.3 Other Consumptions	O2A - Full Removal - Cut and Lift	O3A - Leave (Major) - Rock Placement Over Entire Line	O3B - Leave (Major) - Trench & Bury Entire Line	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	S	N	N	27.3%
O3A - Leave (Major) - Rock Placement Over Entire Line	W	N	W	W	18.2%
O3B - Leave (Major) - Trench & Bury Entire Line	N	S	N	N	27.3%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	N	S	N	N	27.3%

2.4 Seabed Disturbance	O2A - Full Removal - Cut and Lift	O3A - Leave (Major) - Rock Placement Over Entire Line	O3B - Leave (Major) - Trench & Bury Entire Line	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	MS	N	W	24.6%
O3A - Leave (Major) - Rock Placement Over Entire Line	MW	N	MW	VMW	6.9%
O3B - Leave (Major) - Trench & Bury Entire Line	N	MS	N	W	24.6%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	S	VMS	S	N	43.9%

2.5 Legacy Marine Impacts	O2A - Full Removal - Cut and Lift	O3A - Leave (Major) - Rock Placement Over Entire Line	O3B - Leave (Major) - Trench & Bury Entire Line	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	S	S	MS	38.1%
O3A - Leave (Major) - Rock Placement Over Entire Line	W	N	N	S	23.6%
O3B - Leave (Major) - Trench & Bury Entire Line	W	N	N	S	23.6%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	MW	W	W	N	14.7%

L.4 Group 17 Pairwise Comparison Matrices – Technical

3.1 Technical Risk	O2A - Full Removal - Cut and Lift	O3A - Leave (Major) - Rock Placement Over Entire Line	O3B - Leave (Major) - Trench & Bury Entire Line	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	W	W	W	18.2%
O3A - Leave (Major) - Rock Placement Over Entire Line	S	N	N	N	27.3%
O3B - Leave (Major) - Trench & Bury Entire Line	S	N	N	N	27.3%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	S	N	N	N	27.3%

L.5 Group 17 Pairwise Comparison Matrices – Societal

4.1 Fishing	O2A - Full Removal - Cut and Lift	O3A - Leave (Major) - Rock Placement Over Entire Line	O3B - Leave (Major) - Trench & Bury Entire Line	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	S	S	MS	38.1%
O3A - Leave (Major) - Rock Placement Over Entire Line	W	N	N	S	23.6%
O3B - Leave (Major) - Trench & Bury Entire Line	W	N	N	S	23.6%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	MW	W	W	N	14.7%

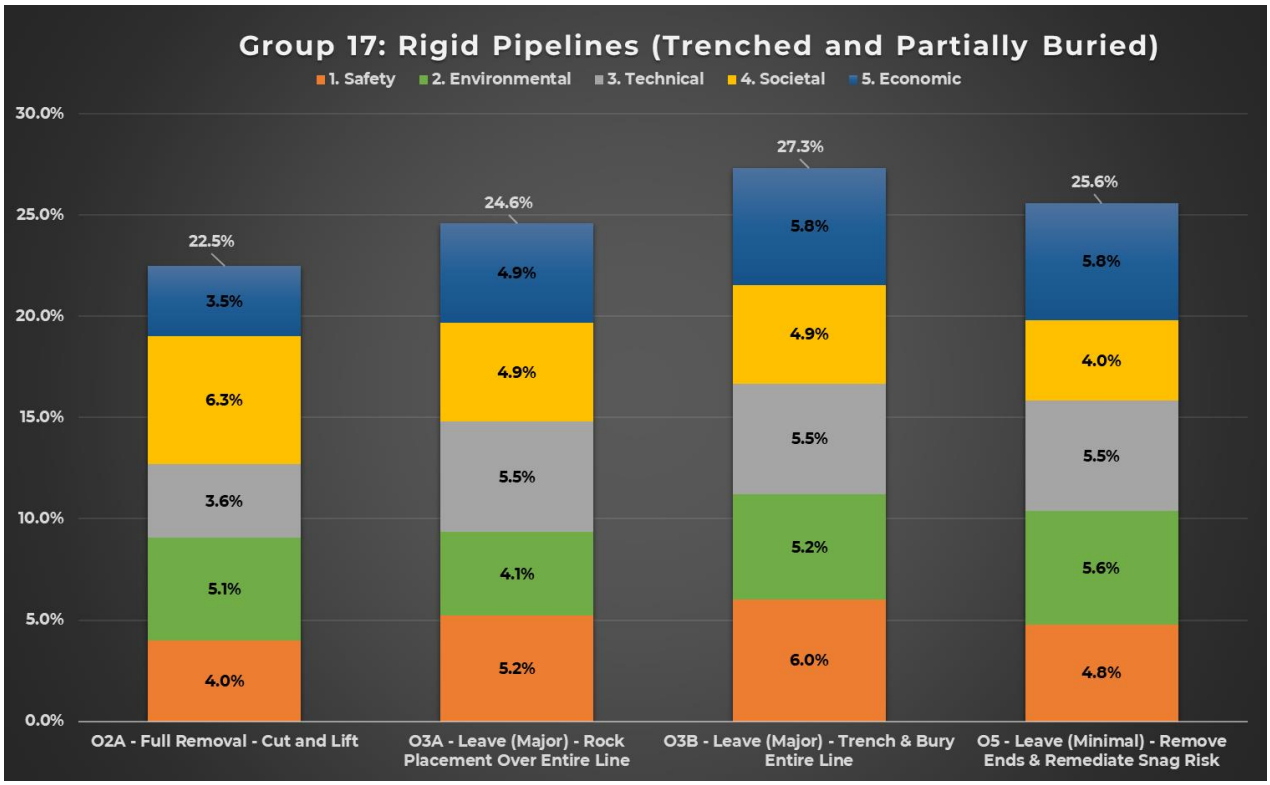
4.2 Other Users	O2A - Full Removal - Cut and Lift	O3A - Leave (Major) - Rock Placement Over Entire Line	O3B - Leave (Major) - Trench & Bury Entire Line	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	N	N	N	25.0%
O3A - Leave (Major) - Rock Placement Over Entire Line	N	N	N	N	25.0%
O3B - Leave (Major) - Trench & Bury Entire Line	N	N	N	N	25.0%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	N	N	N	N	25.0%

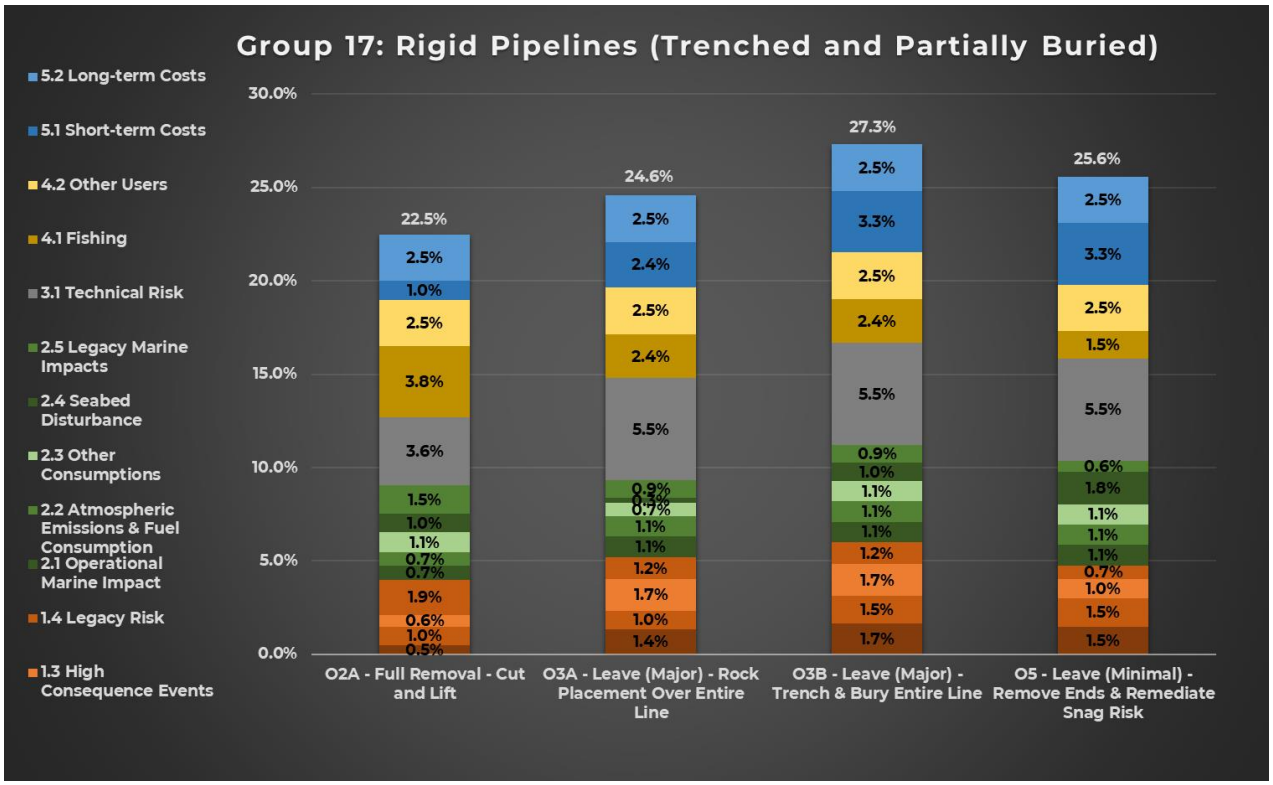
L.6 Group 17 Pairwise Comparison Matrices – Economic

