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**APPENDIX 1:**  
**ENVIRONMENTAL IMPACT ASSESSMENTS BY ENVIRONMENTAL**  
**CATEGORY**



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## Introduction

Appendix 1 provides DNV GL’s assessment matrices for each of the eleven environmental categories and facilities examined as part of the Brent Field Decommissioning ES. Matrices are presented by environmental categories, and then by facility. Descriptions of the environmental categories, what is covered within each category, and any established boundaries and overlaps between categories are presented in the table below.

Category	Description
Onshore Impacts	Onshore Impacts assess onshore impacts occurring from operations as a result of the decommissioning project such as traffic, noise, odour, dust, light and visual impacts. Coastal impacts adjacent to and resulting from, the onshore site are also included. Impacts that relate to both ‘Physical’ and ‘Onshore Impacts’ are covered under ‘Onshore Impacts’. Waste management impacts onshore are assessed under ‘Waste’.
Resource Use	Resource Use covers the use of materials (e.g. grillage or steel material used on platform upgrades to facilitate decommissioning). Energy use and air emissions are covered under ‘Energy and Emissions’.
Hazardous Substances	Hazardous Substances covers the assessment of the handling and removal of hazardous materials present at the facilities (e.g. hydrocarbons, chemicals, asbestos, Naturally Occurring Radioactive Material NORM), or the use of hazardous materials as part of the decommissioning process (e.g. sodium nitrate). Impacts resulting from the disturbance of drill cuttings (seabed and cell top) are covered under ‘Marine’. Impacts from recovering cell sediment (Options 1 and 2) are captured within other matrices (‘Onshore’, ‘Waste management’, ‘Environmental risk of accidents’).
Waste	The waste assessment is based on the non-hazardous material inventories for the Brent Field, and includes materials such as concrete and steel. Any hazardous materials encountered during decommissioning of the topsides are covered under ‘Hazardous Substances’. Wastewater onshore is captured within ‘Onshore Impacts’. Long-term waste impacts due to landfilling are covered within this category.
Physical	Physical impacts cover the offshore activities related to the decommissioning activities and relate to physical changes to the structure or substructure of the seabed as a result of the decommissioning project such as anchor pits and dredging activities. Impacts that relate to both the ‘Physical’ and ‘Onshore Impacts’ are covered under ‘Onshore Impacts’. Impacts to the marine biological environment (e.g. biota, and fish) are covered under ‘Marine’. Long-term impacts such as habitat change (e.g. due to rock dump) are covered under legacy.
Marine (includes underwater noise)	Marine is an assessment of impacts to the marine biological environment including benthic organisms, fish, shellfish, plankton, seabirds and marine mammals. Long-term impacts to the marine environment are assessed under ‘Legacy’ impacts.  ‘Underwater Noise’ impacts on marine mammals and fish (from e.g. cutting of structures in the sea) were assessed individually and assessment results have been incorporated within the ‘Marine’ impacts matrices. Onshore noise nuisance is covered within ‘Onshore’ impacts.
Environmental Risk from Accidents	Environmental Risk from Accidents qualitatively assesses the risk to the environment from potential accidents during the decommissioning activities. The consequences from such accidents are expected to be reversible, usually delaying the schedule of the decommissioning activities. However, some failures will have the potential to impact the environment through operations (e.g. lifting) resulting in spillages of oil or chemicals (from vessels or broken pipelines) or misplaced disposal (dropped module). This is not an environmental risk assessment, and considers environmental risks from accidents only in a broad sense.
Employment	Employment assesses potential impacts to employment resulting from decommissioning activities to both onshore and offshore workforce as well as from vessels activity.
Legacy	Legacy assesses the long-term (legacy) impacts (physical and chemical) of all decommissioning activities and of leaving structures <i>in situ</i> in the sea (to eventually degrade over hundreds of years).

Category	Description
	This is an all-encompassing assessment which looks at overall long-term impacts to all environmental categories (apart from landfilling, which is captured in the 'Waste' category) and is particularly relevant for long term impacts to fisheries, the marine environment and to shipping.
Fisheries	The fisheries assessment of impacts to the fishing industry as a result of decommissioning activities considers operations such as increased marine operations and traffic affecting fishing vessels. The current state of the commercial fishing industry in the area is used as the environmental baseline. Long-term impacts as a result of leaving structures <i>in situ</i> are assessed under 'Legacy'.
Shipping	Impacts to shipping and shipping lanes resulting from operational decommissioning activities are assessed in this category. Proximity of shipping routes to the Brent platforms and ship frequency is considered, as well as projected use of decommissioning vessels. Long-term impacts to shipping as a result of leaving structures <i>in situ</i> are assessed under 'Legacy'.
Energy and Emissions (E&E)	Energy and Emissions estimates the energy use and gaseous emissions (CO <sub>2</sub> , NO <sub>x</sub> , SO <sub>x</sub> ) associated with the various decommissioning options. This comprises E&E from preparatory work through to material removal, offshore transport, onshore demolition, onshore transport, and the recycling of metals and other materials. In addition, the E&E associated with the replacement of 'lost' materials (materials which are either left <i>in situ</i> or disposed of to landfill and thus not recycled) is taken into account. See Section <b>Error! Reference source not found.</b> for further detail.

The main objective of this assessment is to distinguish the significant impacts from those that are less significant, so that further consideration can then be given to those issues considered to have greatest potential for impact, such that decision making is facilitated. The significance of impacts for a specific environmental category is dependent on the ecological value or sensitivity of a given resource, combined with the importance of the effect of a disturbance, thus assessing the total impact.

To do this, DNV GL developed impact matrices. The first section within the matrix gives a general description of the area, including local environment (1). The second section describes the scale of effect, from highly negative to highly positive (2). Finally, the third section (3) establishes the overall impact per environmental category by combining the first two sections. See the main ES report for further explanation of DNV GL's impact assessment methodology.

The matrices are listed in the following order in this Appendix:

- Onshore
- Resource use
- Hazardous substances
- Waste management
- Physical
- Marine
- Environmental risk
- Employment
- Legacy
- Fisheries
- Shipping

There are a large number of pipelines, a large number of decommissioning options assessed and a large number of environmental categories examined. This has generated hundreds of matrices for



pipelines. To make reference for the reader easier, pipeline matrices have been presented together separately at the end of this appendix, and cover the environmental categories in the same order as detailed above.

## 1.1 ONSHORE IMPACTS

**Category: Topsides/Jacket/GBS/Attic Oil/Cell Contents/Drilling Leg and Minicell Annulus/Drill Cuttings/Subsea Structures and Debris/Wells**

**Consequence evaluation for: Onshore Impacts**

### 1. General description of the receiving environment (situation and characteristics)

Onshore impacts can occur from operations as a result of the decommissioning project, such as traffic, noise, odour, dust, light and visual impacts. Impacts that relate to both 'Physical' and 'Onshore' are covered under 'Onshore'. Onshore impacts also include inshore impacts adjacent to the onshore site. Waste management impacts onshore are covered in 'Waste Management'.

Able has been awarded the contract to dismantle the Brent A topsides and jacket, and the Brent B and D topsides at their Able Seaton Port (ASP) facility at Teesside, on the northeast coast of England, which is described in the ES. The details surrounding the dismantling of the Brent C platform are being finalised, although it is anticipated this will follow a similar process to the other Brent topsides. The location and contracts for the dismantling and disposal of the remaining Brent Field facilities have not yet been decided. Shell UK will only use onshore facilities that are licensed to receive the decommissioning wastes that will be generated.

