



**BUCHAN AND HANNAY
DECOMMISSIONING PROGRAMMES
PIPELINES COMPARATIVE ASSESSMENT
REPORT**

March 2020

Document Control Record

| Rev No. | Date | Description | Issued by | Checked by | Approved by | Client Approval |
|---------|---------|-----------------------------|-----------|------------|-------------|-----------------|
| A1 | 12Aug19 | Issued for internal review | JW | | | |
| B1 | 14Aug19 | Issued for client review | JW | MMcF | MMcF | |
| B2 | 13Sep19 | Re-issued for client review | JW | MMcF | MMcF | |
| B3 | 30Oct19 | Re-issued for client review | JW | MMcF | MMcF | |
| D1 | 07Nov19 | Issued for use | JW | MMcF | MMcF | |
| D2 | 21Nov19 | Re-issued for use | MOS | JW | MMcF | |
| D3 | 29Jan20 | Re-issued for use | JW | MMcF | MMcF | |
| D4 | 02Mar20 | Re-issued for use | JW | MMcF | MMcF | |
| D5 | 04Mar20 | Re-issued for use | JW | MMcF | MMcF | |

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ABBREVIATIONS

| | |
|----------------|--|
| BAT | Best Available Technique |
| c | circa |
| CA | Comparative Assessment |
| CoP | Cessation of Production |
| CSV | Construction Support Vessel |
| C&P | Contracting and Procurement |
| dia. | Diameter |
| DSV | Dive Support Vessel |
| DP | Decommissioning Programme |
| EA | Environmental Appraisal |
| ENVID | Environmental Impact Identification |
| EoC | Exchange of Correspondence |
| FPU | Floating Production Unit |
| FPS | Forties Pipeline System |
| FPSO | Floating Production Storage and Offloading |
| FSO | Floating Storage and Offloading |
| HIRA | Hazard Identification Risk Assessment |
| kGBP | 1000 pounds sterling |
| km | kilometres |
| m | metres |
| MDAC | Methane Derived Authigenic Carbonates |
| Misc. | Miscellaneous |
| mm | millimetre |
| MWA | Mid Water Arch |
| NCMPA | Nature Conservation Marine Protected Area |
| ODU | Offshore Decommissioning Unit |
| OGA | Oil and gas Authority |
| OGUK | Oil and Gas UK Ltd |
| OPRED | Offshore Petroleum Regulator for Environment and Decommissioning |
| OSPAR | Oslo-Paris Convention |
| PL | Pipeline |
| PLEM | Pipeline End Manifold |
| PLU | Umbilical |
| pSPA | Potential Special Protection Area |
| PWA | Pipeline Works Authorisation |
| PVA | Particularly Valuable Areas |
| Q | Quarter |
| RAG | Red /Amber / Green |
| RAM | Risk Assessment Matrix |

| | |
|---------------|--|
| ROV | Remotely Operated Vehicle |
| ROVSV | Remotely Operated Vehicle Support Vessel |
| SIMOPS | Simultaneous Operations |
| SSIV | Subsea Isolation Valve |
| Te | Tonne |
| TOP | Top of Pipe |
| UKCS | United Kingdom Continental Shelf |
| WI | Water Injection |

1. EXECUTIVE SUMMARY

This document has been prepared to support the Decommissioning Programmes (DP's) for the Buchan & Hannay Field pipeline systems and associated subsea infrastructure. The Buchan and Hannay Fields commenced production in 1981 and 2002 respectively and ceased production in 2017 and 2013 respectively.

Both fields produced via the Buchan Alpha Floating Production Unit (FPU) but were isolated in 2017, when the FPU was removed from station under an approved 'Exchange of Correspondence' (EoC) with Offshore Petroleum Regulator for Environment and Decommissioning (OPRED).

The Buchan Field is located c.154km North East of Aberdeen in c.115m water depth and spans blocks 20/05a and 21/1 in the Outer Moray Firth area of the North Sea. See field location in Figure 1 and field layout in Figure 2. A more detailed description of the field infrastructure is provided in Section 2.1.

Both fields are now in the decommissioning phase, with Cessation of Production (CoP) having been formally approved, in March 2017, by the Oil and Gas Authority (OGA).

There is c.136.909km of pipelines and umbilicals associated with the Buchan and Hannay Fields to be comparatively assessed. The decommissioning options for the pipelines and umbilicals have been subjected to a process of Comparative Assessment (CA) to assist the Repsol Sinopec Resources UK Limited project team to determine the preferred decommissioning strategy in compliance with the OPRED Guidance Notes [1].

The strategy for structures, jumpers and any exposed stabilisation features (mattresses) is that they will be removed and returned onshore for recycling or disposal. This CA Report, considers the decommissioning options for the subsea pipelines and umbilicals only.

There is a drill cuttings accumulation local to the Buchan Template structure, which will be disturbed during recovery of the template. The environmental impact of this disturbance has been evaluated separately by a Best Available Techniques (BAT) Assessment [10] and is reported separately.

Robust evidence has been gathered in terms of determining quantities and status of the pipelines and umbilicals associated with the field, by review of separate survey reports carried out over the operational life of the field. A review of this evidence has determined the burial depth of the pipelines and umbilical and stability of the seabed is such that the lines currently trenched and buried are predicted to remain so.

The decommissioning options considered were:

- Total Removal, with all removed materials returned onshore for recycling and disposal:
 - By Reverse Reeling;
 - By Reverse S-Lay;
 - By Cut and Lift;
- Remediate In-situ, by leaving the trenched and buried and rock covered sections of the lines in-situ, whilst remediating the exposed sections by one of the following sub options:
 - Rock Cover in-situ;
 - Trenched and Buried in-situ;
 - Cut and Remove with all removed materials returned onshore for recycle and disposal.

Each of the decommissioning options are described in more detail in Section 3.2

All decommissioning options and their sub options listed above, including Total Removal of all pipelines and umbilicals have been carried through to the conclusion of the CA process.

Five separate pipelines/ umbilicals groups were considered during the CA process these are listed, together with the recommended/ preferred decommissioning option for each group in Table 1.

Table 1: Summary of Preferred Decommissioning Option by Pipeline Group

| Group ID ¹ | Component / As-laid Condition | Agreed Groupings ² | Burial Status | Preferred Decommissioning Option ³ |
|-----------------------|---|--|---|---|
| A | <ul style="list-style-type: none"> - Rigid pipeline - Concrete coated - Trenched | Buchan 12" Oil Export ⁴ | Trenched to approx. 2.5m depth with natural backfill (variable) | Remediate In-situ with exposed sections trenched and buried. ⁵ |
| B | <ul style="list-style-type: none"> - Rigid Pipeline - Surface Laid | Includes: <ul style="list-style-type: none"> - One Buchan 12" Oil Export Line⁴ - Two Buchan 4" Production Lines - Two Buchan 4" Water Injection (Wi) Lines - Two Buchan 4" gas Lift Lines | Surface Laid – shallow burial seen along lines | Total Removal by Reverse Reeling |
| C | <ul style="list-style-type: none"> - Rigid Pipeline - Trenched and Buried | Includes: <ul style="list-style-type: none"> - One Redundant 8" Hannay Production and 6" Gas Lift lines (piggybacked) - Replacement Hannay 8" Production | <ul style="list-style-type: none"> - Burial depth of 0.66m (average) with supplementary rock dump to take cover to 1m - Burial depth of 1.44m (average) with supplementary rock dump at 4 locations | Remediate In-situ with exposed sections cut and removed. ⁴ |
| D | <ul style="list-style-type: none"> - Flexible Pipeline/Umbilical - Surface Laid | Includes: <ul style="list-style-type: none"> - Two Buchan 2" Gas Lift flexible - Five Umbilicals one to each Buchan subsea well | Surface Laid - shallow burial seen along lines | Total Removal by Reverse Reeling |
| E | <ul style="list-style-type: none"> - Umbilical - Trenched and Buried | Hannay main umbilical | Burial Depth of 0.63m (average) | Remediate In-situ with exposed sections cut and removed. ⁵ |

¹ Basis for pipeline groupings is described in Section 4.1.4.

² Detailed listings and pipeline numbers of each pipeline/ umbilical included in specific pipelines groups are provided in Table 6.

³ Basis for preferred decommissioning option is clarified in Section 6.1.

⁴ The Group B 12" Oil Export line is a disused section of pipeline line that was replaced by a new section 12" concrete coated pipeline that was trenched (Group A).

⁵ Although options to Remediate in situ with exposed sections either trenched and buried or cut and removed is ranked as preferred option in pipeline groups A, C and E, the difference in rating between all three remediate in-situ options considered is marginal and all three options will be carried through to a Contracting and Procurement (C&P) phase of the project to allow contractors to tender and propose the overall preferred option. If the C&P tendering phase results in other remediate in-situ options being considered more favourable than the preferred options noted in the table, the Operator will engage with OPRED before a decision is taken on overall strategy.

This CA report is one of two documents submitted for consultation in support of the Buchan and Hannay DP's [3], along with the Environmental Appraisal (EA) [4]. Both documents are available online at the OPRED website, on request from Repsol Sinopec Resources UK Limited and, during the consultation period, available at Repsol Sinopec Resources UK Limited offices.

2. PROJECT OVERVIEW

2.1. Field Description

The Buchan Field is located c.154km North East of Aberdeen in c.115m water depth and spans blocks 20/05a and 21/1 in the Outer Moray Firth area of the North Sea. See field location in Figure 1 .

First oil from the Buchan Field was achieved in May 1981.

In total, 12 wells have been drilled in the Buchan field: seven production wells; two appraisal wells: one exploration well and two water injection wells. The Buchan appraisal wells and exploration well are currently suspended and have had their Xmas trees removed. The remaining nine wells are shut-in, and the flow lines have been disconnected and positively isolated with blind flanges. Four of the seven production wells are drilled at the Buchan template, and one production well is drilled next to it. The remaining two production wells and the two water injection wells are located approximately two kilometres to the west and southwest of the Buchan template and are tied back to the template.

The Buchan template was connected to the Buchan Alpha FPU via 19 risers (eight production, eight gas lift, one export and two umbilicals) which were routed over a single mid-water arch.

From the FPU, multiphase hydrocarbons were processed and shipped into the Forties Pipeline System (FPS) via a c.54km flow-line to Forties Charlie. Water depth along the export line varies from c.113-140m.

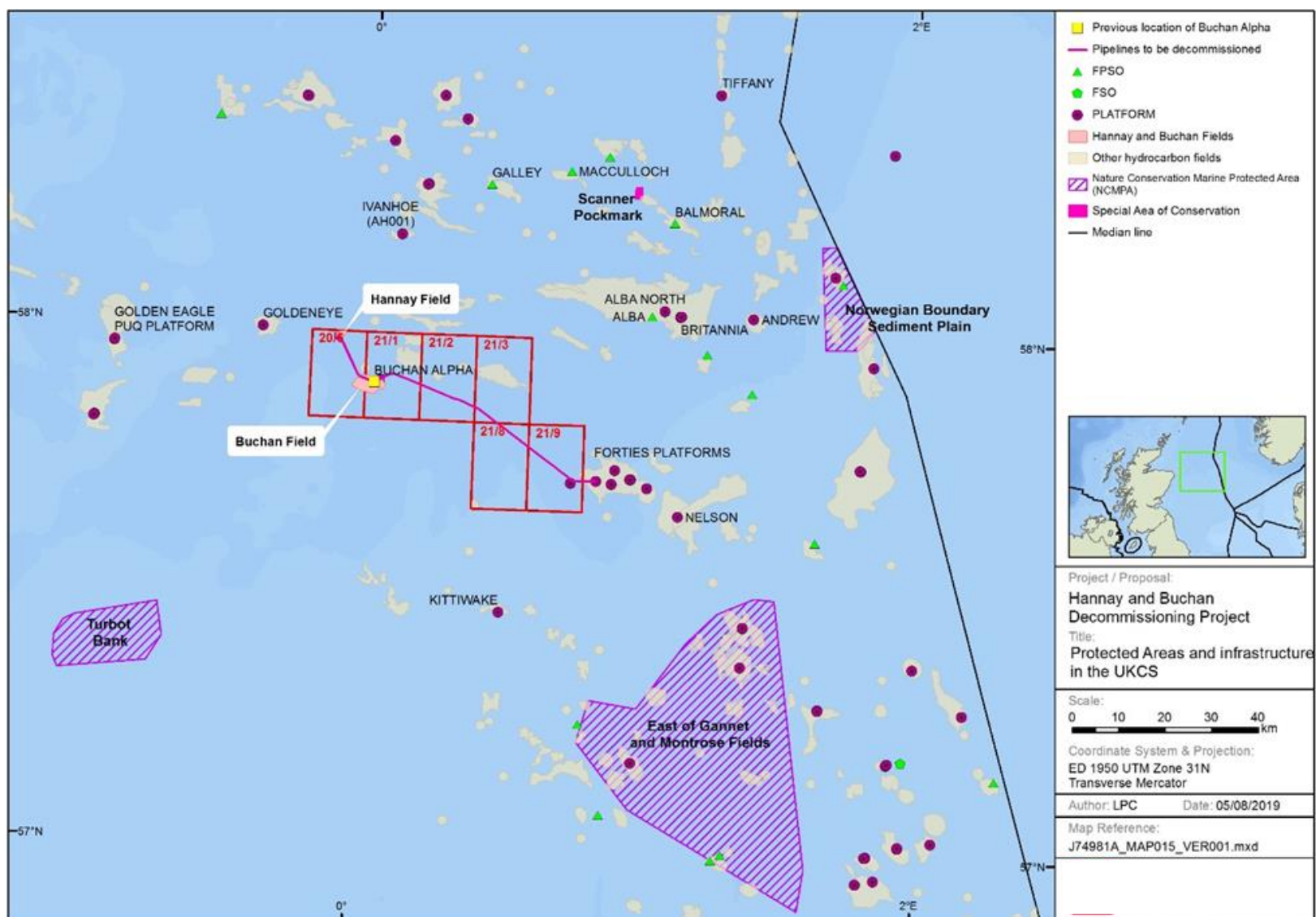
The Hannay Field is located c.13.5km North West of the Buchan template in a water depth of c.123m and comprises two production wells, tied back to the template with rigid production and gas lift pipelines and a control umbilical. The field commenced production in 2002 and the wells were shut-in in 2013 and were positively isolated from all flow-lines (spools removed/ blind flanges installed) in 2017.

Both fields are now in the decommissioning phase, with cessation of production (CoP) being formally approved by the Oil and Gas Authority (OGA). The Buchan Alpha FPU produced between May 1981 and August 2017, when it was removed from station under an approved 'Exchange of Correspondence' (EoC) with OPRED.

The overall Field Layout is shown in Figure 2.

Note: This figure includes the whole field, i.e. components covered by the Decommissioning Programmes (DP's) and the two Exchanges of Correspondence (EoC). Only the pipelines included in the DP's have been subjected to the Comparative Assessment (CA). See Section 2.3 for a detailed description of inclusions, exclusions and boundaries of the CA.

Figure 1: Field Location



2.2. Environment and Social Overview

A detailed description of the environmental and social baseline at the Buchan and Hannay fields is provided in the EA [4], whilst a brief overview is presented in Section 4.1 of the DP's submission [3].

In summary, the fields occur out with any designated areas such that the proposed activities will not impact on any protected sites, see Figure 1. A pre-decommissioning survey [11] found the sediments across the area to be relatively homogenous and to be typical of the Central North Sea. Three main habitats: sublittoral mud, deep circalittoral mixed sediment and circalittoral fine sands; were identified.

At the Hannay well H01 location and along the PL401 pipeline route, megafauna burrowing communities were present at a density considered to be representative of the UK Habitat Feature of Conservation Importance of 'mud habitats in deep water'. However, the survey report concluded that it was likely that the burrowing densities were overestimated due to inclusion of non-megafaunal species (polychaetes) and by counting multiple burrow openings made by the same individuals. Due to the uncertainty, a conservative approach has been taken in the EA where it has been assumed that the megafauna burrowing communities do represent the Habitat Feature of Conservation Importance.

Pockmarks or depressions were observed at one of the stations along PL401 pipeline route, however there was no evidence of Methane Derived Authigenic Carbonates (MDAC) such that the pockmarks were not considered to represent the Annex I habitat 'Submarine structures made by leaking gases'.

The benthic, fish, shellfish, marine mammal and bird communities associated with the area are all typical of the Central North Sea.

2.3. Inclusions, Exclusions and Boundaries for CA

2.3.1 Inclusions

Pipelines and Umbilicals

All pipelines and umbilicals colour coded yellow in Figure 2 are included in the CA evaluation. There are 19 separate pipelines of various diameter and of total c.136.909km length that have been evaluated.

Further details of each pipeline and umbilical is provided in Table 2 and Table 6.

Table 2: Pipelines and Umbilicals Included in the CA Evaluation

| Pipeline Number | Diameter (mm) | Length (km) | Description | Original Product Conveyed | Description of Component Parts | From – To End Points | Burial Status | Pipeline Status | Current Content |
|--------------------|---------------|-------------|--|---------------------------|---|---------------------------------------|-----------------------------|-----------------|---|
| PL126 | 323.9 | 1.697 | Line connecting export riser to PL401 | Oil | Carbon steel/ plastic/ alloy & misc. coatings | Buchan Export Riser Connector to PLEM | Surface laid | Out of use | Inhibited seawater (PRESERVAN 5500) |
| PL401 | 323.9 | 54.043 | Oil Export - pipeline to Forties Charlie | Oil | Carbon steel/ plastic/ alloy & misc. coatings | From PL126 to Forties Charlie | Trenched / natural backfill | Out of use | Inhibited seawater (PRESERVAN 5500) |
| PL3026 (ex PL127A) | 114.3 | 1.617 | Production line from Well B7 | Oil | Carbon steel/ alloy | Well B7 to Buchan Template | Surface laid | Out of use | Inhibited seawater (PRESERVAN 5500) |
| PL597A (ex PL128B) | 176.1 | 1.960 | Water injection line to well B9 | Water injection fluids | Carbon steel/ alloy | Buchan Template to Well B9 | Surface laid | Out of use | Produced water re-injection fluids plus SI-4i4N |
| PL772 (ex PL170A) | 114.3 | 2.514 | Water injection line to well B4A | Water injection fluids | Carbon steel/ alloy | Buchan Template to Well B4A | Surface laid | Out of use | Inhibited seawater (PRESERVAN 5500) |
| PL170 (ex PL170B) | 114.3 | 2.519 | Gas lift line to well B4A | Lift gas | Carbon steel/ alloy | Buchan Template to Well B4A | Surface laid | Out of use | Inhibited seawater (PRESERVAN 5500) |
| PL3017 (ex PL127B) | 114.3 | 1.628 | Gas lift line to well B7 | Lift gas | Carbon steel/ alloy | Buchan Template to Well B7 | Surface laid | Out of use | Inhibited seawater (PRESERVAN 5500) |

Table 2: Continued

| Pipeline Number | Diameter (mm) | Length (km) | Description | Original Product Conveyed | Description of Component Parts | From – To End Points | Burial Status | Pipeline Status | Current Content |
|-------------------|---------------|-------------|-------------------------------------|---------------------------|---|------------------------------------|---------------|-----------------|---|
| PL4210 | 97.4 | 1.850 | Gas lift line to well B8 | Lift gas | Carbon steel/ plastic & misc. coatings | Buchan Template to Well B8 | Surface laid | Out of use | Inhibited seawater (PRESERVAN 5500) |
| PL597B | 114.4 | 1.990 | Gas lift line to well B9 | Lift gas | Carbon steel/ plastic & misc. coatings | Buchan Template to Well B9 | Surface laid | Out of use | Produced water re-injection fluids plus SI-4i4N |
| PL128 (ex PL128A) | 114.4 | 1.856 | Production line from Well B* | Water injection fluids | Carbon steel/ plastic & misc. coatings | Well B8 to Buchan Template | Surface laid | Out of use | Inhibited seawater (PRESERVAN 5500) |
| PLU2551JB4 | 62 | 2.750 | Umbilical to well B4A | Aqualink 300F | Carbon steel/ zinc/plastic & misc. coatings | Buchan Template to Well B4A | Surface laid | Out of use | Aqualink 300F |
| PLU2551JB4X | 60 | 2.930 | Redundant umbilical to well 21/01-4 | Aqualink 300F | Carbon steel/ zinc/plastic & misc. coatings | Buchan Template, (to Well 21/01-4, | Surface laid | Out of use | Aqualink 300F |
| PLU2550JB7H | 62 | 1.838 | Umbilical to well B7 | Aqualink 300F | Carbon steel/ zinc/plastic & misc. coatings | Buchan Template to Well B7 | Surface laid | Out of use | Aqualink 300F |

Table 2: Continued

| Pipeline Number | Diameter (mm) | Length (km) | Description | Original Product Conveyed | Description of Component Parts | From - To End Points | Burial Status | Pipeline Status | Current Content |
|-----------------|---------------|-------------|--|--|---|---|-----------------------------|-----------------|-------------------------------------|
| PLU2550JB8H | 62 | 2.132 | Umbilical to well B8 (includes 200m jumper to Well B7) | Aqualink 300F | Carbon steel/ zinc/plastic & misc. coatings | Buchan Template to Well B8 and onwards to well B7 | Surface laid | Out of use | Aqualink 300F |
| PLU2551JB9 | 62 | 2.066 | Umbilical to well B9 | Aqualink 300F | Carbon steel/ zinc/plastic & misc. coatings | Buchan Template to Well B9 | Surface laid | Out of use | Aqualink 300F |
| PL1865 | 219.1 | 13.461 | Production line from Hannay | Oil | Carbon steel/ plastic & other non-ferrous | Hannay well H02 to Hannay well H01 to the Buchan Template | Trenched/ buried/ spot rock | Out of use | Inhibited seawater (PRESERVAN 5500) |
| PL1865A | 219.1 | 13.189 | Out of service production line from Hannay | Oil | Carbon steel/ plastic & other non-ferrous | Hannay well H02 to Hannay well H01 to the Buchan Template | Trenched/ buried/ spot rock | Out of use | Inhibited seawater (PRESERVAN 5500) |
| PL1866 | 105.5 | 13.408 | Gas lift line to Hannay | Treated seawater | Carbon steel/ plastic & other non-ferrous | Buchan Template to Hannay well H01 to Hannay well H02 | Trenched & buried | Out of use | Inhibited seawater (PRESERVAN 5500) |
| PLU1867 | 140 | 13.461 | Hannay Umbilical | Aquaglycol 24, Transaqua and chemical injection fluids | Carbon steel/ zinc/plastic & misc. coatings/ copper | Hannay Riser Base to Hannay well H01 | Trenched & buried | Out of use | Seawater/ Aquaglycol 24/ Transaqua |

2.3.2 Exclusions

Elements previously covered by Exchange of Correspondence (EOC)

- Buchan Alpha Floating Production Unit (FPU)

The FPU was removed from location in August 2017 under an EOC approved by OPRED in May 2016

A second EoC was approved by OPRED in October 2016 for the recovery of:

- 19 risers and associated hold back frame and turning gabions;
- A Mid-Water Arch (MWA) and its associated tethers and hold down anchors;
- A riser base structure associated with the Hannay umbilical riser;
- Mattresses and grout bags associated with the above.

These items have all now been removed.

As these items will have been or will be removed from the field they do not form part of the DP's submission and are excluded from the CA.

Pipelines and umbilicals

During the pre-screening studies described in Section 4.2, all small diameter and short length pipelines and umbilicals or jumpers were proposed to be removed and returned onshore for recycle or disposal in line with OPRED Guidance Notes [1]. These spools are therefore excluded from the CA evaluation.

Further details of each pipeline and umbilical excluded from this CA is provided in Table 3 .

Table 3: Pipelines and Umbilicals Excluded from the CA

These pipelines and umbilicals are all short length jumpers and have been considered to be removed and returned onshore for recycle and disposal

| Pipeline Number | Diameter (mm) | Length (km) | Description | Original Product Conveyed | Description of Component Parts | From – To End Points | Burial Status | Pipeline Status | Current Content |
|-----------------|---------------|-------------|---|---------------------------|---|--|---------------------|-----------------|-------------------------------------|
| PL126A | 323.9 | 0.08 | Redundant section of oil export line, which previously connected export riser to PLEM | Oil | Carbon steel/ plastic/ alloy & misc. coatings | Cut pipeline end in close proximity to Buchan template to cut pipeline end at big inch mechanical connection | Surface laid | Out of use | Inhibited seawater (PRESERVAN 5500) |
| PLU2551JB1 | 62 | 0.028 | Umbilical to well B1 | Aqualink 300F | Carbon steel/ zinc/plastic & misc. coatings | SDU mounted on Buchan Template to Well B1 | Located in template | Out of use | Aqualink 300F |
| PLU2551JB2 | 62 | 0.026 | Umbilical to well B2 | Aqualink 300F | Carbon steel/ zinc/plastic & misc. coatings | SDU mounted on Buchan Template to Well B2 | Located in template | Out of use | Aqualink 300F |
| PLU2551JB3 | 62 | 0.023 | Umbilical to well B3 | Aqualink 300F | Carbon steel/ zinc/plastic & misc. coatings | SDU mounted on Buchan Template to Well B3 | Located in template | Out of use | Aqualink 300F |
| PLU2551JB6 | 62 | 0.036 | Umbilical to well B6 | Aqualink 300F | Carbon steel/ zinc/plastic & misc. coatings | Buchan Template to Well B6 | Surface laid | Out of use | Aqualink 300F |
| PL773 | 114.3 | 0.017 | Gas Lift Spool at Well B4 | Lift gas | Carbon steel/ plastic & misc. coatings | PL170 pipeline tie in flange to Well B4a | Surface laid | Out of use | Inhibited seawater (PRESERVAN 5500) |
| PL3018 | 60.3 | 0.0127 | G3 Riser Gas Lift Spool | Lift Gas | Carbon steel/ plastic & misc. coatings | Flexible riser (G3) to Well B3 Buchan Template | Surface laid | Out of use | Inhibited seawater (PRESERVAN 5500) |

Table 3: Continued

| Pipeline Number | Diameter (mm) | Length (km) | Description | Original Product Conveyed | Description of Component Parts | From - To End Points | Burial Status | Pipeline Status | Current Content |
|-----------------|---------------|-------------|--|---------------------------|---|---|---------------|-----------------|-------------------------------------|
| PL3019 | 60.3 | 0.0183 | G6 Riser Gas Lift Spool | Lift Gas | Carbon steel/ plastic & misc. coatings | Flexible Riser (G6) to Well B2 Buchan Template | Surface laid | Out of use | Inhibited seawater (PRESERVAN 5500) |
| PL3020 | 60.3 | 0.0096 | Redundant Riser Spool | Lift Gas | Carbon steel/ plastic & misc. coatings | Blind flange to Buchan template | Surface laid | Out of use | Inhibited seawater (PRESERVAN 5500) |
| PL3021 | 60.3 | 0.016 | G1 Riser Gas Lift Spool | Lift Gas | Carbon steel/ plastic & misc. coatings | Flexible Riser (G1) to Well B1 Buchan Template | Surface laid | Out of use | Inhibited seawater (PRESERVAN 5500) |
| PL3022 | 114.3 | 0.012 | P3 Riser Production Spool | Oil | Carbon steel/ plastic & misc. coatings | Well B3 Buchan Template to Flexible Riser (P3) | Surface laid | Out of use | Inhibited seawater (PRESERVAN 5500) |
| PL3023 | 114.3 | 0.016 | P2 Riser Production Spool | Oil | Carbon steel/ plastic & misc. coatings | Well B2 Buchan Template to Flexible Riser (P2) | Surface laid | Out of use | Inhibited seawater (PRESERVAN 5500) |
| PL3024 | 114.3 | 0.2283 | P6 Riser Production Spool | Oil | Carbon steel/ plastic & misc. coatings | Well B2 Buchan Template to Flexible Riser (P2) | Surface laid | Out of use | Inhibited seawater (PRESERVAN 5500) |
| PL3025 | 114.3 | 0.016 | P1 Riser Production Spool | Oil | Carbon steel/ plastic & misc. coatings | Well B1 Buchan Template to Flexible Riser (P1) | Surface laid | Out of use | Inhibited seawater (PRESERVAN 5500) |
| PLU2550 | 26 | 0.1 | Chemical Injection line to Buchan Template | Biocide | Carbon steel/ zinc/plastic & misc. coatings | Hannay SSIV to Buchan Template | Surface laid | Out of use | Aqualink 300F |
| PLU2551 | 207.2 | 0.005 | Buchan Umbilical Riser | Aqualink 300F | Carbon steel/ zinc/plastic & misc. coatings | Umbilical laydown point to SDU at Buchan Template | Surface laid | Out of use | Aqualink 300F |

Structures

There are four main structures associated with the Buchan and Hannay fields (colour coded red on Figure 2), there are a further eight small pipeline anode skids associated with the field. The approximate combined weight of all structures c.554Te. In compliance with OPRED Guidance Notes [1] all structures associated with Buchan & Hannay fields are not candidates for derogation and therefore, the base case is that they will be fully removed and returned onshore for recycle. All structures are therefore excluded from the CA evaluation.

Further details of these individual structures are provided in the DP's [3] and are therefore not repeated here.

Stabilisation / Protection Features

There are 132 pre-fabricated concrete mattresses, with an approximate combined weight of 643.2Te, associated with the Buchan & Hannay subsea systems, two on the Buchan Field and 130 on the Hannay Field. All the mattresses are exposed on the seabed.

There are four grouted saddles, with an approximate combined weight of 12.4Te associated with the PL401/PL64 pipeline crossing. These grouted saddles are already rock covered.

There are approximately 500 grout bags, with an approximate combined weight of 10Te local to the Buchan Template, these grout bags are exposed.

There is approximately 43,270Te of Rock Cover associated with the Buchan & Hannay subsea systems, 6,200Te on the Buchan Field and 37,070Te on the Hannay Field.

From a review of inspection reports, all exposed mattresses and grout bags are expected to be recoverable and it is therefore proposed that these will be recovered. If, during execution of the project, full recovery of all mattresses is not achievable, Repsol Sinopec Resources UK Limited will engage with OPRED to agree alternative options.

Mattresses and grout bags that are already buried or are rock covered will be decommissioned in-situ. Stabilisation features are therefore excluded from the CA evaluation.

Further details of the stabilisation features are provided in the DP's [3] and are therefore not repeated here.

Drill Cuttings:

Based on bathymetric survey, environmental sampling and ROV photographs, the total volume of the cuttings pile around the Buchan template is estimated to be 828 m³ and the area of the seabed covered by the cuttings pile is estimated to be 3,731 m². The main accumulation of cuttings is on the western side of the Buchan template, with limited cuttings on the template itself.

The drill cuttings located at the Buchan Template (see Figure 2) will be disturbed during recovery activity, however, the impact of these activities has been subject to a separate study and Best Available Technique(BAT) Assessment [10]. The drill cuttings are therefore not included in this CA evaluation.

2.3.3 Boundaries

In summary the boundaries of the CA are as follows:

- Export Pipeline:
 - From the pipeline end connector at base of riser at Buchan;
 - Up to the pipeline end flange at Forties Charlie.
- Production / Gas Lift Pipelines:
 - From the Buchan Template;
 - Up to the Buchan remote wells and the Hannay Manifold.
- Umbilicals:
 - From the Buchan Template;
 - Up to the Buchan remote wells and the Hannay Manifold.

3. DECOMMISSIONING OPTIONS

3.1. Regulatory Context

The decommissioning of offshore oil and gas installations and pipelines on the United Kingdom Continental Shelf (UKCS) is controlled through the Petroleum Act 1998 [5], as amended by the Energy Act 2008 [6].