5.1 Short-term Costs	O2A - Full Removal - Cut and Lift	O3A - Leave (Major) - Rock Placement Over Entire Line	O3B - Leave (Major) - Trench & Bury Entire Line	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	MW	MW	MW	9.9%
O3A - Leave (Major) - Rock Placement Over Entire Line	MS	N	W	W	24.3%
O3B - Leave (Major) - Trench & Bury Entire Line	MS	S	N	N	32.9%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	MS	S	N	N	32.9%

5.2 Long-term Costs	O2A - Full Removal - Cut and Lift	O3A - Leave (Major) - Rock Placement Over Entire Line	O3B - Leave (Major) - Trench & Bury Entire Line	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	N	N	N	25.0%
O3A - Leave (Major) - Rock Placement Over Entire Line	N	N	N	N	25.0%
O3B - Leave (Major) - Trench & Bury Entire Line	N	N	N	N	25.0%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	N	N	N	N	25.0%

L.7 Group 17 Results Charts





APPENDIX M GROUP 18 – DETAILED EVALUATION RESULTS

M.1 Group 18 Attributes Table

Group 18: Rigid Pipelines (Trenched and Buried, Low Integrity or Concrete Coated)

Hudson: PL1022.1 - 2" L1 Gas Lift Pipeline from Hudson Manifold to Well L1 - 1.641 km | PL1022.2 - 2" L2 Gas Lift Pipeline from Hudson Manifold to Well L2 - 1.761 km | PL1018 10" - Production Pipeline (disused) from Hudson Manifold to Tern Alpha - 10.41 km
PL1019 - 10" Production Pipeline (disused) from Hudson Manifold to Tern Alpha - 10.41 km | PL1020 - 8" Production/Test Pipeline (disused) from Hudson Manifold to Tern Alpha - 10.41 km | PL1024 - 8" L1 Production/Test Pipeline (disused) from Well L1 to Hudson Manifold - 1.761 km
PL1025 - 8" L2 Production/Test Pipeline (disused) from Well L2 to Hudson Manifold - 1.761 km | PL1021 - 8" Water Injection Pipeline (disused) from Tern Alpha to Hudson Manifold - 10.41 km

Eider: PL475 (N0506) - 12" Oil Pipeline from Eider (Oil Production Tee) to North Cormorant - 13.145 km | PL476 (N1001) - 12" Water Injection Pipeline - Disused Tern to Eider - 16.4 km

Tern: PL478 (N0604) - 8" Gas Pipeline from North Cormorant to Tern - 13. km

Central Cormorant UMC: PL304 (N0902) - 2 x 3" Well Injection Flowlines from UMC to Well W4 - 3.524 km | PL305 (N0903) - 2 x 3" Well Injection Flowlines from UMC to Well W4 - 3.524 km | PL306 (N0707) - 3" Oil - TFL from Well P5 to UMC - 3.142 km
PL307 (N0708) - 3" Oil - TFL from Well P5 to UMC - 3.1 km | PL184 (N0901) - 8" Water Injection Pipeline - New from Cormorant Alpha to UMC - 7.7 km | PL184 (N0930) - 8" Water Injection Pipeline - Old from Cormorant Alpha to UMC - 7.5 km

Otter: PL3132 (T0129) - 10" Water Injection Pipeline from Eider (Water Injection Tee) to Otter - 21.1 km | PL1869 (T0124) - 10" Water Injection Pipeline - Disused from Eider to Otter - 21.1 km | PL1868 (T0123) - 10" Multiphase Pipeline from Otter to Eider - 21.2 km
PL1868a (T0123a) - 10" Multiphase Pipeline - Replacement from Otter to Eider (Oil Production Tee) - 6 km