For the locations that are not yet known, the sensitivity is allocated some uncertainty because it is difficult to assess it without knowing the exact onshore dismantling location, the nature of the surrounding environment and the proximity to the local population. Shell UK's selection procedures will ensure the suitability of the onshore dismantling location and take the above issues into consideration, as some issues such as noise, visual and dust impacts can sometimes be difficult to avoid for communities within the immediate vicinity of the potential deconstruction location. The overall sensitivity is estimated to be 'medium' for the onshore sites that are not currently known; the value could in reality be low as well as high, hence some uncertainty is allocated.

Although the ASP facility is not considered to be a sensitive area with respect to residential receptors because they are located more than 1 km away, several environmentally protected habitats important for both birds and seals are located very close to the site. Hence the ASP facility is allocated a relatively 'high' value, with little uncertainty. The value is only relevant for the Brent Field topsides and jacket, as it is known that they will be brought to the ASP facility.

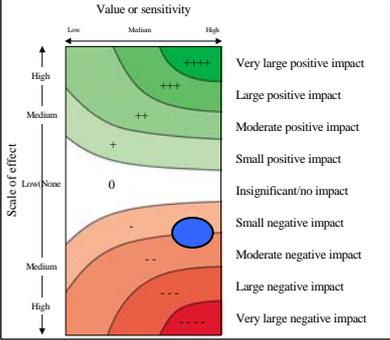
#### Evaluation of the value:

Low Medium High

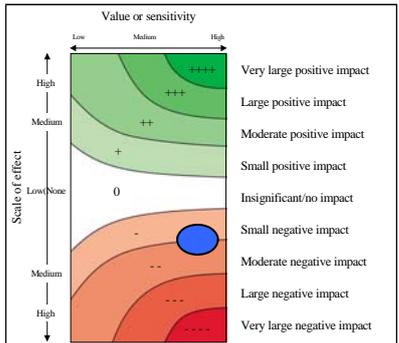
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## TOPSIDES – Onshore Impacts

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 1: Complete Removal by SLV.</b></p> <p>For the topsides only one decommissioning option is considered – complete removal in one piece using SLV.</p> <p>DNV GL’s Environmental Scoping Report [1] helps identify the main activities with potential for onshore impact when decommissioning the Brent Field topsides:</p> <ul style="list-style-type: none"> <li>• Dust emissions from deconstruction of topsides onshore</li> <li>• Dust and noise emissions from increased traffic onshore</li> <li>• Noise from onshore deconstruction activities (e.g. lifting and cutting)</li> <li>• Visual impacts</li> </ul> <p>The topsides will undergo a DPV programme prior to removal to ensure that no pockets of hydrocarbon liquid or gas remain. This will reduce the amount of material brought to shore for processing and disposal.</p> <p>The ASP facility will receive and dismantle the Brent topsides, which includes approximately 76,700 tonnes of steel from the 4 topsides, plus 2,150 t of external steel. The onshore facility is accredited to ISO 9001:2008 (Quality Management System), ISO 14001:2004 (Environmental Management System), OSHAS 18001:2007 (Health and Safety Management System), and ISO 30000 (Ship Recycling Management System). This assessment assumes that the ASP facility will be responsibly managed by Able.</p> <p>The dismantling activities will increase the noise, dust, traffic and visual impacts in the area for prolonged periods of time. The dismantling of each topside is estimated to take 12 months, spread over 8 years. However, Able are licensed to receive decommissioning wastes and mitigation measures and onshore process controls will be in place to minimise impacts, including the establishment of an environmental monitoring regime. Additionally, the nearest residential receptor sensitive to noise, odour and dust is located more than 1 km distant, far enough away to not be of any great concern. Controls such as sweeping vehicles, water sprays and enforced speed limits will also limit dust impacts.</p> <p>There are habitats located very close to the site that are important for birds and seals, and Able manage a stakeholder group, that includes RSPB, English Nature and Hartlepool Council, that meets every quarter to ensure that any concerns are being addressed. The main concern relates to noise from piling, and Able restrict when piling occurs to an agreed timescale. There will be no piling onshore related to Shell BDP, and the topsides dismantling operations will take place more than 500 m away from the area where the birds feed. A thick sand bed will also be in place to minimise noise and vibration.</p> <p>There will be extended periods of visual impact owing to the size of the topsides (the drilling and flare towers reach 84 m and 130 m, respectively) and because the topsides will arrive in one piece. However, given that the onshore location is an established industrial facility, and because the visual impact will reduce as the topsides are dismantled, the anticipated visual impacts will be reduced.</p> <p>Traffic in and out of site should not be a major issue because most of the material leaving site will be steel and this will mainly be shipped out of site or go via train.</p> <p>Onshore operations will be independently audited to help ensure regulatory limits are satisfied.</p> <p>To accommodate the Brent topsides, a new grounding pad is being constructed at the ASP facility as part of ongoing expansion work; additionally, Quay 6 is being strengthened. These activities will be completed prior to receipt of the decommissioned Brent facilities, hence they are not considered as specifically part of the BDP and therefore outside the scope.</p> <p>(contd.)</p>	<p>1) and 2) are combined in the impact matrix.</p> <p><b>Option 1: ‘Small-moderate negative’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle.</p> 

## TOPSIDES – Onshore Impacts

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 1: Complete Removal by SLV.</b></p> <p>(contd.)</p> <p>Based on responsible management and control, the overall evaluation of the scale of effect as a result of topsides decommissioning is found to be ‘low-medium negative’ for complete removal via SLV. This is mainly because of the large volume of material that will be brought ashore, the long time period involved, and the proximity of sensitive receptors (birds and seals) to the site. The evaluation assumes that onshore mitigation controls will be implemented and independently audited, and that the dismantling operations will be carried out under all necessary permits and consents. The overall onshore impact is estimated to be ‘small-moderate negative’.</p> <p>Further detail is provided in the Environmental Statement.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: ‘Small-moderate negative’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle.</p>  <p>The diagram is a 2D matrix with 'Scale of effect' on the vertical axis (High, Medium, Low/None) and 'Value or sensitivity' on the horizontal axis (Low, Medium, High). The matrix is divided into regions of impact: Very large positive impact (++++), Large positive impact (+++), Moderate positive impact (++), Small positive impact (+), Insignificant/no impact (0), Small negative impact (-), Moderate negative impact (--), Large negative impact (---), and Very large negative impact (----). A blue circle is placed in the 'Small negative impact' region, centered around the intersection of 'Medium' sensitivity and 'Medium' scale of effect.</p>

# BRENT A UPPER JACKET – Onshore Impacts

## 2. Description of the scale of effect

### Option 1: Removal in one piece to approx. -84.5m LAT using SLV

DNV GL’s Environmental Scoping Report [1] identified the main activities with potential for onshore impact if not controlled related to the decommissioning of the upper Brent A jacket:

- Odour from marine growth on jacket.
- Noise and vibration from lifting and cutting steel onshore
- Potentially increased onshore traffic nuisance
- If a structure needs to be constructed inshore to receive jacket or jacket sections, construction noise/visual/marine impacts will need to be addressed. Shell advise that such works would be completed before the BDP begins and are not within the scope of this EIA.

These activities are discussed below.