The UK's international obligations on decommissioning are governed principally by the 1992 Convention for the Protection of the Marine Environment of the North East Atlantic (OSPAR Convention). Agreement on the regime to be applied to the decommissioning of offshore installations in the Convention area was reached at a meeting of the OSPAR Commission in July 1998 (OSPAR Decision 98/3) [7]. OPRED Guidance Notes [1] align with OSPAR Decision 98/3.

Pipelines do not fall within the remit of OSPAR Decision 98/3 but OPRED requires that operators apply the OSPAR framework when assessing pipeline decommissioning options.

Because of the widely different circumstances of each case, OPRED does not predict with any certainty what decommissioning strategy may be approved in respect of any class of pipeline. Each pipeline must therefore be considered on its merits and in the light of a CA of the feasible options, considering the safety, environmental, technical, societal and cost impacts of the options. Cost may only be a determining factor when other criteria emerge as equal.

3.2. Options Considered

An overview of the decommissioning options considered for each of the pipelines and umbilicals included in the CA evaluation process is presented below, it should be noted that:

- For the purposes of the descriptions below, the term “pipeline” may refer to a rigid pipeline, a flexible pipeline or an umbilical;
- The term “Exposed section” is where no depth of cover¹ to the pipeline exists;
 - PL401 – 12” Export line was trenched to a depth of around 2m and left to naturally backfill. The exposed non-trenched end-sections exiting the trench have a total length of 766m. The distance from top of pipe to seabed level along the length of the trenched section is a minimum of 0.5m. Pipeline route surveys show evidence of natural backfill and identified no spans. (See Table 6 for more information).
- Where Total Removal is considered remediation of the open trench or seabed after de burial has not been considered as a requirement however discussion with stakeholders may be required if a Total Removal option is recommended by the CA.

3.2.1 Option 1A: Total Removal by Reverse Reeling

In this option, the pipeline(s) would be fully recovered from the seabed by reverse reeling and returned to shore for recycling or disposal. As the pipelines that connect between the Buchan template and the wells are surface laid, those pipelines would not require any de-burial.

The approximate sequence of operations would be as follows:

1. If buried - Excavate pipeline(s) from seabed using a mass flow excavator deployed from a ROV Support Vessel (ROVSV) crane;
2. ROV to attach recovery clamp to end of pipeline and connect to reel lay vessel winch wire;
3. Recover pipeline to reel lay vessel and wind on to main or auxiliary reels;
4. Repeat #2 and #3 for remaining pipelines;
5. Transit to shore and offload recovered pipeline(s).

The capacity of currently available reel lay vessels range from 2000te to 5600te. Multiple trips to shore may be required depending on the quantity of material to be recovered.

This option is not suitable for concrete coated pipelines since concrete coating cannot be reeled onto the reel without the coating cracking and falling off the pipeline. The concrete coated pipe is not designed to develop the bending stresses anticipated with reverse reeling considering the weight of concrete coating.

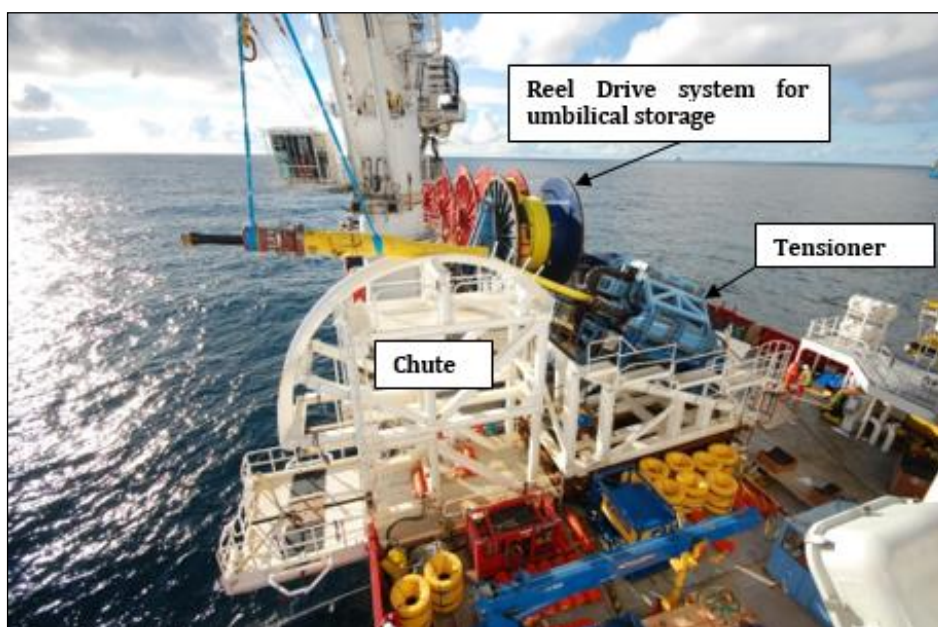
An image of a Typical Reel Lay Vessel is provided in Figure 3.

Figure 3: Typical Reel Lay Vessel



Due to some of the smaller diameter pipeline, flexible and umbilical sizes, recovery could also be achieved by using a ROVSV/DSV with a reel drive system on the deck. Depending on the size of the vessel deck, multiple reels can be used, as shown in Figure 4.

Figure 4: Reel Drive System on a Vessel (umbilical Installation shown)



Alternatively, smaller pipelines and umbilicals could be recovered to wire drums installed on anchor handling vessel, for that purpose.

The Hannay umbilical is buried and it's expected that this would require de burial before recovering but it may be possible to remove the umbilical without excavating the umbilical from the soil. This would be done by pulling the

umbilical free from the soil as it is reeled onto the vessel. This would have to be reviewed during detail design phase of the project, to determine the top tension required to pull the umbilical out of the seabed.

3.2.2 Option 1B: Total Removal by Reverse S-Lay

In this option, the pipeline(s) would be fully recovered from the seabed by reverse S-lay and returned to shore for recycling or disposal. A pipelay barge (Figure 5) would likely be used for the recovery of rigid pipelines specifically the concrete coated export pipeline. The approximate sequence of operations would be as follows:

1. If Buried - Excavate pipeline(s) from seabed using a mass flow excavator deployed from a ROVSV crane;
2. ROV to attach recovery clamp to end of pipeline and connect to S-lay vessel winch wire;
3. Recover pipeline to S-lay vessel, secure in tensioner and cut into sections on deck (usually two pipe joints ~24m);
4. Repeat #2 and #3 for remaining pipelines;
5. Offload to pipe carriers for transit to shore and offload recovered pipeline(s).

The pipeline would need to be emptied of fluids prior to recovery to reduce the top tension on the vessel during recovery. The pipelines were installed dry and then flooded once on the seabed.

Figure 5: Typical Pipelay Barge



It should be noted that there is no industry track record of reverse S-lay of concrete coated pipe. There are also potential issues with the deterioration of the concrete coating over time which would hinder pick up of the pipe and may result in sections falling off during recovery. Also uncertainties over the condition and structural integrity of the pipeline which could fail during recovery.

3.2.3 Option 1C: Total Removal by Cut and Lift

In this option, the pipeline(s) would be fully recovered from the seabed and returned to shore for recycling or disposal. The approximate sequence of operations would be as follows:

1. If buried - Excavate pipeline(s) from seabed using a mass flow excavator deployed from a ROVSV crane;
2. ROV (or divers) to assist with the deployment of cutting tools (typically hydraulic shears - Figure 6) to cut the pipeline into 24 m sections;

3. ROV (or divers) to attach rigging to the cut sections to allow recovery to surface via the Dive Support Vessel (DSV) / ROVSV crane (Figure 7);
4. Repeat #2 and #3 for remaining pipelines;
5. Transit to shore and offload recovered pipeline(s).

Depending on the quantity of material to be recovered it may be more cost efficient to transfer cut sections to a cargo barge which would make multiple trips to and from shore.

Figure 6: Example of Hydraulic Shears



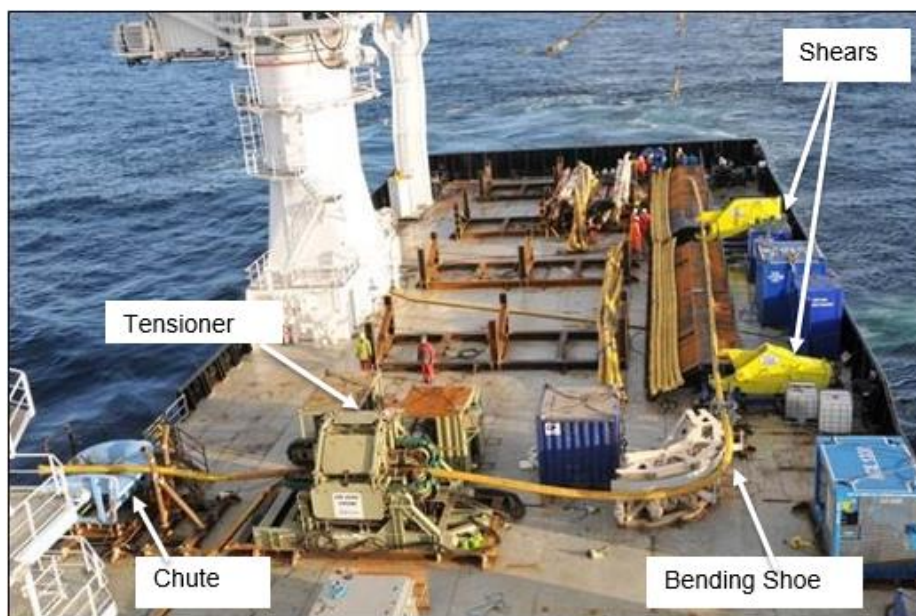
Figure 7: Pipeline Cut into Sections for Recovery



This method has been used extensively in the UKCS and in decommissioning. It is also suitable for all the pipeline types, concrete coated lines and small diameter pipelines/flowlines

An option to firstly recover the pipeline to the vessel and then cut for recovery may reduce vessel time with short length infield umbilicals and flexibles rather than cutting them into sections on the seabed. Figure 8 shows a typical layout for recovery.

Figure 8: Lift and Cut Methods on a Construction Support Vessel (CSV)



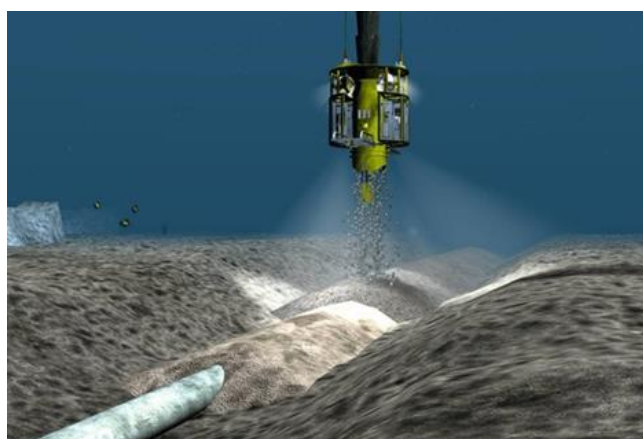
3.2.4 Option 2A: Remediate In-Situ - Exposed Sections Rock Covered

In this option, the exposed sections of pipeline would be left in place on the seabed and rock covered to achieve a rock cover profile consistent with being overtrawlable. Where the pipeline is already trenched and buried, the pipeline ends, trench transitions and exposed sections of pipeline identified in the pipeline survey would be covered with rock deployed from a rock dumping vessel. The amount of rock cover would be in line with industry practise and would be agreed with all consultees during the works authorisation process.

Future inspections of the pipelines left in-situ would be required to confirm that no future exposures develop.

Note: Based on review of historical inspection records and the fact the lines will be no longer in use, the potential for pipeline exposures to occur in future is very unlikely.

Figure 9: Typical Rock Dumping Activity



3.2.5 Option 2B: Remediate In-Situ - Exposed Sections Trenched and Buried

In this option, the exposed pipelines would remain in place on the seabed and would be trenched and buried, using a trenching / jetting unit (Figure 10/Figure 11) deployed from an ROVSV crane. Where the pipeline is already trenched and buried, the pipeline ends, trench transitions and exposed sections of the pipeline identified in the pipeline survey would be trenched and buried. The trenching strategy would be in line with industry practise and would be agreed with all consultees during the works authorisation process.

Future inspections of the pipelines left in-situ would be required to confirm that no future exposures develop.

Note: Based on review of historical inspection records and the fact the lines will be no longer in use, the potential for pipeline exposures to occur in future is very unlikely.

It should be noted that the export pipeline is already in a trench, which would make additional burial difficult as the berms created by trenching, are normally used as the burial material may have dispersed.

Figure 10: Example Jetting/Trenching Unit



Figure 11: Deep Ocean AMP500 Plough



3.2.6 Options 2C: Remediate In-Situ - Exposed Sections Cut and Removed

This option will only apply to pipelines that are already trenched and buried as if the pipeline is surfaced laid, cut and remove is covered under Decommissioning Option 1C.

In this option, the trenched and buried sections of pipeline would remain in place. The pipeline ends, trench transitions and exposed sections of pipeline identified in the pipeline survey would be cut and removed to full trench depth. The approximate sequence of operations would be as follows:

1. Excavate pipeline(s) local to exposed sections to full trench depth using a mass flow excavator deployed from a ROVSV / DSV crane;
2. ROV (or divers) to assist with the deployment of cutting tools (typically hydraulic shears) to cut the pipeline into 24 m sections;
3. ROV (or divers) to attach rigging to the cut sections to allow recovery to surface via the Dive Support Vessel (DSV) / ROVSV crane;
4. Return cut sections to shore.

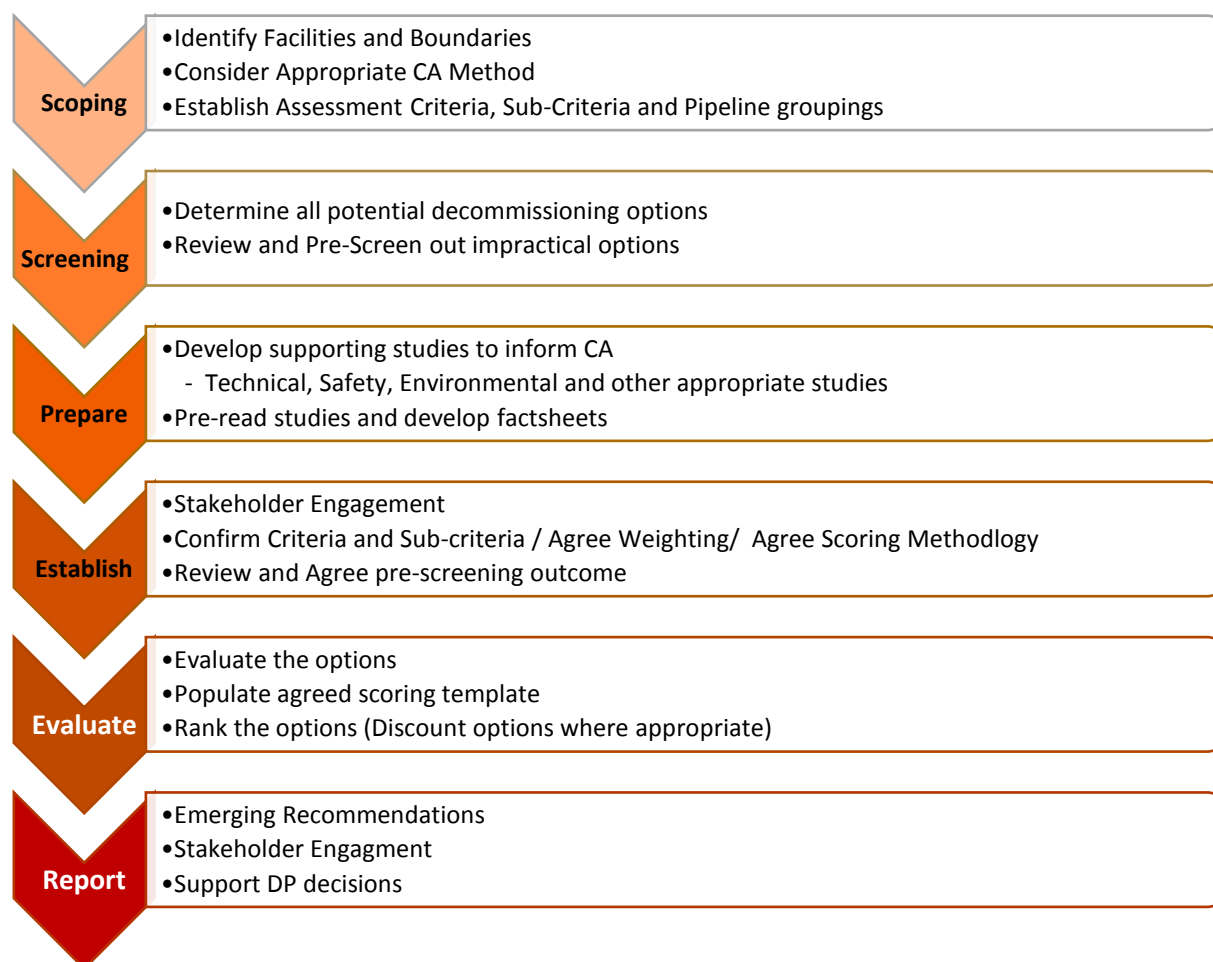
Future inspections of the pipelines left in-situ would be required to confirm that no future exposures develop.

Note: Based on review of historical inspection records at the fact the lines will be no longer in use, the potential for pipeline exposures to occur in future is very unlikely.

4. OVERVIEW OF THE CA PROCESS

The Buchan and Hannay Decommissioning CA has followed the recommended process to be adopted for Comparative Assessment as laid out in 2015 Oil and Gas UK Ltd (OGUK) "Guidelines in CA in Decommissioning Programmes – 2015" [2]. Figure 12, taken from OGUK Guidelines [2], describes the process that was followed.

Figure 12: OGUK CA Process



4.1. Scoping

4.1.1 Facilities and Boundaries:

To ensure robust evidence was available to support and inform the CA evaluation of all decommissioning options, significant preparation by data gathering, reviewing drawings, inspection reports, survey reports and operating history has been completed and technical studies have been completed to accurately determine the quantity, specification, physical layout, status and predicted behaviour of the facilities to be decommissioned.

Three documents were produced that are relevant to and support and inform the CA, they are:

- Pipeline Status and Historical Review Report [5]
- Asset Inventory Study [7]
- Pipeline Removal Methods, Technical Feasibility Assessment and Option Pre-screening [8]

The results from these studies is summarised in the tables and narrative provided throughout this CA report. However, these documents are available upon request.

4.1.2 Evaluation Method:

It was agreed that Evaluation Method A, as described in the OGUK Guidelines [2] should be adopted i.e. Qualitative Assessment using Red/Amber/Green (RAG) to rate the performance of each decommissioning option against a pre-determined set of sub-criteria.

Under this Evaluation Method A, colour coding represents the relative preference of the options with respect to the criteria and sub-criteria, see Table 4.

Table 4: Evaluation Method A – Comparative Impact

| Performance | Comparative Impact |
|-----------------|---|
| Most Preferred | Lower Impact |
| | Moderate Impact |
| Least Preferred | Higher Impact |
| No Preference | No significant impact across options ¹ |

¹ OPRED Guidance Notes [1] Annex A identifies that “The preferred option should be selected by focusing on the matters where the impacts of the options are significantly different”; therefore, where there is no significant difference between the options the sub-criterion across the options should be colour coded grey.

4.1.3 Assessment Criteria:

The main criteria adopted for the evaluation aligns with OPRED Guidelines [1] and the sub-criteria adopted generally aligns. Table 5 highlights the slight difference in the sub-criteria adopted compared to that provided in the OPRED Guidance Notes [1].

Table 5: Main Criteria and Sub-criteria adopted in the CA evaluation

| Main Criteria | Sub-Criteria | | In aligned with OPRED Guidance Notes [1] on sub-criteria |
|---------------|---|---|--|
| Technical | Risk of major project failure | | Yes |
| | Technical complexity & track record | | No- Additional sub-criteria |
| Safety | Risk During Project Execution Phase | To project personnel | Yes |
| | | To other users of the sea | Yes |
| | | To those on land | Yes |
| | | Likelihood of a High Consequence Event | No- Additional sub-criteria |
| | From end points | Residual risk to other users of the sea | No- but guideline states take account for future use of area |
| Environment | Impact of Decommissioning Operations Offshore (includes emissions to air, discharges to sea and underwater noise) | | Environmental covers all sub-criteria identified in the Guidance Notes [1] but combines some and splits out others to make more appropriate to this specific project |
| | Seabed Disturbance- Short Term (includes disturbance to the cuttings pile) | | |
| | Loss of Habitat - Long Term | | |
| | Waste Processing (i.e. processing of returned materials and use of landfill) | | |
| Societal | Commercial impact on fisheries and tourism | | Yes |
| | Socio-economic impact on communities and amenities | | Yes - Communities and amenities combined in one sub-criterion |
| Economic | Cost of Decommissioning | | Guidance Notes [1] do not elaborate on economic sub-criteria, but highlight that long-term cost should be a consideration |
| | Cost for long term monitoring / potential future remediation activities | | |

4.1.4 Pipeline Groupings:

On completion of the subsea studies, listed in Section 4.1.1, where the quantity, specification, physical layout, current status and predicted behaviour of the facilities to be decommissioned was determined, an evaluation of similarities between individual pipelines was completed to determine appropriate pipeline groupings.

Table 6 identifies the agreed pipeline groupings and details of each pipeline within each group.

Table 6: Pipeline and Umbilicals Grouping for CA

| Group ID | Component / As-laid Condition | Agreed Groupings | Boundary | Length (km) | Weight (Te) | Burial Status | Exposed Length (km) |
|----------|---|---|-----------------|-----------------|-------------|---|---------------------|
| A | - Rigid pipeline - Concrete coated - Trenched | PL401 12" Oil Export | Entire Length | 54.043 | 13,661 | Trenched to around 2 m depth with natural backfill (variable) | 0.766 ¹ |
| B | - Rigid Pipeline - Surface Laid | PL126 12" Oil Export - Buchan to PLEM | KP0.065 - 1.632 | 1.697 | 167.4 | Surface Laid – shallow burial seen along lines | 1.697 |
| | | PL772 (ex PL170A) B4a 4" Water Injection (WI) | Entire Length | 2.514 | 72.7 | | 2.514 |
| | | PL170 (ex PL170B) B4a 4" Gas Lift | | 2.519 | 61.3 | | 2.519 |
| | | PL3026 (ex PL127A) B7 4" Production | | 1.617 | 35.7 | | 1.617 |
| | | PL3017 (ex PL127B) Well B7 4" Gas Lift | | 1.628 | 36.0 | | 1.628 |
| | | PL128 (ex PL128A) B8 4" Production | | 1.856 | 53.3 | | 1.856 |
| | | PL597A (ex PL128B) B9 4" WI | | 1.960 | 47.3 | | 1.960 |
| | | | | | | | |
| C | - Rigid Pipeline - Trenched and Buried | PL1865A/PL1866 Redundant 8" Hannay Production and 6" Gas Lift (piggybacked) | Entire Length | 13.189 / 13.408 | 1345 / 201 | Burial depth of 0.66m ² (average) with supplementary rock dump to take cover to 1m | 0.107 ³ |
| | | PL1865 Replacement Hannay 8" Production | | 13.461 | 1258 | Burial depth of 1.44m (average) with supplementary rock dump at 4 locations | 0.285 ⁴ |

¹ Exposed out of trench end sections total 766m. The rest of the pipeline (c.53.277 km) was laid in a trench with a minimum distance between top of pipe and seabed level of approximately 0.5m. At this depth, the trenched pipeline is not considered to require remediation as there is no evidence of spans whilst there is evidence of natural backfill occurring. For c.34.295 km, the depth of cover within the trench is > 0.4 m and this depth is expected to continue to increase over time. Given that

the distance from top of pipe to seabed level is a minimum of 0.5 m, those areas where depth of cover is currently < 0.4 m are not considered to pose a risk and are expected to naturally backfill over time.

² KP0.200-0.230 has a cover depth of 0.25m and KP0.245-0.275 a cover depth of 0.09m.

³ Exposures assumed at pipeline ends and trench transitions, calculated from layout drawings.

⁴ Burial reported between KP0.065-KP12.920. Exposures at pipeline ends and trench transitions.

Table 6: Continued

| Group ID | Component / As-laid Condition | Agreed Groupings | Boundary | Length (km) | Weight (Te) | Burial Status | Exposed Length (km) |
|----------|--|--|---------------|-------------|-------------|--|---------------------|
| D | <ul style="list-style-type: none"> - Flexible Pipeline/ Umbilical - Surface Laid | PL4210 (ex PL128B) B8 2" Gas Lift flexible | Entire Length | 1.850 | 52.7 | Surface Laid - shallow burial seen along lines | 1.850 |
| | | PL597B B9 2" Gas Lift flexible | | 1.990 | 45 | | 1.990 |
| | | PLU2551 JB4 Well B4 umbilical | | 2.750 | 41.4 | | 2.750 |
| | | PLU2551 JB4X Redundant Well JB4 umbilical | | 2.930 | 44 | | 2.930 |
| | | PLU2550 JB7H Well B7 umbilical | | 1.838 | 27.8 | | 1.838 |
| | | PLU2550 JB8H Well B8 umbilical | | 2.132 | 32 | | 2.132 |
| | | PLU2551 JB9 Well B9 umbilical | | 2.066 | 29.1 | | 2.066 |
| E | <ul style="list-style-type: none"> - Umbilical - Trenched and Buried | PLU1867 Hannay main umbilical | Entire Length | 13.461 | 353.6 | Burial Depth of 0.63m (average) | 0.288 ⁵ |

⁵ Exposed sections at each end of the umbilical, 150m at Buchan template and 138m at Hannay Well. Shallow section where umbilical has cover is between 0.2- 0.4m at KP1.3-KP2.1 (KP0.0 at Buchan template).

4.2. Screening

OPRED Guidance Notes [1] annexe A, provides guidance on expectations for option screening:

Where decommissioning of a pipeline in-situ is being considered, a Comparative Assessment of the options is required. A two-stage process with an early option screening process to narrow options is permissible.

Stage 1: Option Screening

- Identify a comprehensive list of potential decommissioning options;
- Identify the criteria against which each option will be considered;
- Complete an evidence-based evaluation to reduce the number of reasonable/technically feasible options to a short-list;
- Expert review of evaluation results to assure the outcome and choice of options to be carried forward to a more detailed comparative assessment.

Stage 2: Detailed Comparative Assessment process

- Adopting shortlisted options from Stage 1, undertake a detailed Comparative Assessment of each option;
- Assessments must be evidenced based, using existing data where possible or gathering additional or new information as appropriate;
- Decisions must be transparent, and regulators and stakeholders must understand the rationale underpinning the assessment and decision-making process.

To fulfil the requirements of Stage 1 Option screening, these options were taken offline and were studied in detail to define the methods, equipment and vessels needed to support each option. The results of this study are reported Pipeline Removal Methods, Technical Feasibility Assessment and Option Pre-screening [8]

Similar assessment criteria as described in Section 4.1.3 were applied during the option screening study. The O&G UK Guidelines [2] Evaluation “Type A” approach as described in 4.1.2 was also adopted, where each of the pipeline and umbilical decommissioning options were qualitatively assessed using the Red-Amber-Green (RAG) evaluation method shown below.

The results of this pre-screening study are summarised in Section reported in detail in the Options Pre-Screening Study [8] which is available upon request.

4.3. Preparation

In addition to the Technical studies described in Section 4.1.1, safety and environmental studies were carried out in support of the CA:

4.3.1 Safety Risk Assessment/ Environmental Impact Identification

Before the CA evaluation workshop was convened a combined Hazard Identification and Risk Assessment (HIRA) /Environmental (Hazard) Identification (ENVID) was convened to inform the CA.

The objectives of the combined HIRA/ENVID was to:

- Identify initiating events that have the potential to give rise to safety, health, societal and environmental consequences;
- Evaluate the safeguards, controls and mitigating measures;
- Risk assess the hazards identified across the options; and
- If appropriate, make recommendations for adequate safeguards, controls, mitigating and emergency response measures to minimise the occurrence, reduce the consequences and escalation potential such that the risk is reduced as low as reasonably practicable (ALARP).

The activities associated with each decommissioning option under consideration were assessed separately which enabled the specific safety and environmental related risks of each option to be identified.

The HIRA/ ENVID processes involved a structured approach, in line with general industry practice. The methodology adopted and the results from the HIRA/ENVID are summarised in Appendix A. The combined HIRA/ ENVID Report [9] provides more detail and is available upon request.

HIRA:

To enable a comparative evaluation of the risks across each decommissioning option under consideration, a Repsol Sinopec Resources UK, Risk Assessment Matrix (RAM) was adopted and used to rate each decommissioning option against an agreed set of guide words.

The ratings were then summated to derive the relative safety performance of each decommissioning option against:

- Project Risk to Offshore Personnel;
- Project Risk to Other Users of the Sea;
- Project Risk to those on land;
- Risk of High consequence event / Major accident hazard (MAH) Event.

These risk criteria align with the safety sub-criteria to be considered in the CA evaluation as discussed in Section 4.1.3 and in Table 5.

A summary table was prepared following the HIRA to inform the CA Evaluation Workshop. The summary tables are also provided in Appendix A, for reference.

ENVID:

The ENVID was expanded to include the assessment of Societal Impacts of each decommissioning option. The ratings were then summated to derive the relative Environmental and Societal performance of each decommissioning option against:

- Emissions to air;
 - Vessels
 - Atmospherics associated with material recycling including transport onshore
- Resource use (offshore and onshore);
 - Energy consumption (fuel use by offshore and onshore plant/equipment)
 - Use of landfill space
- Disturbance to the seabed;
 - Disturbance to the seabed
- Discharges to sea;
 - Routine vessel (e.g. greywater, blackwater, ballast) and/or facilities discharges
 - Chemicals/hydrocarbons from the umbilicals / pipelines etc.
- Underwater noise;
 - Underwater noise from vessels (injury/disturbance to marine species)
 - Underwater noise from cutting noise
- Physical Presence;
 - Physical presence of vessels in relation to other sea users
 - Physical presence of infrastructure recovered as part of a later campaign
- Onshore dismantling yard activities;
 - Airborne noise, including traffic movements at onshore sites, odour etc.
- Waste generation;
 - Non-hazardous waste
 - Marine growth
 - Hazardous waste e.g. oil entrained in the pipelines
- Unplanned discharges to sea;
 - Accidental loss of vessel inventory
- Unplanned disturbance to the seabed;
 - Dropped objects.

Summary fact sheets were prepared following the ENVID to inform the CA Evaluation Workshop, these factsheets as presented in the CA are provided in Appendix B, for reference.

4.4. Establish

4.4.1 Stakeholder Engagement

A Stakeholder Engagement Plan [12] has been prepared which identifies stakeholders, communication methods and indicative timings of engagement.

Consulting with stakeholders is an important part of the decommissioning impact assessment process as it allows any concerns or issues which stakeholders may have, to be communicated and addressed. In July 2019, as part of the informal stakeholder engagement process Repsol Sinopec Resources UK Limited issued a Scoping Report [13] to a number of stakeholders. The Scoping Report provided an overview of the Buchan and Hannay Fields, the proposed decommissioning activities (including results from the CA) and an overview of the impacts to be assessed in this EA. Stakeholders were invited to comment on the Scoping Report with respect to any concerns they may have.