		O2A - Full Removal - Cut and Lift	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk
		- Pipelines are disconnected - De-burial of lines by MFE (1 pass) - Lines are fully recovered by cut and lift - Concrete spalling debris is recovered by DSV (25% of cuts), 3 lines only	- Pipelines are disconnected - Pipeline ends are removed by cut and lift in 10m sections - Rock placement over mid-line areas of spans / exposures / shallow burial	- Pipelines are disconnected - Re-trench and bury areas of spans / exposures / shallow burial	- Pipelines are disconnected - Remove areas of spans / exposures / shallow burial by cut and lift - Remediate cut ends with rock using an FPV	- Pipelines are disconnected - Remove pipeline ends by cut and lift - Remediate cut ends with rock using an FPV
1. Safety	1.1 Operations Personnel	Vessel Type: PoB / Days / Hours / PLL DSV: 110 / 26.3 / 34,769 / 2.61E-03 Divers: 18 / 26.3 / 11,379 / 1.10E-02 CSV: 76 / 983.5 / 896,934 / 6.73E-02 Total offshore hours: 943,081 hrs Total offshore PLL: 8.09E-02 Resource Type: Days / Hours / PLL Engineering & Management: 12,916.2 / 103,329 / 4.13E-04 Project Management: 12,513.0 / 100,104 / 4.00E-04 Onshore Operations (includes Cleaning & Disposal): 946.0 / 60,544 / 7.45E-03 Total onshore hours: 263,977 hrs Total onshore PLL: 8.26E-03 Total operational hours: 1,207,059 hrs Total operational PLL: 8.92E-02	Vessel Type: PoB / Days / Hours / PLL CSV: 76 / 52.1 / 47,470 / 3.56E-03 Rockdump Vessel: 20 / 89.1 / 21,372 / 1.60E-03 Total offshore hours: 68,842 hrs Total offshore PLL: 5.16E-03 Resource Type: Days / Hours / PLL Engineering & Management: 1,551.5 / 12,412 / 4.96E-05 Project Management: 2,154.0 / 17,232 / 6.89E-05 Onshore Operations (includes Cleaning & Disposal): 22.0 / 1,408 / 1.73E-04 Total onshore hours: 31,052 hrs Total onshore PLL: 2.92E-04 Total operational hours: 99,893 hrs Total operational PLL: 5.45E-03	Vessel Type: PoB / Days / Hours / PLL Trenching Vessel: 55 / 100.5 / 66,323 / 4.97E-03 Total offshore hours: 66,323 hrs Total offshore PLL: 4.97E-03 Resource Type: Days / Hours / PLL Engineering & Management: 2,495.6 / 19,965 / 7.99E-05 Project Management: 2,313.0 / 18,504 / 7.40E-05 Total onshore hours: 38,469 hrs Total onshore PLL: 1.54E-04 Total operational hours: 104,792 hrs Total operational PLL: 5.13E-03	Vessel Type: PoB / Days / Hours / PLL CSV: 76 / 441.2 / 402,347 / 3.02E-02 Rockdump Vessel: 20 / 105.7 / 25,361 / 1.90E-03 Total offshore hours: 427,708 hrs Total offshore PLL: 3.21E-02 Resource Type: Days / Hours / PLL Engineering & Management: 6,214.7 / 49,718 / 1.99E-04 Project Management: 6,081.0 / 48,648 / 1.95E-04 Onshore Operations (includes Cleaning & Disposal): 205.0 / 13,120 / 1.61E-03 Total onshore hours: 111,486 hrs Total onshore PLL: 2.01E-03 Total operational hours: 539,193 hrs Total operational PLL: 3.41E-02	Vessel Type: PoB / Days / Hours / PLL CSV: 76 / 49.3 / 44,943 / 3.37E-03 Rockdump Vessel: 20 / 4.8 / 1,147 / 8.60E-05 Total offshore hours: 46,091 hrs Total offshore PLL: 3.46E-03 Resource Type: Days / Hours / PLL Engineering & Management: 850.0 / 6,800 / 2.72E-05 Project Management: 835.0 / 6,680 / 2.67E-05 Onshore Operations (includes Cleaning & Disposal): 22.0 / 1,408 / 1.73E-04 Total onshore hours: 14,888 hrs Total onshore PLL: 2.27E-04 Total operational hours: 60,979 hrs Total operational PLL: 3.68E-03
		MW	MW	W	MW	N	MS	W	MS	N	MW
		16.366972	17.387914	2.6158358	24.23913	1.062378168	0.159824047	1.480978261	0.150439883	1.394021739	9.266304348
	Summary	The assessment of the Operations Personnel sub-criterion is as follows: Option 2A is assessed as being Much Weaker than Option 4A and Option 4B due to the risk exposure being around 17 times higher in Option 2A. This is due to the greater offshore scope (with diver support) associated with the full removal of these lines versus the smaller scope and lower risk activities to perform rock placement over / trenching of problem areas of the lines in Option 4A and Option 4B. Option 2A is assessed as being Weaker than Option 4C due to the risk exposure being more than double in Option 2A due to the greater offshore scope to fully remove the lines versus the smaller scope to remove problem areas of the lines. Option 2A is assessed as being Much Weaker than Option 5 due the risk exposure being around 24 times higher for the greater scope associated with fully removing the lines versus the smallest scope to remove the line ends only in Option 5. Option 4A is assessed as being Neutral to Option 4B as the scope and the risk exposure is similar for both options. Option 4A is assessed as being Much Stronger than Option 4C due to the risk exposure being around 7 times higher for Option 4C due to the greater scope associated with removing the problem areas in Option 4C. Option 4A is assessed as being Weaker than Option 5 as the risk exposure is around 50% higher for Option 4A due to the smallest scope associated with the line end removal in Option 5. Option 4B is assessed as being Much Stronger than Option 4C due to the risk exposure being around 7 times higher for Option 4C due to the greater scope associated with removing the problem areas in Option 4C. Option 4B is assessed as being Neutral to Option 5 as the risk exposure is around 40% higher for Option 4B due to the smallest scope associated with the line end removal in Option 5. Option 4C is assessed as being Much Weaker than Option 5 due to the risk exposure being almost 10 times higher for Option 4C due to the greater scope associated with removing the problem areas in Option 4C. **Overall, Option 5 is preferred from a risk to Operations Personnel perspective.**					
1. Safety	1.2 Other Users	Vessel Days: DSV: 26.3 CSV: 983.5 Total vessel days: 1,009.8 days Transits: 64	Vessel Days: CSV: 52.1 Rockdump Vessel: 89.1 Total vessel days: 141.1 days Transits: 34	Vessel Days: Trenching Vessel: 100.5 Total vessel days: 100.5 days Transits: 10	Vessel Days: CSV: 441.2 Rockdump Vessel: 105.7 Total vessel days: 546.8 days Transits: 36	Vessel Days: CSV: 49.3 Rockdump Vessel: 4.8 Total vessel days: 54.1 days Transits: 4
		MW	MW	W	MW	W	S	W	MS	N	MW
	Summary	The assessment of the Other Users sub-criterion is as follows: Option 2A is assessed as being Much Weaker than Option 4A, Option 4B and Option 5 due to the much higher number of vessel days and transits associated with the full removal option. Option 2A is assessed as being Weaker than Option 4C due to the higher number of vessel days and transits in Option 4C. Option 4A is assessed as being Weaker than Option 4B and Option 5 as there are more transits required in Option 4A. Option 4A is assessed as being Stronger than Option 4C as, while the transits are similar in both options, there are a much higher number of vessel days in Option 4C. Option 4B is assessed as being Much Stronger than Option 4C due to the much higher number of vessel days and transits in Option 4C. Option 4B is assessed as being Neutral to Option 5 as, while there are differences in the vessel days and transits, these are considered insufficient to express a preference. Option 4C is assessed as being Much Weaker than Option 5 due to the much higher number of vessel days and transits in Option 4C. **Overall, Option 4B and Option 5 are equally preferred from a risk to Other Users perspective.**					