Under Option 1, the Brent A upper jacket will be removed to -84.5 m LAT using an SLV. The decommissioned upper jacket will be brought onshore to the ASP facility. Approximately 8,400 t of steel will be taken onshore. The facility is accredited to ISO 9001:2008 (Quality Management System), ISO 14001:2004 (Environmental Management System), OSHAS 18001:2007 (Health and Safety Management System), and ISO 30000 (Ship Recycling Management System).

Marine growth on the jacket structure can result in odour emissions onshore, the impact will depend on the amount of marine growth, temperature, air exposure time, drying and the efficiency of disposal methods. The mass of marine growth is estimated to be 1,600 t for Option 1. At the ASP facility, the marine growth is likely to be left to dry until it drops off the jacket sections. Birds will eat the dried marine growth but residues will be disposed of to landfill. Able has experience of handling marine growth from decommissioned oil and gas facilities and there is no local population in the immediate vicinity of the site, so only odour impacts onsite are anticipated. The waste, after drying, will be disposed of to the local Seaton Meadows landfill (see ‘Waste’ matrices).

There will be periods of visual impact owing to the size of the jacket section, but given that the onshore location is an established industrial facility, the anticipated visual impacts will be reduced.

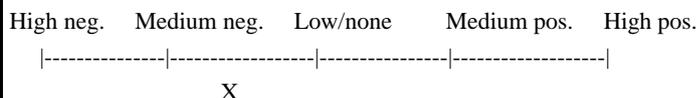
Noise and dust impacts are possible during dismantling operations, although the nearest residential receptor sensitive to noise and dust is located 1 km away, far enough to not be of any great concern. There are environmentally protected habitats located very close to the site that are important for birds and seals, and Able manage a stakeholder group, that includes RSPB, English Nature and Hartlepool Council, that meets every quarter to ensure that any issues are being addressed. The main concern with regards to noise relates to piling, and Able restrict when piling occurs to an agreed timescale. There will be no piling onshore related to the Shell BDP. A thick sand bed will also be in place to minimise noise and vibration.

Dust emissions could also potentially be significant to local populations, but again owing to their distance from the site, impacts are expected to be small. Mitigation measures will be put in place where necessary (e.g. water sprays to control dust from concrete crushing, on-site speed restrictions, strict controls, independent auditing).

Traffic in and out of site should not be a significant issue because most of the material leaving site will be steel and will be shipped or sent by train.

The overall evaluation of onshore impacts as a result of the Brent A upper jacket decommissioning is found to be ‘small negative’ for Option 1. The evaluation assumes that strict onshore mitigation controls will be implemented and independently audited, that an environmental monitoring and management regime will be in place and that the dismantling operations will be carried out under all necessary permits and consents. Further detail is provided in the Environmental Statement.

### Evaluation of scale of effect:

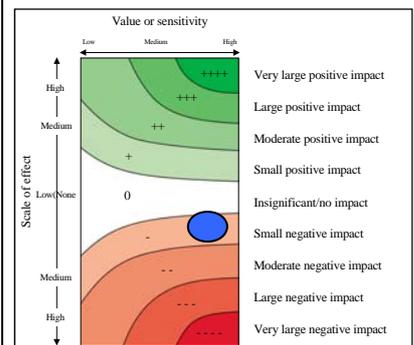


## 3. Total (environmental) impact

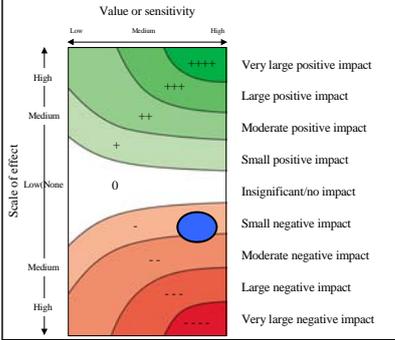
1) and 2) are combined in the impact matrix.

### Option 1: ‘Small negative’

The uncertainty of the total impact is highlighted by the size of the circles/ellipses.

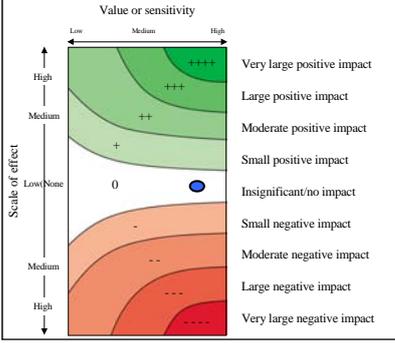


# BRENT A JACKET FOOTINGS – Onshore Impacts

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 1: Complete removal by SSCV in several pieces, after cuttings the piles externally</b></p> <p>The decommissioned Brent A jacket footings will be brought onshore to the ASP facility under Option 1. The potential onshore impacts when decommissioning the Brent A jacket footings are like those described in the matrix for the Brent A upper jacket, including: odour from marine growth, noise, dust and vibration, and increased traffic nuisance.</p> <p>The main difference for this option is the volumes of material involved.</p> <p>The removal of the jacket footings will result in the following volumes coming to shore: approximately 14,850 tonnes of recyclable steel, 5,200 tonnes of concrete, 1,130 tonnes of marine growth and 155 tonnes of metal anodes. The impacts will be similar to those described in more detail in the Brent A upper jacket matrix, but as the volumes of material involved are larger, the onshore impact of decommissioning the footings is estimated to be ‘small-moderate’ negative, given that the activities associated with this option would require more time to be executed.</p> <p>The evaluation assumes that strict onshore mitigation controls will be implemented and independently audited, and that the dismantling operations will be carried out under all necessary permits and consents. Further detail is provided in the Environmental Statement.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: ‘Small-moderate negative’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p> 

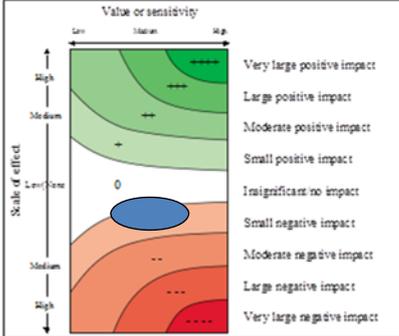


## BRENT A JACKET FOOTINGS – Onshore Impacts

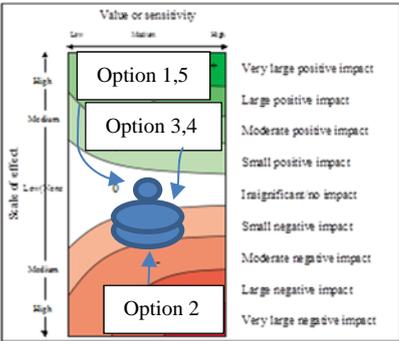
2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 3: Leave <i>in situ</i></b></p> <p>As the Brent A jacket footings will be left <i>in situ</i> in Option 3, there are no onshore impacts.</p> <p><b>Evaluation of scale of effect:</b>            High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 3: ‘No impact’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p> 