Comments on the Scoping Report are awaited from some stakeholders. From comments received to date, it is acknowledged that the addition of stabilisation materials (e.g. rock dump to cover the exposed sections of lines decommissioned in situ) should be minimised.

In addition, to issuing the Scoping Report, Repsol Sinopec Resources UK Limited have carried out an External Stakeholder Engagement Workshop, on 07 November 2019, where the results of this CA were shared. There was no feedback received during the stakeholder engagement that indicated the recommendations from this CA were not acceptable to the stakeholders.

4.4.2 Agreed Criteria, Sub-Criteria and Weightings

Agreed main and sub-criteria is as described in Section 4.1.3.

As described in Section 4.1.2, a qualitative RAG approach to rating performance of each decommissioning option and across each sub-criterion was adopted, therefore, no numerical scoring was available during the evaluation. The application of arithmetic weightings across the criteria to be evaluated was therefore not possible. i.e. all sub-criteria were given equal weighting.

Sensitivity analyses was completed for each pipeline group to test the inability to weight specific criteria and this is described in Section 6.1. The outcome of the sensitivity analyses carried out is also provided in Sections 6.1.1 to 6.1.5 under each pipeline group.

4.4.3 Review and Agree pre-screening outcome

A Pipelines Removal Methods, Technical Feasibility Assessment and Option Screening Study [8] was carried out and published to the wider project team for review ahead of the CA Evaluation Workshop.

The updates from the review cycle of this study [8] was presented as the introduction at the CA Evaluation Workshop described under Section 4.5. Technical fact sheets were prepared to summarise the results of both the Options screening study [8], the Asset Inventory study [7] and the Pipeline Status & Historical Review Report [5]. The technical fact sheets are provided in Appendix C for reference.

4.5. Evaluate

The CA Evaluation Workshop was convened on 04 June 2019. Details of participants is provided in Table 7.

Table 7: CA Workshop Participants

| Repsol Sinopec Resources UK Limited | |
|--|--|
| Simon Reid | Project Manager |
| Tim Hollis | Environmental Advisor |
| Stephen Etherson | Subsea Engineer |
| Genesis | |
| John Wilson | Senior Consultant Decommissioning (Chair) |
| Martha O'Sullivan | Consultant Environmental Engineer |
| Louis Findlay | Skills Group Manager – Technical Safety & Risk |
| Neil Torrance | Senior Subsea Consultant |

Workshop considerations are explained in Section 5, outcome of the workshop is reported in Section 6.1.

4.6. Report

This document reports the emerging recommendations of the CA Workshop and these are summarised in Section 6.1.

The outcome and recommendations of the CA are reflected in the draft Decommissioning Programme [3] to be issued for public consultation.

5. CA WORKSHOP CONSIDERATIONS

5.1. Results of Options Pre-screening

The Options Pre-screening Report [8] describes the pre-screening process and provides the basis for the short-listed options to be taken forward in the CA workshop.

Table 8 below, identifies for each pipeline and umbilical group:

- the options considered initially;
- the options pre-screened out by the study; and
- the options that were carried forward to the CA workshop.

Detailed descriptions of all methods evaluated are described in the Options Pre-screening Report [8] and are not repeated here. Presentation slides provided an overview of each decommissioning option at the CA workshop.

The reasoning for decommissioning options being discounted at pre-screening stage is also provided in the option pre-screening study [8] and only summarised here:

1a) - Total Removal by Reverse Reeling

- Concrete coated pipe installed by "S" lay has not been designed to be reeled on to a vessel, the pipe integrity would fail during reeling operations.
- It is deemed not possible to reverse-reel large diameter pipelines with aged concrete coating due to the reeling process where the concrete coating will not deform around the reel without cracking and could fall on the vessel causing harm to personnel and damage to equipment. There is also no track record in the industry of this method of recovery for this type of pipeline.
- This option has therefore been discounted as not technically feasible in the pre-screening report for Group A.
- This option has been carried forward as a Total Removal option for each of the other Groups in the CA workshop evaluation.

1b) - Total Removal by Reverse S-Lay

- There is no industry track record of reverse S-lay of concrete coated pipe and there is concern that the deterioration of the concrete coating over time would hinder initial pick up of the pipe and may result in sections of concrete coating falling off during recovery. For this reason, this recovery method has also been discounted for Group A in the pre-screening report.
- Reverse Reel and Reverse S-Lay methods of recovery have been rated similarly in the Pre-screening Report for pipeline groups with small diameter and/or more flexible lines and where no concrete coating exists, i.e. Groups B to E, such that the outcome of a formal CA evaluation is likely to be similar for both options in the CA process. Therefore, it has been deemed necessary to only carry forward one of these Total Removal methods and as removal by reverse reeling incurs less vessel time, less deck space requirements, less manual handling and lower cost, removal by reverse S-Lay has been discounted for all pipeline groups in the pre-screening report.

1c) - Total Removal by Cut and Lift

- Total Removal would involve multiple seabed to vessel deck lifts which would have an increase in safety to deck personnel and onshore personnel when pipe is back loaded onshore.
- Cut and Lift compared with other Total Removal options would require significantly longer duration of offshore work and vessel days, which could drive a longer decommissioning offshore campaign or campaigns, which increases the chance of schedule slippages, for all pipeline groups.
- In line with OSPAR and OPRED clean seabed policy, at least one Total Removal option must be considered in the CA Workshop evaluation:

- Since both other Total Removal methods, by reverse reeling and by reverse S Lay, have already been discounted for Pipeline Group A in the Pre-Screening Report [8], it is proposed to carry forward the cut and lift option for Group A.
- Since Total Removal by reverse reeling is to be carried forward to the already trenched and buried pipelines groups C and E, Total Removal by cut and lift has been screened out for these groups.
- It has been recommended that, since pipeline groups B and D are surface laid, these groups should be evaluated in the CA workshop for both methods, Total Removal by reverse reel and by cut and lift.

2a) - Remediate In-situ: Exposed Sections Rock Covered

- This decommissioning option is to be carried forward for all pipeline groups.
- In this option, the exposed sections of pipelines would be left in place on the seabed and rock dumped to achieve a profile of rock cover that is over-trawlable. Where the pipeline is already trenched and buried, the pipeline ends, trench transitions and mid-line exposures would be covered with rock, to achieve a profile of rock cover that is over-trawlable. The amount of rock cover would be in line with industry practise and would be agreed with all consultees during the works authorisation process.
- Future periodic inspections of the pipelines left in-situ would be required to confirm that no future exposures develop.
 - Note: Based on review of historical inspection records and the fact the lines will be no longer in use, the potential for pipeline exposures to occur in future is very unlikely.































2b) - Remediate In-situ: Exposed Sections Trenched and Buried


- This decommissioning option is to be carried forward for all pipeline groups.
- In this option, the exposed sections pipelines would remain in place on the seabed and would be trenched and buried, using a trenching / jetting unit. Where the pipeline is already trenched and buried, the pipeline ends, trench transitions and any mid-line exposures would be trenched and buried. The trenching strategy would be in line with industry practise and would be agreed with all consultees during the works authorisation process.
- Future periodic inspections of the pipelines left in-situ would be required to confirm that no future exposures develop.
 - Note: Based on review of historical inspection records and the fact the lines will be no longer in use, the potential for pipeline exposures to occur in future is very unlikely.


2c) - Remediate In-Situ: Exposed Sections Cut and Removed

- This option will only apply to pipelines that are already trenched and buried as if the pipeline is surfaced laid, cut and remove is covered under the Total Removal Option 1c.
- This decommissioning option is therefore to be carried forward for all pipeline groups that are already trenched and buried i.e. Pipeline Groups A, C and E
- In this option, the trenched and buried sections of pipeline would remain in place. The pipeline ends, trench transitions and mid-line exposures would be cut and removed to full trench depth.
- Future periodic inspections of the pipelines left in-situ would be required to confirm that no future exposures develop.
 - Note: Based on review of historical inspection records and the fact the lines will be no longer in use, the potential for pipeline exposures to occur in future is very unlikely.

Table 8: Option Pre-Screening Study Recommendations

| GROUP ID | Component type / as-laid condition | 1. Total Removal By: | | | 2. Remediate in-situ, with Exposed Sections: | | |
|----------|---|---|--|---|---|---|--|
| | | 1a) | 1b) | 1c) | 2a) | 2b) | 2c) |
| | | Reverse Reeling | Reverse S-Lay | Cut and Lift | Rock covered | Trenched and buried | Cut and Removed |
| A | - Rigid pipeline - Concrete coated - Trenched |  Not Technically Feasible |  Pre-screened out |  |  |  |  |
| B | - Rigid pipeline - Surface Laid |  |  Pre-screened out |  |  |  |  N/A |
| C | - Rigid pipeline - Trenched and buried |  |  Pre-screened out |  Pre-screened out |  |  |  |
| D | - Flexible pipeline/umbilical - Surface Laid |  |  N/A |  |  |  |  N/A |
| E | - Umbilical - Trenched and buried |  |  N/A |  Pre-screened out |  |  |  |

 denotes this decommissioning option is to be carried through to the CA workshop for evaluation

 denotes this decommissioning option will not be evaluated in the CA workshop

5.2. Evaluation Workshop Tools

5.2.1 Qualitative Assessment - Rating Guide Table

A project specific guide table for each sub-criterion to be comparatively assessed qualitatively was prepared and published to ensure workshop participants were aligned in the application of RED/ AMBER/ GREEN (RAG) rating against each sub-criterion. This guide table is provided in Appendix D, for reference.

5.2.2 Evaluation / Rating Workbook

A project specific evaluation/ rating workbook was prepared in M.S Excel format which reflects the criteria and sub-criteria to be assessed against the specific decommissioning options for the project and for each group being evaluated.

This workbook was populated at the workshop with the agreed ratings and relevant narrative explaining the reasoning behind the rating of each sub-criterion against each decommissioning option.

The evaluation/ rating workbook is provided in Appendix E, for reference and elaborates on the basis to the recommended decommissioning options recorded in Section 6.1.

5.2.3 Decommissioning Fact Sheets

Decommissioning fact sheets have been prepared and are included in Appendices B and C. These present a summary of the results of the supporting studies and were used to inform the workshop participants throughout the workshop.

Note: that the authors of the factsheets also participated in the evaluation workshop and were, when required, able to expand and clarify the facts.

5.3. Mechanics of Rating the Options

The evaluation / rating workbook described in Section 5.2.2 was live on screen and was populated during the workshop.

Each pipeline group was assessed in turn, by:

- a) Taking each sub-criterion in turn and assessing and rating across each decommissioning option. This ensured a true comparison of the options for each sub-criterion, which would not be the case if each decommissioning option had been assessed in isolation and for all criteria first;
- b) When appropriate, comments have been added in the cell being rated to record the reasoning for the rating. These comments have been used to develop the summary narrative in Section 6.1;
- c) Steps a) and b) were repeated for each sub-criterion in turn until all sub-criteria had been assessed for all decommissioning options;
- d) Summating the ratings was not completed until each criterion has been assessed and rated individually. This avoided the possibility of summation results influencing ratings across subsequent criteria;
- e) Once all criteria had been completed, a summary page was collated and viewed to determine the overall ranking for each decommissioning option:
 - i. The decommissioning option with the most number of sub criteria rated as RED (Higher Impact), was agreed to be the least preferred option;
 - ii. The decommissioning option with the least number of sub criteria rated as RED (Higher Impact) and the most number of sub criteria rated GREEN (Low Impact), was agreed to be the most preferred option;
 - iii. Other options were then ranked in order, based on relative numbers of RED (Higher Impact) and AMBER (Low Impact) that the sub-criteria have attracted.

The results by individual sub-criteria were then viewed and an overall rating and ranking for each pipeline group was agreed. See the “Visual Summary” page for each pipeline group in the workbook provided in Appendix E, for reference.

5.3.1 Sensitivity Analysis

Two Sensitivity Analyses were conducted to review potential impact on the recommended / preferred decommissioning options for each pipelines group.

Sensitivity Analysis 1 – Equal Weighting of the Main Criteria

Since no numerical scoring was adopted during the evaluation, the application of arithmetic weightings across the criteria to be evaluated could not be applied. i.e. all sub-criteria were given equal weighting. Therefore, the more sub-criteria evaluated against a specific main criterion results in that specific main criterion having greater influence on the outcome than other main criteria.

To review the impact if all main criteria had an application of equal weighting, the individual sub-criteria ratings were viewed and an average weighting against the specific main criterion was agreed.

The average ratings across all five main criteria, were then viewed and equal weighting rating and ranking was agreed for each pipeline group.

The results of this sensitivity analysis are summarised against each pipeline group in Section 6.1. See also the “Sensitivity Analysis 1” page for each pipeline group in the workbook provided in Appendix E, for reference.

Sensitivity Analysis 2 – Equal Weighting of the Main Criteria with Economic Criteria Removed

Taking account of OPRED Guidance Notes [1], where it states, “it is unlikely that costs alone will be accepted as the deciding factor in arriving at the preferred option unless all other matters show no significant difference”. Sensitivity Analysis 2 has removed the Economic Criteria and evaluated the outcome on the remaining equally weighted main criteria.

The results of this sensitivity analysis are summarised against each pipeline group in Section 6.1. See also the “Sensitivity Analysis 2” page for each pipeline group in the workbook provided in Appendix E, for reference.

6. COMPARATIVE ASSESSMENT EVALUATION

6.1. Results, Conclusions and Recommendations

This section provides a summary of the ranking reached for each decommissioning option under consideration and for each pipeline group. Options ranked 1 being the preferred option and options ranked 2 to 4 being poorer performing options compared to the preferred option.

During the Evaluation Workshop, the allocated ratings were recorded on a pre-prepared MS Excel evaluation workbook and narrative was added to explain and justify each rating. A full set of the evaluation workbook / worksheets is provided in Appendix E.

The overall ratings and rankings for each pipeline group were determined from a summation of the ratings of the individual sub-criteria. Since no numerical scoring was adopted during the evaluation, the application of weightings across the criteria to be evaluated could not be applied. i.e. all sub-criteria were given equal weighting. Therefore, the more sub-criteria evaluated against a specific main criterion results in that specific main criterion having greater influence on the outcome than other main criteria.

i.e. In this CA evaluation, Safety has five sub-criteria, Environmental has four sub-criteria whereas Technical, Societal and Economic each have only two sub-criteria. Therefore, the ratings allocated to Safety and Environmental have had a greater influence on the outcome overall than the other main criteria.

The impact of this spread of influence has been tested by carrying out a sensitivity analysis, for each pipeline group:

Sensitivity Analysis 1 has averaged the results of the ratings of each sub-criterion and allocated an average rating to each main criterion. The application of average rating to each main criterion nullifies the influence of the number of sub-criteria and means that each main criterion has an equal weight in influencing the outcome.

Sensitivity Analysis 2, taking account of OPRED Guidance Notes [1], where it states, “it is unlikely that costs alone will be accepted as the deciding factor in arriving at the preferred option unless all other matters show no significant difference”. Sensitivity Analysis 2 has removed the Economic Criteria and evaluated the outcome on the remaining equally weighted main criteria.

Each sub-section below provides conclusions and recommendations as to the preferred decommissioning options for each group and provides a summary of the influencing factors which caused this ranking. Each sub-section also provides conclusions on the impact of the sensitivity analyses carried out.

6.1.1 Pipelines Group A

| Component / As-laid Condition | Agreed Groupings | Length (km) | Weight (Te) | Burial Status | Exposed Length (km) |
|---|----------------------|-------------|-------------|--|---------------------|
| <ul style="list-style-type: none"> - Rigid pipeline - Concrete coated - Trenched | PL401 12" Oil Export | 54.043 | 13,661 | Trenched to around 2m depth with natural backfill (variable) | 0.766 |

The CA Evaluation Workshop ranking and recommendation for each decommissioning option was as follows:

| | Group A - Decommissioning Options | | | | | |
|----------------|-----------------------------------|------------------|---------------------------|--|-------------------|---------------|
| | Total Removal by: | | | Remediate In-situ with exposed sections: | | |
| Sub-Option | 1a) | 1b) | 1c) | 2a) | 2b) | 2c) |
| | Reverse Reeling | Reverse S-Lay | Cut & Lift | Rock Covered | Trenched & Buried | Cut & Removed |
| Ranking | | | 4 | 3 | 1 | 2 |
| Recommendation | Not Technically Feasible | Pre-screened out | Discounted option in DP's | Although Option 2b) Remediate in situ with exposed sections - trenched and buried is ranked as preferred option, the difference in rating between 2b) , 2a) and 2c) is marginal and all three options will be carried through to a Contracting and Procurement (C&P) phase of the project to allow contractors to tender and propose the overall preferred option. If the C&P tendering phase results in either options 2a) or 2c) being considered more favourable than option 2b) the Operator will engage with OPRED before a decision is taken on overall strategy . | | |

Key influencing factors in ranking this group:

Technical Criteria

The rating of moderate impact, allocated to Option 1c resulted in a worse ranking than all other options as, although this technique has been used for partial removal of relatively new concrete coated pipelines, the technique has not been widely used for older lines where the condition of the line and the coating is uncertain. The anticipated duration in recovery of the line compared to the other options, if even small growth was encounter in individual activities, could result in significant delay to the project overall due to the repetitive nature of the tasks involved.

Option 2b), generally exposed sections being trenched and buried could be a challenge depending on the trencher equipment used and the type of soils, see discussion under economic criterion.

Option 1c) was considered the worst performing option from a Technical feasibility perspective, with all other options being rated equally as low impact.

Safety Criteria

The rating allocated to Option 1c) resulted in a worse rating (higher impact) than all other remediate in-situ options due to the risk exposure time and extent of handling of materials on deck, which was regarded as significantly greater for Option 1c) than other options. Risk to onshore personnel was also an influence for the higher impact rating, as more materials were returned onshore to be handled than the remediate in-situ options.

The rating of moderate impact allocated to Option 2b) was the worst option for the safety sub-criterion of residual risk to other users of the sea, specifically fishermen during trawling activities. Under this option the additional rock cover installed at exposed sections, whilst will be specified to be over trawlable, the rating recognises potential for the new rock cover to become unstable over time. and cause a potential future snagging hazard.

Although a significantly smaller quantity of materials will be recovered under Option 2c) compared to Option 1c), the rating of moderate impact allocated to Options 2c) resulted in a worse rating than Option 2a) and 2b) acknowledging that there may be some increased risk involved in loading the recovered sections onto the vessel and in the back loading and handling of returned pipeline sections onshore.

Option 1c) was considered the worst performing option from a Safety perspective, with Option 2b) performing marginally better than Options 2a) and 2c).

Societal Criteria

No significant positive or negative impact is anticipated to onshore communities or amenities from any of the options. The rating of moderate impact allocated to Option 2a) resulted in a marginally worse rating than the other options on potential impact to commercial fisheries, as it recognises potential for new rock cover to become unstable over time which may result in fishermen avoiding the area.

Option 2a) was considered marginally the worst performing option from a Societal perspective, with all other options being rated equally as low impact.

Economic Criteria

The ratings allocated were on comparative cost of each option, and the cost for long term monitoring / potential future remediation activities.

Overall Option 1c) is rated as higher impact due to the significant decommissioning cost compared to the remediate in-situ Options 2a), 2b) and 2c) which have been rated as low impact overall.

Option 2b) trenching and burying exposed sections could be more uncertain from an economic perspective than the other remediate in-situ options. This will depend on whether the trench meets specification on first pass, where multiple passes may then be required. Also pipe end anodes and end flanges may need to be removed before trenching and will depend on the type of trenching equipment used.

Option 1c) will cost over 145 times more than the other options which has resulted in its higher impact rating. All three remediate in-situ options have similar costs.

Option 1c) will have minimal long-term monitoring cost and has been rated lower impact for this sub-criterion, whereas the potential impact of additional post project monitoring surveys and potential remedial works for the leave in-situ options has also been considered where these options have been rated as moderate impact.

Option 1c) was considered the worst performing option from an Economic perspective, with all other options being rated equally as low impact.

Environmental Criteria

The ratings allocated to Option 1b resulted in a worse ranking than all other options as it is anticipated that there will be more seabed disturbance in exposing the already trenched and buried pipelines their full length, due to available excavation techniques that will spread seabed materials, to allow the large diameter pipelines to be fully removed.

The ratings allocated to Option 2b resulted in a worse ranking than all other remediate in-situ options for long-term loss of habitat as it was acknowledged introducing new materials to the seabed was the worst option of this sub-criteria.

Options 1c) and 2a) were considered marginally worse performing options from an Environmental perspective (moderate impact), than Options 2b) and 2c) being rated equally as low impact.

Sensitivity Analysis

Sensitivity Analysis 1 – equal weighted main criteria:

Results in a change from Original Evaluation above in that Option 2c) – exposed sections cut and removed, performance improves marginally (2 less Moderate Impact ratings), making it first equal with Option 2b)-exposed sections trenched and buried. Rating of Options 1c) and 2a) are not affected by this sensitivity analysis.

Sensitivity Analysis 2 – equal weighted main criteria and no economic criteria considered:

No change in rating or ranking from Sensitivity Analysis 1.

6.1.2 Pipelines Group B

| Component / As-laid Condition | Agreed Groupings | Length (km) | Weight (Te) | Burial Status | Exposed Length (km) |
|--|---|-------------|-------------|--|---------------------|
| <ul style="list-style-type: none"> - Rigid Pipeline - Surface Laid | PL126 12" Oil Export - Buchan to PLEM | 1.697 | 167.4 | Surface Laid – shallow burial seen along lines | 1.697 |
| | PL772 (ex PL170A) B4a 4" Water Injection (WI) | 2.514 | 72.7 | | 2.514 |
| | PL170 (ex PL170B) B4a 4" Gas Lift | 2.519 | 61.3 | | 2.519 |
| | PL3026 (ex PL127A) B7 4" Production | 1.617 | 35.7 | | 1.617 |
| | PL3017 (ex PL127B) Well B7 4" Gas Lift | 1.628 | 36.0 | | 1.628 |
| | PL128 (ex PL128A) B8 4" Production | 1.856 | 53.3 | | 1.856 |
| | PL597A WI line to Well B9 | 1.960 | 47.3 | | 1.960 |

The CA Evaluation Workshop ranking and recommendation for each decommissioning option was as follows:

| | Group B - Decommissioning Options | | | | | |
|----------------|-----------------------------------|------------------|----------------------------|---------------------------------------|-------------------|--|
| | Total Removal by: | | | Remediate In-situ with full pipeline: | | |
| Sub-Option | 1a) | 1b) | 1c) | 2a) | 2b) | 2c) |
| | Reverse Reeling | Reverse S-Lay | Cut & Lift | Rock Covered | Trenched & Buried | Cut & Removed |
| Ranking | 1 | Pre-screened out | 2= | 2= | 2= | Surface laid – Option 1c) provides this option |
| Recommendation | Preferred option in DP's | | Discounted options in DP's | | | |

Key influencing factors in ranking this group:

Technical Criteria

The rating of moderate impact was allocated to Option 2b) for the sub-criterion risk of project failure, since the pipelines are near each other, it may be difficult to trench and bury individual lines.

However, overall rating was that all options being were not significantly different from a technical feasibility perspective.

Safety Criteria

A low impact rating was allocated to Options 1a) as although option it involves recovery of the small diameter pipelines onto a reel, this type of activity has minimal intervention of the deck crew.

The rating allocated to Option 1c) resulted in a worse rating (higher impact) than all other remediate in-situ options due to the risk exposure time and extent of handling of materials on deck, which was regarded as significantly greater for Option 1c) than other options. Risk to onshore personnel was also an influence for the higher impact rating, as more materials were returned onshore to be handled than the remediate in-situ options.

The rating of moderate impact allocated to Option 2a) was the worst option for the safety sub-criterion of residual risk to other users of the sea, specifically fishermen during trawling activities. Under this option the additional rock cover installed at exposed sections, whilst will be specified to be over trawlable, the rating recognises potential for the new rock cover to become unstable over time. and cause a potential future snagging hazard.

A low impact rating was allocated to Option 2b) across all the sub-criteria as interaction with deck crew and onshore personnel was minimal.

Option 1c) was considered the worst performing option from a Safety perspective, with Options 1a) and 2b) performing marginally better than Option 2a).

Societal Criteria

No significant positive or negative impact is anticipated to onshore communities or amenities from any of the options. The rating of moderate impact allocated to Option 2a) resulted in a marginally worse rating than the other options on potential impact to commercial fisheries, as it recognises potential for new rock cover to become unstable over time which may result in fishermen avoiding the area.

Option 2a) was considered marginally the worst performing option from a Societal perspective, with all other options being rated equally as low impact.

Economic Criteria

The ratings allocated were on comparative cost of each option, and the cost for long term monitoring / potential future remediation activities.

Overall Option 1c) is rated as higher impact due to the significant decommissioning cost compared to the Options 1a) 2a), 2b) which have been rated as low impact overall.

Option 1c) will cost over 600 times more than the lowest cost Option 2b) which has resulted in its higher impact rating. Option 1a) is similar in cost to Option 2b)

Option 2a) has been rated as moderate impact as it has a cost estimated to be 1.6 times more than the lowest cost Option 2b)

Options 1a) and 1c) will has minimal long-term monitoring cost and has been rated lower impact for this sub-criterion, whereas the potential impact of additional post project monitoring surveys and potential remedial works for the leave in-situ Options 2a) and 2b), has also been considered where these options have been rated as moderate impact.

Option 1c) was considered the worst performing option from an Economic perspective, with Options 1a) and 2b) performing marginally better than Option 2a).

Environmental Criteria

The ratings allocated to Option 2a resulted in a marginally worse ranking than all other options as it is anticipated that there will be more seabed disturbance and long-term loss of habitat in the application of new rock cover to the seabed

Option 2a) was considered a marginally worse performing option from an Environmental perspective, with all other options being rated equally as low impact.

Sensitivity Analysis

Sensitivity Analysis 1 – equal weighted main criteria:

Results in a change from Original Evaluation above in that Option 2b) – Trench and bury full pipeline, performance improves marginally to make it 1= in ranking with Option 1a) – Full removal by reverse reeling, and perhaps should be carried forward as an option in the DP's.

However, due the uncertainty in the ability to trench and bury the pipelines when in such proximity to each other it is concluded that Option 1a) – Reverse Reeling should be taken forward as the preferred option alone.

Sensitivity Analysis 2 – equal weighted main criteria and no economic criteria considered:

No change in rating or ranking from Sensitivity Analysis 1

6.1.3 Pipelines Group C

| Component / As-laid Condition | Agreed Groupings | Length (km) | Weight (Te) | Burial Status | Exposed Length (km) |
|---|---|---------------|-------------|--|---------------------|
| <ul style="list-style-type: none"> - Rigid Pipeline - Trenched and Buried | PL1865A/PL1866 Redundant 8" Hannay Production and 6" Gas Lift (piggybacked) | 13.189/13.408 | 1345/201 | Burial depth of 0.66m (average) with supplementary rock dump to take cover to 1m | 0.107 |
| | PL1865 Replacement Hannay 8" Production | 13.461 | 1258 | Burial depth of 1.44m (average) with supplementary rock dump at 4 locations | 0.285 |

The CA Evaluation Workshop ranking and recommendation for each decommissioning option was as follows:

| | Group C - Decommissioning Options | | | | | |
|----------------|-----------------------------------|------------------|------------------|---|-------------------|---------------|
| | Total Removal by: | | | Remediate In-situ with exposed sections: | | |
| Sub-Option | 1a) | 1b) | 1c) | 2a) | 2b) | 2c) |
| | Reverse Reeling | Reverse S-Lay | Cut & Lift | Rock Covered | Trenched & Buried | Cut & Removed |
| Ranking | 4 | | | 3 | 1= | 1= |
| Recommendation | Discounted option in DP's | Pre-screened out | Pre-screened out | Although Remediated In Situ Option 2b (Exposed Sections trenched and buried) and Option 2c) (Exposed Sections cut and removed) are ranked as joint preferred options, the difference in rating between 2b, 2c and 2a is marginal and all three options will be carried through to a Contracting and Procurement (C&P) phase of the project to allow contractors to tender and propose the overall preferred option. If the C&P tendering phase results in Option 2a) being considered more favourable than the preferred options, the Operator will engage with OPRED before a decision is taken on overall strategy. | | |

Key influencing factors in ranking this group:

Technical Criteria

The rating of moderate impact, allocated to Option 1a) resulted in a marginally worse ranking than all other options as, although due to the uncertainty of the ability to pull the pipeline through the burial medium, including rock cover and the fact that the original line was retired due to internal corrosion, may hinder the ability to reverse reel.

Option 2b), generally exposed sections being trenched and buried could be a challenge depending on the trencher equipment used and the type of soils, see discussion under economic criterion.

Option 1c) was considered a marginally worse performing option from a Technical feasibility perspective, with all other remediate in-situ options being rated equally as low impact.

Safety Criteria

The rating allocated to Option 1a) resulted in a marginally worse rating (moderate impact) than all other remediate in-situ options due to the risk exposure during recovery of the pipeline retired with internal corrosion, and the equivalent risk to personnel in the disposal yard when handling and cutting the pipeline.

Option 1a) was considered the worst performing option from a Safety perspective, with all other remediate in-situ options being rated equally as low impact.

Societal Criteria

No significant positive or negative impact is anticipated to onshore communities or amenities from any of the options. The rating of moderate impact allocated to Option 2a) resulted in a marginally worse rating than the other options on potential impact to commercial fisheries, as it recognises potential for new rock cover to become unstable over time which may result in fishermen avoiding the area.

Option 2a) was considered marginally the worst performing option from a Societal perspective, with all other options being rated equally as low impact.

Economic Criteria

The cost of decommissioning adopting any of the options evaluated was not considered significantly different as the costs of each option is estimated to be within 22% of the lowest cost option.

Option 2b) trenching and burying exposed sections could be more uncertain from an economic perspective than the other remediate in-situ options. This will depend on whether the trench meets specification on first pass, where multiple passes may then be required. Also pipe end anodes and end flanges may need to be removed before trenching and will depend on the type of trenching equipment used.

Option 1a) will have minimal long-term monitoring cost and has been rated lower impact for this sub-criterion, whereas the potential impact of additional post project monitoring surveys and potential remedial works for the leave in-situ options has also been considered where these options have been rated as moderate impact.

Option 1a) was considered the best performing and preferred option from an Economic perspective, with all other options being rated marginally worse as moderate impact.

Environmental Criteria

The ratings allocated to Option 1a) were marginally worse than Options 2b) and 2c) as it is anticipated that there will be more short-term seabed disturbance in exposing the already trenched and buried pipelines their full length, due to available excavation techniques that will spread seabed materials, to allow the pipelines to be fully removed. If it can be proven that the pipelines can be withdrawn from the seabed without pre-excavation this will limit short term seabed disturbance further, but this is not concluded as possible at the time of the evaluation.

The ratings allocated to Option 2b) resulted in a marginally worse ranking than all other options for long-term loss of habitat as it was acknowledged introducing new materials (rock cover) to the seabed was the worst option of this sub-criteria.

Options 1a) and 2a) were considered marginally worse performing options from an Environmental perspective (moderate impact), than Options 2b) and 2c) being rated equally as low impact.

Sensitivity Analysis

Sensitivity Analysis 1 – equal weighted main criteria:

Results in a change from Original Evaluation above in that Option 1a) – Total Removal by reverse reeling, performance improves marginally, bringing it to same ranking as Option 2a) - remediate in-situ with exposed sections rock covered, making it 3rd equal with Option 2a). Rating of Options 1c) – Total Removal by cut and lift and 2a) are not affected by this sensitivity analysis and remain 1st equal.