	O2A - Full Removal - Cut and Lift	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk
1. Safety – 1.3 High Consequence Events	Routine cut and lift operations. Very high number of lifts (18886) through the water column to recover line sections. Additional lifting to transfer pipeline sections to quayside. High number of lifting operations to deploy and recover deburial equipment.	Routine, low risk rock cover operations. High number of lifting operations (504) to recover the line ends. Moderate number of lifting operations through the water column to deploy and recover cutting equipment. In addition there is the potential for dropped object associated with the offloading of the cut line sections to the quayside.	Routine, low risk trenching operations. High number of lifting operations (774) to deploy and recover trenching equipment.	High number of lifting operations (8316) to recover the line ends and areas of spans / exposure / shallow burial. High number of lifting operations through the water column to deploy and recover cutting equipment. In addition there is the potential for dropped object associated with the offloading of the cut line sections to the quayside.	High number of lifting operations (924) to recover the line ends. High number of lifting operations through the water column to deploy and recover cutting equipment. In addition there is the potential for dropped object associated with the offloading of the cut line sections to the quayside.
	VMW VMW MW VMW	N MS N	MS N	MW	
Summary	The assessment of the High Consequence Events sub-criterion is as follows: Option 2A is assessed as being Very Much Weaker than Option 4A, Option 4B and Option 5 as there are 18,000 offshore lifts and hence potential for high consequence events from dropped objects, associated with Option 2A versus much fewer lifts (hundreds) with the other options. Option 2A is assessed as being Much Weaker than Option 4C as there are around 18,000 lifts associated with Option 2A versus around 8,000 in Option 4C. Option 4A is assessed as being Neutral to Option 4B and Option 5 as, while there are differences in the number of lifts across these option, the differences are deemed insufficient to express a preference. Option 4A is assessed as being Much Stronger than Option 4C as there are a much higher number of lifts associated with Option 4C. Option 4B is assessed as being Much Stronger than Option 4C as there are a much higher number of lifts associated with Option 4C. Option 4B is assessed as being Neutral to Option 5 as, while there are differences in the number of lifts across these option, the differences are deemed insufficient to express a preference.. Option 4C is assessed as being Much Weaker than Option 5 as there are a much higher number of lifts associated with Option 4C. **Overall, Option 4A, Option 4B and Option 5 are equally preferred from a High Consequence Events perspective.**				
1. Safety – 1.4 Legacy Risk	No legacy risk from this full removal option.	The lines would remain in-situ with this option although the majority of their length would be trenched and buried with rock placement over areas of spans \ exposures \ shallow burial. The survey & monitoring programme is committed to ensuring that the potential snag hazard from left in-situ infrastructure continues to be managed & mitigated as appropriate. Vessel Type: PoB / Days / Hours / PLL Survey Vessel (Legacy): 44 / 71.1 / 37,557 / 2.82E-03	The lines would remain in-situ with this option although would be fully trenched and buried. The survey & monitoring programme is committed to ensuring that the potential snag hazard from left in-situ infrastructure continues to be managed & mitigated as appropriate. Vessel Type: PoB / Days / Hours / PLL Survey Vessel (Legacy): 44 / 71.1 / 37,557 / 2.82E-03	The lines would remain in-situ with this option although would be fully trenched and buried as areas of spans / exposures / shallow burial are removed. The survey & monitoring programme is committed to ensuring that the potential snag hazard from left in-situ infrastructure continues to be managed & mitigated as appropriate. Vessel Type: PoB / Days / Hours / PLL Survey Vessel (Legacy): 44 / 71.1 / 37,557 / 2.82E-03	The lines would remain in-situ with this option although the majority of their length would be trenched and buried. The line ends will be removed with small areas of rock cover to mitigate potential snag hazard from cut ends. Spans and exposures will remain. The survey & monitoring programme is committed to ensuring that the potential snag hazard from left in-situ infrastructure continues to be managed & mitigated as appropriate. Vessel Type: PoB / Days / Hours / PLL Survey Vessel (Legacy): 44 / 71.1 / 37,557 / 2.82E-03
	S S S MS	W W S	N S	S	
Summary	The assessment of the Legacy Risk sub-criterion is as follows: Option 2A is assessed as being Stronger than Option 4A, Option 4B and Option 4C as the lines are fully removed and as such there is no legacy risk versus the lines remaining largely trenched and buried with problem areas addressed by rock cover / trenching / removal in the other options, where the potential for snag hazard remains although this is mitigated by the survey and monitoring programme. Option 2A is assessed as being Much Stronger than Option 5 as there is no legacy risk as the lines are removed versus the lines remaining, largely trenched and buried albeit with areas of spans remaining in Option 5. Option 4A is assessed as being Weaker than Option 4B and Option 4C as, while the lines remain in all three options, Option 4B and Option 4C present more of a clear seabed due to the problem areas being trenched or removed versus being rock covered in Option 4A. Option 4A is assessed as being Stronger than Option 5 as while the lines remain in both options, problem areas are rock covered in Option 4A whereas the problem areas would remain in Option 5. Option 4B is assessed as being Neutral to Option 4C as both options present a clear seabed. Option 4B is assessed as being Stronger than Option 5 as while the lines remain in both options, problem areas are trenched in Option 4A whereas the problem areas would remain in Option 5. Option 4C is assessed as being Stronger than Option 5 as while the lines remain in both options, problem areas are removed in Option 4A whereas the problem areas would remain in Option 5. **Overall, Option 2A is preferred from a Legacy Risk perspective.**				
2. Environmental – 2.1 Operational Marine Impact	Vessel Noise (days on-site): 905.8 days Tooling Noise (MFE & DWC) = 865.4 days Operation releases: Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush and releases to the marine environment during flushing activities. Cutting of line ends and midline cuts would lead to an elevated release of fluids from within the line. However, given the prior cleaning of the line, the concentration and quantity of release should still be low overall. Therefore, the related impact is also anticipated to be low. Vessel releases: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore at 905.8 days is the highest of all options. The environmental impact is considered to be low.	Vessel Noise (days on-site): 87.4 days Tooling Noise (Hydraulic Shears) = 21.0 days Operation releases: Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush and releases to the marine environment during flushing activities. Cutting of line ends would lead to an elevated release of fluids from within the line. However, given the prior cleaning of the line, the concentration and quantity of release should still be low overall. Therefore, the related impact is also anticipated to be low. Vessel releases: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore at 87.4 days is not considered significant. The environmental impact is considered to be negligible.	Vessel Noise (days on-site): 84.5 days Tooling Noise (Trenching) = 74.9 days Operation releases: Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush and releases to the marine environment during flushing activities. As line is being trenched there is negligible release from the line. Vessel releases: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore at 84.5 days is not considered significant. The environmental impact is considered to be negligible.	Vessel Noise (days on-site): 487.6 days Tooling Noise (Hydraulic Shears) = 206.5 days Operation releases: Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush and releases to the marine environment during flushing activities. Cutting of line ends and midline cuts would lead to an elevated release of fluids from within the line. However, given the prior cleaning of the line, the concentration and quantity of release should still be low overall. Therefore, the related impact is also anticipated to be low. Vessel releases: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore at 487.6 days is notable. The environmental impact is considered to be low.	Vessel Noise (days on-site): 45.4 days Tooling Noise (Hydraulic Shears) = 19.3 days Operation releases: Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush and releases to the marine environment during flushing activities. Cutting of line ends would lead to an elevated release of fluids from within the line. However, given the prior cleaning of the line, the concentration and quantity of release should still be low overall. Therefore, the related impact is also anticipated to be low. Vessel releases: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore at 45.4 days is the lowest of the options. The environmental impact is considered to be negligible.
	VMW VMW MW VMW	N MS N	MS N	MW	
Summary	The assessment of the Operational Marine Impact sub-criterion is as follows: Option 2A is assessed as being Very Much Weaker than Option 4A, Option 4B and Option 5 as there are many more vessel days and days of tooling operations associated with Option 2A. Option 2A is assessed as being Much Weaker than Option 4C as the vessel days and tooling noise are higher for Option 2A. Option 4A is assessed as being Neutral to Option 4B and Option 5 as, while there are differences in the vessel days and tooling durations, these differences are considered insufficient to express a preference. Option 4A is assessed as being Much Stronger than Option 4C as the vessel days and tooling noise are higher for Option 4C. Option 4B is assessed as being Much Stronger than Option 4C as the vessel days and tooling noise are higher for Option 4C. Option 4B is assessed as being Neutral to Option 5 as, while there are differences in the vessel days and tooling durations, these differences are considered insufficient to express a preference. Option 4C is assessed as being Much Weaker than Option 5 as the vessel days and tooling noise are higher for Option 4C. **Overall, Option 4A, Option 4B and Option 5 are equally preferred from an Operational Marine Impact perspective.**				