## GBS ATTIC OIL - Onshore Impacts

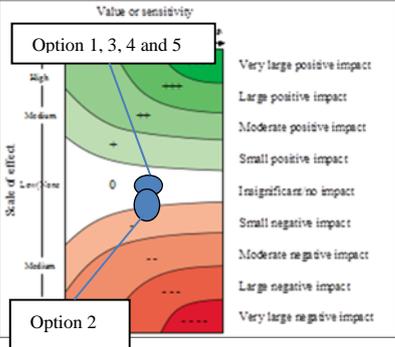
2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 1: Recover to Shore</b></p> <p>For all cell contents options, the attic oil (approximately 12-14,000 m<sup>3</sup> in total) will be recovered and taken to shore for treatment and re-use. It will likely be taken offsite by road tanker; hence the biggest impact onshore is likely to be traffic nuisance, with an associated 'small negative' impact. The onshore location is not yet known, but Shell will ensure it is responsibly managed, is licensed to perform waste management operations, and that operations will be carried out within licence conditions. Shell will also audit onshore operations to ensure regulatory limits are met.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: 'Small negative'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p> 

## GBS CELL CONTENTS – Onshore Impacts

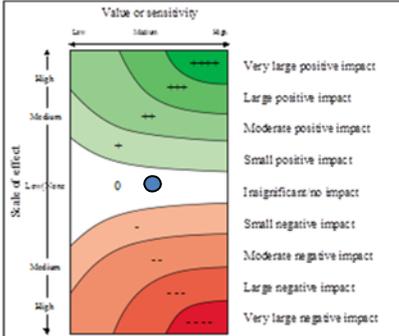
2. Description of the scale of effect Options 1, 2, 3, 4, 5	3. Total (environmental) impact
<p>For the GBS cell contents, 5 decommissioning options are considered:</p> <ul style="list-style-type: none"> <li>Option 1: mobilise to vessel and re-inject to new wells in the Brent Field</li> <li>Option 2: mobilise and retrieve to vessel and transport to shore for treatment</li> <li>Option 3: cap or cover <i>in situ</i> in the cells using e.g. a mixture of sand / gravel</li> <li>Option 4: leave <i>in situ</i> in the cells and treat with MNA</li> <li>Option 5: leave <i>in situ</i> in the cells for natural degradation</li> </ul> <p>For all cell contents options, the attic oil /interphase material (total approximately 12-14,000 m<sup>3</sup>) will be recovered and taken to shore for treatment and potentially re-used, but this is assessed within the Attic Oil matrices. Hence Options 1 and 5 have ‘no onshore impact’.</p> <p>Options 3 and 4 will involve the return of displaced cell water to shore for treatment (between approximately 15,000-35,000 m<sup>3</sup>) as a result of the addition of materials to the cells. Although the volume is large, the oily content is not, and treatment onsite would reduce wastewater contaminants to acceptable levels before discharge. There would be only limited transport of residual oils offsite (and hence limited potential nuisance). Hence the onshore impact is considered small.</p> <p>For Option 2, a ‘small-moderate negative’ impact is allocated due to the handling, treatment and disposal of slurry onshore, as there are large quantities of the diluted slurry that will be brought to shore (~600,000 m<sup>3</sup> slurry for all three GBS, plus an additional 640,000 m<sup>3</sup> of cell water). It is assumed that the water phase (90%) of the dilute slurry (and the cell water) will be treated at the onshore facility. Only the remaining 10% of residual sludge would be transported on the road network and this could cause some nuisance owing to the volumes involved. Although there are large volumes of cell sediment, the impacts will be less than for GBS because handling/crushing concrete is considered to have more potential for local disturbance, because of associated dust and noise issues.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p>----- ----- ----- ----- ----- </p> <p>                  X<sub>2</sub>    X<sub>3,4</sub>    X<sub>1,5</sub></p>	<p>1) and 2) are combined in the impact matrix.</p> <p><b>Options 1, 5: ‘No impact’</b>  <b>Options 3/4: ‘Small negative’</b>  <b>Option 2: ‘Small-moderate negative’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p> 



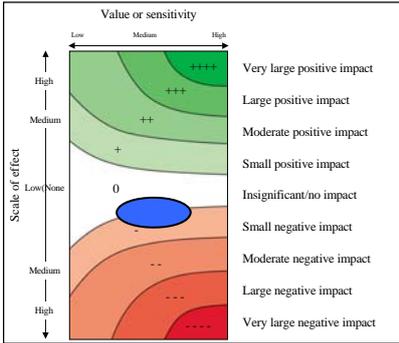
# GBS MINICELL ANNULUS MATERIAL – Onshore Impacts

2. Description of the scale of effect Options 1, 2, 3, 4, 5	3. Total (environmental) impact
<p>For the GBS Brent B and D minicell annulus material, 5 decommissioning options are considered:</p> <p>Option 1: Mobilise and re-inject in a ‘new’ drilled subsea well away from site            Option 2: Mobilise and retrieve to vessel and dispose onshore.            Option 3: Cap or cover <i>in situ</i> using sand and coarse gravel.            Option 4: Leave <i>in situ</i> and improve natural biodegradation by adding chemicals (Monitored Natural Attenuation, MNA)            Option 5: Leave <i>in situ</i> for natural biodegradation</p> <p>For Options 1 and 5 there are no onshore activities, therefore no onshore impact.</p> <p>Option 2:            For Brent B and D, it is estimated that 500 m<sup>3</sup> of sediment would be dredged and mobilised as a slurry to a SSCV. The total slurry volume generated will only be about 1% of the total GBS cell sediment slurry volumes generated (3 GBS) for Option 2.</p> <p>The slurry will be transported to shore, dewatered and then treated via low temperature thermal desorption. Dry inert solids will be sent to landfill and recovered oil will be re-used, and their transport on the road network may cause some minor nuisance but the volumes involved are very small, and an ‘Insignificant –small negative’ impact is allocated due to the handling, treatment and disposal of slurry onshore.</p> <p>Option 3 and 4:            Option 3 and 4 will only involve the return of small volumes of displaced cell water to shore for treatment as a result of the addition of materials to the minicells. Hence the onshore impact is considered insignificant.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X<sub>2</sub> X<sub>1,3,4,5</sub></p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Options 1, 3,4, 5: ‘No impact/insignificant’</b>  <b>Option 2: ‘Insignificant – small negative’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p> 

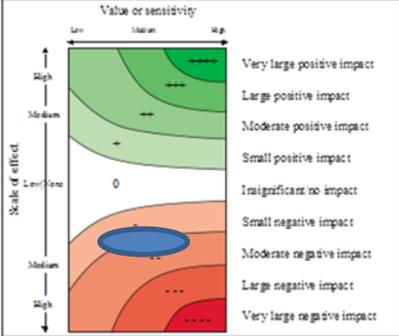
## SEABED DRILL CUTTINGS – Onshore Impacts

<p><b>2. Description of the scale of effect</b>  <b>Option 1: Leave <i>in situ</i></b></p>	<p><b>3A. Total (environmental) impact</b></p>
<p>For the seabed drill cuttings, the decommissioning option is to leave <i>in situ</i> on the seabed for natural degradation.</p> <p>As the decommissioning option considered for the drill cuttings on seabed does not involve onshore activities the impact onshore is zero.</p> <p><b>Evaluation of scale of effect:</b>          High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: No impact</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p> 

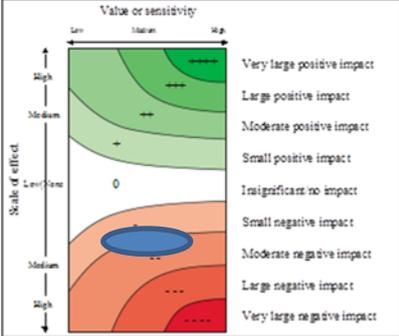
## BRENT A SEABED DRILL CUTTINGS - Onshore Impacts