Sensitivity Analysis 2 – equal weighted main criteria and no economic criteria considered:

When economic criterion is not considered the best performing Options 2b) - remediate in-situ with exposed sections trenched and buried and 2c) - remediate in-situ with exposed sections cut and removed are not affected however Option 1a) – Total Removal by reverse reeling, reverts to its original rating and ranking of higher impact and ranked 4th.

6.1.4 Pipelines Group D

| Component / As-laid Condition | Agreed Groupings | Length (km) | Weight (Te) | Burial Status | Exposed Length (km) |
|---|--|-------------|-------------|--|---------------------|
| - Flexible Pipeline/Umbilical - Surface Laid | PL4210 (ex PL128B) B8 2" Gas Lift flexible | 1.850 | 52.7 | Surface Laid - shallow burial seen along lines | 1.850 |
| | PL597B B9 2" Gas Lift flexible | 1.990 | 45 | | 1.990 |
| | PLU2551 JB4 Well B4 umbilical | 2.750 | 41.4 | | 2.750 |
| | PLU2551 JB4X Redundant Well JB4 umbilical | 2.930 | 44 | | 2.930 |
| | PLU2550 JB7H Well B7 umbilical | 1.838 | 27.8 | | 1.838 |
| | PLU2550 JB8H Well B8 umbilical | 2.132 | 32 | | 2.132 |
| | PLU2551 JB9 Well B9 umbilical | 2.066 | 29.1 | | 2.066 |

The CA Evaluation Workshop ranking and recommendation for each decommissioning option was as follows:

| | Group D - Decommissioning Options | | | | | |
|----------------|-----------------------------------|------------------|----------------------------|---|-------------------|--|
| | Total Removal by: | | | Remediate In-situ, with exposed sections: | | |
| Sub-Option | 1a) | 1b) | 1c) | 2a) | 2b) | 2c) |
| | Reverse Reeling | Reverse S-Lay | Cut & Lift | Rock Covered | Trenched & Buried | Cut & Removed |
| Ranking | 1 | Pre-screened out | 3= | 3= | 2 | Surface laid – Option 1c) provides this option |
| Recommendation | Preferred option in DP's | | Discounted options in DP's | | | |

Key influencing factors in ranking this group:

Technical Criteria

The rating of moderate impact was allocated to Option 2b) for the sub-criterion risk of project failure, since the pipelines are near each other, it may be difficult to trench and bury individual lines.

However, overall rating was that all options being were not significantly different from a technical feasibility perspective.

Safety Criteria

A low impact rating was allocated to Options 1a) as although option it involves recovery of the small diameter pipelines and umbilicals onto a reel, this type of activity has minimal intervention of the deck crew.

The rating allocated to Option 1c) resulted in a worse rating (higher impact) than all other remediate in-situ options due to the risk exposure time and extent of handling of materials on deck, which was regarded as significantly greater for Option 1c) than other options. Risk to onshore personnel was also an influence for

the higher impact rating, as more materials were returned onshore to be handled than the remediate in-situ options.

The rating of moderate impact allocated to Option 2a) was the worst option for the safety sub-criterion of residual risk to other users of the sea, specifically fishermen during trawling activities. Under this option the additional rock cover installed at exposed sections, whilst will be specified to be over trawlable, the rating recognises potential for the new rock cover to become unstable over time. and cause a potential future snagging hazard.

A low impact rating was allocated to Option 2b) across all the sub-criteria as interaction with deck crew and onshore personnel was minimal.

Option 1c) was considered the worst performing option from a Safety perspective, with Options 1a) and 2b) performing marginally better than Option 2a).

Societal Criteria

No significant positive or negative impact is anticipated to onshore communities or amenities from any of the options. The rating of moderate impact allocated to Option 2a) resulted in a marginally worse rating than the other options on potential impact to commercial fisheries, as it recognises potential for new rock cover to become unstable over time which may result in fishermen avoiding the area.

Option 2a) was considered marginally the worst performing option from a Societal perspective, with all other options being rated equally as low impact.

Economic Criteria

The ratings allocated were on comparative cost of each option, and the cost for long term monitoring / potential future remediation activities.

Overall Option 1c) is rated as higher impact due to the significant decommissioning cost compared to the Options 1a) 2a), 2b) which have been rated as low impact overall.

Option 1c) will cost over seven times more than the lowest cost Option 2b) which has resulted in its higher impact rating. Option 1a) is similar in cost to Option 2b)

Option 2a) has been rated as moderate impact as it has a cost estimated to be 1.6 times more than the lowest cost Option 2b)

Options 1a) and 1c) will have minimal long-term monitoring cost and has been rated lower impact for this sub-criterion, whereas the potential impact of additional post project monitoring surveys and potential remedial works for the leave in-situ Options 2a) and 2b), has also been considered where these options have been rated as moderate impact.

Option 1c) was considered the worst performing option from an Economic perspective, with Options 1a) and 2b) performing marginally better than Option 2a).

Environmental Criteria

The ratings allocated to Option 2a) resulted in a marginally worse ranking than all other options as it is anticipated that there will be more seabed disturbance and long-term loss of habitat in the application of new rock cover to the seabed

Option 2a) was considered a marginally worse performing option from an Environmental perspective, with all other options being rated equally as low impact.

Sensitivity Analysis

Sensitivity Analysis 1 – equal weighted main criteria:

Results in a change from Original Evaluation above in that Option 2b) – Trench and bury full pipeline, performance improves marginally to make it 1= in ranking with Option 1a) – Total Removal by reverse reeling, and perhaps should be carried forward as an option in the DP's.

However, due the uncertainty in the ability to trench and bury the pipelines and umbilicals when in such proximity to each other it is concluded that Option 1a) – Total Removal by reverse reeling should be taken forward as the preferred option alone.

Sensitivity Analysis 2 – equal weighted main criteria and no economic criteria considered:

No change in rating or ranking from Sensitivity Analysis 1

6.1.5 Pipelines Group E

| Component / As-laid Condition | Agreed Groupings | Length (km) | Weight (Te) | Burial Status | Exposed Length (km) |
|--------------------------------------|-------------------------------|-------------|-------------|---------------------------------|---------------------|
| - Umbilical - Trenched and Buried | PLU1867 Hannay main umbilical | 13.461 | 353.6 | Burial Depth of 0.63m (average) | 0.288 |

The CA Evaluation Workshop ranking and recommendation for each decommissioning option was as follows:

| | Group E - Decommissioning Options | | | | | |
|----------------|-----------------------------------|------------------|------------------|---|-------------------|---------------|
| | Total Removal by: | | | Remediate In-situ, with exposed sections: | | |
| Sub-Option | 1a) | 1b) | 1c) | 2a) | 2b) | 2c) |
| | Reverse Reeling | Reverse S-Lay | Cut & Lift | Rock Covered | Trenched & Buried | Cut & Removed |
| Ranking | 4 | | | 3 | 1= | 1= |
| Recommendation | Discounted option in DP's | Pre-screened out | Pre-screened out | <p>Although remediate in situ Option 2b) (exposed sections trenched and buried) and Option 2c) (exposed sections cut and removed) are ranked as joint preferred options, the difference in rating between 2b, 2c and 2a is marginal and all three options will be carried through to a Contracting and Procurement (C&P) phase of the project to allow contractors to tender and propose the overall preferred option.</p> <p>If the C&P tendering phase results in option 2a) being considered more favourable than the preferred options, the Operator will engage with OPRED before a decision is taken on overall strategy.</p> | | |

Key influencing factors in ranking this group:

Technical Criteria

The evaluation concluded that there was no significant difference between all decommissioning options from a technical feasibility perspective. It was considered more likely that the umbilicals would be able to be pulled through the burial medium when recovering by reverse reeling.

Option 2b), generally exposed sections being trenched and buried could be a challenge depending on the trencher equipment used and the type of soils, see discussion under economic criterion.

Safety Criteria

The rating allocated to Option 1a) resulted in a marginally worse rating (moderate impact) than all other remediate in-situ options due to potential risk of exposure of disposal yard personnel to chemicals from umbilical cores when handling and cutting the umbilicals for onward disposal or recycle.

Option 1a) was considered a marginally worse performing option from a Safety perspective (moderate impact), with all other remediate in-situ options being rated equally as low impact.

Societal Criteria

No significant positive or negative impact is anticipated to onshore communities or amenities from any of the options. The rating of moderate impact allocated to Option 2a) resulted in a marginally worse rating than the other options on potential impact to commercial fisheries, as it recognises potential for new rock cover to become unstable over time which may result in fishermen avoiding the area.

Option 2a) was considered marginally the worst performing option from a Societal perspective, with all other options being rated equally as low impact.

Economic Criteria

The cost of decommissioning if adopting any of the options evaluated was not considered significantly different as the costs of each option is estimated to be within 18% of the lowest cost option.

Option 2b) trenching and burying exposed sections could be more uncertain from an economic perspective than the other remediate in-situ options. This will depend on whether the trench meets specification on first pass, where multiple passes may then be required. Also pipe end anodes and end flanges may need to be removed before trenching and will depend on the type of trenching equipment used.

Option 1a) will have minimal long-term monitoring cost and has been rated lower impact for this sub-criterion, whereas the potential impact of additional post project monitoring surveys and potential remedial works for the leave in-situ options has also been considered where these options have been rated as moderate impact.

Option 1a) was considered the marginally the best performing and preferred option from an Economic perspective, with all other options being rated marginally worse as moderate impact.

Environmental Criteria

The ratings allocated to Option 1a) were marginally worse than Options 2b) and 2c) as it is anticipated that there will be more short-term seabed disturbance in extracting the already trenched and buried pipelines their full length.

The ratings allocated to Option 2b) resulted in a marginally worse ranking than all other options for long-term loss of habitat as it was acknowledged introducing new materials (rock cover) to the seabed was the worst option of this sub-criteria.

Options 1a) and 2a) were considered marginally worse performing options from an Environmental perspective (moderate impact), than options 2b) and 2c) being rated equally as low impact.

Sensitivity Analysis

Sensitivity Analysis 1 – equal weighted main criteria:

Results in a change from Original Evaluation above in that Options 1a), 2a) and 2b) become equally rated (moderate impact), leaving Option 2c – remediate in-situ with exposed sections cut and removed as the preferred option (low impact)

Sensitivity Analysis 2 – equal weighted main criteria and no economic criteria considered:

When economic criterion is not considered the performance of Options 2b) and 2c) are not affected and Option 2c) remains the preferred option. However, Option 1a) – ~~T~~total ~~R~~emoval by reverse reeling, reverts to its original rating (higher impact) and is and ranked 4th.

7. REFERENCES

| Reference Number | Document Title | Document Number / Revision/Date |
|------------------|---|---|
| 1 | OPRED Guidance Notes: Decommissioning of Offshore Oil and Gas Installations and Pipelines under the Petroleum Act 1998, | November 2018 |
| 2 | Oil and Gas UK Guidelines for Comparative Assessment in Decommissioning Programmes. | October 2015. |
| 3 | Buchan and Hannay Decommissioning Programme – 1st Pre-draft | RP-DTABUC001-DC-0076/ R02/ Aug. 2019 |
| 4 | Buchan and Hannay Decommissioning Environmental Appraisal (EA) | RP-DTABUC001-HS-0093/ R01/ still to be issued. |
| 5 | Buchan and Hannay Pipeline Status & Historical Review Report | RP-DTABUC001-GE-0069/ C01/ June 2019 |
| 6 | Buchan and Hannay Decommissioning: Basis of Design Report | BOD-DTABUC001-GE- 0070/C01/ Sept. 2019 |
| 7 | Buchan and Hannay Decommissioning Project: Asset Inventory | RP-DTABUC001-GE-0071/ C03/ July 2019 |
| 8 | Pipeline Removal Methods, Technical Feasibility Assessment and Option Pre-Screening | RP-DTABUC001-SS-0082/ C01/ June 2019 |
| 9 | Buchan and Hannay Decommissioning HIRA/ENVID Report | RP-DTABUC001-HS-0079/ C01/ June 2019 |
| 10 | Buchan and Hannay Drill Cuttings Management: BAT Assessment | RP-DTABUC001-HS-0092/ C01/ Aug 2019 |
| 11 | Benthic Solutions Ltd (2019). Habitat Assessment Report. Buchan Decommissioning Survey Services. | INS-ASB-RSRUK-020-REP- 0002. |
| 12 | Buchan and Hannay Stakeholder Engagement Plan | RP-DTABUC001-HS-0094/ R01/ Aug 2019 |
| 13 | Buchan and Hannay EA Scoping Report | RP-DTABUC001-HS-0095/ D1/ Aug 2019 |

APPENDIX A – HIRA RESULTS

The HIRA was completed on 11 June 2019 and although a separate HIRA/ENVID Report [9] has been published, HIRA summary tables of the results of the HIRA were prepared to inform the workshop participants. These summary tables are provided herein for reference.

Risk Assessment Matrix

| CONSEQUENCE | | | | SEVERITY | LIKELIHOOD | | | | |
|---|---|---|--|----------|---|---|---|---|---|
| People / Safety | Environment | Asset / Business / Production Change (annualised) | Reputation | | Very Unlikely A freak combination of factors would be required for an incident to result | Unlikely A rare combination of factors would be required for an incident to result | Possible Could happen when additional, unusual factors are present but otherwise unlikely to occur | Likely Not certain to happen under normal conditions but could happen if a predictable additional factor was present | Very Likely Almost inevitable that an incident would result. |
| P | E | A | R | | A | B | C | D | E |
| Two or more fatalities | Critical Release: Release from a catastrophic pipeline failure or freeflowing hydrocarbons from the reservoir (either from a well or uncontrollable release from the topsides). Released mass ≥50 tonnes. | Extensive damage - Multiple system damage. Business value change >£10m >100k boe. | Serious international reputation impact. Revocation of Permit or corporate prosecution. | 5 | Medium / Alert | Medium | High | High | High / Alarm |
| Single Fatality or Total Permanent Disability | Major Release: ≥20 and <50 tonnes hydrocarbon or non-PLONOR chemical. | Major damage - system shutdown. Business value change <£10M >10k boe. | Major national reputation impact. Prohibition notice. | 4 | Low / Caution | Medium | Medium | High | High |
| Major Injury Includes injuries requiring >7 consecutive days off work as per RIDDOR definition. | Serious Release: ≥1 and <20 tonnes hydrocarbon or non-PLONOR chemical. | Moderate damage - system requires some isolation. Business value change <£1M >1k boe. | Local reputation impact. Improvement notice or enforcement notice. | 3 | Low | Low | Medium | Medium | High |
| Moderate Injury Includes injuries requiring 3 or more consecutive days off work and recordable under RIDDOR. | Minor Release: <1 tonne hydrocarbon or non-PLONOR chemical. >10 tonnes of a PLONOR chemical. | Minor damage - system requires partial isolation. Business value change <£500k >100 boe. | Internal reputation impact. Informal notification of opportunities for improvement or letter. | 2 | Very Low / Care | Low | Low | Medium | Medium |
| Minor Injury Includes injuries requiring <3 days off work, or no time off. Not recordable or reportable under RIDDOR. | Negligible Release: Release of 10 tonnes or less of a PLONOR chemical. None or minimal clean-up required. PLONOR: Considered to pose little or no risk to the environment | Slight damage - system still safe to operate. Business value change <£100K <100 boe. | Scrutiny from Internal Auditor - ICP Action | 1 | Very Low | Very Low | Low | Low | Medium |
| No injury | No release or environmental impact | No damage/ cost | No impact | 0 | Very Low | | | | |

HIRA Summary Tables

The scoring and colour coding of each facet of each sub-criterion and for each decommissioning option was agreed at the HIRA whilst adopting the RAM above.

It was agreed at the HIRA that the risk assessment is relevant to all pipeline groups.

| Sub-Criterion | Basis of Rating | Decommissioning Option | | | | | |
|---------------------------|-----------------------------|------------------------|------------------|-----------------|---|------------------------|--------------------|
| Risk to Project Personnel | Hazard/ Guideword | 1.Total Removal by: | | | 2. Remediate in-situ with exposed sections: | | |
| | | a) Reverse Reeling | b) Reverse S-Lay | c) Cut-and-Lift | a) Rock-Covered | b) Trenched and Buried | c) Cut and Removed |
| | Release at Deck (HCs) | 1A | n/a | 2A | 0A | 0A | 2A |
| | Release at sea | 1A | n/a | 1A | 0A | 0A | 1A |
| | Release at Deck (Chemicals) | 2B | n/a | 2B | 0A | 0A | 2A |
| | Fire | 1A | n/a | 1A | 0A | 0A | 1A |
| | Explosion | 1A | n/a | 1A | 0A | 0A | 1A |
| | Impact - Lifting | 4B | n/a | 4B | 0A | 0A | 4A |
| | Impact - Rock Dump | n/a | n/a | n/a | 2A | n/a | n/a |
| | Impact - Snagging | 4B | n/a | n/a | n/a | n/a | n/a |
| | Structural Failure | 2A | n/a | 4A | n/a | n/a | 4A |
| | Climatic | 1B | n/a | 1B | 1A | 1A | 1B |
| | Occupational - congestion | 2A | n/a | 3B | 2A | 2A | 3B |
| | SIMOPs - Onshore lifting | 4B | n/a | 4B | n/a | n/a | 4B |
| | SIMOPs - Onshore NORM | 3C | n/a | 3B | n/a | n/a | 3A |

| Sub-Criterion | Basis of Rating | Decommissioning Option | | | | | |
|--------------------------------|--------------------------|------------------------|------------------|-----------------|---|------------------------|--------------------|
| Risk to Other Users of the Sea | Hazard/ Guideword | 1.Total Removal by: | | | 2. Remediate in-situ with exposed sections: | | |
| | | a) Reverse Reeling | b) Reverse S-Lay | c) Cut-and-Lift | a) Rock-Covered | b) Trenched and Buried | c) Cut and Removed |
| | Impact - During activity | 3B | n/a | 3B | n/a | n/a | n/a |
| | Impact - Post activity | 2A | n/a | 2A | 3B | 3A | 3A |
| | Climatic | 1B | n/a | 1B | 1A | 1A | 1B |

| Sub-Criterion | Basis of Rating | Decommissioning Option | | | | | |
|-----------------------|------------------------|------------------------|------------------|-----------------|---|------------------------|--------------------|
| Risk to Those on Land | Hazard/ Guideword | 1.Total Removal by: | | | 2. Remediate in-situ with exposed sections: | | |
| | | a) Reverse Reeling | b) Reverse S-Lay | c) Cut-and-Lift | a) Rock-Covered | b) Trenched and Buried | c) Cut and Removed |
| | Structural Failure | 3B | n/a | 3C | n/a | n/a | 3C |
| | Occupational - Cutting | 4B | n/a | 4A | n/a | n/a | 4A |
| | Occupational - Noise | 2C | n/a | 2B | n/a | n/a | 2B |
| | SIMOPs - hot work | 2C | n/a | 2B | n/a | n/a | 2B |

APPENDIX B – ENVID FACT SHEETS

The ENVID was completed on 12June2019 and although a separate HIRA/ENVID Report [9] has been published, ENVID fact sheets summarising the results of the ENVID were prepared to inform the workshop participants. These factsheets are provided herein for reference.

| Group ID | CA Subcriteria | ENVID Nodes within each Subcriteria | Decommissioning Option | | | |
|----------|---|--|---|---|--------------------------|--------------------------|
| | | | 1.Total Removal by: | 2. Remediate in-situ with exposed sections: | | |
| | | | c) Cut-and-Lift | a) Rock-Covered | b) Trenched and Buried | c) Cut and Removed |
| Group A | Environmental Sub-criteria | | | | | |
| | Impact of Decommissioning Operations Offshore | Energy use and emissions | Impact significance: Low | Impact significance: Low | Impact significance: Low | Impact significance: Low |
| | | | The ENVID determined that the impact significance of energy use and the resultant atmospherics from vessels is low across all options, such that they can be ranked all the same in the CA. | | | |
| | | Underwater noise | Impact significance: Low | Impact significance: Low | Impact significance: Low | Impact significance: Low |
| | | | The ENVID determined that the impact significance of noise from vessels is low across all options, such that they can be ranked all the same in the CA. | | | |
| | | Discharges to sea from vessels, flowline, concrete falling off | Impact significance: Low | Impact significance: Low | Impact significance: Low | Impact significance: Low |
| | | | The ENVID determined that the impact significance of discharges to sea is low across all options, such that they can be ranked all the same in the CA. | | | |
| | Seabed Disturbance - Short Term | Disturbance to the seabed <i>Note for this group the drill cuttings pile at Buchan will not be impacted</i> | Impact significance: Low | Impact significance: Moderate | Impact significance: Low | Impact significance: Low |
| | | | ENVID workshop determined that the addition of rock cover had the greatest level of impact significance. Though Option 1c has similar impact significance to Option 2b and 2c, the magnitude of effect was ranked higher (minor as opposed to negligible). | | | |
| | Loss of Habitat - Long Term | Impact of physical presence of materials left on the seabed <i>only on benthic species- not fishing.</i> | N/A | Impact significance: Low | Impact significance: Low | Impact significance: Low |
| | | | Though Option 2a has similar impact significance to Option 2b and 2c, the magnitude of effect was ranked higher (minor as opposed to negligible) to take account of fact that laying rock in a sandy seabed area. | | | |
| | Waste Processing i.e. processsing of returned materials and use of landfill | Generation of waste/use of landfill | Impact significance: Low | N/A | N/A | Impact significance: Low |
| | | | Though Option 1c has similar impact significance to Option 2c, the magnitude of effect was ranked higher (minor v's negligible) with respect to volume of waste generated and landfill used (minor as opposed to negligible). <i>Note this does not refer to routine vessel waste, rather waste associated with the infrastructure to be decommissioned.</i> | | | |
| | Societal Sub-criteria | | | | | |
| | Impact on Commercial Fisheries | Impact of materials left on the seabed on other users | N/A | Impact significance: Low | Impact significance: Low | Impact significance: Low |
| | | | Though Option 2a has similar impact significance to Option 2b and Option 2c, the magnitude of effect was ranked higher (minor v's negligible) to take account of the rock dump and its potential impact over time. ENVID assumed if trenched and buried, the ends would remain so, given the stable nature of the seabed. | | | |
| | Socio-economic impact on communities and amenities | Yard activities | Impact significance: Low | N/A | N/A | Impact significance: Low |
| | | | The ENVID determined that the impact significance of yard activities is low across all applicable options. | | | |

| Group ID | CA Subcriteria | ENVID Nodes within each Subcriteria | Decommissioning Option | | | |
|----------|--|--|---|--------------------------|---|--------------------------|
| | | | 1. Total Removal by | | 2. Remediate in-situ with exposed sections: | |
| | | | a) Reverse Reeling | c) Cut-and-Lift | a) Rock-Covered | b) Trenched and Buried |
| Group B | Environmental Sub-criteria | | | | | |
| | Impact of Decommissioning Operations Offshore | Energy use and emissions | Impact significance: Low | Impact significance: Low | Impact significance: Low | Impact significance: Low |
| | | | The ENVID determined that the impact significance of energy use by vessels and the resultant atmospherics from vessels is low across all options, such that they can be ranked all the same in the CA. | | | |
| | | Underwater noise | Impact significance: Low | Impact significance: Low | Impact significance: Low | Impact significance: Low |
| | | | The ENVID determined that the impact significance of noise from vessels is low across all options, such that they can be ranked all the same in the CA. | | | |
| | | Discharges to sea from vessels and flowlines | Impact significance: Low | Impact significance: Low | Impact significance: Low | Impact significance: Low |
| | | | The ENVID determined that the impact significance of discharges to sea is low across all options, such that they can be ranked all the same in the CA. | | | |
| | Seabed Disturbance - Short Term | Disturbance to the seabed (Note consideration was given to fact that one end of all pipelines is in contact with the drill cuttings pile) | Impact significance: Low | Impact significance: Low | Impact significance: Moderate | Impact significance: Low |
| | | | ENVID workshop determined that the addition of rock cover had the greatest level of impact significance. When disturbance to the cuttings pile was considered, the magnitude of effect was minor. | | | |
| | Loss of Habitat - Long Term | Impact of physical presence of materials left on the seabed <i>only on benthic species- not fishing.</i> | N/A | N/A | Impact significance: Low | Impact significance: Low |
| | | | Though Option 2a has similar impact significance to Option 2b, the magnitude of effect was ranked higher (minor as opposed to negligible) to take account of fact that laying rock in a sandy seabed area. | | | |
| | Waste Processing i.e. processing of returned materials and use of landfill | Generation of waste/use of landfill | Impact significance: Low | Impact significance: Low | N/A | N/A |
| | | | Magnitude of effect for Option 1a and 1b is minor. | | | |
| | Societal Sub-criteria | | | | | |
| | Socio-economic: legacy impacts | Impact of materials left on the seabed on other users | N/A | N/A | Impact significance: Low | Impact significance: Low |
| | | | Though Option 2a has similar impact significance to Option 2b and Option 2c, the magnitude of effect was ranked higher (minor v's negligible) to take account of the rock dump and its potential impact over time. ENVID assumed if trenched and buried, the ends would remain so, given the stable nature of the seabed. | | | |
| | Socio-economic impact on communities and amenities | Yard activities | Impact significance: Low | Impact significance: Low | N/A | N/A |
| | | | The ENVID determined that the impact significance of yard activities is low across all applicable options. | | | |

| Group ID | CA Subcriteria | ENVID Nodes within each Subcriteria | Decommissioning Option | | | |
|----------|--|--|---|---|--------------------------|--------------------------|
| | | | 1.Total Removal by: | 2. Remediate in-situ with exposed sections: | | |
| | | | a) Reverse Reeling | a) Rock-Covered | b) Trenched and Buried | c) Cut and Removed |
| Group C | Environmental Sub-criteria | | | | | |
| | Impact of Decommissioning Operations Offshore | Energy use and emissions | Impact significance: Low | Impact significance: Low | Impact significance: Low | Impact significance: Low |
| | | | The ENVID determined that the impact significance of energy use and the resultant atmospherics from vessels is low across all options, such that they can be ranked all the same in the CA. | | | |
| | | Underwater noise | Impact significance: Low | Impact significance: Low | Impact significance: Low | Impact significance: Low |
| | | | The ENVID determined that the impact significance of noise from vessels is low across all options, such that they can be ranked all the same in the CA. | | | |
| | | Discharges to sea from vessels and flowlines | Impact significance: Low | Impact significance: Low | Impact significance: Low | Impact significance: Low |
| | | | The ENVID determined that the impact significance of discharges to sea is low across all options, such that they can be ranked all the same in the CA. | | | |
| | Seabed Disturbance - Short Term | Disturbance to the seabed <i>Note for this group the drill cuttings pile at Buchan will not be impacted</i> | Impact significance: Low | Impact significance: Low | Impact significance: Low | Impact significance: Low |
| | | | ENVID workshop determined that the addition of rock cover had the greatest magnitude of effect, however due to the short length of exposures (approximately 390 m) the impact significance was considered low. Though Option 1a has similar impact significance to Option 2b and 2c, the magnitude of effect was ranked higher (minor as opposed to negligible). | | | |
| | Loss of Habitat - Long Term | Impact of physical presence of materials left on the seabed <i>only on benthic species- not fishing.</i> | N/A | Impact significance: Low | Impact significance: Low | Impact significance: Low |
| | | | Though Option 2a has similar impact significance to Option 2b and 2c, the magnitude of effect was ranked higher (minor as opposed to negligible) to take account of fact that laying rock in a sandy seabed area. | | | |
| | Waste Processing i.e. processing of returned materials and use of landfill | Generation of waste/use of landfill | Impact significance: Low | N/A | N/A | Impact significance: Low |
| | | | Though Option 1a has similar impact significance to Option 2c, the magnitude of effect was ranked higher (minor v's negligible) with respect to volume of waste generated and landfill used (minor as opposed to negligible). <i>Note this does not refer to routine vessel waste, rather waste associated with the infrastructure to be decommissioned.</i> | | | |
| | Societal Sub-criteria | | | | | |
| | Socio-economic: legacy impacts | Impact of materials left on the seabed on other users | N/A | Impact significance: Low | Impact significance: Low | Impact significance: Low |
| | | | Though Option 2a has similar impact significance to Option 2b and Option 2c, the magnitude of effect was ranked higher (minor v's negligible) to take account of the rock dump and its potential impact over time. ENVID assumed if trenched and buried, the ends would remain so, given the stable nature of the seabed. | | | |
| | Socio-economic impact on communities and amenities | Yard activities | Impact significance: Low | N/A | N/A | Impact significance: Low |
| | | | The ENVID determined that the impact significance of yard activities is low across all applicable options. | | | |

| Group ID | CA Subcriteria | ENVID Nodes within each Subcriteria | Decommissioning Option | | | |
|----------|--|--|---|--------------------------|---|--------------------------|
| | | | 1. Total Removal by: | | 2. Remediate in-situ with exposed sections: | |
| | | | a) Reverse Reeling | c) Cut-and-Lift | a) Rock-Covered | b) Trenched and Buried |
| Group D | Environmental Sub-criteria | | | | | |
| | Impact of Decommissioning Operations Offshore | Energy use and emissions | Impact significance: Low | Impact significance: Low | Impact significance: Low | Impact significance: Low |
| | | | The ENVID determined that the impact significance of energy use by vessels and the resultant atmospherics from vessels is low across all options, such that they can be ranked all the same in the CA. | | | |
| | | Underwater noise | Impact significance: Low | Impact significance: Low | Impact significance: Low | Impact significance: Low |
| | | | The ENVID determined that the impact significance of noise from vessels is low across all options, such that they can be ranked all the same in the CA. | | | |
| | | Discharges to sea from vessels, flowlines and umbilicals | Impact significance: Low | Impact significance: Low | Impact significance: Low | Impact significance: Low |
| | | | The ENVID determined that the impact significance of discharges to sea is low across all options, such that they can be ranked all the same in the CA. | | | |
| | Seabed Disturbance - Short Term | Disturbance to the seabed (Note consideration was given to fact that a number of lines in this group are in contact with the drill cuttings pile) | Impact significance: Low | Impact significance: Low | Impact significance: Moderate | Impact significance: Low |
| | | | ENVID workshop determined that the addition of rock cover had the greatest level of impact significance. When disturbance to the cuttings pile was considered, the magnitude of effect was minor across all the other options. | | | |
| | Loss of Habitat - Long Term | Impact of physical presence of materials left on the seabed <i>only on benthic species- not fishing.</i> | N/A | N/A | Impact significance: Low | Impact significance: Low |
| | | | Though Option 2a has similar impact significance to Option 2b and 2c, the magnitude of effect was ranked higher (minor as opposed to negligible) to take account of fact that laying rock in a sandy seabed area. | | | |
| | Waste Processing i.e. processing of returned materials and use of landfill | Generation of waste/use of landfill | Impact significance: Low | Impact significance: Low | N/A | N/A |
| | | | Magnitude of effect for Option 1a and 1c is minor. | | | |
| | Societal Sub-criteria | | | | | |
| | Socio-economic: legacy impacts | Impact of materials left on the seabed on other users | N/A | N/A | Impact significance: Low | Impact significance: Low |
| | | | Though Option 2a has similar impact significance to Option 2b, the magnitude of effect was ranked higher (minor v's negligible) to take account of the rock dump and its potential impact over time. ENVID assumed if trenched and buried, the ends would remain so, given the stable nature of the seabed. | | | |
| | Socio-economic impact on communities and amenities | Yard activities | Impact significance: Low | Impact significance: Low | N/A | N/A |
| | | | The ENVID determined that the impact significance of yard activities is low across all applicable options. | | | |

| Group ID | CA Subcriteria | ENVID Nodes within each Subcriteria | Decommissioning Option | | | |
|--|--|--|---|---|--------------------------|--------------------------|
| | | | 1.Total Removal by: | 2. Remediate in-situ with exposed sections: | | |
| | | | a) Reverse Reeling | a) Rock-Covered | b) Trenched and Buried | c) Cut and Removed |
| Group E | Environmental Sub-criteria | | | | | |
| | Impact of Decommissioning Operations Offshore | Energy use and emissions | Impact significance: Low | Impact significance: Low | Impact significance: Low | Impact significance: Low |
| | | | The ENVID determined that the impact significance of energy use and the resultant atmospherics from vessels is low across all options, such that they can be ranked all the same in the CA. | | | |
| | | Underwater noise | Impact significance: Low | Impact significance: Low | Impact significance: Low | Impact significance: Low |
| | | | The ENVID determined that the impact significance of noise from vessels is low across all options, such that they can be ranked all the same in the CA. | | | |
| | | Discharges to sea from vessels and the umbilical | Impact significance: Low | Impact significance: Low | Impact significance: Low | Impact significance: Low |
| | | | The ENVID determined that the impact significance of discharges to sea is low across all options, such that they can be ranked all the same in the CA. | | | |
| | Seabed Disturbance - Short Term | Disturbance to the seabed <i>Note for this group the drill cuttings pile at Buchan will not be impacted</i> | Impact significance: Low | Impact significance: Low | Impact significance: Low | Impact significance: Low |
| | | | Though all Options had a similar impact significance, the magnitude of effect was ranked higher for Option 1a and 2a (minor as opposed to negligible). Due to the short length of exposures (approximately 288 m) the magnitude of effect of rock cover was not considered to be greater than minor. | | | |
| | Loss of Habitat - Long Term | Impact of physical presence of materials left on the seabed <i>only on benthic species- not fishing.</i> | N/A | Impact significance: Low | Impact significance: Low | Impact significance: Low |
| | | | Though Option 2a has similar impact significance to Option 2b and 2c, the magnitude of effect was ranked higher (minor as opposed to negligible) to take account of fact that laying rock in a sandy seabed area. | | | |
| | Waste Processing i.e. processing of returned materials and use of landfill | Generation of waste/use of landfill | Impact significance: Low | N/A | N/A | Impact significance: Low |
| | | | Though Option 1a has similar impact significance to Option 2c, the magnitude of effect was ranked higher (minor v's negligible) with respect to volume of waste generated and landfill used (minor as opposed to negligible). <i>Note this does not refer to routine vessel waste, rather waste associated with the infrastructure to be decommissioned.</i> | | | |
| | Societal Sub-criteria | | | | | |
| | Socio-economic: legacy impacts | Impact of materials left on the seabed on other users | N/A | Impact significance: Low | Impact significance: Low | Impact significance: Low |
| | | | Though Option 2a has similar impact significance to Option 2b and Option 2c, the magnitude of effect was ranked higher (minor v's negligible) to take account of the rock dump and its potential impact over time. ENVID assumed if trenched and buried, the ends would remain so, given the stable nature of the seabed. | | | |
| | Socio-economic impact on communities and amenities | Yard activities | Impact significance: Low | N/A | N/A | Impact significance: Low |
| The ENVID determined that the impact significance of yard activities is low across all applicable options. | | | | | | |

APPENDIX C – TECHNICAL FACT SHEETS

Technical factsheets were prepared by the subsea engineer on completion of the engineering/ supporting study listed in Section 4.1.1.