	O2A - Full Removal - Cut and Lift				O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial			O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial		O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk
2. Environmental **2.2 Atmospheric Emissions & Fuel Consumption**	Vessel Emissions (in tonnes): Fuel: 27,987 CO2: 88,719 NOx: 1,662.43 SO2: 111.95 Vessel Energy Use: 1,203,444 GJ				Vessel Emissions (in tonnes): Fuel: 5,121 CO2: 16,235 NOx: 304.21 SO2: 20.49 Vessel Energy Use: 220,223 GJ			Vessel Emissions (in tonnes): Fuel: 3,903 CO2: 12,374 NOx: 231.86 SO2: 15.61 Vessel Energy Use: 167,846 GJ		Vessel Emissions (in tonnes): Fuel: 16,304 CO2: 51,682 NOx: 968.43 SO2: 65.21 Vessel Energy Use: 701,051 GJ	Vessel Emissions (in tonnes): Fuel: 3,590 CO2: 11,381 NOx: 213.26 SO2: 14.36 Vessel Energy Use: 154,380 GJ
	MW	**MW**	**W**	**MW**	**N**	**S**	**N**	**S**	**N**	**W**	
Summary	The assessment of the Atmospheric Emissions & Consumptions sub-criterion is as follows: Option 2A is assessed as being Much Weaker than Option 4A, Option 4B and Option 5 as the emissions and fuel use are much higher (between 5 and 8 times higher) for Option 2A due to the larger offshore scope for full removal. Option 2A is assessed as being Weaker than Option 4C as the emissions and fuel use are almost double for Option 2A. Option 4A is assessed as being Neutral to Option 4B and Option 5 as, while there are differences in the emissions and fuel use across these options, the differences are considered insufficient to express a preference. Option 4A is assessed as being Stronger than Option 4C as the fuel use and emissions are 3 times higher for Option 4C. Option 4B is assessed as being Stronger than Option 4C as the fuel use and emissions are around 4 times higher for Option 4C. Option 4B is assessed as being Neutral to Option 5 as, while there are differences in the emissions and fuel use across these options, the differences are considered insufficient to express a preference. Option 4C is assessed as being Weaker than Option 5 as the fuel use and emissions are more than 4 times higher for Option 4C. **Overall, Option 4A, Option 4B and Option 5 are equally preferred from an Atmospheric Emissions & Consumptions perspective.**										
2. Environmental **2.3 Other Consumptions**	Material Emissions (CO2 in tonnes): Recovered Material: 27,692 Remaining Material: Total: 27,692 Rock: N/A tonnes				Material Emissions (CO2 in tonnes): Recovered Material: 617 Remaining Material: 41,023 Total: 41,640 Rock: 367,050 tonnes			Material Emissions (CO2 in tonnes): Recovered Material: Remaining Material: 41,937 Total: 41,937 Rock: N/A tonnes		Material Emissions (CO2 in tonnes): Recovered Material: 5,988 Remaining Material: 32,884 Total: 38,872 Rock: 57,800 tonnes	Material Emissions (CO2 in tonnes): Recovered Material: 617 Remaining Material: 41,023 Total: 41,640 Rock: 10,500 tonnes
	MS	**S**	**S**	**S**	**MW**	**W**	**MW**	**S**	**S**	**W**	
Summary	The assessment of the Other Consumptions sub-criterion is as follows: Option 2A is assessed as being Much Stronger than Option 4A due to the large quantity of rock resource required in Option 4A. Option 2A is assessed as being Stronger than all other options as there is no rock resource required in Option 2A and the impact from processing the returned material is almost half that associated with replacing material left in-situ. Option 4A is assessed as being Much Weaker than Option 4B and Option 5 due to the much larger quantity of rock resource required in Option 4A. Option 4A is assessed as being Weaker than Option 4C due to the higher quantity of rock resource required in Option 4A. Option 4B is assessed as being Stronger than Option 4C and Option 5 as there is no rock resource required in this option. Option 4C is assessed as being Weaker than Option 5 due to the higher quantity of rock resource required in Option 4C. **Overall, Option 2A is preferred from an Other Consumptions perspective.**										
2. Environmental **2.4 Seabed Disturbance**	Seabed Disturbance (m2): Rock Cover: 950 MFE: 942,495 Habitat Loss / Change (m2): Rock Bags: 950				Seabed Disturbance (m2): Rock Cover: 369,900 Habitat Loss / Change (m2): Rock Cover: 369,900			Seabed Disturbance (m2): Trenching: 605,955 No rock cover in this option.		Seabed Disturbance (m2): Rock Cover: 231,200 Habitat Loss / Change (m2): Rock Cover: 231,200	Seabed Disturbance (m2): Rock Cover: 4,200 Habitat Loss / Change (m2): Rock Cover: 4,200
	MS	**W**	**MS**	**W**	**MW**	**W**	**MW**	**MS**	**W**	**MW**	
Summary	The assessment of the Seabed Disturbance sub-criterion is as follows: Option 2A is assessed as being Much Stronger than Option 4A as, while there is significant area of seabed disturbance from the deburial operations in Option 2A, this impact is temporary in nature whereas the area impacted in Option 4A is significant and represents a permanent habitat change. Option 2A is assessed as being Weaker than Option 4B as there is a larger area of temporary seabed impact in Option 2A and there is a small area of permanent habitat change associated with rock placement around crossing locations. Option 2A is assessed as being Much Stronger than Option 4C as, while there is significant area of seabed disturbance from the deburial operations in Option 2A, this impact is temporary in nature whereas the area impacted in Option 4C is significant and represents a permanent habitat change. Option 2A is assessed as being Weaker than Option 5 as the large area of temporary seabed impact in Option 2A is considered to have a greater impact than the small area of rock cover despite this being a permanent habitat change. Option 4A is assessed as being Much Weaker than Option 4B and Option 5 due to the large area of permanent habitat change introduced in this option. Option 4A is assessed as being Weaker than Option 4C as, while both options introduce significant rock cover, the area impacted by Option 4A is much greater. Option 4B is assessed as being Much Stronger than Option 4C as, while there is significant area of seabed disturbance from the deburial operations in Option 4B, this impact is temporary in nature whereas the area impacted in Option 4C is significant and represents a permanent habitat change. Option 4B is assessed as being Weaker than Option 5 as the large area of temporary seabed impact in Option 4B is considered to have a greater impact than the small area of rock cover despite this being a permanent habitat change. Option 4C is assessed as being Much Weaker than Option 5 due to the large area of permanent habitat change introduced in this option. **Overall, Option 5 is preferred from a Seabed Disturbance perspective.**										
2. Environmental **2.5 Legacy Marine Impacts**	No legacy marine impact from this full removal option.				Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush. The legacy marine impact from the slow release of these low concentration / quantity releases is therefore expected to be low overall.			Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush. The legacy marine impact from the slow release of these low concentration / quantity releases is therefore expected to be low overall.		Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush. The legacy marine impact from the slow release of these low concentration / quantity releases is therefore expected to be low overall.	Line cleaning and flushing operations will use Best Environmental Practice (BEP) and the Best Available Techniques (BAT) to minimise as far as possible both residual hydrocarbon and other chemical levels in line post flush. The legacy marine impact from the slow release of these low concentration / quantity releases is therefore expected to be low overall.
	S	**S**	**S**	**MS**	**N**	**N**	**S**	**N**	**S**	**S**	
Summary	The assessment of the Legacy Marine Impacts sub-criterion is as follows: Option 2A is assessed as being Stronger than Option 4A, Option 4B and Option 4C as there is no legacy marine impacts associated with the full removal option whereas there will be slow degradation of the lines and releases over a long time period with the other options although this is reduced as the lines will be fully / largely trenched and buried with rock cover trenching / removal of problem areas. As such, the lines left in-situ will be largely isolated from the marine environment. Option 2A is assessed as being Much Stronger than Option 5 as there is no legacy marine impacts associated with the full removal option whereas there will be slow degradation of the lines and releases over a long time period with Option 5 where sections of the lines remain exposed to the marine environment. Option 4A is assessed as being Neutral to both Option 4B and Option 4C as the lines remain in all options and are largely isolated from the marine environment. Option 4A is assessed as being Stronger than Option 5 as the legacy marine impact is expected to be marginally greater for Option 5 where sections of the lines remain exposed to the marine environment. Option 4B is assessed as being Neutral to Option 4C as the lines remain in both options and are largely isolated from the marine environment. Option 4B is assessed as being Stronger than Option 5 as the legacy marine impact is expected to be marginally greater for Option 5 where sections of the lines remain exposed to the marine environment. Option 4C is assessed as being Stronger than Option 5 as the legacy marine impact is expected to be marginally greater for Option 5 where sections of the lines remain exposed to the marine environment. **Overall, Option 2A is preferred from a Legacy Marine Impacts perspective.**										