<p><b>2A. Description of the scale of effect</b></p> <p><b>Brent A Seabed Drill Cuttings: Option 1: Dredge, transfer to Brent C topsides and treat and discharge water and solids to sea</b></p>	<p><b>3A. Total (environmental) impact</b></p>
<p>For the complete removal of the jacket footings Option 1, the seabed drill cuttings at Brent A will need to be removed by dredging to enable the Brent A jacket footings to be cut. There are 4 options available to manage the dredged drill cuttings.</p> <p>Option 1 involves dredging approximately 8,000 m<sup>3</sup> of seabed drill cuttings and contaminated seabed around the Brent A jacket, treating the slurry on the Brent C topsides and discharging the treated seawater and solids to sea. Only the recovered oil would be returned to shore; this is estimated to be less than 500 tonnes of oil. This volume of material is relatively small, and although there will be some associated traffic/noise nuisance in managing the recovered oil onshore, the onshore impact is estimated to be 'insignificant-small negative'.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p><b>Option 1: 'Insignificant-small negative'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p> 

## BRENT A SEABED DRILL CUTTINGS - Onshore Impacts

<b>2B. Description of the scale of effect</b> <b>Brent A Seabed Drill Cuttings: Option 2: Dredge, transfer to vessel and transport slurry to shore for treatment and disposal</b>	<b>3B. Total (environmental) impact</b>
<p>For complete removal of the jacket footings Option 1, the seabed drill cuttings at Brent A will need to be removed by dredging to enable the Brent A jacket footings to be cut. There are 4 options available to manage the drill cuttings.</p> <p>Option 2 involves dredging approximately 8,000 m<sup>3</sup> of seabed drill cuttings and contaminated seabed from around the Brent A jacket and transporting the slurry by shuttle tanker to shore for treatment. As the cuttings to water ratio in the dredging operation is estimated to be 1:10, the amount of slurry generated would be approximately 80,000 m<sup>3</sup>.</p> <p>The main potential for onshore impacts relates to increased traffic, noise, waste, odour, wastewater and nuisance impacts related to the handling and treatment of 80,000 m<sup>3</sup> of slurry (containing less than 1% oil) onshore, a significant volume.</p> <p>Assuming that:</p> <ul style="list-style-type: none"> <li>the slurry will settle in holding tanks and hence be de-watered onsite to some degree (reduced to approx. 15,000 m<sup>3</sup> sludge); the water will be treated and returned to sea or sewer in accordance with permit conditions.</li> <li>the 15,000 m<sup>3</sup> of thick sludge will be transported offsite (800 trips) and further de-watered and then treated by thermal desorption. The cleaned processed powder deposited at a licensed landfill site in accordance with permit conditions.</li> <li>the recovered oil will be recycled (~500 tonnes).</li> <li>all activities will be undertaken under responsible management and control and in line with permit conditions;</li> </ul> <p>The impact can be managed to acceptable levels. The most significant onshore impact is considered to be the transport of thickened sludge out of the onshore site; an estimated 800 trips will be required. This will have some nuisance impact upon the local area, the extent of which is very dependent on the location. A traffic management plan may need to be developed to mitigate impacts. It is currently not known if the thermal desorption processes will be located at the onshore location. If so, this would reduce the volumes of materials requiring transport offsite by 50% as the excess water contained within the cuttings slurry will be removed onsite.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 2: ‘Small-moderate negative’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p> 

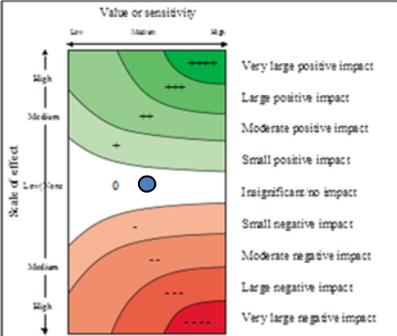
## BRENT A SEABED DRILL CUTTINGS - Onshore Impacts

<b>2C. Description of the scale of effect</b> <b>Brent A Seabed Drill Cuttings: Option 3: Dredge to vessel, transfer to Brent C topsides; water treated and discharged to sea, solids to shore</b>	<b>3C. Total (environmental) impact</b>
<p>For complete removal of the jacket footings Option 1, the seabed drill cuttings at Brent A will need to be removed by dredging to enable the Brent A jacket footings to be cut. There are 4 options available to manage the drill cuttings.</p> <p>Option 3 involves dredging approximately 8,000 m<sup>3</sup> of seabed drill cuttings and contaminated seabed from around the Brent A jacket, dewatering the slurry (approximately 80,000 m<sup>3</sup>) on the Brent C topsides, and transporting the resultant thickened sludge (approximately 10,000 m<sup>3</sup>) by shuttle tanker to shore for treatment.</p> <p>The main potential for onshore impacts (if not controlled) relate to increased traffic, noise, waste, odour, wastewater and nuisance impacts related to handling and treating 10,000 m<sup>3</sup> of thickened sludge onshore.</p> <p>Assuming that:</p> <ul style="list-style-type: none"> <li>the 10,000 m<sup>3</sup> of thickened sludge will be transported offsite and thereafter treated by thermal desorption and the cleaned solids deposited at licensed landfill site in accordance with permit conditions.</li> <li>the recovered oil will be recycled (~500 tonnes).</li> <li>all activities will be undertaken under responsible management and control and in line with permit conditions.</li> </ul> <p>The impact can be managed to acceptable levels. The most significant onshore impact will be the transport of solids/oil out of the onshore site; an estimated 580 trips will be required. This will have some nuisance impact upon the local area, the extent of which is very dependent on the location. A traffic management plan may need to be developed to mitigate impacts. It is currently not known if the thermal desorption processes will be located on the onshore location. If so, this would reduce the volumes of materials requiring transport offsite by 50% as the excess water contained within the solids will be removed onsite.</p> <p>The overall impact would be a little lower than Option 2 because less material is received and managed onsite, but Option 3 is still considered as small-moderate negative because the transport of the thickened sludge off the site still retains potential to impact upon local communities, and the volume transported offsite is similar, albeit smaller, to Option 2.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 3: ‘Small-moderate negative’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p> 

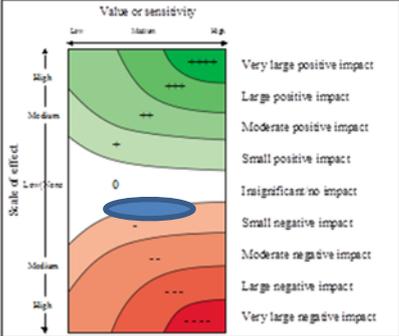




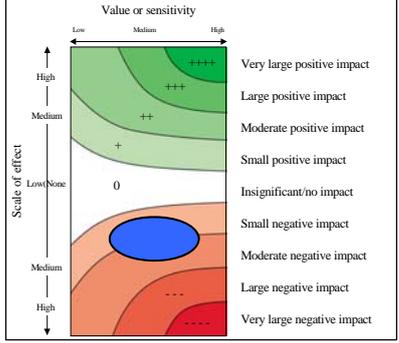
## TRI-CELL DRILL CUTTINGS – Onshore Impacts