Although certain options were pre-screened out as described in Section 5.1 the metrics that were prepared during the pre-screening are included in the technical fact sheets herein for reference.

| Group ID | Basis of Rating | Decommissioning Option | | | | | |
|----------|--|--------------------------|------------------|-----------------|---|------------------------|--------------------|
| | | 1. Total Removal by: | | | 2. Remediate in-situ with exposed sections: | | |
| | | a) Reverse Reeling | b) Reverse S-Lay | c) Cut-and-Lift | a) Rock-Covered | b) Trenched and Buried | c) Cut and Removed |
| A | Total vessel days | Not Technically Feasible | 103 (187%) | 955 (1736%) | 58 (105%) | 55 (100%) | 71 (129%) |
| | Vessel SIMOPS days | | 12 | 381 | 0 | 0 | 0 |
| | Mob and demob days | | 45 | 39 | 17 | 14 | 14 |
| | Number vessel transit days | | 6.7 (335%) | 16.7 (835%) | 2 (100%) | 2 (100%) | 2 (100%) |
| | Quantity of materials returned to shore (Te) | | 6900 | 13,889 | 0 | 0 | 468 |
| | Quantity of materials left on or in seabed (Te) | | 0 | 0 | 13,889 | 13,889 | 13,889 |
| | Quantity of rock cover applied (Te) | | 0 | 0 | 7423 | 0 | 0 |
| | Cost estimate (kGBP) Commercial figures are confidential and are removed from this version % difference only quoted | | 316% | 1448% | 109% | 100% | 136% |

| Group ID | Basis of Score | Decommissioning Option | | | | | |
|----------|--|------------------------|------------------|-----------------|---|------------------------|------------------------------------|
| | | 1. Total Removal by: | | | 2. Remediate in-situ with exposed sections: | | |
| | | a) Reverse Reeling | b) Reverse S-Lay | c) Cut-and-Lift | a) Rock-Covered | b) Trenched and Buried | c) Cut and Removed |
| B | Total vessel days | 24 (100%) | 38 (158%) | 244 (1017%) | 44 (183%) | 31 (129%) | Not Applicable - Same as Option1c) |
| | Vessel SIMOPS days | 0 | 3 | 94 | 0 | 0 | |
| | Mob and demob days | 14 | 21 | 15 | 17 | 14 | |
| | Number vessel transit days | 1.5 (115%) | 2.7 (208%) | 4.7 (362%) | 1.3 (100%) | 1.3 (100%) | |
| | Quantity of materials returned to shore (Te) | 547 | 547 | 547 | 0 | 0 | |
| | Quantity of materials left on or in seabed (Te) | 0 | 0 | 0 | 547 | 547 | |
| | Quantity of rock cover applied (Te) | 0 | 0 | 0 | 72681 | 0 | |
| | Cost estimate (kGBP) Commercial figures are confidential and are removed from this version % difference only quoted | 124% | 266% | 629% | 158% | 100% | |

| Group ID | Basis of Score | Decommissioning Option | | | | | |
|----------|--|------------------------|------------------|-----------------|---|------------------------|--------------------|
| | | 1. Total Removal by: | | | 2. Remediate in-situ with exposed sections: | | |
| | | a) Reverse Reeling | b) Reverse S-Lay | c) Cut-and-Lift | a) Rock-Covered | b) Trenched and Buried | c) Cut and Removed |
| C | Total vessel days | 29 (100%) | 32 (110%) | 465 (1603%) | 38 (131%) | 35 (121%) | 41 (141%) |
| | Vessel SIMOPS days | 2 | 6 | 183 | 0 | 0 | 0 |
| | Mob and demob days | 12 | 11 | 23 | 17 | 14 | 14 |
| | Number vessel transit days | 2 (154%) | 2 (154%) | 8.7 (669%) | 1.3 (100%) | 1.3 (100%) | 1.3 (100%) |
| | Quantity of materials returned to shore (Te) | 2891 | 2891 | 2891 | 0 | 0 | 42 |
| | Quantity of materials left on or in seabed (Te) | 0 | 0 | 0 | 2891 | 2891 | 2849 |
| | Quantity of rock cover applied (Te) | 0 | 0 | 0 | 2898 | 0 | 0 |
| | Cost estimate (kGBP) Commercial figures are confidential and are removed from this version % difference only quoted | 122% | 178% | 1099% | 113% | 100% | 121% |

| Group ID | Basis of Score | Decommissioning Option | | | | | |
|----------|--|------------------------|------------------|-----------------|---|------------------------|-----------------------------------|
| | | 1. Total Removal by: | | | 2. Remediate in-situ with exposed sections: | | |
| | | a) Reverse Reeling | b) Reverse S-Lay | c) Cut-and-Lift | a) Rock-Covered | b) Trenched and Buried | c) Cut and Removed |
| D | Total vessel days | 20 (100%) | Not Applicable | 276 (1380%) | 47 (235%) | 33 (165%) | Not Applicable- Same as Option1c) |
| | Vessel SIMOPS days | 0 | | 108 | 0 | 0 | |
| | Mob and demob days | 8 | | 15 | 17 | 14 | |
| | Number vessel transit days | 1.3 (100%) | | 5.3 (408%) | 1.3 (100%) | 1.3 (100%) | |
| | Quantity of materials returned to shore (Te) | 29 | | 261 | 0 | 0 | |
| | Quantity of materials left on or in seabed (Te) | 0 | | 0 | 261 | 261 | |
| | Quantity of rock cover applied (Te) | 0 | | 0 | 70240 | 0 | |
| | Cost estimate (kGBP) Commercial figures are confidential and are removed from this version % difference only quoted | 108% | | 668% | 159% | 100% | |

| Group ID | Basis of Score | Decommissioning Option | | | | | |
|----------|--|------------------------|------------------|-----------------|---|------------------------|--------------------|
| | | 1. Total Removal by: | | | 2. Remediate in-situ with exposed sections: | | |
| | | a) Reverse Reeling | b) Reverse S-Lay | c) Cut-and-Lift | a) Rock-Covered | b) Trenched and Buried | c) Cut and Removed |
| E | Total vessel days | 22 (100%) | Not Applicable | 241 (1095%) | 29 (132%) | 26 (118%) | 30 (136%) |
| | Vessel SIMOPS days | 0 | | 93 | 0 | 0 | 0 |
| | Mob and demob days | 12 | | 15 | 17 | 14 | 14 |
| | Number vessel transit days | 2 (154%) | | 4.7 (362%) | 1.3 (100%) | 1.3 (100%) | 1.3 (100%) |
| | Quantity of materials returned to shore (Te) | 354 | | 354 | 0 | 0 | 8 |
| | Quantity of materials left on or in seabed (Te) | 0 | | 0 | 354 | 354 | 346 |
| | Quantity of rock cover applied (Te) | 0 | | 0 | 1536 | 0 | 0 |
| | Cost estimate (kGBP) Commercial figures are confidential and are removed from this version % difference only quoted | 119% | | 766% | 118%) | 100% | 118% |

APPENDIX D – CA RATINGS GUIDE TABLE

| Assessment Criteria | RATING | | LOW | MODERATE | HIGH |
|-----------------------|---|---------------------------|---|--|--|
| TECHNICAL FEASIBILITY | Risk of Major Project Failure | | Offshore Execution Phase Schedule unlikely to slip beyond planned schedule plus contingencies applied. Scope is straightforward and understood. | Potential for extended Offshore Execution Phase duration > 1month but < 3 months beyond planned schedule but within same campaign/season. Some minor uncertainties. | Potential for unplanned and unforeseen activity delaying project end by > 4 months, and potential to cause a 2nd unplanned campaign in a separate season. Major uncertainties exist |
| | Technical Complexity & Track Record | | No new technology or working practices to be introduced. Option has good industry track record in the basin and can be executed by contractors with significant previous experience of all activities involved. | No new technology or working practices to be introduced. Option has limited industry track record in the basin and can be executed by contractors with some previous experience of most activities involved. | New Technology or Untried working practice to be introduced. Option has no industry track record in the basin, nor within the contracting community. |
| SAFETY | Risk During Project Execution | To Project Personnel | Result from HIRA carried out 11 and 12 June 2019 were adopted to determine ratings of each decommissioning option. See HIRA summary sheets in Appendix A. | | |
| | | To other Users of the Sea | | | |
| | | To those on Land | | | |
| | | High consequence event | | | |
| | Residual Risk from End Points | To other Users of the Sea | No increased risk to fishing trawlers introduced than currently present out with the current Buchan & Hannay field exclusion zones. | Some additional risk to fishing vessels introduced due to infrastructure being decommissioned in-situ and remain above the seabed. However snagging risk mitigated by infrastructure expected to remain over trawable. | Increased risk from structures / exposed sections of pipeline or protection / stabilisation features decommissioned in-situ, with no mitigation introduced to prevent snagging from over trawling. |
| ENVIRONMENTAL | Impact of Decommissioning Operations Offshore <i>(includes emissions to air, discharges to sea and underwater noise)</i> | | Results from ENVID carried out 11 and 12 June 2019 were adopted to determine ratings of each decommissioning option. See Environmental fact sheets in Appendix B. | | |
| | Seabed Disturbance- Short Term <i>(includes disturbance to the cuttings pile)</i> | | | | |
| | Loss of Habitat - Long Term | | | | |
| | Waste Processing <i>(i.e. processing of returned materials and use of landfill)</i> | | | | |
| SOCIETAL | Impact on Commercial Fisheries | | Results from ENVID (which included a review of Societal Impacts) carried out 11 and 12 June 2019 were adopted to determine ratings of each decommissioning option. See Societal fact sheets in Appendix B. | | |
| | Socio-economic impact on communities and amenities | | | | |
| ECONOMIC RISK | Cost for Decommissioning/ Removal activities | | Lowest Cost | Costs between lowest and highest to be ranked accordingly, if within 20% lowest also rank Green, if within 20% of highest also rank Red | Highest Cost |
| | Cost for long term monitoring / Remediation activities | | Lowest Cost | Costs between lowest and highest to be ranked accordingly, if within 20% lowest also rank Green, if within 20% of highest also rank Red | Highest Cost |

APPENDIX E – CA EVALUATION WORKSHOP RESULTS WORKBOOK

This Appendix contains a large volume of information and has been provided with its own index for easy reference.

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GROUP A - RIGID PIPELINE, CONCRETE COATED, TRENCHED AND PARTIALLY BURIED
TECHNICAL AND SAFETY CRITERIA

| Assessment Criteria | MAIN OPTIONS | | TOTAL REMOVAL | | | REMEDiate IN SITU | | | | |
|---|-------------------------------------|---------------------------|---|---------------------------------|--|---|---|--|-----------------------------|--|
| | Sub-Options Number | | 1a) | 1b) | 1c) | 2a) | 2b) | 2c) | | |
| | Sub-Criteria/ / Sub-Options | | REVERSE REELING | REVERSE S-LAY | CUT & LIFT | EXPOSED SECTIONS ROCK COVERED | EXPOSED SECTIONS TRENCHED & BURIED | EXPOSED SECTIONS CUT & LIFT | | |
| TECHNICAL | Risk of Major Project Failure | | NOT TECHNICALLY FEASIBLE FOR GROUP A | PRE-SCREENED OUT FOR ALL GROUPS | Unlikely that this option will fail, but unforeseen challenges will exist but be manageable. Schedule contingency should be planned accordingly. However, due to overall duration of the execution phase for this option compared to other options, even small growth in individual tasks could cause significant delay due to the repetitive nature of the tasks. | Offshore Execution Phase schedule unlikely to slip beyond planned schedule plus contingencies applied. Scope is straightforward and understood. | Offshore Execution Phase schedule unlikely to slip beyond planned schedule plus contingencies applied. Scope is straightforward and understood. | Offshore Execution Phase schedule unlikely to slip beyond planned schedule plus contingencies applied. Scope is straightforward and understood. | | |
| | RATING | | | | | Moderate Impact | Lower Impact | Lower Impact | Lower Impact | |
| | Technical Complexity & Track Record | | | | No new technology or working practices to be introduced in any of the options. All options have industry track record and can be executed by contractors with previous experience of all activities involved. | | | | | |
| | RATING | | | | | Not significantly different | Not significantly different | Not significantly different | Not significantly different | |
| TECHNICAL: OVERALL RATING BASED ON AVERAGE | | | | | Moderate Impact | Lower Impact | Lower Impact | Lower Impact | | |
| TECHNICAL: OVERALL RATING BASED ON DISCUSSION | | | | | Since Technical Complexity & Track Record sub-criterion has been rated as "Not significantly different" The rating of sub-criterion "Risk of Major Project Failure" takes precedence in the overall rating of Technical Criterion | | | | | |
| SAFETY | RISK DURING PROJECT EXECUTION | To Project Personnel | | | Number of vessel days is 15 times longer than the other options (with other options being of similar in duration). Multiple vessels in field and SIMOPS for over 1 year. This combined with significant repetitive activities over a prolonged duration, plus recovery of multiple sections of open pipeline being handled on vessel deck. Concrete coating prone to cracking and falling on deck. Potential exposure to hydrocarbon residues from open pipe ends on deck. | No vessel SIMOPS, only single vessel in field at any time. Relatively short vessel duration overall. No materials recovered to or to be handled on deck. Minimum exposure to deck crew. | Very similar to Option 2a in terms of vessel durations , but different type of vessel. No SIMOPS or materials recovered to vessel . | Slightly longer vessel duration than Options 2a) and 2b) and different type of vessel. No SIMOPS, however exposed sections of pipeline recovered to vessel, so similar risks to deck crew as Option 1c) but only 2% of quantities of pipeline recovered compared to Option 1c. | | |
| | | RATING | | | Higher Impact | Lower Impact | Lower Impact | Moderate Impact | | |
| | | To Other Users of the Sea | | | More vessels and significantly longer campaign duration (>1 year) than other options. Many vessel duration transits to and from onshore to unload recovered pipeline sections. However risk to other users of the sea can be mitigated. | Campaign is relatively short duration, single vessel in field at any time, activity largely within 500m zone at each end of pipeline. | Campaign is relatively short duration, single vessel in field at any time, activity largely within 500m zone at each end of pipeline. | Campaign is relatively short duration, single vessel in field at any time, activity largely within 500m zone at each end of pipeline. | | |
| | | RATING | | | Moderate Impact | Lower Impact | Lower Impact | Lower Impact | | |
| | | To Those on Land | | | Approximately 6900te of pipeline returned to shore, similar handling risks to onshore crew and deck crew when moving pipe sections in the yard. Also additional risks when removing concrete coating in yard as part of recycling activity. | Nothing returned onshore. Approximately 7000te of rock cover to be supplied, however not identified as a major risk as supply of rock cover is an ongoing industry practice. | Nothing returned onshore. | Similar risks to onshore crew as Option 1c), however only 468te of pipe line returned onshore. | | |
| | | RATING | | | Higher Impact | Moderate Impact | Lower Impact | Moderate Impact | | |
| | | High Consequence Event | HIRA carried out 16th May 2019 determined there is no specific differentiation identified between all decommissioning options in terms of potential high consequence event . Therefore this sub-criterion was considered not to be a significant differentiator in the CA Workshop. | | | | | | | |
| | | RATING | | | Not significantly different | Not significantly different | Not significantly different | Not significantly different | | |
| | RESIDUAL RISK FROM END POINTS | To other Users of the Sea | | | No residual risk as option will leave a clean seabed. | Additional rock cover at exposed ends will be installed to be over trawlable, rating recognises potential for new rock cover to become unstable over time. | No increased risk compared to existing operating condition, existing trrenched section remains over trawlable and exposed sections will be trrenched and buried to become over trawlable and thus leave a clean seabed. | No increased risk compared to existing operating condition, existing trrenched section remains over trawlable and exposed sections will be removed to leave a clean seabed. | | |
| | | RATING | | | Lower Impact | Moderate Impact | Lower Impact | Lower Impact | | |
| SAFETY: OVERALL RATING BASED ON AVERAGE | | | | | Higher Impact | Moderate Impact | Lower Impact | Moderate Impact | | |
| SAFETY: OVERALL RATING BASED ON DISCUSSION | | | | | Rating for Safety Criterion overall is based on average rating across the sub criteria | | | | | |

GROUP A - RIGID PIPELINE, CONCRETE COATED, TRENCHED AND PARTIALLY BURIED
SOCIAL AND ECONOMIC CRITERIA

| Assessment Criteria | MAIN OPTIONS | TOTAL REMOVAL | | | REMEDIATE IN SITU | | |
|---------------------|--|-----------------|---------------|---|---|---|---|
| | Sub-Options Number | 1a) | 1b) | 1c) | 2a) | 2b) | 2c) |
| | Sub-Criteria/ / Sub-Options | REVERSE REELING | REVERSE S-LAY | CUT & LIFT | EXPOSED SECTIONS ROCK COVERED | EXPOSED SECTIONS TRENCHED & BURIED | EXPOSED SECTIONS CUT & REMOVED |
| SOCIETAL | Impact on Commercial Fisheries | | | Removing the pipeline may result in a deeper trench left behind, however the trench profile is shallow on trench sides. May be concerns from fishermen on length of open trench in future. However not evaluated as having an impact. | Additional rock cover at exposed ends will be installed to be over trawlable, rating recognises potential for new rock cover to become unstable over time. May result in fishermen avoiding the area. | No impact anticipated. | No impact anticipated. |
| | RATING | | | Lower Impact | Moderate Impact | Lower Impact | Lower Impact |
| | Socio-economic impact on communities and amenities | | | Pro: Ongoing employment but relatively short term and in established yards. No new business. Con: More material to be transported and handled (impact in road congestion etc.). No odour (marine growth) issues expected. | No impact anticipated. | No impact anticipated. | No impact anticipated. |
| | RATING | | | Not significantly different | Not significantly different | Not significantly different | Not significantly different |
| | SOCIETAL: OVERALL RATING BASED ON AVERAGE | | | Lower Impact | Moderate Impact | Lower Impact | Lower Impact |
| | SOCIETAL: OVERALL RATING BASED ON DISCUSSION | | | Since "socio-economic impact on communities and amenities" sub-criterion has been rated as "Not significantly different", the rating of sub-criterion "Impact on Commercial Fisheries" takes precedence in the overall rating of Societal Criterion. | | | |
| ECONOMIC | Cost for Decommissioning/ Removal activities | | | 145 times the cost of the lowest cost option. | Within 10% of lowest cost option. | Lowest cost option. | Within 35% of lowest cost option. |
| | RATING | | | Higher Impact | Lower Impact | Lower Impact | Lower Impact |
| | Cost for long term monitoring / Remediation activities | | | Clean seabed, post decomm survey only. Possible one future visit to monitor behaviour of the trench. | Anticipate only two future surveys to monitor behaviour of the end point. | Anticipate only two future surveys to monitor behaviour of the end point. | Anticipate only two future surveys to monitor behaviour of the end point. |
| | RATING | | | Lower Impact | Moderate Impact | Moderate Impact | Moderate Impact |
| | ECONOMIC: OVERALL RATING BASED ON AVERAGE | | | Although "Cost for long term monitoring / Remediation activities" sub-criterion is rated as best for Option 1c, the comparative costs during Decommissioning/ Removal activities are orders of magnitude higher than monitoring and remediation costs and therefore the rating of sub-criterion "Cost for Decommissioning/ Removal activities" takes precedence in the overall rating of Economic Criterion | | | |
| | ECONOMIC: OVERALL RATING BASED ON DISCUSSION | | | Higher Impact | Lower Impact | Lower Impact | Lower Impact |

GROUP A - RIGID PIPELINE, CONCRETE COATED, TRENCHED AND PARTIALLY BURIED
ENVIRONMENTAL CRITERION

| Assessment Criteria | MAIN OPTIONS | TOTAL REMOVAL | | | REMEDiate IN SITU | | |
|---|--|--------------------------------------|---------------------------------|--|--|--|--|
| | Sub-Options Number | 1a) | 1b) | 1c) | 2a) | 2b) | 2c) |
| | Sub-Criteria/ / Sub-Options | REVERSE REELING | REVERSE S-LAY | CUT & LIFT | EXPOSED SECTIONS ROCK COVERED | EXPOSED SECTIONS TRENCHED & BURIED | EXPOSED SECTIONS CUT & REMOVED |
| ENVIRONMENTAL | Impact of Decommissioning Operations Offshore <i>(includes emissions to air, discharges to sea and underwater noise)</i> | NOT TECHNICALLY FEASIBLE FOR GROUP A | PRE-SCREENED OUT FOR ALL GROUPS | The ENVID determined that the impact significance of energy use and the resultant atmospherics, of noise from vessels and of discharges to sea is low across all options, such that the environmental impact of decommissioning operations offshore is not considered a significant differentiator. | | | |
| | RATING | | | Not significantly different | Not significantly different | Not significantly different | Not significantly different |
| | Seabed Disturbance- Short Term <i>(includes disturbance to the cuttings pile)</i> | | | Deburial of approximately 54km of pipeline will result in greater disturbance than other options where only current exposed sections of pipeline are remediated. | Rock dumping activity is recognised to result in short term disturbance during rock placement. The footprint of this short term disturbance is likely to be greater than actual footprint. However short term impact not anticipated to be worse than Option 2b) | Approximately 760m length of new trench created, disturbance for considered minor. | Minimal impact anticipated. |
| | RATING | | | Moderate Impact | Moderate Impact | Moderate Impact | Lower Impact |
| | Loss of Habitat - Long Term | | | Ecosystem recovery commences as soon as operations are completed. | Additional rock cover means the introduction of a different habitat type to the area. This will impact existing ecosystem, by allowing other species to settle in the area. | Ecosystem recovery commences as soon as operations are completed. | Ecosystem recovery commences as soon as operations are completed. |
| | RATING | | | Lower Impact | Moderate Impact | Lower Impact | Lower Impact |
| | Waste Processing <i>(i.e. processing of returned materials and use of landfill)</i> | | | Approximately 6900te of pipeline transferred onshore. Although steel will be recycled, significantly more handling involved in separation of concrete coating and management of residues wastes including volume of NORM inside pipeline. Significantly more waste to be managed than Option 2c) and increase in materials going to landfill. Moderate rating assumes concrete can be separated, treated and recycled and does not go to not landfill. | Nothing returned onshore. | Nothing returned onshore. | Only 96te approximately of pipeline with concrete and residues returning onshore, following adherence to waste hierarchy only minimal impact on available landfill and recycling industry. |
| | RATING | | | Moderate Impact | Lower Impact | Lower Impact | Lower Impact |
| ENVIRONMENTAL: OVERALL RATING BASED ON AVERAGE | | | | Moderate Impact | Moderate Impact | Lower Impact | Lower Impact |
| ENVIRONMENTAL : OVERALL RATING BASED ON DISCUSSION | | | | Rating for Environmental Criterion overall is based on average rating across the sub-criteria. | | | |

GROUP A - RIGID PIPELINE, CONCRETE COATED, TRENCHED AND PARTIALLY BURIED
VISUAL RATING SUMMARY

| Assessment Criteria | MAIN OPTIONS | TOTAL REMOVAL | | | REMEDiate IN SITU | | |
|---------------------|---|-----------------|---------------|-----------------------------|--|------------------------------------|--------------------------------|
| | Sub-Options Number | 1a) | 1b) | 1c) | 2a) | 2b) | 2c) |
| | Sub-Criteria/ / Sub-Options | REVERSE REELING | REVERSE S-LAY | CUT & LIFT | EXPOSED SECTIONS ROCK COVERED | EXPOSED SECTIONS TRENCHED & BURIED | EXPOSED SECTIONS CUT & REMOVED |
| TECHNICAL | Risk of Major Project Failure | | | Moderate Impact | Lower Impact | Lower Impact | Lower Impact |
| | Technical Complexity & Track Record | | | Not significantly different | Not significantly different | Not significantly different | Not significantly different |
| SAFETY | To Project Personnel | | | Higher Impact | Lower Impact | Lower Impact | Moderate Impact |
| | To Other Users of the Sea | | | Moderate Impact | Lower Impact | Lower Impact | Lower Impact |
| | To Those on Land | | | Higher Impact | Moderate Impact | Lower Impact | Moderate Impact |
| | High Consequence Event | | | Not significantly different | Not significantly different | Not significantly different | Not significantly different |
| | Residual Risk To other Users of the Sea | | | Lower Impact | Moderate Impact | Lower Impact | Lower Impact |
| SOCIETAL | Impact on Commercial Fisheries | | | Lower Impact | Moderate Impact | Lower Impact | Lower Impact |
| | Socio-economic impact on communities and amenities | | | Not significantly different | Not significantly different | Not significantly different | Not significantly different |
| COST | Cost for Decommissioning/ Removal activities | | | Higher Impact | Lower Impact | Lower Impact | Lower Impact |
| | Cost for long term monitoring / Remediation activities | | | Lower Impact | Moderate Impact | Moderate Impact | Moderate Impact |
| ENVIRONMENTAL | Impact of Decommissioning Operations Offshore <i>(includes emissions to air, discharges to sea and underwater noise)</i> | | | Not significantly different | Not significantly different | Not significantly different | Not significantly different |
| | Seabed Disturbance- Short Term <i>(includes disturbance to the cuttings pile)</i> | | | Moderate Impact | Moderate Impact | Moderate Impact | Lower Impact |
| | Loss of Habitat - Long Term | | | Lower Impact | Moderate Impact | Lower Impact | Lower Impact |
| | Waste Processing <i>(i.e. processing of returned materials and use of landfill)</i> | | | Moderate Impact | Lower Impact | Lower Impact | Lower Impact |
| | OVERALL RATING | | | Higher Impact | Moderate Impact | Lower Impact | Moderate Impact |
| | OVERALL RANKING | | | 4 | 3 | 1 | 2 |
| | | | | Discounted option in DP | Although Option 2b) Remediate in situ with exposed sections - trench and buried is ranked as preferred option, the difference in rating between 2b) , 2a) and 2c) is marginal and all three options will be carried through to a Contracting and Procurement (C&P) phase of the project to allow contractors to tender and propose the overall preferred option. If the C&P tendering phase results in either options 2a) or 2c) being considered more favourable than option 2b) the Operator will engage with OPRED before a decision is taken on overall strategy . | | |