		O2A - Full Removal - Cut and Lift				O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow Burial			O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial		O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk
3. Technical	3.1 Technical Risk	Concept Maturity: Cut and lift techniques are well proven with multiple options available on the market. (Score 3) Technical Risks: Technical risks with this option are associated with the scale of the operation. (Score 2)				Concept Maturity: Rock placement is well proven with a good track record (Score 3) Technical Risks: Limited technical risks associated with this option (Score 3)			Concept Maturity: Post trenching of pipeline sections has a good track record. (Score 3) Technical Risks: The group represents trenched pipelines, therefore trenching should be feasible. However, areas of exposure may be associated with difficult to trench sections. (Score 2)		Concept Maturity: Pipe cutting operation is well proven with a good track record (Score 3) Technical Risks: Limited technical risks associated with this option (Score 3)	Concept Maturity: Pipe cutting operation is well proven with a good track record (Score 3) Technical Risks: Limited technical risks associated with this option (Score 3)
		W	W	W	MW	S	S	N	N	W	W	
	Summary	The assessment of the Technical Risk sub-criterion is as follows: Option 2A is assessed as being Weaker than Option 4A, Option 4B and Option 4C as, while all operations are considered routine, there are challenges performing deburial and cutting / lifting at this scale (189 km of lines), particularly for the concrete coated lines, whereas the scopes for Option 4A, Option 4B and Option 4C are smaller in scale. Option 2A is assessed as being Much Weaker than Option 5 as the activities are similar but again, the scale for the full removal presents the potential for technical challenges over 189 km of lines rather than addressing line ends only in Option 5. Option 4A is assessed as being Stronger than Option 4B and Option 4C as the simple rock cover operations are expected to present less challenges than the trenching or removal of problem areas of the lines. Option 4A is assessed as being Neutral to Option 5 as the simple rock cover operations or line end removal are expected to present similar, low potential for technical challenges. Option 4B is assessed as being Neutral to Option 4C as trenching or removal of problem areas expected to present similar challenges. Option 4B is assessed as being Weaker than Option 5 as the trenching of the problem areas is expected to present greater technical challenges than removal of line ends only. Option 4C is assessed as being Weaker than Option 5 as, while the operations are similar in both options, there is greater scope to remove the problem areas of the lines in Option 4C which has greater potential for technical challenges. **Overall, Option 5 is preferred from a Technical Risk perspective.**										
4. Societal	4.1 Fishing	Large scale disruption associated with the removal operation, however, infrastructure is removed long term, beneficial for the fishing industry. (Score 2)				Relatively short operation. Rock berms are not fishing industry's preferred decommissioning solution. (Score 1)			Medium duration operation in the short-term. If successful, seabed will be left clear for fishing operations. (Score 3)		Significant duration operation in the short-term. Rock to mitigate cut ends should be flush with seabed and not pose any obstacle to fishing operations. (Score 2)	Relatively short duration operation in the short-term. Rock to mitigate cut ends should be flush with seabed and not pose any obstacle to fishing operations. (Score 3)
		S	S	S	MS	W	W	S	N	S	S	
	Summary	The assessment of the Societal impact on Fishing sub-criterion is as follows: Option 2A is assessed as being Stronger than Option 4A, Option 4B and Option 4C as the full removal of the lines in Option 2A is preferred to lines remaining trenched and buried with problem areas addressed by rock cover / trenching or removal respectively. Option 2A is assessed as being Much Stronger than Option 5 as the lines are removed versus lines remaining largely trenched and buried with problem areas remaining. Option 4A is assessed as being Weaker than Option 4B and Option 4C as, while the lines remain in all three options, Option 4B and Option 4C present more of a clear seabed due to the problem areas being trenched or removed versus being rock covered in Option 4A. Option 4A is assessed as being Stronger than Option 5 as while the lines remain in both options, problem areas are rock covered in Option 4A whereas the problem areas would remain in Option 5. Option 4B is assessed as being Neutral to Option 4C as both options present a clear seabed. Option 4B is assessed as being Stronger than Option 5 as while the lines remain in both options, problem areas are trenched in Option 4B whereas the problem areas would remain in Option 5. Option 4C is assessed as being Stronger than Option 5 as while the lines remain in both options, problem areas are removed in Option 4C whereas the problem areas would remain in Option 5. **Overall, Option 2A is preferred from a Societal impact on Fishing perspective.**										
4. Societal	4.2 Other Users	Significant amount of recyclable material returned. (Score 3) Materials Returned: Steel: 17,960 tonnes (recyclable) Concrete: 9,126 tonnes (landfill) Polymer: 1,276 tonnes (landfill)				Minimal societal benefits / impacts with this option. (Score 3) Materials Returned: Steel: 401 tonnes (recyclable) Concrete: 204 tonnes (landfill) Polymer: 29 tonnes (landfill)			Minimal societal benefits / impacts with this option. (Score 3) Materials Returned: None.		Minimal societal benefits / impacts with this option. (Score 3) Materials Returned: Steel: 3,884 tonnes (recyclable) Concrete: 1,974 tonnes (landfill) Polymer: 276 tonnes (landfill)	Minimal societal benefits / impacts with this option. (Score 3) Materials Returned: Steel: 401 tonnes (recyclable) Concrete: 204 tonnes (landfill) Polymer: 29 tonnes (landfill)
		S	S	S	S	N	N	N	N	N	N	
	Summary	The assessment of the Societal impact on Other Users sub-criterion is as follows: Option 2A is assessed as being Stronger than all other options due to the significant quantity of useful, recyclable material returned (steel) and the job creation / retention associated with the large offshore and onshore scope in Option 2A. This is offset somewhat by the significant quantity of material (concrete / polymer) that is likely to end up in landfill. Overall, Option 2A is deemed to present a small societal benefit over the other options. All other options are assessed as being Neutral to each other as the positive and negative societal impacts are considered largely similar for those options. **Overall, Option 2A is preferred from a Societal impact on Other Users perspective.**										
5. Economic	5.1 Short-term Costs	£122.2 Million				£21.195 Million			£22.744 Million		£59.484 Million	£8.903 Million
		MW	MW	W	VMW	N	S	W	S	W	MW	
		101.005 million more	99.456 million more	62.716 million more	113.297 million more	1.549 million less	38.289 million less	12.292 million more	36.74 million less	13.841 million more	50.581 million more	
		476.6% higher	437.3% higher	105.4% higher	1272.6% higher	6.8% lower	64.4% lower	138.1% higher	61.8% lower	155.5% higher	568.1% higher	
	Summary	The assessment of the Short-term Costs sub-criterion is as follows: Option 2A is assessed as being Much Weaker than Option 4A and Option 4B due to the costs to deliver this option being more than 5 times higher (around £100 million more) than Option 4A / Option 4C. Option 2A is assessed as being Weaker than Option 4C due to the costs being around double (£62.7 million more) than Option 4C. Option 2A is assessed as being Very Much Weaker than Option 5 due to the costs being more than 13 times higher (£113 million more) than Option 5. Option 4A is assessed as being Neutral to Option 4B as the costs are similar. Option 4A is assessed as being Stronger than Option 4C as the costs are almost 3 times higher (£38 million more) for Option 4C. Option 4A is assessed as being Weaker than Option 5 as the costs are almost 1.5 times higher (£12.3 million more) for Option 4A. Option 4B is assessed as being Stronger than Option 4C as the costs are almost 3 times higher (£37 million more) for Option 4C. Option 4B is assessed as being Weaker than Option 5 as the costs are around 1.5 times higher (£13.8 million more) for Option 4B. Option 4C is assessed as being Much Weaker than Option 5 as the costs are more than 6 times higher (£50.6 million more) for Option 4C. **Overall, Option 5 is preferred from a Short-term Cost perspective.**										
5. Economic	5.2 Long-term Costs	Surveys: N/A FLTC: N/A Total Legacy Cost: £0 Million				Surveys: £2.13 Million FLTC: N/A Total Legacy Cost: £2.13 Million			Surveys: £2.13 Million FLTC: N/A Total Legacy Cost: £2.13 Million		Surveys: £2.13 Million FLTC: N/A Total Legacy Cost: £2.13 Million	Surveys: £2.13 Million FLTC: £0.565 Million Total Legacy Cost: £2.7 Million
		S	S	S	S	N	N	N	N	N	N	
	Summary	The assessment of the Long-term Costs sub-criterion is as follows: Option 2A is assessed as being Stronger than all other options due to there being no legacy costs associated with Option 2A versus the costs associated with the surveying and monitoring of the infrastructure left in-situ in the other options. All other options are assessed as being Neutral to each other as the long-term costs are largely similar for these options. **Overall, Option 2A is preferred from a Long-term Cost perspective.**										

M.2 Group 18 Pairwise Comparison Matrices – Safety

1.1 Operations Personnel	O2A - Full Removal - Cut and Lift	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	MW	MW	W	MW	8.4%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	MS	N	N	MS	W	25.1%
O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	MS	N	N	MS	N	27.2%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	S	MW	MW	N	MW	9.8%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	MS	S	N	MS	N	29.5%

1.2 Other Users	O2A - Full Removal - Cut and Lift	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	MW	MW	W	MW	8.5%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	MS	N	W	S	W	20.4%
O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	MS	S	N	MS	N	29.9%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	S	W	MW	N	MW	11.4%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	MS	S	N	MS	N	29.9%

1.3 High Consequence Events	O2A - Full Removal - Cut and Lift	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	VMW	VMW	MW	VMW	3.2%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	VMS	N	N	MS	N	29.0%
O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	VMS	N	N	MS	N	29.0%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	MS	MW	MW	N	MW	9.7%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	VMS	N	N	MS	N	29.0%