2. Description of the scale of effect Options 1	3. Total (environmental) impact
<p>For the tri-cell drill cuttings, the preferred decommissioning option is to leave <i>in situ</i> for natural degradation.</p> <p>As the decommissioning option considered for the tri-cell drill cuttings does not involve onshore activities the impact onshore is zero.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: No impact</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p> 

## SUBSEA STRUCTURES AND DEBRIS – Onshore Impacts

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 1: Complete removal</b></p> <p>There is only one option – the complete removal of subsea structures and debris, and this will result in approximately 1,000 tonnes of waste steel (recyclable) and 500 tonnes grout coming onshore for handling and recycling.</p> <p>The waste generated from collection of the seabed structures and debris are:</p> <ul style="list-style-type: none"> <li>• Steel (from SSIV, SPAR protection cover and PLEM, umbilical splitter, VASP and scaffolding)</li> <li>• Grout</li> </ul> <p>There will be some associated impacts onshore (e.g. increased traffic, nuisance, dust and noise) but the impact is considered to be ‘small negative’ owing to the relatively small quantities involved, and because the onshore facilities will be licensed to handle and manage the wastes.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: ‘Small negative’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p> 

## WELLS – Onshore Impacts

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 1: Plugging and Abandonment</b></p> <p>There is only one option to decommission the wells – P&amp;A, and this will result (in total from all 146 wells) approximately 40,000 tonnes of waste steel (recyclable), and up to approximately 11,520 m<sup>3</sup> of OMB/WBM fluids. All this material will come onshore and will require handling, recycling and disposal.</p> <p>Wastes generated from the P&amp;A of Brent’s 146 wells are estimated to be:</p> <ul style="list-style-type: none"> <li>• Steel (tubings, conductors, casings, and subsea wellheads): 40,000 tonnes</li> <li>• OBM/ WBM recirculated fluids: 3,600 - 11,520 m<sup>3</sup></li> <li>• Marine growth on the Brent C conductors.</li> </ul> <p>No cement or concrete will be recovered.</p> <p>The onshore facilities will be licensed to handle and manage the wastes. But there may still be some associated impacts onshore (e.g. increased traffic, nuisance, dust and noise) owing to the large volumes involved, and activities may require careful management.</p> <p>The overall evaluation of onshore impacts as a result of decommissioning the wells is estimated to be ‘small–moderate negative’ for Option 1.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: ‘Small- moderate negative’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle.</p> 

<sup>1</sup> DNV GL, *Environmental Scoping Report for Brent Field Decommissioning EIA*, Rev 5, 24 May 2011.



## 1.2 RESOURCE USE

**Category: Topsides/Jacket/GBS/Attic Oil/Cell Contents/Drilling Legs and Minicell Annulus/Drill Cuttings/Subsea Structures and Debris/Wells**

**Consequence evaluation for: Resource Use**

### 1. General description of the receiving environment (situation and characteristics)

For all categories, a significant issue when considering resource use is fossil fuel consumption from onshore and offshore decommissioning activities. Details about this are presented in DNV GL's report *Energy and Emissions Report for the Brent Field Decommissioning EIA* [1]. The corresponding energy consumption (and associated air emissions) from fuel use are captured as part of 'Energy and Emissions' category. Hence this 'Resource Use' category does not include fuel use. This is also the case for the energy required to manufacture the relatively small quantities of steel (e.g. for grillage, sea fastening etc.) and concrete (e.g. for plugging wells, or manufacturing concrete caps) that will be required during decommissioning.

But other resources besides these will be consumed, such as H<sub>2</sub>S scavenger, nutrients, sand, gravel and cement. The 'value' of the resource used is considered 'medium' as none of the materials involved are scarce.

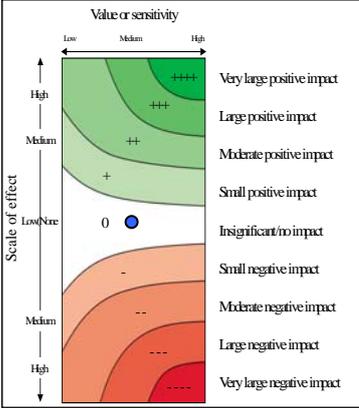
#### Evaluation of the value:

Low Medium High

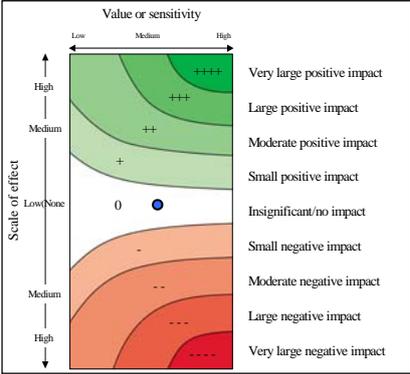
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X

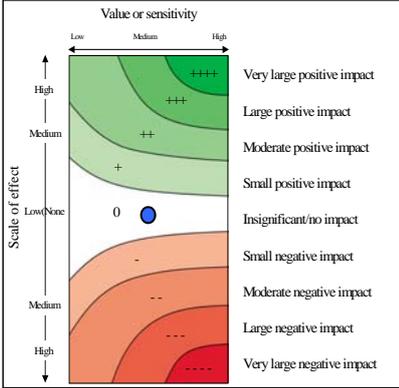
## TOPSIDES – Resource Use

2. Description of the scale of effect <b>Option 1: Complete removal in a single piece via Single Lift Vessel (SLV)</b>	3. Total (environmental) impact
<p>The impact of fuel consumption is captured within the ‘Energy and Emissions’ category, as is the energy required to manufacture new steel to produce grillage, and concrete for the caps and Navaid for GBS Option 2 (which is part of the topsides programme of work).</p> <p>This ‘Resource Use’ category focusses on the use of other resources, which are none, hence ‘no impact’.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p>----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: ‘No impact’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

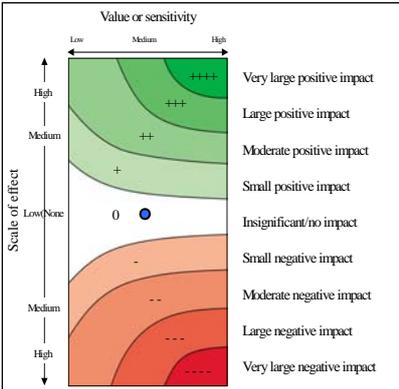
## BRENT A UPPER JACKET – Resource Use

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 1: Removal in one piece to approx. -84.5m LAT using SLV</b></p> <p>The direct fuel consumption for this option from activities offshore and onshore is captured within the 'Energy and Emissions' category, as is the energy required to manufacture the small quantities of steel to produce grillage used in this decommissioning option.</p> <p>This 'Resource Use' category focusses on the use of other resources, which are none, hence 'no impact'.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p>----- ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: 'No impact'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipses.</p> 

## BRENT A JACKET FOOTINGS – Resource Use

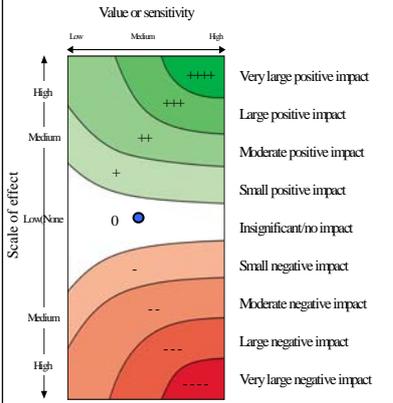
2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 1: Complete removal by SSCV in several pieces, after cuttings the piles externally</b></p> <p>The direct fuel consumption for this option from activities offshore and onshore is captured within the 'Energy and Emissions' category, as is the energy required to manufacture the small quantities of steel to produce grillage used in this decommissioning option.</p> <p>This 'Resource Use' category focusses on the use of other resources, which are none, hence no impact.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: 'No impact'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