GROUP A - RIGID PIPELINE, CONCRETE COATED, TRENCHED AND PARTIALLY BURIED

NARRATIVE SUMMARY

| SUMMARY | MAIN OPTIONS | TOTAL REMOVAL | | | REMEDiate IN SITU | | |
|----------------|-----------------------------|--------------------------------------|---------------------------------|--|--|---|--|
| | Sub-Options Number | 1a) | 1b) | 1c) | 2a) | 2b) | 2c) |
| | Sub-Criteria/ / Sub-Options | REVERSE REELING | REVERSE S-LAY | CUT & LIFT | EXPOSED SECTIONS ROCK COVERED | EXPOSED SECTIONS TRENCHED & BURIED | EXPOSED SECTIONS CUT & REMOVED |
| | Technical | NOT TECHNICALLY FEASIBLE FOR GROUP A | PRE-SCREENED OUT FOR ALL GROUPS | No new technology or working practices, not technically complex and proposed activities have a track record in the industry. Overall project failure unlikely, however, due to overall duration of the execution phase for this option compared to other options, even small growth in individual tasks could cause significant delay due to the repetitive nature of the tasks. | No new technology or working practices, not technically complex and proposed activities have a track record in the industry. Offshore Execution Phase schedule unlikely to slip beyond planned schedule plus contingencies applied. Scope is straightforward and understood. | No new technology or working practices, not technically complex and proposed activities have a track record in the industry. Offshore Execution Phase schedule unlikely to slip beyond planned schedule plus contingencies applied. Scope is straightforward and understood. | No new technology or working practices, not technically complex and proposed activities have a track record in the industry. Offshore Execution Phase schedule unlikely to slip beyond planned schedule plus contingencies applied. Scope is straightforward and understood. |
| | RATING | | | Moderate Impact | Lower Impact | Lower Impact | Lower Impact |
| | Safety | | | Number of vessel days is 15 times longer than the other options (with other options being of similar in duration). Multiple vessels in field and SIMOPS for >1 year. Significant repetitive activities plus recovery of multiple sections of concrete coated, open pipeline being handled on vessel deck. Many vessel duration transits to and from onshore to unload recovered pipeline sections. 6900te of pipeline returned to shore, similar handling risks to onshore crew and deck crew when moving pipe sections in the yard. Also additional risks when removing concrete coating in yard as part of recycling activity. There is no specific differentiation identified between all decommissioning options in terms of potential high consequence event. | No vessel SIMOPS, only single vessel in field at any time with activity largely within 500m zone at each end of pipeline for relatively short duration. No materials recovered to or to be handled on deck or onshore. 7,000te rock cover to be supplied, however not identified as a risk as supply of rock cover is an ongoing industry practice. There is no specific differentiation identified between all decommissioning options in terms of potential high consequence event. | No vessel SIMOPS, only single vessel in field at any time with activity largely within 500m zone at each end of pipeline for relatively short duration. No materials recovered to, or to be handled on deck or onshore. There is no specific differentiation identified between all decommissioning options in terms of potential high consequence event | Slightly longer vessel duration than Options 2a and 2b and different type of vessel. No SIMOPS, only single vessel in field at any time with activity largely within 500m zone at each end of pipeline for relatively short duration. However exposed sections of pipeline recovered to vessel and unloaded onshore, so similar risks to deck crew and yard crew as Option 1c) but only 96te pipeline recovered compared to 6900te for Option 1c. There is no specific differentiation identified between all decommissioning options in terms of potential high consequence event. |
| | RATING | | | Higher Impact | Moderate Impact | Lower Impact | Moderate Impact |
| | Societal | | | Removing the pipeline may result in a deeper trench left behind, however the trench profile is shallow on trench sides. May be concerns from fishermen on length of open trench in future. However not evaluated as having an impact. There is no specific differentiation identified between all decommissioning options in terms of Socio-economic impact on communities and amenities. | Additional rock cover at exposed ends will be installed to be over trawlable, rating recognises potential for new rock cover to become unstable over time. May result in fishermen avoiding the area. There is no specific differentiation identified between all decommissioning options in terms of Socio-economic impact on communities and amenities. | No impact to commercial fisheries anticipated. There is no specific differentiation identified between all decommissioning options in terms of Socio-economic impact on communities and amenities. | No impact to commercial fisheries anticipated. There is no specific differentiation identified between all decommissioning options in terms of Socio-economic impact on communities and amenities. |
| | RATING | | | Lower Impact | Moderate Impact | Lower Impact | Lower Impact |
| | Economic | | | 145 times the project execution cost of the lowest cost option. Clean seabed, post decomm survey only. Possible one future visit to monitor behaviour of the trench. Although "Cost for long term monitoring / Remediation activities" sub-criterion is rated as best for Option 1c, the comparative costs during project Execution activities are orders of magnitude higher than monitoring and remediation costs. | Within 10% of project execution lowest cost option. Anticipate only two future surveys to monitor behaviour of the end point. | Lowest project execution cost option. Anticipate only two future surveys to monitor behaviour of the end point. | Within 35% of project execution lowest cost option. Anticipate only two future surveys to monitor behaviour of the end point. |
| | RATING | | | Higher Impact | Lower Impact | Lower Impact | Lower Impact |
| | Environmental | | | The impact significance of energy use and the resultant atmospherics, of noise from vessels and of discharges to sea is not considered a significant differentiator across all options. Deburial of 54km line greater disturbance than other options where only current exposed sections of pipeline are remediated. Recovery of habitat commences as soon as operations are completed. 6900te of pipeline returned onshore, results in significantly more waste (Including NORM) to be managed, than Option 2c and increase in materials going to landfill. Moderate rating assumes concrete can be separated, treated and recycled and does not go to not landfill. | The impact significance of energy use and the resultant atmospherics, of noise from vessels and of discharges to sea is not considered a significant differentiator across all options. Introducing 7400te of new rock cover will disturb the seabed short term. However will not allow the re-population of existing benthos below rock cover, additional rock cover may have to be added to in future (e.g. remedial action to maintain berm). No waste returned onshore. | The impact significance of energy use and the resultant atmospherics, of noise from vessels and of discharges to sea is not considered a significant differentiator across all options. Only 760m length of new trench created, short term seabed disturbance is considered minor. Recovery of habitat commences as soon as operations are completed. No waste returned onshore. | The impact significance of energy use and the resultant atmospherics, of noise from vessels and of discharges to sea is not considered a significant differentiator across all options. Minimal seabed disturbance anticipated. Recovery of habitat commences as soon as operations are completed. Only 96te of pipeline with concrete and residues returning to shore, minimal impact on available landfill and recycling industry. |
| | RATING | | | Moderate Impact | Moderate Impact | Lower Impact | Lower Impact |
| OVERALL RATING | Higher Impact | | | Moderate Impact | Lower Impact | Moderate Impact | |
| RANKING | | | | | 4 | 3 | 1 |
| | | | | Although Option 2b) Remediate in situ with exposed sections - trenched and buried is ranked as preferred option, the difference in rating between 2b) , 2a) and 2c) is marginal and all three options will be carried through to a Contracting and Procurement (C&P) phase of the project to allow contractors to tender and propose the overall preferred option. If the C&P tendering phase results in either options 2a) or 2c) being considered more favourable than option 2b) the Operator will engage with OPRED before a decision is taken on overall strategy . | | | |
| | | | | Discounted in the DP | | | |

GROUP A - RIGID PIPELINE, CONCRETE COATED, TRENCHED AND PARTIALLY BURIED
SENSITIVITY ANALYSIS 1 - MAIN CRITERIA EQUALLY WEIGHTED

By adopting the average ratings for each main criteria from the individual worksheet a single rating by main criteria only can be visualised.
 By adopting this visualisation to arrive at a ranking each main criteria is therefore equally weighted. The difference between this Sensitivity and the original ranking by subcriteria is demonstrated at the bottom of the table below.

| SUMMARY | MAIN OPTIONS | TOTAL REMOVAL | | | REMEDiate IN SITU | | |
|---------------------------------|-----------------------------|-----------------|---------------|----------------------|---|------------------------------------|--------------------------------|
| | Sub-Options Number | 1a) | 1b) | 1c) | 2a) | 2b) | 2c) |
| | Sub-Criteria/ / Sub-Options | REVERSE REELING | REVERSE S-LAY | CUT & LIFT | EXPOSED SECTIONS ROCK COVERED | EXPOSED SECTIONS TRENCHED & BURIED | EXPOSED SECTIONS CUT & REMOVED |
| | Technical | | | | | | |
| | RATING | | | Moderate Impact | Lower Impact | Lower Impact | Lower Impact |
| | Safety | | | | | | |
| | RATING | | | Higher Impact | Moderate Impact | Lower Impact | Moderate Impact |
| | Societal | | | | | | |
| | RATING | | | Lower Impact | Moderate Impact | Lower Impact | Lower Impact |
| | Economic | | | | | | |
| | RATING | | | Higher Impact | Lower Impact | Lower Impact | Lower Impact |
| | Environmental | | | | | | |
| | RATING | | | Moderate Impact | Moderate Impact | Lower Impact | Lower Impact |
| SENSITIVITY 1 - OVERALL RATING | | | | Higher Impact | Moderate Impact | Lower Impact | Lower Impact |
| SENSITIVITY 1 - OVERALL RANKING | | | | 4 | 3 | 1= | 1= |
| | | | | Discounted in the DP | Although Option 2b) Remediate in situ with exposed sections - trench and buried is ranked as preferred option, the difference in rating between 2b) , 2a) and 2c) is marginal and all three options will be carried through to a Contracting and Procurement (C&P) phase of the project to allow contractors to tender and propose the overall preferred option. If the C&P tendering phase results in either options 2a) or 2c) being considered more favourable than option 2b) the Operator will engage with OPRED before a decision is taken on overall strategy . | | |
| ORIGINAL OVERALL RATING | | | | Higher Impact | Moderate Impact | Lower Impact | Moderate Impact |
| ORIGINAL - OVERALL RATING | | | | 4 | 3 | 1 | 2 |

Change from Original Evaluation is that Option 2c) performance improves slightly (2 less Moderate Impact ratings), making it first equal with option 2b)

GROUP A - RIGID PIPELINE, CONCRETE COATED, TRENCHED AND PARTIALLY BURIED

SENSITIVITY ANALYSIS 1 - MAIN CRITERIA EQUALLY WEIGHTED

By adopting the average ratings for each main criteria from the individual worksheet a single rating by main criteria only can be visualised.
By adopting this visualisation to arrive at a ranking each main criteria is therefore equally weighted. The difference between this Sensitivity and the original ranking by subcriteria is demonstrated at the bottom of the table below.

| SUMMARY | MAIN OPTIONS | TOTAL REMOVAL | | | REMEDiate IN SITU | | |
|---------------------------------|-----------------------------|--------------------------------------|---------------------------------|----------------------|---|------------------------------------|--------------------------------|
| | Sub-Options Number | 1a) | 1b) | 1c) | 2a) | 2b) | 2c) |
| | Sub-Criteria/ / Sub-Options | REVERSE REELING | REVERSE S-LAY | CUT & LIFT | EXPOSED SECTIONS ROCK COVERED | EXPOSED SECTIONS TRENCHED & BURIED | EXPOSED SECTIONS CUT & REMOVED |
| | Technical | NOT TECHNICALLY FEASIBLE FOR GROUP A | PRE-SCREENED OUT FOR ALL GROUPS | | | | |
| | RATING | | | Moderate Impact | Lower Impact | Lower Impact | Lower Impact |
| | Safety | | | | | | |
| | RATING | | | Higher Impact | Moderate Impact | Lower Impact | Moderate Impact |
| | Societal | | | | | | |
| | RATING | | | Lower Impact | Moderate Impact | Lower Impact | Lower Impact |
| | Environmental | | | | | | |
| | RATING | | | Moderate Impact | Moderate Impact | Lower Impact | Lower Impact |
| SENSITIVITY 2 - OVERALL RATING | Higher Impact | | | Moderate Impact | Lower Impact | Lower Impact | |
| SENSITIVITY 2 - OVERALL RANKING | 4 | | | 3 | 1= | 1= | |
| | | | | Discounted in the DP | Although Option 2b) Remediate in situ with exposed sections - trench and buried is ranked as preferred option, the difference in rating between 2b) , 2a) and 2c) is marginal and all three options will be carried through to a Contracting and Procurement (C&P) phase of the project to allow contractors to tender and propose the overall preferred option. If the C&P tendering phase results in either options 2a) or 2c) being considered more favourable than option 2b) the Operator will engage with OPRED before a decision is taken on overall strategy . | | |
| ORIGINAL OVERALL RATING | | | | Higher Impact | Moderate Impact | Lower Impact | Moderate Impact |
| ORIGINAL - OVERALL RANKING | | | | 4 | 3 | 1 | 2 |
| SENSITIVITY 1 - OVERALL RATING | | | | Higher Impact | Moderate Impact | Lower Impact | Lower Impact |
| SENSITIVITY 1 - OVERALL RANKING | | | | 4 | 3 | 1= | 1= |

GROUP B - RIGID PIPELINE, SURFACE LAID (NOT CONCRETE COATED)

TECHNICAL AND SAFETY CRITERIA

| Assessment Criteria | | MAIN Options | TOTAL REMOVAL | | | REMEDiate IN SITU | | | |
|---|--|---|--|--|---|---|---|---|--|
| | | Sub-Options Number | 1a) | 1b) | 1c) | 2a) | 2b) | 2c) | |
| | | Sub-Criteria/ / Sub-Options | REVERSE REELING | REVERSE S-LAY | CUT & LIFT | FULL PIPELINE ROCK COVERED | FULL PIPELINE TRENCHED & BURIED | EXPOSED SECTIONS CUT & LIFT | |
| TECHNICAL | | Risk of Major Project Failure | Pipelines were originally installed from reel and can be reverse reeled. Offshore Execution Phase schedule unlikely to slip beyond planned schedule plus contingencies applied. Scope is straightforward and understood. | PRE-SCREENED OUT FOR ALL GROUPS | Offshore Execution Phase schedule unlikely to slip beyond planned schedule plus contingencies applied. Scope is straightforward and understood. | Offshore Execution Phase schedule unlikely to slip beyond planned schedule plus contingencies applied. Scope is straightforward and understood. | Individual lines are in close proximity to others pipelines within this group and other surface laid groups (being only circa 15m apart). This may make trenching slightly more difficult. | SURFACE LAID PIPELINE - OPTION 1c PROVIDES THIS OPTION | |
| | | RATING | Lower Impact | | Lower Impact | Lower Impact | Moderate Impact | | |
| | | Technical Complexity & Track Record | No new technology or working practices to be introduced. Option has good industry track record in the basin and can be executed by contractors with significant previous experience of all activities involved. | | No new technology or working practices to be introduced. Option has good industry track record in the basin and can be executed by contractors with significant previous experience of all activities involved. | | | | |
| | | RATING | Not significantly different | | Not significantly different | Not significantly different | Not significantly different | | |
| TECHNICAL: OVERALL RATING BASED ON AVERAGE | | See note under Options 1c), 2a) and 2b) | | | Average rating not adopted for this main criteria. Although Option 2b) was rated as Moderate Impact for risk of major project failure, workshop participants agreed that all options are straightforward and understood with a track record of these types of activity. Although proximity of adjacent pipelines may make Option 2b) slightly more difficult to execute than the other options, it is not regarded as significantly different in terms of technical feasibility. All options were therefore rated as not significantly different. | | | | |
| TECHNICAL: OVERALL RATING BASED ON DISCUSSION | | Not significantly different | | Not significantly different | Not significantly different | Not significantly different | Not significantly different | | |
| SAFETY | | RISK DURING PROJECT EXECUTION | To Project Personnel | Small diameter lines and simple recovery method once on the reel with minimal intervention of deck crew. | PRE-SCREENED OUT FOR ALL GROUPS | Overall duration of vessel days 5 to 10 times longer than other options with multiple vessels and SIMOPS but < 4 month campaign. Repetitive activities and deck handling of pipelines sections on deck (approximately 570te) with potential exposure to residues from cut pipeline ends. | Relatively short single vessel campaign combined with minimal interaction with deck crew. | Relatively short single vessel campaign combined with minimal interaction with deck crew. | SURFACE LAID PIPELINE - OPTION 1c PROVIDES THIS OPTION |
| | | | RATING | Lower Impact | | Moderate Impact | Lower Impact | Lower Impact | |
| | | | To Other Users of the Sea | Single vessel campaign of relatively short duration, low numbers of vessel transits to and from onshore. | | Multiple vessels for longer duration, more vessel transits to and from onshore relative to other options. | Single vessel campaign of relatively short duration, low numbers of vessel transits to and from onshore. | Single vessel campaign of relatively short duration, low numbers of vessel transits to and from onshore. | |
| | | | RATING | Lower Impact | | Moderate Impact | Lower Impact | Lower Impact | |
| | | | To Those on Land | Approximately 570te of pipeline returned onshore, yard crew exposure to residues to be managed when pipeline is un-reeled and cut into sections for onward disposal and recycle. | | Approximately 570te returned onshore, yard crew exposure to residues to be managed when handling for onward disposal and recycle. | Nothing returned onshore. Approximately 72,000te of rock cover to be supplied and transported, however not identified as a major risk as supply of rock cover is an ongoing industry practice. | Nothing returned onshore. | |
| | | | RATING | Moderate Impact | | Moderate Impact | Moderate Impact | Lower Impact | |
| | | | High Consequence Event | See note under Options 1c), 2a) and 2b). | | HIRA carried out 16th May 2019 determined there is no specific differentiation identified between all decommissioning options in terms of potential high consequence event . Therefore this sub-criterion was considered not to be a significant differentiator in the CA Workshop. | | | |
| | | | RATING | Not significantly different | | Not significantly different | Not significantly different | Not significantly different | |
| | | RESIDUAL RISK FROM END POINTS | To other Users of the Sea | No residual risk as option will leave a clean seabed. | | No residual risk as option will leave a clean seabed. | Approximately 72,000te of new rock berms introduced, however will be designed and installed to be over trawable, but could become unstable over time. | Pipelines will be trenching and buried to required depth to ensure no subsequent exposures over time and will therefore be over trawable. | |
| | | | RATING | Lower Impact | | Lower Impact | Moderate Impact | Lower Impact | |
| SAFETY: OVERALL RATING BASED ON AVERAGE | | | | | Average rating not adopted for this main criteria. Due to Option 1c) being evaluated as Moderate risk for all 3 project execution risks. It has been evaluated as a Higher Impact risk option overall due to level vessel SIMOPS and deck crew interaction in managing the materials. The introduction of such quantities of rock cover has meant Option 2a) is evaluated as Moderate Impact overall, mainly due to residual risk. | | | | |
| SAFETY: OVERALL RATING BASED ON DISCUSSION | | Lower Impact | | Higher Impact | Moderate Impact | Lower Impact | | | |

GROUP B - RIGID PIPELINE, SURFACE LAID (NOT CONCRETE COATED)
SOCIAL AND ECONOMIC CRITERIA

| Assessment Criteria | MAIN Options | TOTAL REMOVAL | | | REMEDIATE IN SITU | | |
|--|--|--|---------------|---|---|---|--------------------------------|
| | Sub-Options Number | 1a) | 1b) | 1c) | 2a) | 2b) | 2c) |
| | Sub-Criteria/ / Sub-Options | REVERSE REELING | REVERSE S-LAY | CUT & LIFT | FULL PIPELINE ROCK COVERED | FULL PIPELINE TRENCHED & BURIED | EXPOSED SECTIONS CUT & REMOVED |
| SOCIETAL | Impact on Commercial Fisheries | No impact anticipated, as clean seabed is the end state. | | No impact anticipated, as clean seabed is the end state. | Application of new rock cover will be over-trawlable, however, profile could become unstable and require remedial action. Proximity of adjacent lines/ rock berms (15m apart) may be an issue to the fishermen and may mean additional rock application between the berms. | No impact anticipated, as pipelines will be trenched and buried to required depth to ensure no subsequent exposures over time and will therefore be over-trawlable. | |
| | RATING | Lower Impact | | Lower Impact | Moderate Impact | Lower Impact | |
| | Socio-Economic Impact on Communities and Amenities | Pro: potentially more employment but relatively short term and in established yards. Con: potentially more material to be transported and handled (roads congestion etc.). No odour (marine growth) issues expected. | | Pro: potentially more employment but relatively short term and in established yards. Con: potentially more material to be transported and handled (roads congestion etc.). No odour (marine growth) issues expected. | No impact as nothing returned onshore. Supply of additional rockcover will be from existing industry source and will not generate new business or employment. | No impact as nothing returned onshore. | |
| | RATING | Not significantly different | | Not significantly different | Not significantly different | Not significantly different | |
| | SOCIETAL: OVERALL RATING BASED ON AVERAGE | Lower Impact | | Lower Impact | Moderate Impact | Lower Impact | |
| SOCIETAL: OVERALL RATING BASED ON DISCUSSION | | See note under Options 1c), 2a) and 2b). | | Average rating has been adopted for this main criteria. Since "socio-economic impact on communities and amenities" subcriterion has been rated as "Not significantly different" The rating of subcriterion "Impact on Commercial Fisheries" takes precedence in the overall rating of Societal Criterion. | | | |
| ECONOMIC | Cost for Decommissioning/ Removal Activities | Within 24% of lowest cost Option. | | Over 600 times the cost of the lowest cost Option. | 1.6 times the lowest cost Option. | Lowest cost Option. | |
| | RATING | Lower Impact | | Higher Impact | Moderate Impact | Lower Impact | |
| | Cost for Long Term Monitoring / Remediation Activities | End state is clean seabed, anticipate one post decomm survey only. | | End state is clean seabed, anticipate one post decomm survey only. | Anticipate only two future surveys to monitor behaviour rock berms. | Anticipate only two future surveys to monitor behaviour fully buried pipeline. | |
| | RATING | Lower Impact | | Lower Impact | Moderate Impact | Moderate Impact | |
| ECONOMIC: OVERALL RATING BASED ON AVERAGE | | | | Average rating not adopted for this main criteria. Although "Cost for long term monitoring / Remediation activities" subcriterion is rated as best for Option 1a, the comparative costs during Decommissioning/ Removal activities are orders of magnitude higher than monitoring and remediation costs of a survey/ monitoring vessel and therefore the rating of subcriterion "Cost for Decommissioning/ Removal activities" takes precedence in the overall rating of Economic Criterion | | | |
| ECONOMIC: OVERALL RATING BASED ON DISCUSSION | | Lower Impact | | Higher Impact | Moderate Impact | Lower Impact | |

PRE-SCREENED OUT FOR ALL GROUPS

SURFACE LAID PIPELINE - OPTION 1c PROVIDES THIS OPTION

GROUP B - RIGID PIPELINE, SURFACE LAID (NOT CONCRETE COATED)
ENVIRONMENTAL CRITERION

| Assessment Criteria | MAIN Options | TOTAL REMOVAL | | | REMEDiate IN SITU | | |
|--|--|---|---------------------------------|--|--|---|--------------------------------|
| | Sub-Options Number | 1a) | 1b) | 1c) | 2a) | 2b) | 2c) |
| | Sub-Criteria/ / Sub-Options | REVERSE REELING | REVERSE S-LAY | CUT & LIFT | FULL PIPELINE ROCK COVERED | FULL PIPELINE TRENCHED & BURIED | EXPOSED SECTIONS CUT & REMOVED |
| ENVIRONMENTAL | Impact of Decommissioning Operations Offshore <i>(includes emissions to air, discharges to sea and underwater noise)</i> | See note under Options 1c), 2a) and 2b). | PRE-SCREENED OUT FOR ALL GROUPS | The ENVID determined that the impact significance of energy use and the resultant atmospherics, of noise from vessels and of discharges to sea is low across all Options, such that the environmental impact of decommissioning operations offshore is not considered a significant differentiator.. | | | |
| | RATING | Not significantly different | | Not significantly different | Not significantly different | Not significantly different | |
| | Seabed Disturbance- Short Term <i>(includes disturbance to the cuttings pile)</i> | Recovery method anticipated to have minimal impact as pipelines are surface laid. | | Recovery method anticipated to have minimal impact as pipelines are surface laid. | Rock dumping activity is recognised to result in short term disturbance during rock placement. The footprint of this short term disturbance is likely to be greater than actual footprint. However short term impact not anticipated to be worse than Option 2b) | New trench required across full pipeline lengths. | |
| | RATING | Lower Impact | | Lower Impact | Moderate Impact | Moderate Impact | |
| | Loss of Habitat - Long Term | Ecosystem recovery commences as soon as operations are completed. | | Ecosystem recovery commences as soon as operations are completed. | Additional rock cover means the introduction of a different habitat type to the area. This will impact existing ecosystem, by allowing other species to settle in the area. | Ecosystem recovery commences as soon as operations are completed. | |
| | RATING | Lower Impact | | Lower Impact | Moderate Impact | Lower Impact | |
| | Waste Processing <i>(i.e. processing of returned materials and use of landfill)</i> | Approximately 570te of pipeline transferred onshore. Although steel will be recycled, management of residues wastes including volumes of NORM inside pipeline required. | | Approximately 570te of pipeline transferred onshore. Although steel will be recycled, management of residues wastes including volumes of NORM inside pipeline required. | Nothing returned onshore. | Nothing returned onshore. | |
| | RATING | Moderate Impact | | Moderate Impact | Lower Impact | Lower Impact | |
| | ENVIRONMENTAL: OVERALL RATING BASED ON AVERAGE | Lower Impact | | Lower Impact | Moderate Impact | Lower Impact | |
| ENVIRONMENTAL : OVERALL RATING BASED ON DISCUSSION | | See note under Options 1c), 2a) and 2b). | | Overall rating for Environmental Main Criteria is based on the average rating across the Environmental Sub-Criterion. | | | |

SURFACE LAID PIPELINE - OPTION 1c PROVIDES THIS OPTION

GROUP B - RIGID PIPELINE, SURFACE LAID (NOT CONCRETE COATED)
VISUAL RATING

| Assessment Criteria | MAIN OPTIONS | TOTAL REMOVAL | | | REMEDiate IN SITU | | |
|---------------------|---|-----------------------------|---------------|-----------------------------|-------------------------------|------------------------------------|--------------------------------|
| | Sub-Options Number | 1a) | 1b) | 1c) | 2a) | 2b) | 2c) |
| | Sub Criteria/ / Sub-Options | REVERSE REELING | REVERSE S-LAY | CUT & LIFT | EXPOSED SECTIONS ROCK COVERED | EXPOSED SECTIONS TRENCHED & BURIED | EXPOSED SECTIONS CUT & REMOVED |
| TECHNICAL | Risk of Major Project Failure | Lower Impact | | Lower Impact | Lower Impact | Moderate Impact | |
| | Technical Complexity & Track Record | Not significantly different | | Not significantly different | Not significantly different | Not significantly different | |
| SAFETY | To Project Personnel | Lower Impact | | Moderate Impact | Lower Impact | Lower Impact | |
| | To Other Users of the Sea | Lower Impact | | Moderate Impact | Lower Impact | Lower Impact | |
| | To Those on Land | Moderate Impact | | Moderate Impact | Moderate Impact | Lower Impact | |
| | High Consequence Event | Not significantly different | | Not significantly different | Not significantly different | Not significantly different | |
| | Residual Risk to other Users of the Sea | Lower Impact | | Lower Impact | Moderate Impact | Lower Impact | |
| SOCIETAL | Impact on Commercial Fisheries | Lower Impact | | Lower Impact | Moderate Impact | Lower Impact | |
| | Socio-economic Impact on Communities and Amenities | Not significantly different | | Not significantly different | Not significantly different | Not significantly different | |
| ECONOMIC | Cost for Decommissioning/ Removal Activities | Lower Impact | | Higher Impact | Moderate Impact | Lower Impact | |
| | Cost for Long Term monitoring / Remediation Activities | Lower Impact | | Lower Impact | Moderate Impact | Moderate Impact | |
| ENVIRONMENTAL | Impact of Decommissioning Operations Offshore <i>(includes emissions to air, discharges to sea and underwater noise)</i> | Not significantly different | | Not significantly different | Not significantly different | Not significantly different | |
| | Seabed Disturbance- Short Term <i>(includes disturbance to the cuttings pile)</i> | Lower Impact | | Lower Impact | Moderate Impact | Moderate Impact | |
| | Loss of Habitat - Long Term | Lower Impact | | Lower Impact | Moderate Impact | Lower Impact | |
| | Waste Processing <i>(i.e. processing of returned materials and use of landfill)</i> | Moderate Impact | | Moderate Impact | Lower Impact | Lower Impact | |
| | Rating | Lower Impact | | Higher Impact | Higher Impact | Moderate Impact | |
| | Ranking | 1 | | 3= | 3= | 2 | |
| | | Preferred option in DP | | Discounted options in DP | | | |

GROUP B - RIGID PIPELINE, SURFACE LAID (NOT CONCRETE COATED)

NARRATIVE SUMMARY

| SUMMARY | MAIN Options | TOTAL REMOVAL | | | REMEDiate IN SITU | | |
|----------------|-----------------------------|--|---------------|---|---|---|--------------------------------|
| | Sub-Options Number | 1a) | 1b) | 1c) | 2a) | 2b) | 2c) |
| | Sub-Criteria/ / Sub-Options | REVERSE REELING | REVERSE S-LAY | CUT & LIFT | EXPOSED SECTIONS ROCK COVERED | EXPOSED SECTIONS TRENCHED & BURIED | EXPOSED SECTIONS CUT & REMOVED |
| | Technical | Scope is straightforward and understood. | | Scope is straightforward and understood. | Scope is straightforward and understood. | Scope is straightforward and understood. Proximity of lines (15m apart) may introduce some slight technical difficulty but no overall concern. | |
| | RATING | Not significantly different | | Not significantly different | Not significantly different | Not significantly different | |
| | Safety | Small diameter lines with a simple recovery method once on the reel and minimal intervention of deck crew. Single vessel campaign of relatively short duration and low numbers of vessel transits. Approximately 570te of pipeline returned to shore, yard crew exposure to residues when pipeline is unreel and cut into sections for onward disposal and recycle, however risk can be mitigated. No residual risk to other users of the sea as Option will leave a clean seabed. | | Overall duration of vessel days is 5 to 10 times longer than other options with multiple vessels and SIMOPS and more vessel transits to and from onshore. Repetitive activities and deck handling of pipelines sections on deck (approximately 570te) with potential exposure to residues from cut pipeline ends. No residual risk to other users of the sea as Option will leave a clean seabed. | Relatively short single vessel campaign combined with minimal interaction with deck crew. Low numbers of vessel transits to and from onshore. Rock cover supply and transport not identified as a major risk as supply of rock cover is an ongoing industry practice. The introduction of large quantities of rock cover has meant Option 2a) is evaluated as Moderate Impact overall, mainly due to residual risk of rock berms becoming unstable over time and a risk to fishing vessels. | Relatively short single vessel campaign combined with minimal interaction with deck crew. Nothing returned onshore. Pipelines will be trench and buried to required depth to ensure no subsequent exposures over time and will therefore be over-trawlable. | |
| | RATING | Lower Impact | | Higher Impact | Moderate Impact | Lower Impact | |
| | Societal | No impact to commercial fisheries anticipated, as clean seabed is the end state. Socio-economic impact on communities and amenities has been evaluated as not significantly different across the options as quantities of materials returned onshore is not significant. | | No impact to commercial fisheries anticipated, as clean seabed is the end state. Socio-economic impact on communities and amenities has been evaluated as not significantly different across the options as quantities of materials returned onshore is not significant. | Application of new rock cover will be over-trawlable, however proximity of adjacent lines/ rock berms (15m apart) may be an issue to the fishing vessels and may mean additional rock application between the berms. Socio-economic impact on communities and amenities has been evaluated as not significantly different across the options as quantities of materials returned onshore is not significant. | No impact to commercial fisheries anticipated, as pipelines will be trench and buried to required depth to ensure no subsequent exposures over time and will therefore be over-trawlable. Socio-economic impact on communities and amenities has been evaluated as not significantly different across the options as quantities of materials returned onshore is not significant. | |
| | RATING | Lower Impact | | Lower Impact | Moderate Impact | Lower Impact | |
| | Economic | Within 24% of lowest cost option. | | Over 6 times the cost of the lowest cost option. Although "cost of long term monitoring / remediation activities" subcriterion is rated as best for Option 1c) compared to Options 2a) and 2b), the comparative costs of Decommissioning/ Removal activities are orders of magnitude higher than monitoring and remediation costs of a survey/ monitoring vessel. | 1.6 times of lowest cost option. | Lowest cost option. | |
| | RATING | Lower Impact | | Higher Impact | Moderate Impact | Lower Impact | |
| | Environmental | The impact significance of energy use and the resultant atmospheric, of noise from vessels and of discharges to sea is low across all options. Recovery method anticipated to have minimal short term seabed disturbance as pipelines are surface laid. Some waste returned onshore but limited quantities anticipated to landfill. | | The impact significance of energy use and the resultant atmospheric, of noise from vessels and of discharges to sea is low across all options. Recovery method anticipated to have minimal short term seabed disturbance as pipelines are surface laid. Some waste returned onshore but limited quantities anticipated to landfill. | The impact significance of energy use and the resultant atmospheric, of noise from vessels and of discharges to sea is low across all options. Approximately 72,000te of new rock cover, close proximity adjacent pipelines (15m apart) may result potentially in blanket rock cover across multiple lines, with associated short term and long term impact on local benthos. No waste returned onshore. | The impact significance of energy use and the resultant atmospheric, of noise from vessels and of discharges to sea is low across all options. No waste returned onshore. | |
| | RATING | Lower Impact | | Lower Impact | Moderate Impact | Lower Impact | |
| OVERALL RATING | | Lower Impact | | Higher Impact | Higher Impact | Moderate Impact | |
| RANKING | | 1 | | 3= | 3= | 2 | |
| | | Preferred option in DP | | Discounted options in DP | | | |