1.4 Legacy Risk	O2A - Full Removal - Cut and Lift	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	S	S	S	MS	30.3%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	W	N	W	W	S	16.2%
O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	W	S	N	N	S	20.7%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	W	S	N	N	S	20.7%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	MW	W	W	W	N	12.0%

M.3 Group 18 Pairwise Comparison Matrices – Environment

2.1 Operational Marine Impact	O2A - Full Removal - Cut and Lift	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	VMW	VMW	MW	VMW	3.2%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	VMS	N	N	MS	N	29.0%
O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	VMS	N	N	MS	N	29.0%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	MS	MW	MW	N	MW	9.7%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	VMS	N	N	MS	N	29.0%

2.2 Atmospheric Emissions & Fuel Consumption	O2A - Full Removal - Cut and Lift	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	MW	MW	W	MW	8.9%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	MS	N	N	S	N	25.1%
O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	MS	N	N	S	N	25.1%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	S	W	W	N	W	15.8%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	MS	N	N	S	N	25.1%

2.3 Other Consumptions	O2A - Full Removal - Cut and Lift	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	MS	S	S	S	29.3%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	MW	N	MW	W	MW	8.8%
O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	W	MS	N	S	S	24.9%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	W	S	W	N	W	15.7%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	W	MS	W	S	N	21.2%

2.4 Seabed Disturbance	O2A - Full Removal - Cut and Lift	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	MS	W	MS	W	23.0%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	MW	N	MW	W	MW	8.3%
O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	S	MS	N	MS	W	27.1%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	MW	S	MW	N	MW	9.8%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	S	MS	S	MS	N	31.8%

2.5 Legacy Marine Impacts	O2A - Full Removal - Cut and Lift	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	S	S	S	MS	30.4%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	W	N	N	N	S	19.2%
O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	W	N	N	N	S	19.2%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	W	N	N	N	S	19.2%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	MW	W	W	W	N	12.1%

M.4 Group 18 Pairwise Comparison Matrices – Technical

3.1 Technical Risk	O2A - Full Removal - Cut and Lift	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	W	W	W	MW	12.1%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	S	N	S	S	N	24.5%
O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	S	W	N	N	W	17.7%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	S	W	N	N	W	17.7%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	MS	N	S	S	N	28.1%

M.5 Group 18 Pairwise Comparison Matrices – Societal

4.1 Fishing	O2A - Full Removal - Cut and Lift	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	S	S	S	MS	30.3%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	W	N	W	W	S	16.2%
O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	W	S	N	N	S	20.7%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	W	S	N	N	S	20.7%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	MW	W	W	W	N	12.0%

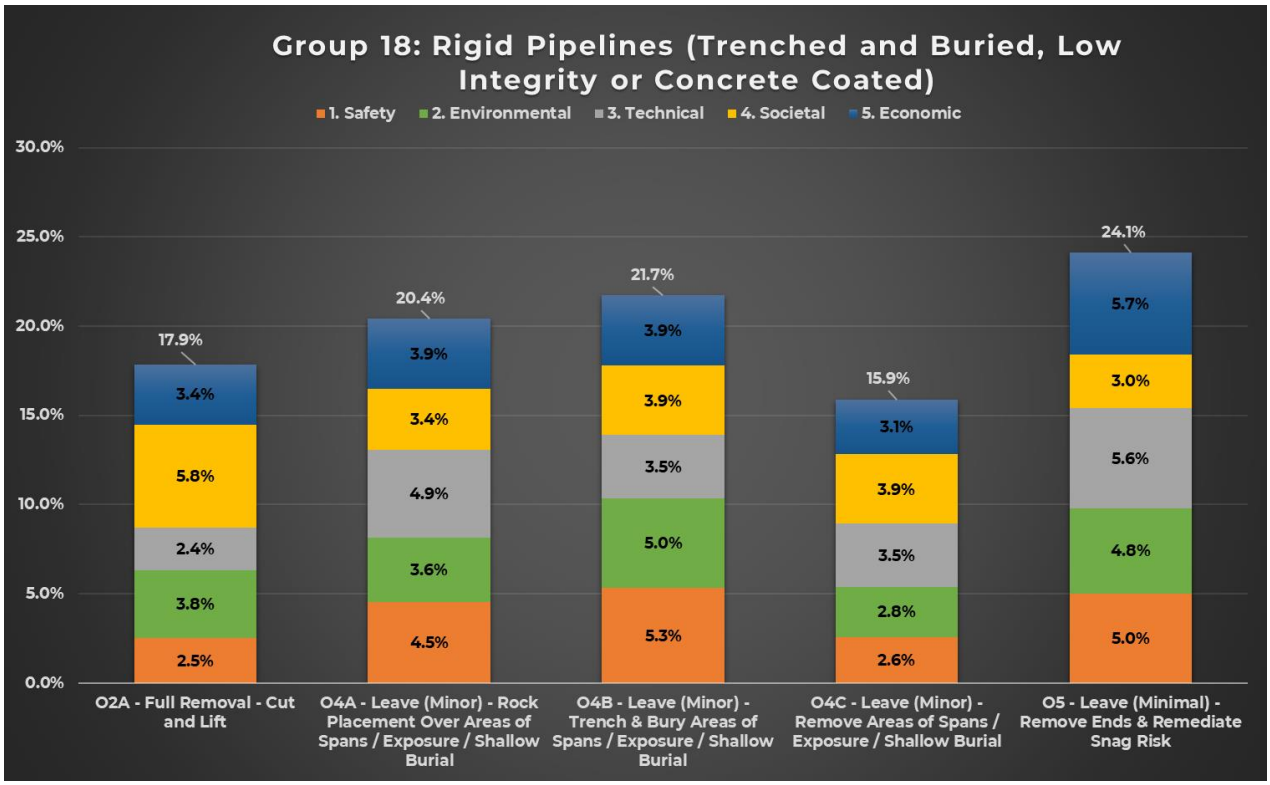
4.2 Other Users	O2A - Full Removal - Cut and Lift	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	S	S	S	S	27.3%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	W	N	N	N	N	18.2%
O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	W	N	N	N	N	18.2%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	W	N	N	N	N	18.2%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	W	N	N	N	N	18.2%

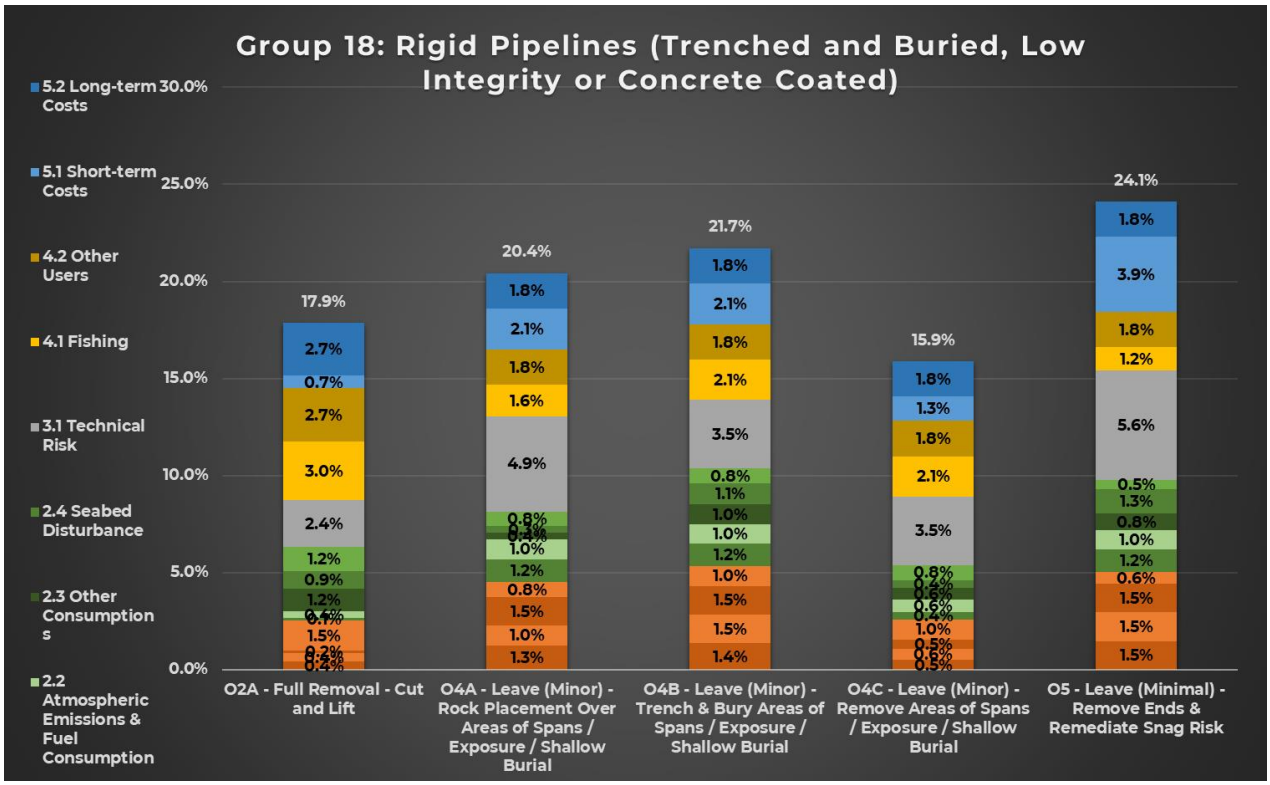
M.6 Group 18 Pairwise Comparison Matrices – Economic