## BRENT A JACKET FOOTINGS – Resource Use

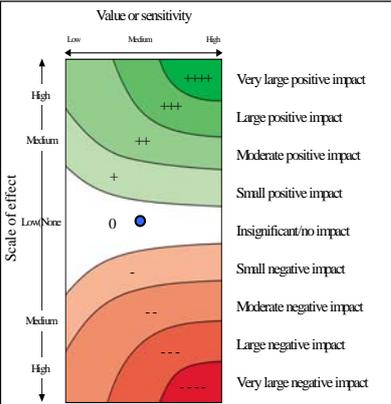
2. Description of the scale of effect <b>Option 2: Complete removal by SSCV in several pieces, after cutting the piles internally</b>	3. Total (environmental) impact
<p>The direct fuel consumption for this option from activities offshore and onshore is captured within the 'Energy and Emissions' category, as is the energy required to manufacture the small quantities of steel to produce grillage used in this decommissioning option.</p> <p>This 'Resource Use' category focusses on the use of other resources, which are none, hence no impact.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 2: 'No impact'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 



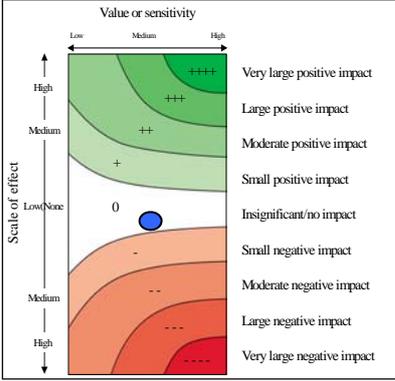
## GBS – Resource Use

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 1: Remove legs in a single piece down to approximately -55 m LAT</b></p> <p>The impact of fuel consumption from activities offshore and onshore is captured within the 'Energy and Emissions' category, as is the energy required to manufacture several thousand tonnes of steel that are required to fabricate several new pieces of equipment including slings, lifting attachments, spreader bar, diamond wire, mooring points, anchor wire and a steel frame for transporting the legs.</p> <p>This 'Resource Use' category focusses on the use of other resources, which are none, hence no impact.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: 'No impact'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

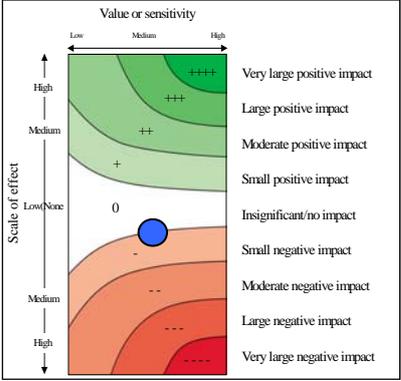
## GBS – Resource Use

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 2: Leave <i>in situ</i></b></p> <p>The direct fuel consumption for this option from activities offshore and onshore is captured within the 'Energy and Emissions' category. This 'Resource Use' category focusses on the use of other resources.</p> <p>The manufacture and installation of newly-fabricated concrete caps and a Navaid to be fitted on the GBS legs for Option 2 leave <i>in situ</i> is included in the topsides programme of work. Therefore there will be 'no impact' from Option 2.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 2: 'No impact'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

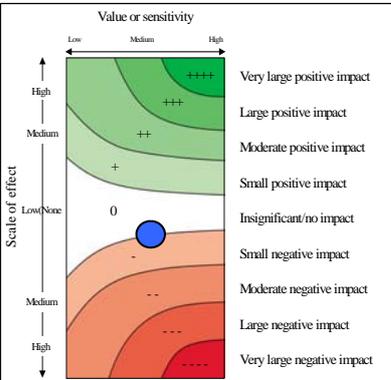
## GBS ATTIC OIL – Resource Use

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 1: Recover to Shore</b></p> <p>Approximately 680 m<sup>3</sup> of H<sub>2</sub>S scavenger will be required during operations to remove the attic oil. This is not considered as important as fuel as a resource, and only a relatively small quantity is required.</p> <p>Additionally, wax solvent may be required to make the oil easier to pump, but this is currently unknown.</p> <p>With regards to resource use, the impact is estimated to be ‘insignificant-small negative’.</p> <p><b>Evaluation of scale of effect:</b>            High neg.   Medium neg.   Low/none   Medium pos.   High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: ‘Insignificant’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p>  <p>The diagram is a 3x3 matrix. The vertical axis is 'Scale of effect' with levels High, Medium, and Low/None. The horizontal axis is 'Value or sensitivity' with levels Low, Medium, and High. The cells are color-coded and labeled as follows:</p> <ul style="list-style-type: none"> <li>High/High: Very large positive impact (++++)</li> <li>High/Medium: Large positive impact (++++)</li> <li>High/Low: Moderate positive impact (+++)</li> <li>Medium/High: Small positive impact (++)</li> <li>Medium/Medium: Insignificant/no impact (+)</li> <li>Medium/Low: Small negative impact (0)</li> <li>Low/High: Moderate negative impact (-)</li> <li>Low/Medium: Large negative impact (--)</li> <li>Low/Low: Very large negative impact (---)</li> </ul> <p>A blue circle is positioned in the 'Medium/Low' cell, corresponding to 'Insignificant/no impact'.</p>

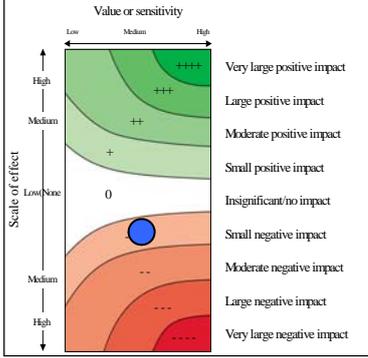
## GBS CELL CONTENTS – Resource Use

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 1: Remove, mobilise to vessel and re-inject into a new well</b></p> <p>The direct fuel consumption for this option from activities offshore and onshore is captured within the 'Energy and Emissions' category, as is the energy required to manufacture the quantities of new steel (~2,600 tonnes) required in setting up a template for cell access, and for casings for the new wells. This 'Resource Use' category focusses on the use of other resources.</p> <p>The volume of water used for mobilising the sediments is estimated to be 600,000 m<sup>3</sup> but seawater is a widely available resource, and thus is an insignificant impact.</p> <p>Additionally, approximately 10,000 m<sup>3</sup> of H<sub>2</sub>S scavenger would be required, but it not considered as important a resource like fuel, but the quantity involved is not unsubstantial.</p> <p>The impact is considered to be 'insignificant-small negative'.</p> <p><b>Evaluation of scale of effect:</b>            High neg.   Medium neg.   Low/none   Medium pos.   High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: 'Insignificant-small negative'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