When using average weighting for main criteria, Options 1a) and 2b) have been rated the same in terms of a rated green. However Refer to the Visual summary table where option 2b) was rated moderate impact for potential for project failure (technical criteria) due to the fact the lines are in close proximity to each other, which may make trenching difficult. 2b) was also rated moderate impact for cost of long term monitoring, as lines are left buried in seabed but would still require future monitoring surveys. Therefore Option 2b) is rated Moderate Impact overall compared to Option 1a)

GROUP B - RIGID PIPELINE, SURFACE LAID (NOT CONCRETE COATED)

SENSITIVITY ANALYSIS 1 - MAIN CRITERIA EQUALLY WEIGHTED

By adopting the average ratings for each main criteria from the individual worksheet a single rating by main criteria only can be visualised. By adopting this visualisation to arrive at a ranking each main criteria is therefore equally weighted.
The difference between this Sensitivity and the original ranking by subcriteria is demonstrated at the bottom of the table below.

| SUMMARY | MAIN Options | TOTAL REMOVAL | | | REMEDiate IN SITU | | |
|--|-----------------------------|-----------------------------|---------------|-----------------------------|-------------------------------|--|---|
| | Sub-Options Number | 1a) | 1b) | 1c) | 2a) | 2b) | 2c) |
| | Sub-Criteria/ / Sub-Options | REVERSE REELING | REVERSE S-LAY | CUT & LIFT | EXPOSED SECTIONS ROCK COVERED | EXPOSED SECTIONS TRENCHED & BURIED | EXPOSED SECTIONS CUT & REMOVED |
| | Technical | | | | | | |
| | RATING | Not significantly different | | Not significantly different | Not significantly different | Not significantly different | |
| | Safety | | | | | | |
| | RATING | Lower Impact | | Higher Impact | Moderate Impact | Lower Impact | |
| | Societal | | | | | | |
| | RATING | Lower Impact | | Lower Impact | Moderate Impact | Lower Impact | |
| | Economic | | | | | | |
| | RATING | 0 | | Higher Impact | Moderate Impact | Lower Impact | |
| | Environmental | | | | | | |
| | RATING | Lower Impact | | Lower Impact | Moderate Impact | Lower Impact | |
| SENSITIVITY 1 - OVERALL RATING | | Lower Impact | | Higher Impact | Higher Impact | Lower Impact | Change from Original Evaluation is that Option 2b) performance improves slightly to make it 1= in ranking with Option 1a), and perhaps should be carried forward as an option in the DP |
| SENSITIVITY 1 - OVERALL RANKING | | 1= | | 3= | 3= | 1= | |
| | | Preferred option in DP | | Discounted options in DP | | Potentially could carry option 2b) through to C&P, but not if Technical criteria rating was changed to Moderate Impact and other options were Low Impact. See Technical Criteria worksheet detail. | |
| When using equal weighting for main criteria only, Options 1a) and 2b) have been rated the same in terms of a rated green. However Refer to the Visual summary table where option 2b) was rated moderate impact for potential for project failure (technical criteria) due to the fact the lines are in close proximity to each other, which may make trenching difficult.2b) was also rated moderate impact for cost of long term monitoring, as lines are left buried in seabed but would still require future monitoring surveys. Therefore Option 2b) is rated Modferate Impact overall compared to Option 1a) | | | | | | | |
| ORIGINAL OVERALL RATING | | Lower Impact | | Higher Impact | Higher Impact | Moderate Impact | |
| ORIGINAL - OVERALL RATING | | 1 | | 3= | 3= | 2 | |
| | | Preferred option in DP | | Discounted options in DP | | | |

GROUP B - RIGID PIPELINE, SURFACE LAID (NOT CONCRETE COATED)

SENSITIVITY ANALYSIS 2 - MAIN CRITERIA EQUALLY WEIGHTED AND ECONOMIC CRITERION REMOVED

By adopting the average ratings for each main criteria from the individual worksheet a single rating by main criteria only can be visualised. Removing the Economic criterion provides a further sensitivity.
By adopting this visualisation to arrive at a ranking each main criteria is therefore equally weighted. The difference between this Sensitivity and the original ranking by subcriteria is demonstrated at the bottom of the table below.

| SUMMARY | MAIN Options | TOTAL REMOVAL | | | REMEDiate IN SITU | | |
|---------------------------------|-----------------------------|-----------------------------|---------------|-----------------------------|-------------------------------|--|---|
| | Sub-Options Number | 1a) | 1b) | 1c) | 2a) | 2b) | 2c) |
| | Sub-Criteria/ / Sub-Options | REVERSE REELING | REVERSE S-LAY | CUT & LIFT | EXPOSED SECTIONS ROCK COVERED | EXPOSED SECTIONS TRENCHED & BURIED | EXPOSED SECTIONS CUT & REMOVED |
| | Technical | | | | | | |
| | RATING | Not significantly different | | Not significantly different | Not significantly different | Not significantly different | |
| | Safety | | | | | | |
| | RATING | Lower Impact | | Higher Impact | Moderate Impact | Lower Impact | |
| | Societal | | | | | | |
| | RATING | Lower Impact | | Lower Impact | Moderate Impact | Lower Impact | |
| | Environmental | | | | | | |
| | RATING | Lower Impact | | Lower Impact | Moderate Impact | Lower Impact | |
| SENSITIVITY 2 - OVERALL RATING | | Lower Impact | | Moderate Impact | Moderate Impact | Lower Impact | No change in ranking of options from Sensitivity Analysis 1. Options 1c) and 2a) improve slightly in rating as one less red and one less amber respectively by the removal of economic criteria |
| SENSITIVITY 2 - OVERALL RANKING | | 1= | | 3= | 3= | 1= | |
| | | Preferred option in DP | | Discounted options in DP | | See Sensitivity 1 Analysis recommendations | |
| ORIGINAL OVERALL RATING | | Lower Impact | | Higher Impact | Higher Impact | Moderate Impact | |
| ORIGINAL - OVERALL RATING | | 1 | | 3= | 3= | 2 | |
| | | Preferred option in DP | | Discounted options in DP | | | |
| SENSITIVITY 1 - OVERALL RATING | | Lower Impact | | Higher Impact | Higher Impact | Lower Impact | |
| SENSITIVITY 1 - OVERALL RANKING | | 1= | | 3= | 3= | 1= | |
| | | Preferred option in DP | | Discounted options in DP | | Potentially could carry option 2b) through to C&P, but not if Technical criteria rating was changed to Moderate Impact and other options were Low Impact. See Technical Criteria worksheet detail. | |

GROUP C - RIGID PIPELINE, TRENCHED AND BURIED (NOT CONCRETE COATED)

TECHNICAL AND SAFETY CRITERIA

| Assessment Criteria | MAIN OPTIONS | | TOTAL REMOVAL | | | REMEDiate IN SITU | | |
|---|-------------------------------------|--|---|---------------------------------|------------------------------|--|---|--|
| | Sub-Options Number | | 1a) | 1b) | 1c) | 2a) | 2b) | 2c) |
| | Sub-Criteria/ / Sub-Options | | REVERSE REELING | REVERSE S-LAY | CUT & LIFT | EXPOSED SECTIONS ROCK COVERED | EXPOSED SECTIONS TRENCHED & BURIED | EXPOSED SECTIONS CUT & LIFT |
| TECHNICAL | Risk of Major Project Failure | | Originally installed from reel. Potential requirement to excavate from trench before recovery with some areas currently rock covered. Technical Risk assessment on soils and existing rock cover will be required before deciding requirement for excavation. 8" diameter lines may possibly be pulled through the burial medium. | PRE-SCREENED OUT FOR ALL GROUPS | PRE-SCREENED OUT FOR GROUP C | Total exposure only 390m across all lines. Offshore Execution Phase Schedule unlikely to slip beyond planned schedule plus contingencies applied. Scope is straightforward and understood. | Total exposure only 390m across all lines. Offshore Execution Phase Schedule unlikely to slip beyond planned schedule plus contingencies applied. Scope is straightforward and understood. | Total exposure only 390m across all lines. Offshore Execution Phase Schedule unlikely to slip beyond planned schedule plus contingencies applied. Scope is straightforward and understood. |
| | RATING | | Moderate Impact | | | Lower Impact | Lower Impact | Lower Impact |
| | Technical Complexity & Track Record | | No new technology or working practices to be introduced. However one of the original pipeline was retired due to internal corrosion potential to reel a badly corroded pipeline is in doubt. | | | No new technology or working practices to be introduced. Options have good industry track record in the North Sea and can be executed by contractors with significant previous experience of all activities involved. | | |
| | RATING | | Moderate Impact | | | Lower Impact | Lower Impact | Lower Impact |
| TECHNICAL: OVERALL RATING BASED ON AVERAGE | | Moderate Impact | Lower Impact | | | Lower Impact | Lower Impact | |
| TECHNICAL: OVERALL RATING BASED ON DISCUSSION | | See note under Options 2a), 2b) and 2c). | Rating for Technical Criterion overall is based on average rating across the sub-criteria. | | | | | |
| SAFETY | RISK DURING PROJECT EXECUTION | To Project Personnel | Single vessel, minor (2 day) SIMOPS if excavation is required, Shortest overall vessel duration but similar to options 2a), 2b) and 2c). 8" diameter pipelines simple recovery method once on reel with minimal intervention of deck crew. However one of the original pipelines was retired due to internal corrosion, such that potential to reel a badly corroded pipeline is in doubt and increased risk of failure during recovery on reel if attempted. | PRE-SCREENED OUT FOR ALL GROUPS | PRE-SCREENED OUT FOR GROUP C | Relatively short duration, single vessel, no SIMOPS, combined with minimal deck crew interaction. | Relatively short duration, single vessel, no SIMOPS, combined with minimal deck crew interaction. | Relatively short duration, single vessel, no SIMOPS, Some deck crew material handling (Approximately 42te) in recovery of exposed sections of pipelines, potential exposure to pipeline residues at cut ends. But all small diameter pipelines and risks can be mitigated. |
| | | RATING | Moderate Impact | | | Lower Impact | Lower Impact | Lower Impact |
| | | To Other Users of the Sea | Relatively short duration of overall activity < 1month. No vessel transits other than initial Mobilisation and Demobilisation. Reel vessel connected to pipeline on seabed during recovery, but guard vessel can mitigate risks. | | | Relatively short duration circa 6 days and largely within 500m zone at each end of pipeline. Single vessel, no SIMOPS. | Relatively short duration circa 5 days and largely within 500m zone at each end of pipeline. Single vessel, no SIMOPS. | Relatively short duration circa 10 days and largely within 500m zone at each end of pipeline. Single vessel, no SIMOPS. No connection to pipeline on seabed during recovery |
| | | RATING | Not significantly different | | | Not significantly different | Not significantly different | Not significantly different |
| | | To Those on Land | Approximately 2,900te of pipeline returned onshore, yard crew exposure to residues to be managed when pipeline is un-reeled and cut into sections for onward disposal and recycle. | | | Nothing returned onshore. Approximately 2,900te rock cover to be supplied and transported, however not identified as a major risk as supply of rock cover is an ongoing industry practice. | Nothing returned onshore | Only approximately 42te of recovered pipeline returned onshore, minimal quantities and not a differentiator to 2a and 2b |
| | | RATING | Moderate Impact | | | Lower Impact | Lower Impact | Lower Impact |
| | | High Consequence Event | See note under Options 2a), 2b) and 2c). | | | HIRA carried out 16th May 2019 determined there is no specific differentiation identified between all decommissioning options in terms of potential high consequence event. | | |
| | | RATING | Not significantly different | | | Not significantly different | Not significantly different | Not significantly different |
| | RESIDUAL RISK FROM END POINTS | To other Users of the Sea | No residual risk as option will leave a clean seabed. | | | 2,900te of new rock berms introduced, however will be designed and installed to be over trawlable, but could become unstable over time. | No increased risk from existing operating condition, existing trench and buried sections will remain so and exposed sections will be buried to a depth to ensure no future exposure. | No increased risk from existing operating condition, existing trench and buried sections will remain so and exposed sections will be recovered leaving a clean seabed in these areas, cut ends will be at full trench depth and cut ends remaining will be buried. |
| | | RATING | Not significantly different | | | Not significantly different | Not significantly different | Not significantly different |
| SAFETY: OVERALL RATING BASED ON AVERAGE | | Moderate Impact | | | Lower Impact | Lower Impact | Lower Impact | |
| SAFETY: OVERALL RATING BASED ON DISCUSSION | | See note under Options 2a), 2b) and 2c). | Overall rating for Safety Criterion overall is based on average rating across the sub-criteria | | | | | |

GROUP C - RIGID PIPELINE, TRENCHED AND BURIED (NOT CONCRETE COATED)
SOCIAL AND ECONOMIC CRITERIA

| Assessment Criteria | MAIN OPTIONS | TOTAL REMOVAL | | | REMEDiate IN SITU | | |
|--|---|--|---------------------------------|------------------------------|--|--|---|
| | Sub-Options Number | 1a) | 1b) | 1c) | 2a) | 2b) | 2c) |
| | Sub-Criteria/ / Sub-Options | REVERSE REELING | REVERSE S-LAY | CUT & LIFT | EXPOSED SECTIONS ROCK COVERED | EXPOSED SECTIONS TRENCHED & BURIED | EXPOSED SECTIONS CUT & REMOVED |
| SOCIETAL | Impact on Commercial Fisheries | Removing the pipeline may result in a deeper trench left behind. May be concerns from fishermen on length of open trench in future. However not evaluated as having a significant impact. | PRE-SCREENED OUT FOR ALL GROUPS | PRE-SCREENED OUT FOR GROUP C | Additional rock cover at exposed ends will be installed to be over trawlable, rating recognises potential for new rock cover to become unstable over time. May result in fishermen avoiding the area. | No impact anticipated | No impact anticipated |
| | RATING | Lower Impact | | | Moderate Impact | Lower Impact | Lower Impact |
| | Socio-Economic Impact on Communities and Amenities | Quantity of materials recovered onshore is only 2,900te approximately of small diameter pipework, no impact anticipated and not a differentiator. | | | Nothing returned onshore, no impact anticipated. | Nothing returned onshore, no impact anticipated. | Duration of activity and quantity of materials recovered onshore is only 42te of small diameter pipework, no impact anticipated and not a differentiator. |
| | RATING | Not significantly different | | | Not significantly different | Not significantly different | Not significantly different |
| | SOCIETAL: OVERALL RATING BASED ON AVERAGE | Lower Impact | | | Moderate Impact | Lower Impact | Lower Impact |
| SOCIETAL: OVERALL RATING BASED ON DISCUSSION | | | | | | | |
| ECONOMIC | Cost for Decommissioning/ Removal Activities | Within 22% of lowest cost option. | PRE-SCREENED OUT FOR ALL GROUPS | PRE-SCREENED OUT FOR GROUP C | Within 13% of lowest cost option. | Lowest cost option. | Within 21% of lowest cost option. |
| | RATING | Not significantly different | | | Not significantly different | Not significantly different | Not significantly different |
| | Cost for Long Term Monitoring / Remediated Activities | Clean seabed, post decomm survey only. Possible one future visit to monitor behaviour of the trench. | | | Anticipate only two future surveys to monitor behaviour of the rock berms. | Anticipate only two future surveys to monitor behaviour of the fully buried pipelines. | Anticipate only two future surveys to monitor behaviour of the end point. |
| | RATING | Lower Impact | | | Moderate Impact | Moderate Impact | Moderate Impact |
| | ECONOMIC: OVERALL RATING BASED ON AVERAGE | | | | Differential of total cost of each option evaluated is not significant across the options and is less than half the cost of additional monitoring surveys for remediate in situ options. Therefore reducing the need for future monitoring surveys would be most cost efficient strategy. Option 1a) is rated best option accordingly from a cost perspective. | | |
| ECONOMIC: OVERALL RATING BASED ON DISCUSSION | | Lower Impact | | | Moderate Impact | Moderate Impact | Moderate Impact |

GROUP C - RIGID PIPELINE, TRENCHED AND BURIED (NOT CONCRETE COATED)
ENVIRONMENTAL CRITERION

| Assessment Criteria | MAIN OPTIONS | TOTAL REMOVAL | | | REMEDiate IN SITU | | |
|---|--|---|---------------|------------|---|---|---|
| | Sub-Options Number | 1a) | 1b) | 1c) | 2a) | 2b) | 2c) |
| | Sub-Criteria/ / Sub-Options | REVERSE REELING | REVERSE S-LAY | CUT & LIFT | EXPOSED SECTIONS ROCK COVERED | EXPOSED SECTIONS TRENCHED & BURIED | EXPOSED SECTIONS CUT & REMOVED |
| ENVIRONMENTAL | Impact of Decommissioning Operations Offshore <i>(includes emissions to air, discharges to sea and underwater noise)</i> | See note under Options 2a), 2b) and 2c) | | | The ENVID determined that the impact significance of energy use and the resultant atmospherics, of noise from vessels and of discharges to sea is low across all options, such that the environmental impact of decommissioning operations offshore is not considered a significant differentiator. | | |
| | RATING | Not significantly different | | | Not significantly different | Not significantly different | Not significantly different |
| | Seabed Disturbance- Short Term <i>(includes disturbance to the cuttings pile)</i> | Approximately 26km of buried pipeline will be disturbed either by excavation or by recovery by "pulling through" the cover. Recovery of benthic communities will commence once recovery operations are complete. | | | Approximately 2,900te of new rock cover introduced, close proximity of adjacent pipeline exposed sections could potentially mean blanket rock cover across multiple lines, with impact on local benthos. | Short extensions to existing trenches required. | Minimal impact anticipated. |
| | RATING | Moderate Impact | | | Moderate Impact | Lower Impact | Lower Impact |
| | Loss of Habitat - Long Term | Ecosystem recovery commences as soon as operations are completed. | | | Additional rock cover means the introduction of a different habitat type to the area. This will impact existing ecosystem, by allowing other species to settle in the area. | Ecosystem recovery commences as soon as operations are completed. | Ecosystem recovery commences as soon as operations are completed. |
| | RATING | Lower Impact | | | Moderate Impact | Lower Impact | Lower Impact |
| | Waste Processing <i>(i.e. processing of returned materials and use of landfill)</i> | Approximately 39 km of 8"/6" diameter pipeline (2,900te) with residues returning onshore, increased materials to landfill from piggybacked lines, step change in volumes of NORM to be managed, although recycling available. Waste is significantly more than Option 2c. | | | Nothing returned onshore. | Nothing returned onshore. | Total quantities returned onshore only 390m across all pipelines (42te approximately, not significantly different to Options 2a) and 2b) but much less than option 1a). |
| | RATING | Moderate Impact | | | Lower Impact | Lower Impact | Lower Impact |
| ENVIRONMENTAL: OVERALL RATING BASED ON AVERAGE | | Moderate Impact | | | Moderate Impact | Lower Impact | Lower Impact |
| ENVIRONMENTAL : OVERALL RATING BASED ON DISCUSSION | | See note under Options 2a), 2b) and 2c) | | | Rating for Environmental Criterion overall is based on average rating across the sub-criteria | | |

GROUP C - RIGID PIPELINE, TRENCHED AND BURIED (NOT CONCRETE COATED)

VISUAL RATING SUMMARY

| Assessment Criteria | MAIN OPTIONS | TOTAL REMOVAL | | | REMEDiate IN SITU | | |
|---------------------|---|-----------------------------|---------------|------------|--|------------------------------------|--------------------------------|
| | Sub-Options Number | 1a) | 1b) | 1c) | 2a) | 2b) | 2c) |
| | Sub-Criteria/ / Sub-Options | REVERSE REELING | REVERSE S-LAY | CUT & LIFT | EXPOSED SECTIONS ROCK COVERED | EXPOSED SECTIONS TRENCHED & BURIED | EXPOSED SECTIONS CUT & REMOVED |
| TECHNICAL | Risk of Major Project Failure | Moderate Impact | | | Lower Impact | Lower Impact | Lower Impact |
| | Technical Complexity & Track Record | Moderate Impact | | | Lower Impact | Lower Impact | Lower Impact |
| SAFETY | To Project Personnel | Moderate Impact | | | Lower Impact | Lower Impact | Lower Impact |
| | To Other Users of the Sea | Not significantly different | | | Not significantly different | Not significantly different | Not significantly different |
| | To Those on Land | Moderate Impact | | | Lower Impact | Lower Impact | Lower Impact |
| | High Consequence Event | Not significantly different | | | Not significantly different | Not significantly different | Not significantly different |
| | Residual Risk To other Users of the Sea | Not significantly different | | | Not significantly different | Not significantly different | Not significantly different |
| | | | | | | | |
| SOCIETAL | Impact on Commercial Fisheries | Lower Impact | | | Moderate Impact | Lower Impact | Lower Impact |
| | Socio-economic impact on communities and amenities | Not significantly different | | | Not significantly different | Not significantly different | Not significantly different |
| ECONOMIC | Cost for Decommissioning/ Removal activities | Not significantly different | | | Not significantly different | Not significantly different | Not significantly different |
| | Cost for long term monitoring / Remediated activities | Lower Impact | | | Moderate Impact | Moderate Impact | Moderate Impact |
| ENVIRONMENTAL | Impact of Decommissioning Operations Offshore <i>(includes emissions to air, discharges to sea and underwater noise)</i> | Not significantly different | | | Not significantly different | Not significantly different | Not significantly different |
| | Seabed Disturbance- Short Term <i>(includes disturbance to the cuttings pile)</i> | Moderate Impact | | | Moderate Impact | Lower Impact | Lower Impact |
| | Loss of Habitat - Long Term | Lower Impact | | | Moderate Impact | Lower Impact | Lower Impact |
| | Waste Processing <i>(i.e. processing of returned materials and use of landfill)</i> | Moderate Impact | | | Lower Impact | Lower Impact | Lower Impact |
| | Rating | Higher Impact | | | Moderate Impact | Lower Impact | Lower Impact |
| | Ranking | 4 | | | 3 | 1= | 1= |
| | | Discounted option in DP | | | <p>Although Remediated In Situ Option 2b (Exposed Sections trenched and buried) Option 2c) (Exposed Sections cut and removed) are ranked as joint preferred options, the difference in rating between 2b, 2c and 2a is marginal and all three options will be carried through to a Contracting and Procurement (C&P) phase of the project to allow contractors to tender and propose the overall preferred option.</p> <p>If the C&P tendering phase results in either option 2a) being considered more favourable than the preferred options, the Operator will engage with OPRED before a decision is taken on overall strategy.</p> | | |

GROUP C - RIGID PIPELINE, TRENCHED AND BURIED (NOT CONCRETE COATED)

NARRATIVE SUMMARY

| SUMMARY | MAIN OPTIONS | TOTAL REMOVAL | | | REMEDiate IN SITU | | |
|----------------|-----------------------------|---|---------------------------------|------------------------------|--|--|---|
| | Sub-Options Number | 1a) | 1b) | 1c) | 2a) | 2b) | 2c) |
| | Sub-Criteria/ / Sub-Options | REVERSE REELING | REVERSE S-LAY | CUT & LIFT | EXPOSED SECTIONS ROCK COVERED | EXPOSED SECTIONS TRENCHED & BURIED | EXPOSED SECTIONS CUT & REMOVED |
| | Technical | Originally installed from reel. Potential requirement to excavate from trench before recovery with some areas currently rock covered. One of the original pipelines was retired due to internal corrosion, therefore the potential to reel a badly corroded pipeline is in doubt. | PRE-SCREENED OUT FOR ALL GROUPS | PRE-SCREENED OUT FOR GROUP C | Scope is straightforward and understood. No new technology or working practices to be introduced. Option has good industry track record in the North Sea and can be executed by contractors with significant previous experience of all activities involved. | Scope is straightforward and understood. No new technology or working practices to be introduced. Option has good industry track record in the North Sea and can be executed by contractors with significant previous experience of all activities involved. | Scope is straightforward and understood. No new technology or working practices to be introduced. Option has good industry track record in the North Sea and can be executed by contractors with significant previous experience of all activities involved. |
| | RATING | Moderate Impact | | | Lower Impact | Lower Impact | Lower Impact |
| | Safety | Single vessel, minor (2 day) SIMOPS if excavation is required, Shortest overall vessel duration but similar to options 2a), 2b) and 2c). 8" diameter pipelines simple recovery method once on reel with minimal intervention of deck crew. However original pipeline was retired due to internal corrosion potential to reel a badly corroded pipeline is in doubt and increased risk of failure during recovery on reel if attempted. Circa 36km (2,900te) pipeline returned to shore, yard crew exposure to residues to be managed when pipeline is un-reeled and cut into sections for onward disposal and recycle. | | | No vessel SIMOPS, only single vessel in field at any time with activity largely within 500m zone at each end of pipeline for relatively short duration. No materials recovered to or to be handled on deck or onshore. Approximately 2,900te of rock cover to be supplied, however not identified as a risk as supply of rock cover is an ongoing industry practice. There is no specific differentiation identified between all decommissioning options in terms of potential high consequence event. | No vessel SIMOPS, only single vessel in field at any time with activity largely within 500m zone at each end of pipeline for relatively short duration. No materials recovered to or to be handled on deck or onshore. There is no specific differentiation identified between all decommissioning options in terms of potential high consequence event. | No vessel SIMOPS, only single vessel in field at any time with activity largely within 500m zone at each end of pipeline for relatively short duration. Very small quantity of materials to be recovered to and to be handled on deck or onshore. There is no specific differentiation identified between all decommissioning options in terms of potential high consequence event. |
| | RATING | Moderate Impact | | | Lower Impact | Lower Impact | Lower Impact |
| | Societal | Removing the pipeline may result in a deeper trench left behind. May be concerns from fishermen on length of open trench in future. However not evaluated as having a significant impact. Duration of activity and quantity of materials recovered onshore is only 2,900te approximately, of small diameter pipework, no impact anticipated and not a differentiator. | | | Additional rock cover at exposed ends will be installed to be over trawable, although potential for new rock cover to become unstable over time, quantity of rock cover being added is low. Proximity of exposed sections of adjacent pipelines lines, rock berms may be an issue, but not significant, therefore no impact to commercial fisheries anticipated. There is no specific differentiation identified between all decommissioning options in terms of Socio-economic impact on communities and amenities. | No impact to commercial fisheries anticipated. There is no specific differentiation identified between all decommissioning options in terms of socio-economic impact on communities and amenities. | No impact to commercial fisheries anticipated. There is no specific differentiation identified between all decommissioning options in terms of socio-economic impact on communities and amenities. |
| | RATING | Lower Impact | | | Moderate Impact | Lower Impact | Lower Impact |
| | Economic | See note under Options 2a), 2b) and 2c) | | | Differential of total cost of each option evaluated is not significant across the options and is less than half the cost of additional monitoring surveys for remediate in situ options. Therefore reducing the need for future monitoring surveys would be most cost efficient strategy. Option 1a) is rated best option accordingly from a cost perspective. | | |
| | RATING | Lower Impact | | | Moderate Impact | Moderate Impact | Moderate Impact |
| | Environmental | The impact significance of energy use and the resultant atmospherics, of noise from vessels and of discharges to sea is low across all options. Deburial of approximately 26km pipeline introduces greater disturbance than other options where only current exposed sections of pipeline are remediated. However recovery of habitat commences as soon as operations are completed. 2,900te of pipeline with residues returning onshore, increased materials to landfill, step change in volume of NORM to managed although recycling available. Waste is significantly more than Option 2c). | | | The impact significance of energy use and the resultant atmospherics, of noise from vessels and of discharges to sea is low across all options. 2,900te new rock cover, close proximity of adjacent pipeline exposed sections could potentially mean blanket rock cover across multiple lines, with impact on local benthos. Rock cover, will not allow the re-population of existing benthos. Nothing returned onshore. | The impact significance of energy use and the resultant atmospherics, of noise from vessels and of discharges to sea is low across all options. Nothing returned onshore. | The impact significance of energy use and the resultant atmospherics, of noise from vessels and of discharges to sea is low across all options. Total quantities returned onshore only 42te approximately, and not significantly different to Options 2a) and 2b) but much less than Option 1a) |
| | RATING | Moderate Impact | | | Moderate Impact | Lower Impact | Lower Impact |
| OVERALL RATING | | Higher Impact | | | Moderate Impact | Lower Impact | Lower Impact |
| RANKING | | 4 | | | 3 | 1= | 1= |
| | | Discounted Option in DP | | | Although Remediated In Situ Option 2b (Exposed Sections trenched and buried) Option 2c) (Exposed Sections cut and removed) are ranked as joint preferred options, the difference in rating between 2b, 2c and 2a is marginal and all three options will be carried through to a Contracting and Procurement (C&P) phase of the project to allow contractors to tender and propose the overall preferred option. If the C&P tendering phase results in either option 2a) being considered more favourable than the preferred options, the Operator will engage with OPRED before a decision is taken on overall strategy . | | |

GROUP C - RIGID PIPELINE, TRENCHED AND BURIED (NOT CONCRETE COATED)

SENSITIVITY ANALYSIS 1 - MAIN CRITERIA EQUALLY WEIGHTED

By adopting the average ratings for each main criteria from the individual worksheet a single rating by main criteria only can be visualised.
By adopting this visualisation to arrive at a ranking each main criteria is therefore equally weighted. The difference between this Sensitivity and the original ranking by sub-criteria is demonstrated at the bottom of the table below.

| SUMMARY | MAIN OPTIONS | TOTAL REMOVAL | | | REMEDiate IN SITU | | |
|--------------------------|-----------------------------|-------------------------|---------------|------------|--|------------------------------------|--------------------------------|
| | Sub-Options Number | 1a) | 1b) | 1c) | 2a) | 2b) | 2c) |
| | Sub-Criteria/ / Sub-Options | REVERSE REELING | REVERSE S-LAY | CUT & LIFT | EXPOSED SECTIONS ROCK COVERED | EXPOSED SECTIONS TRENCHED & BURIED | EXPOSED SECTIONS CUT & REMOVED |
| | Technical | | | | | | |
| | RATING | Moderate Impact | | | Lower Impact | Lower Impact | Lower Impact |
| | Safety | | | | | | |
| | RATING | Moderate Impact | | | Lower Impact | Lower Impact | Lower Impact |
| | Societal | | | | | | |
| | RATING | Lower Impact | | | Moderate Impact | Lower Impact | Lower Impact |
| | Economic | | | | | | |
| | RATING | Lower Impact | | | Moderate Impact | Moderate Impact | Moderate Impact |
| | Environmental | | | | | | |
| | RATING | Moderate Impact | | | Moderate Impact | Lower Impact | Lower Impact |
| OVERALL RATING | | Moderate Impact | | | Moderate Impact | Lower Impact | Lower Impact |
| RANKING | | 3= | | | 3= | 1= | 1= |
| | | Discounted Option in DP | | | Although Remediated In Situ Option 2b (Exposed Sections trenchd and buried) Option 2c) (Exposed Sections cut and removed) are ranked as joint preferred options, the difference in rating between 2b, 2c and 2a is marginal and all three options will be carried through to a Contracting and Procurement (C&P) phase of the project to allow contractors to tender and propose the overall preferred option. If the C&P tendering phase results in either option 2a) being considered more favourable than the preferred options, the Operator will engage with OPRED before a decision is taken on overall strategy. | | |
| ORIGINAL OVERALL RATING | | Higher Impact | | | Moderate Impact | Lower Impact | Lower Impact |
| ORIGINAL OVERALL RANKING | | 4 | | | 3 | 1= | 1= |

Change from Original Evaluation is that Option 1a) performance improves slightly, bring it to same ranking as Option 2a)

GROUP C - RIGID PIPELINE, TRENCHED AND BURIED (NOT CONCRETE COATED)

SENSITIVITY ANALYSIS 2 - MAIN CRITERIA EQUALLY WEIGHTED AND ECONOMIC CRITERION REMOVED

By adopting the average ratings for each main criteria from the individual worksheet a single rating by main criteria only can be visualised. Removing the Economic criterion provides a further sensitivity.
By adopting this visualisation to arrive at a ranking each main criteria is therefore equally weighted. The difference between this Sensitivity and the original ranking by sub-criteria is demonstrated at the bottom of the table below.

| SUMMARY | MAIN OPTIONS | TOTAL REMOVAL | | | REMEDiate IN SITU | | |
|---------------------------------|-----------------------------|-------------------------|---------------|------------|---|------------------------------------|--------------------------------|
| | Sub-Options Number | 1a) | 1b) | 1c) | 2a) | 2b) | 2c) |
| | Sub-Criteria/ / Sub-Options | REVERSE REELING | REVERSE S-LAY | CUT & LIFT | EXPOSED SECTIONS ROCK COVERED | EXPOSED SECTIONS TRENCHED & BURIED | EXPOSED SECTIONS CUT & REMOVED |
| | Technical | | | | | | |
| | RATING | Moderate Impact | | | Lower Impact | Lower Impact | Lower Impact |
| | Safety | | | | | | |
| | RATING | Moderate Impact | | | Lower Impact | Lower Impact | Lower Impact |
| | Societal | | | | | | |
| | RATING | Lower Impact | | | Moderate Impact | Lower Impact | Lower Impact |
| | Environmental | | | | | | |
| | RATING | Moderate Impact | | | Moderate Impact | Lower Impact | Lower Impact |
| OVERALL RATING | | Higher Impact | | | Moderate Impact | Lower Impact | Lower Impact |
| RANKING | | 4 | | | 3 | 1= | 1= |
| | | Discounted Option in DP | | | Although Remediated In Situ Option 2b (Exposed Sections trenched and buried) Option 2c) (Exposed Sections cut and removed) are ranked as joint preferred options, the difference in rating between 2b, 2c and 2a is marginal and all three options will be carried through to a Contracting and Procurement (C&P) phase of the project to allow contractors to tender and propose the overall preferred option. If the C&P tendering phase results in either option 2a) being considered more favourable than the preferred options, the Operator will engage with OPRED before a decision is taken on overall strategy. | | |
| ORIGINAL OVERALL RATING | | Higher Impact | | | Moderate Impact | Lower Impact | Lower Impact |
| ORIGINAL OVERALL RANKING | | 4 | | | 3 | 1= | 1= |
| SENSITIVITY 1 - OVERALL RATING | | Moderate Impact | | | Moderate Impact | Lower Impact | Lower Impact |
| SENSITIVITY 1 - OVERALL RANKING | | 3= | | | 3= | 1= | 1= |

Change from Original Evaluation is that Option 1a) reverts back to original rating of Higher Impact .