5.1 Short-term Costs	O2A - Full Removal - Cut and Lift	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	MW	MW	W	VMW	6.5%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	MS	N	N	S	W	21.2%
O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	MS	N	N	S	W	21.2%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	S	W	W	N	MW	12.6%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	VMS	S	S	MS	N	38.6%

5.2 Long-term Costs	O2A - Full Removal - Cut and Lift	O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	S	S	S	S	27.3%
O4A - Leave (Minor) - Rock Placement Over Areas of Spans / Exposure / Shallow	W	N	N	N	N	18.2%
O4B - Leave (Minor) - Trench & Bury Areas of Spans / Exposure / Shallow Burial	W	N	N	N	N	18.2%
O4C - Leave (Minor) - Remove Areas of Spans / Exposure / Shallow Burial	W	N	N	N	N	18.2%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	W	N	N	N	N	18.2%

M.7 Group 18 Results Charts





APPENDIX N PIPE IN PIPE HYBRID COMPONENTS

The pipe-in-pipe hybrids were towed into position by vessels using the towheads located at each end of each section, ref. Figure 15-1. The towheads incorporate manual isolation valves. To aid installation the carrier pipe had vent valves and trim chains attached, these remained following installation however are redundant, ref. Figure 15-2 and Figure 15-3. The inner pipes within the pipe-in-pipe hybrids are supported by centralisers, ref. Figure 15-4.

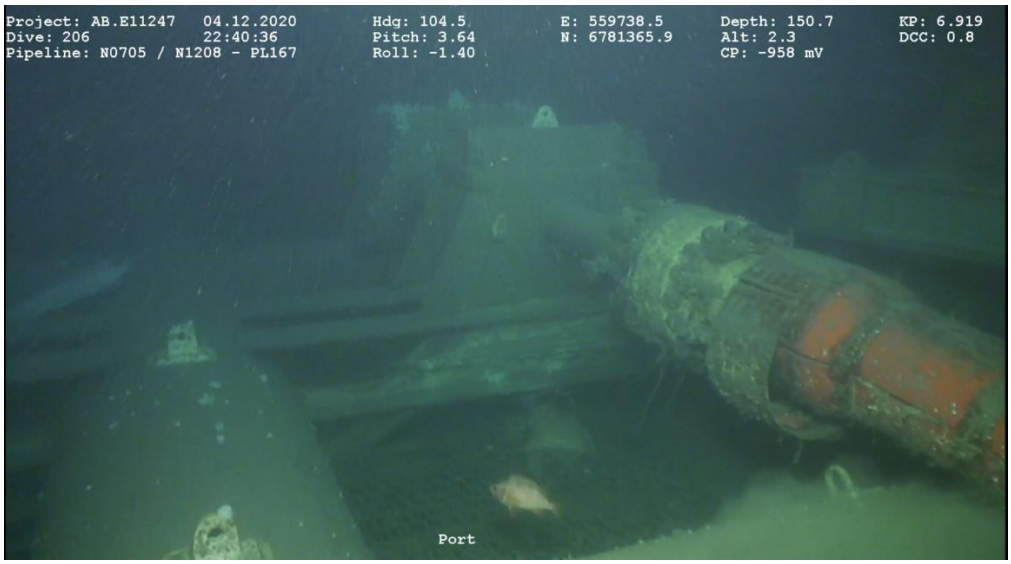


Figure 15-1 Towhead (example)

Figure 15-2 Vent valve (example)

Figure 15-3 Pipe-in-pipe carrier pipe showing redundant trim chain (right hand side)

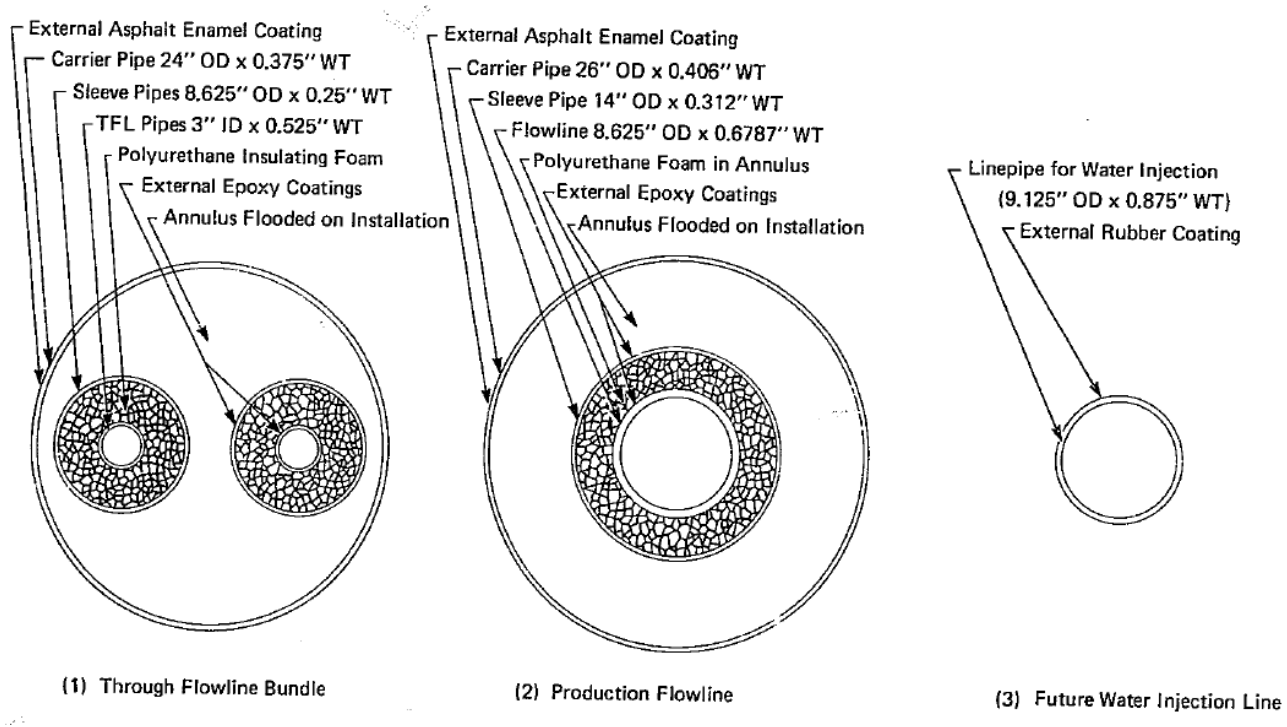


Figure 15-4 Pipe-in-pipe internal arrangement