GROUP E - UMBILICAL, TRENCHED AND BURIED
TECHNICAL AND SAFETY CRITERIA

| Assessment Criteria | MAIN OPTIONS | | TOTAL REMOVAL | | | REMEDiate IN SITU | | | | |
|---|-------------------------------------|---------------------------|---|---------------------------------|------------------------------|--|---|--|---|--|
| | Sub-Options Number | | 1a) | 1b) | 1c) | 2a) | 2b) | 2c) | | |
| | Sub Criteria/ / Sub Options | | REVERSE REELING | REVERSE S-LAY | CUT & LIFT | EXPOSED SECTIONS ROCK COVERED | EXPOSED SECTIONS TRENCHED & BURIED | EXPOSED SECTIONS CUT & LIFT | | |
| TECHNICAL | Risk of Major Project Failure | | Originally installed from reel. Potential requirement to excavate from trench before recovery with some areas currently rock covered. Technical assessment on soils and existing rock cover will be required before deciding requirement for excavation. Umbilcal more likely to be pulled through the burial medium than larger diameter pipelines. | PRE-SCREENED OUT FOR ALL GROUPS | PRE-SCREENED OUT FOR GROUP C | Total exposure only 300m at ends of umbilcal. Offshore Execution Phase Schedule unlikely to slip beyond planned schedule plus contingencies applied. Scope is straightforward and understood. | Total exposure only 300m at ends of umbilcal. Offshore Execution Phase Schedule unlikely to slip beyond planned schedule plus contingencies applied. Scope is straightforward and understood. | Total exposure only 300m at ends aof umbilcal Offshore Execution Phase Schedule unlikely to slip beyond planned schedule plus contingencies applied. Scope is straightforward and understood. | | |
| | RATING | | Not significantly different | | | Not significantly different | Not significantly different | Not significantly different | Not significantly different | |
| | Technical Complexity & Track Record | | No new technology or working practices to be introduced. | | | No new technology or working practices to be introduced. Option has good industry track record in the North Sea and can be executed by contractors with significant previous experience of all activities involved. | | | | |
| | RATING | | Not significantly different | | | Not significantly different | Not significantly different | Not significantly different | Not significantly different | |
| TECHNICAL: OVERALL RATING BASED ON AVERAGE | | | Not significantly different | | | Not significantly different | Not significantly different | Not significantly different | | |
| TECHNICAL: OVERALL RATING BASED ON DISCUSSION | | | See note under Options 2a), 2b) and 2c). | | | Rating for Technical Criterion overall is based on risk of major project failure as technical complexity is not a differentiator across all options. | | | | |
| SAFETY | RISK DURING PROJECT EXECUTION | To Project Personnel | Relatively short duration, single vessel, no SIMOPS, and minimal deck crew interaction. | PRE-SCREENED OUT FOR ALL GROUPS | PRE-SCREENED OUT FOR GROUP C | Relatively short duration, single vessel, no SIMOPS, and minimal deck crew interaction. | Relatively short duration, single vessel, no SIMOPS, and minimal deck crew interaction. | Relatively short duration , single vessel, no SIMOPS, Some deck crew material handling 1.1km (8te) in recovery of exposed sections of umbilical, potential exposure to chemical core residues at cut ends, but risks can be mitigated. | | |
| | | RATING | Lower Impact | | | | Lower Impact | Lower Impact | Moderate Impact | |
| | | To Other Users of the Sea | Relatively short duration of overall activity < 1 month. No vessel transits other than initial Mobilisation and Demobilisation. Reel vessel connected to pipeline on seabed during recovery, but guard vessel can mitigate risks | | | | | Relatively short duration of overall activity < 6 days. No vessel transits other thaninitial Mobilisation and Demobilisation, and largely within 500m zone at each end of umbilical. Single vessel, no SIMOPS. | Relatively short duration of overall activity < 6 days. No vessel transits other thaninitial Mobilisation and Demobilisation, and largely within 500m zone at each end of umbilical. Single vessel, no SIMOPS. | Relatively short duration of overall activity < 6 days. No vessel transits other thaninitial Mobilisation and Demobilisation, and largely within 500m zone at each end of umbilical. Single vessel, no SIMOPS. |
| | | RATING | Not significantly different | | | | | Not significantly different | Not significantly different | Not significantly different |
| | | To Those on Land | Circa 13.4km (350te) umbilical returned to shore, yard crew exposure to trapped chemicals in cores to be managed when umbilical is un-reeled and cut into sections for onward disposal and recycle. | | | | | Nothing returned onshore. Approximately 1,550te rock cover to be supplied and transported, however not identified as a major risk as supply of rock cover is an ongoing industry practice. | nothing returned onshore | Only 8te recovered pipeline returned onshore, minimal quantities and not a differentiator to 2a and 2b |
| | | RATING | Moderate Impact | | | | | Lower Impact | Lower Impact | Lower Impact |
| | | High Consequence Event | See note under Options 2a), 2b) and 2c). | | | | | HIRA carried out 16th May 2019 determined there is no specific differentiation identified between all decommissioning options in terms of potential high consequence event. | | |
| | | RATING | Not significantly different | | | | | Not significantly different | Not significantly different | Not significantly different |
| | RESIDUAL RISK FROM END POINTS | To other Users of the Sea | No residual risk as option will leave a clean seabed. | | | | | Approximately 1,550te of new rock berms introduced, however will be designed and installed to be over trawable, but could become unstable over time. | No increased risk from existing operating condition, existing trench and buried sections will remain so and exposed sections will be buried to a depth to ensure no future exposure. | No increased risk from existing operating condition, existing trench and buried sections will remain so and exposed sections will be recovered leaving a clean seabed in these areas, cut ends will be at full trench depth and cut ends remaining will be buried. |
| | | RATING | Lower Impact | | | | | Moderate Impact | Lower Impact | Lower Impact |
| SAFETY: OVERALL RATING BASED ON AVERAGE | | | Moderate Impact | | | Lower Impact | Lower Impact | Lower Impact | | |
| SAFETY: OVERALL RATING BASED ON DISCUSSION | | | See note under Options 2a), 2b) and 2c) | | | Rating for Safety Criterion overall is based on average rating across the subcriteria. | | | | |

GROUP E - UMBILICAL, TRENCHED AND BURIED
SOCIAL AND ECONOMIC CRITERIA

| Assessment Criteria | MAIN OPTIONS | TOTAL REMOVAL | | | REMEDiate IN SITU | | |
|--|--|---|---------------------------------|------------------------------|--|---|--|
| | Sub-Options Number | 1a) | 1b) | 1c) | 2a) | 2b) | 2c) |
| | Sub Criteria/ / Sub Options | REVERSE REELING | REVERSE S-LAY | CUT & LIFT | EXPOSED SECTIONS ROCK COVERED | EXPOSED SECTIONS TRENCHED & BURIED | EXPOSED SECTIONS CUT & REMOVED |
| SOCIETAL | Impact on Commercial Fisheries | Removing the umbilical may result in a deeper trench left behind. May be concerns from fishermen on length of open trench in future. However not evaluated as having a significant impact. | PRE-SCREENED OUT FOR ALL GROUPS | PRE-SCREENED OUT FOR GROUP E | Additional rock cover at exposed ends will be installed to be over trawable, although potential for new rock cover to become unstable over time. Proximity of exposed sections of adjacent pipelines lines, rock berms may be an issue, no rock cover areas on existing umbilical route. | No impact anticipated. | No impact anticipated. |
| | RATING | Lower Impact | | | Moderate Impact | Lower Impact | Lower Impact |
| | Socio-Economic Impact on Communities and Amenities | Quantity of materials recovered onshore is only 13.4km (350te) of umbilical, no impact anticipated and not a differentiator. | | | Nothing returned onshore, no impact anticipated. | Nothing returned onshore, no impact anticipated. | Quantity of materials recovered onshore is only 300m (8te) of umbilical, no impact anticipated and not a differentiator. |
| | RATING | Not significantly different | | | Not significantly different | Not significantly different | Not significantly different |
| SOCIETAL: OVERALL RATING BASED ON AVERAGE | | Lower Impact | | | Moderate Impact | Lower Impact | Lower Impact |
| SOCIETAL: OVERALL RATING BASED ON DISCUSSION | | See note under Options 2a), 2b) and 2c). | | | Rating for Societal Criterion overall is based on impact on commercial fisheries as there is not differential across the options on socio-economic impact on communities and amenities. | | |
| ECONOMIC | Cost for Decommissioning/ Removal Activities | Within 19% of lowest cost option. | PRE-SCREENED OUT FOR ALL GROUPS | PRE-SCREENED OUT FOR GROUP E | Within 18% of lowest cost option. | Lowest cost option. | Within 18% of lowest cost option. |
| | RATING | Not significantly different | | | Not significantly different | Not significantly different | Not significantly different |
| | Cost for Long Term Monitoring / Remediation Activities | Clean seabed, post decomm survey only. Possible one future visit to monitor behaviour of the trench. | | | Anticipate only two future surveys to monitor behaviour of the end point. | Anticipate only two future surveys to monitor behaviour of the end point. | Anticipate only two future surveys to monitor behaviour of the end point. |
| | RATING | Lower Impact | | | Moderate Impact | Moderate Impact | Moderate Impact |
| ECONOMIC: OVERALL RATING BASED ON AVERAGE | | See note under Options 2a), 2b) and 2c). | | | Differential of total cost of each option evaluated is not significant across the options and is less than half the cost of additional monitoring surveys for remediate in situ options. Therefore reducing the need for future monitoring surveys would be most cost efficient strategy. Option 1a) is rated best option accordingly from a cost perspective. | | |
| ECONOMIC: OVERALL RATING BASED ON DISCUSSION | | Lower Impact | | | Moderate Impact | Moderate Impact | Moderate Impact |

GROUP E - UMBILICAL, TRENCHED AND BURIED
ENVIRONMENTAL CRITERION

| Assessment Criteria | MAIN OPTIONS | TOTAL REMOVAL | | | REMEDiate IN SITU | | |
|--|--|---|---------------------------------|------------------------------|---|---|---|
| | Sub-Options Number | 1a) | 1b) | 1c) | 2a) | 2b) | 2c) |
| | Sub Criteria/ / Sub Options | REVERSE REELING | REVERSE S-LAY | CUT & LIFT | EXPOSED SECTIONS ROCK COVERED | EXPOSED SECTIONS TRENCHED & BURIED | EXPOSED SECTIONS CUT & REMOVED |
| ENVIRONMENTAL | Impact of Decommissioning Operations Offshore <i>(includes emissions to air, discharges to sea and underwater noise)</i> | See note under Options 2a), 2b) and 2c) | PRE-SCREENED OUT FOR ALL GROUPS | PRE-SCREENED OUT FOR GROUP E | The ENVID determined that the impact significance of energy use and the resultant atmospherics, of noise from vessels and of discharges to sea is low across all options, such that the environmental impact of decommissioning operations offshore is not considered a significant differentiator. | | |
| | RATING | Not significantly different | | | Not significantly different | Not significantly different | Not significantly different |
| | Seabed Disturbance- Short Term <i>(includes disturbance to the cuttings pile)</i> | Approximately 13.4km of buried umbilical will be disturbed either by excavation or by recovery by "pulling through" the cover. Although recovery of benthos expected to commence once activities are completed. | | | Approximately 1,550te of new rock cover, close proximity of adjacent pipeline exposed sections could potentially mean blanket rock cover across multiple lines, with impact on local benthos. | Extension to existing trench required. | Minimal impact anticipated. |
| | RATING | Moderate Impact | | | Moderate Impact | Lower Impact | Lower Impact |
| | Loss of Habitat - Long Term | Ecosystem recovery commences as soon as operations are completed. | | | Additional rock cover means the introduction of a different habitat type to the area. This will impact existing ecosystem, by allowing other species to settle in the area. | Ecosystem recovery commences as soon as operations are completed. | Ecosystem recovery commences as soon as operations are completed. |
| | RATING | Lower Impact | | | Moderate Impact | Lower Impact | Lower Impact |
| | Waste Processing <i>(i.e. processing of returned materials and use of landfill)</i> | 13.4km of umbilical (350te) with chemical residues in cores returning onshore, increased materials to landfill. Waste is significantly more than Option 2c. Maximum recycling anticipated with minimum going to landfill. | | | Nothing returned onshore. | Nothing returned onshore. | Total quantity returned onshore approx 1.1km of umbilical (8te). Maximum recycle anticipated with minimal going to landfill. Not significantly different to Options 2a) and 2b) but much less than Option 1a) |
| | RATING | Moderate Impact | | | Lower Impact | Lower Impact | Lower Impact |
| ENVIRONMENTAL: OVERALL RATING BASED ON AVERAGE | | Moderate Impact | | | Moderate Impact | Lower Impact | Lower Impact |
| ENVIRONMENTAL : OVERALL RATING BASED ON DISCUSSION | | See note under Options 2a), 2b) and 2c). | | | Overall rating for Environmental Criterion overall is based on average rating across the subcriteria | | |

GROUP E - UMBILICAL, TRENCHED AND BURIED
VISUAL RATING

| Assessment Criteria | MAIN OPTIONS | TOTAL REMOVAL | | | REMEDiate IN SITU | | |
|---------------------|---|-----------------------------|---------------------------------|------------------------------|---|------------------------------------|--------------------------------|
| | Sub-Options Number | 1a) | 1b) | 1c) | 2a) | 2b) | 2c) |
| | Sub Criteria/ / Sub Options | REVERSE REELING | REVERSE S-LAY | CUT & LIFT | EXPOSED SECTIONS ROCK COVERED | EXPOSED SECTIONS TRENCHED & BURIED | EXPOSED SECTIONS CUT & REMOVED |
| TECHNICAL | Risk of Major Project Failure | Not significantly different | PRE-SCREENED OUT FOR ALL GROUPS | PRE-SCREENED OUT FOR GROUP E | Not significantly different | Not significantly different | Not significantly different |
| | Technical Complexity & Track Record | Not significantly different | | | Not significantly different | Not significantly different | Not significantly different |
| SAFETY | To Project Personnel | Lower Impact | | | Lower Impact | Lower Impact | Moderate Impact |
| | To Other Users of the Sea | Not significantly different | | | Not significantly different | Not significantly different | Not significantly different |
| | To Those on Land | Moderate Impact | | | Lower Impact | Lower Impact | Lower Impact |
| | High Consequence Event | Not significantly different | | | Not significantly different | Not significantly different | Not significantly different |
| | Residual Risk To other Users of the Sea | Lower Impact | | | Moderate Impact | Lower Impact | Lower Impact |
| SOCIETAL | Impact on Commercial Fisheries | Lower Impact | | | Moderate Impact | Lower Impact | Lower Impact |
| | Socio-Economic Impact on Communities and Amenities | Not significantly different | | | Not significantly different | Not significantly different | Not significantly different |
| ECONOMIC | Cost for Decommissioning/ Removal Activities | Not significantly different | | | Not significantly different | Not significantly different | Not significantly different |
| | Cost for Long Term Monitoring / Remediation Activities | Lower Impact | | | Moderate Impact | Moderate Impact | Moderate Impact |
| ENVIRONMENTAL | Impact of Decommissioning Operations Offshore <i>(includes emissions to air, discharges to sea and underwater noise)</i> | Not significantly different | | | Not significantly different | Not significantly different | Not significantly different |
| | Seabed Disturbance- Short Term <i>(includes disturbance to the cuttings pile)</i> | Moderate Impact | | | Moderate Impact | Lower Impact | Lower Impact |
| | Loss of Habitat - Long Term | Lower Impact | | | Moderate Impact | Lower Impact | Lower Impact |
| | Waste Processing <i>(i.e. processing of returned materials and use of landfill)</i> | Moderate Impact | | | Lower Impact | Lower Impact | Lower Impact |
| | Rating | Higher Impact | | | Moderate Impact | Lower Impact | Lower Impact |
| | Ranking | 4 | | | 3 | 1= | 1= |
| | Discounted option in DP | | | | Although remediate in situ Option 2b) (exposed sections trenched and buried) and Option 2c) (exposed sections cut and removed) are ranked as joint preferred options, the difference in rating between 2b, 2c and 2a is marginal and all three options will be carried through to a Contracting and Procurement (C&P) phase of the project to allow contractors to tender and propose the overall preferred option. | | |

GROUP E - UMBILICAL, TRENCHED AND BURIED
NARRATIVE SUMMARY

| SUMMARY | MAIN OPTIONS | TOTAL REMOVAL | | | REMEDiate IN SITU | | |
|----------------|-----------------------------|---|---------------------------------|------------------------------|--|--|--|
| | Sub-Options Number | 1a) | 1b) | 1c) | 2a) | 2b) | 2c) |
| | Sub Criteria/ / Sub Options | REVERSE REELING | REVERSE S-LAY | CUT & LIFT | EXPOSED SECTIONS ROCK COVERED | EXPOSED SECTIONS TRENCHED & BURIED | EXPOSED SECTIONS CUT & REMOVED |
| | Technical | Originally installed from reel. Umbilical more likely to be pulled through the burial medium than larger diameter pipelines. No new technology or working practices to be introduced. | PRE-SCREENED OUT FOR ALL GROUPS | PRE-SCREENED OUT FOR GROUP E | Offshore Execution Phase Schedule unlikely to slip beyond planned schedule plus contingencies applied. No new technology or working practices to be introduced. Option has good industry track record in the North Sea and can be executed by contractors with significant previous experience of all activities involved. | Offshore Execution Phase Schedule unlikely to slip beyond planned schedule plus contingencies applied. No new technology or working practices to be introduced. Option has good industry track record in the North Sea and can be executed by contractors with significant previous experience of all activities involved. | Offshore Execution Phase Schedule unlikely to slip beyond planned schedule plus contingencies applied. No new technology or working practices to be introduced. Option has good industry track record in the North Sea and can be executed by contractors with significant previous experience of all activities involved. |
| | RATING | Not significantly different | | | Not significantly different | Not significantly different | Not significantly different |
| | Safety | Relatively short duration, single vessel, no SIMOPS, and minimal deck crew interaction. No vessel transits other than initial Mobilisation and Demobilisation. Reel vessel connected to pipeline on seabed during recovery, but guard vessel can mitigate risks. Circa 13.4km (350te) umbilical returned to shore, yard crew exposure to trapped chemicals in cores to be managed when umbilical is un-reeled and cut into sections for onward disposal and recycle. No residual risk to other users of the sea as option will leave a clean seabed. There is no specific differentiation identified between all decommissioning options in terms of potential high consequence event. | | | Relatively short duration, single vessel, no SIMOPS, and no materials recovered to or to be handled on deck or onshore. Approximately 1,550te of rock cover to be supplied, however not identified as a risk as supply of rock cover is and ongoing industry practice. There is no specific differentiation identified between all decommissioning options in terms of potential high consequence event. | Relatively short duration, single vessel, no SIMOPS, and no materials recovered to or to be handled on deck or onshore. There is no specific differentiation identified between all decommissioning options in terms of potential high consequence event. | Relatively short duration, single vessel, no SIMOPS. Very small quantity of materials recovered to or to be handled on deck or onshore. There is no specific differentiation identified between all decommissioning options in terms of potential high consequence event. |
| | RATING | Moderate Impact | | | Lower Impact | Lower Impact | Lower Impact |
| | Societal | Removing the umbilical may result in a deeper trench left behind. May be concerns from fishermen on length of open trench in future. However not evaluated as having a significant impact. Quantity of materials recovered onshore is only 13.4km (350te) of umbilical, no societal impact anticipated and not a differentiator. | | | Additional rock cover at exposed ends will be installed to be over trawlable, although potential for new rock cover to become unstable over time, quantity of rock cover being added is low. Proximity of exposed sections of adjacent pipelines lines, rock berms may be an issue, but not significant, therefore no impact to commercial fisheries anticipated. There is no specific differentiation identified between all decommissioning options in terms of Socio-economic impact on communities and amenities. | No impact to commercial fisheries anticipated. There is no specific differentiation identified between all decommissioning options in terms of Socio-economic impact on communities and amenities. | No impact to commercial fisheries anticipated. There is no specific differentiation identified between all decommissioning options in terms of Socio-economic impact on communities and amenities. |
| | RATING | Lower Impact | | | Moderate Impact | Lower Impact | Lower Impact |
| | Economic | See note under Options 2a), 2b) and 2c). | | | Differential of total cost of each option evaluated is not significant across the options and is less than half the cost of additional monitoring surveys for remediate in situ options. Therefore reducing the need for future monitoring surveys would be most cost efficient strategy. Option 1a) is rated best option accordingly from a cost perspective. | | |
| | RATING | Lower Impact | | | Moderate Impact | Moderate Impact | Moderate Impact |
| | Environmental | The impact significance of energy use and the resultant atmospherics, of noise from vessels and of discharges to sea is low across all options. Deburial of 26km pipeline introduces greater disturbance than other options where only current exposed sections of pipeline are remediated. However recovery of habitat commences as soon as operations are completed. 2,900te of pipeline with residues returning onshore, increased materials to landfill from piggybacked lines, step change in NORM to handle although recycling available. Waste is significantly more than Option 2c). | | | The impact significance of energy use and the resultant atmospherics, of noise from vessels and of discharges to sea is low across all options. 2,900te new rock cover, close proximity of adjacent pipeline exposed sections could potentially mean blanket rock cover across multiple lines, with impact on local benthos. Rock cover, will not allow the re-population of existing benthos. Nothing returned onshore. | The impact significance of energy use and the resultant atmospherics, of noise from vessels and of discharges to sea is low across all options. Nothing returned onshore. | The impact significance of energy use and the resultant atmospherics, of noise from vessels and of discharges to sea is low across all options. Total quantities returned onshore only 42te, and not significantly different to Options 2a) and 2b) but much less than option 1a) |
| | RATING | Moderate Impact | | | Moderate Impact | Lower Impact | Lower Impact |
| OVERALL RATING | | Higher Impact | | | Moderate Impact | Lower Impact | Lower Impact |
| RANKING | | 4 | | | 3 | 1= | 1= |
| | | Discounted Option in DP | | | Although Remediate In Situ Option 2b (Exposed Sections trenched and buried) Option 2c (Exposed Sections cut and removed) are ranked as joint preferred options, the difference in rating between 2b, 2c and 2a is marginal and all three options will be carried through to a Contracting and Procurement (C&P) phase of the project to allow contractors to tender and propose the overall preferred option. | | |

GROUP E - UMBILICAL, TRENCHED AND BURIED

SENSITIVITY ANALYSIS 1 - MAIN CRITERIA EQUALLY WEIGHTED

By adopting the average ratings for each main criteria from the individual worksheet a single rating by main criteria only can be visualised. By adopting this visualisation to arrive at a ranking each main criteria is therefore equally weighted.
The difference between this Sensitivity and the original ranking by subcriteria is demonstrated at the bottom of the table below.

| SUMMARY | MAIN OPTIONS | TOTAL REMOVAL | | | REMEDiate IN SITU | | |
|---------------------------------|-----------------------------|-----------------------------|---------------|------------|--|------------------------------------|--------------------------------|
| | Sub-Options Number | 1a) | 1b) | 1c) | 2a) | 2b) | 2c) |
| | Sub Criteria/ / Sub Options | REVERSE REELING | REVERSE S-LAY | CUT & LIFT | EXPOSED SECTIONS ROCK COVERED | EXPOSED SECTIONS TRENCHED & BURIED | EXPOSED SECTIONS CUT & REMOVED |
| | Technical | | | | | | |
| | RATING | Not significantly different | | | Not significantly different | Not significantly different | Not significantly different |
| | Safety | | | | | | |
| | RATING | Moderate Impact | | | Lower Impact | Lower Impact | Lower Impact |
| | Societal | | | | | | |
| | RATING | Not significantly different | | | Not significantly different | Not significantly different | Not significantly different |
| | Economic | | | | | | |
| | RATING | Lower Impact | | | Moderate Impact | Moderate Impact | Moderate Impact |
| | Environmental | | | | | | |
| | RATING | Moderate Impact | | | Moderate Impact | Lower Impact | Lower Impact |
| SENSITIVITY 1 - OVERALL RATING | | Moderate Impact | | | Moderate Impact | Moderate Impact | Lower Impact |
| SENSITIVITY 1 - OVERALL RANKING | | 2= | | | 2= | 2= | 1 |
| | | Discounted Option in DP | | | Based on Sensitivity Analysis 1 with main criteria equally rated, only Option 2C should be carried forward as the preferred option in the DP | | |

Change from Original Evaluation is that Option 1a) a performance improves slightly, but Option 2b) is worse

| | | | | | | |
|---------------------------|-------------------------|--|--|--|--------------|--------------|
| ORIGINAL OVERALL RATING | Higher Impact | | | Moderate Impact | Lower Impact | Lower Impact |
| ORIGINAL - OVERALL RATING | 4 | | | 3 | 1= | 1= |
| | Discounted Option in DP | | | Although Remediate In Situ Option 2b) exposed sections trenchd and buried, Option 2c) exposed sections cut and removed, are ranked as joint preferred options, the difference in rating between 2b, 2c and 2a is marginal and all three options will be carried through to a Contracting and Procurement (C&P) phase of the project to allow contractors to tender and propose the overall preferred option. | | |

GROUP E - UMBILICAL, TRENCHED AND BURIED

SENSITIVITY ANALYSIS 2 - MAIN CRITERIA EQUALLY WEIGHTED AND ECONOMIC CRITERION REMOVED

By adopting the average ratings for each main criteria from the individual worksheet a single rating by main criteria only can be visualised. Removing the Economic criterion provides a further sensitivity.
By adopting this visualisation to arrive at a ranking each main criteria is therefore equally weighted. The difference between this Sensitivity and the original ranking by subcriteria is demonstrated at the bottom of the table below.

| SUMMARY | MAIN OPTIONS | TOTAL REMOVAL | | | REMEDiate IN SITU | | | |
|---------------------------------|-----------------------------|-----------------------------|---------------|------------|---|------------------------------------|--------------------------------|---|
| | Sub-Options Number | 1a) | 1b) | 1c) | 2a) | 2b) | 2c) | |
| | Sub Criteria/ / Sub Options | REVERSE REELING | REVERSE S-LAY | CUT & LIFT | EXPOSED SECTIONS ROCK COVERED | EXPOSED SECTIONS TRENCHED & BURIED | EXPOSED SECTIONS CUT & REMOVED | |
| | Technical | | | | | | | |
| | RATING | Not significantly different | | | Not significantly different | Not significantly different | Not significantly different | |
| | Safety | | | | | | | |
| | RATING | Moderate Impact | | | Lower Impact | Lower Impact | Lower Impact | |
| | Societal | | | | | | | |
| | RATING | Not significantly different | | | Not significantly different | Not significantly different | Not significantly different | |
| | Environmental | | | | | | | |
| | RATING | Moderate Impact | | | Moderate Impact | Lower Impact | Lower Impact | |
| SENSITIVITY 2 - OVERALL RATING | | Higher Impact | | | Moderate Impact | Moderate Impact | Lower Impact | Main change from Sensitivity analysis 1 is that option 1a performance is worse slightly worse but could still be moderate |
| SENSITIVITY 2 - OVERALL RANKING | | 4 | | | 2= | 2= | 1 | |
| | | Discounted Option in DP | | | Based on Sensitivity Analysis 2 with main criteria equally weighted and Economic criteria removed, only Option 1a) is more poorly rated than 2a) and 2b). It does not change the outcome on the preferred option which remains Option 2c) and this option should be carried forward as the preferred option in the DP | | | |

| | | | | | | |
|---------------------------|---------------|--|--|-----------------|--------------|--------------|
| ORIGINAL - OVERALL RATING | Higher Impact | | | Moderate Impact | Lower Impact | Lower Impact |
| ORIGINAL - OVERALL RATING | 4 | | | 3 | 1= | 1= |

| | | | | | | |
|--------------------------------|-----------------|--|--|-----------------|-----------------|--------------|
| SENSITIVITY 1 - OVERALL RATING | Moderate Impact | | | Moderate Impact | Moderate Impact | Lower Impact |
| SENSITIVITY 1 - OVERALL RATING | 2= | | | 2= | 2= | 1 |