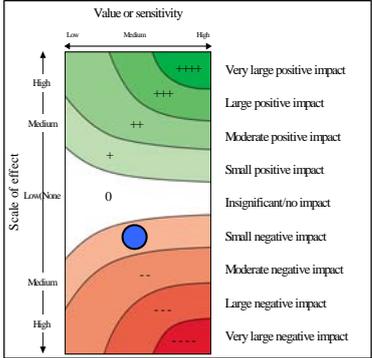
## GBS CELL CONTENTS – Resource Use

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 2: Mobilise and retrieve to vessel, transport to shore for treatment</b></p> <p>The direct fuel consumption for this option from activities offshore and onshore is captured within the 'Energy and Emissions' category, as is the energy required to manufacture the quantities of new steel required (~700 tonnes) in setting up a template for cell access. This 'Resource Use' category focusses on the use of other resources.</p> <p>The volume of water used in mobilising the sediments is estimated to be 600,000 m<sup>3</sup>, but seawater is a widely available resource, and thus is an insignificant impact.</p> <p>Additionally, approximately 10,000 m<sup>3</sup> of H<sub>2</sub>S scavenger would be required, and the impact is estimated to be like Option 1: 'insignificant-small negative'.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 2: 'Insignificant-small negative'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

## GBS CELL CONTENTS – Resource Use

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 3: Cap or cover <i>in situ</i> in the cells using (e.g.) mixture of sand/gravel</b></p> <p>The direct fuel consumption for this option from activities offshore and onshore is captured within the ‘Energy and Emissions’ category, as is the energy required to manufacture the quantities of new steel required (~600 tonnes) in setting up a template for cell access. This ‘Resource Use’ category focusses on the use of other resources.</p> <p>Approximately 10,000 m<sup>3</sup> of H<sub>2</sub>S scavenger would be required, in addition to 3,500-5,500 tonnes of nutrients. An estimated 31,400 m<sup>3</sup> of sand and gravel would be required for the capping agent (the amount of sand and gravel produced in UK in 2010 is 47,167,000 tonnes [2]).</p> <p>These are not considered as important as resources like fuel, but the volumes involved are not insignificant; the impact is estimated to be ‘small negative’.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 3: ‘Small negative’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

## GBS CELL CONTENTS – Resource Use

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 4: Leave <i>in situ</i> in the cells and treat with MNA</b></p> <p>The direct fuel consumption for this option from activities offshore and onshore is captured within the ‘Energy and Emissions’ category, as is the energy required to manufacture the quantities of new steel required (~600 tonnes) in setting up a template for cell access. This ‘Resource Use’ category focusses on the use of other resources.</p> <p>Approximately 10,000 m<sup>3</sup> of H<sub>2</sub>S scavenger would be required and volumes of nutrients (between 10,400-16,400 t) would need to be added to the cells to aid degradation of hydrocarbons.</p> <p>These are not considered as important as resources like fuel, but the volumes involved are not insignificant; the impact is estimated to be ‘small negative’.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 4: ‘Small negative’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse</p> 

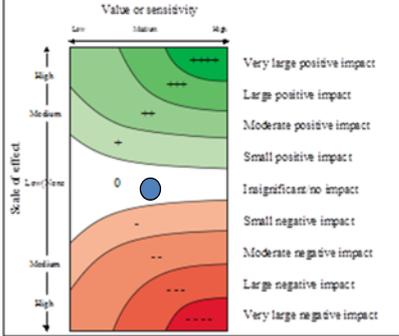
## GBS CELL CONTENTS – Resource Use

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 5: Leave <i>in situ</i> in the cells for natural degradation</b></p> <p>The direct fuel consumption for this option from activities offshore and onshore is captured within the 'Energy and Emissions' category. This 'Resource Use' category focusses on the use of other resources.</p> <p>There are no other resources used in Option 5 and therefore there is no impact.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 5: 'No impact'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> <div style="border: 1px solid black; padding: 5px;"> <p style="text-align: center;">Value or sensitivity</p> <p style="text-align: center;">Low      Medium      High</p> <p style="text-align: center;">Scale of effect</p> <p style="text-align: center;">High</p> <p style="text-align: center;">Medium</p> <p style="text-align: center;">Low/None</p> <p style="text-align: center;">High</p> <p style="text-align: center;">Medium</p> <p style="text-align: center;">High</p> <p style="text-align: center;">0</p> <p style="text-align: center;">Very large positive impact</p> <p style="text-align: center;">Large positive impact</p> <p style="text-align: center;">Moderate positive impact</p> <p style="text-align: center;">Small positive impact</p> <p style="text-align: center;">Insignificant/no impact</p> <p style="text-align: center;">Small negative impact</p> <p style="text-align: center;">Moderate negative impact</p> <p style="text-align: center;">Large negative impact</p> <p style="text-align: center;">Very large negative impact</p> </div>

# GBS DRILLING LEG MATERIAL – Resource Use

2. Description of the scale of effect Options 1, 2, 3, 4, 5	3. Total (environmental) impact
<p>Note: the direct fuel consumption from activities offshore and onshore is captured within the ‘Energy and Emissions’ category. This ‘Resource Use’ category focusses on the use of other resources.</p> <p>For the GBS Brent B and D drilling legs material, 5 decommissioning options are considered:</p> <ul style="list-style-type: none"> <li>Option 1: Mobilise and re-inject in a ‘new’ drilled subsea well away from site</li> <li>Option 2. Mobilise and retrieve to vessel and dispose onshore.</li> <li>Option 3. Cap or cover <i>in situ</i> using sand and coarse gravel.</li> <li>Option 4. Leave <i>in situ</i> and improve natural biodegradation by adding chemicals. Monitored Natural Attenuation, MNA</li> <li>Option 5. Leave <i>in situ</i> for natural biodegradation</li> </ul> <p>For Options 1,2,3 and 4 there are further sub-options considered:</p> <ul style="list-style-type: none"> <li>Options 1a, 2a, 3a, 4a: these options are applicable to GBS Brent B only, with Brent B topsides in place, and used to facilitate access to the drilling legs.</li> <li>Options 1b, 2b, 3b, 4b: these options are applicable to both GBS Brent B and D (post-topsides removal) so access to the drilling legs will be from a SSCV.</li> </ul> <p>But whichever combination of sub-options is selected, they would result in the similar impact, so the assessment below just details Options 1-5. No H<sub>2</sub>S scavenger would be used for any option.</p> <p>Options 1 and 2: There is a volume of water required to mobilise the sediment (~80,000 m<sup>3</sup>) but seawater is a widely available resource, and thus is an insignificant impact.</p> <p>Option 3: Approximately 1,450 tonnes of sand and bentonite would be required for the capping agent, a relatively small volume of a widely available resource (and only ~3% of the volumes required for GBS cell contents Option 3), hence ‘Insignificant-small negative’ impact. The amount of sand and gravel produced in UK in 2010 is 47,167,000 tonnes [2].</p> <p>Option 4: Approximately 1,000 t of bio-stimulation material such as nitrate, potassium nitrate and urea would need to be added to the cells to aid degradation of hydrocarbons. This is only a fraction (&lt;10%) of the volumes required for GBS cell contents Option 4, and is allocated ‘Insignificant-small negative’ impact.</p> <p>Option5: There are no other resources used in Option 5, hence no impact.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p>----- ----- ----- ----- ----- </p> <p style="text-align: center;">X<sub>3,4</sub> X<sub>1,2,5</sub></p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Options 1,2, 5: ‘No impact/Insignificant’</b> <b>Options 3,4: ‘Insignificant -small negative’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p>

## GBS MINICELL ANNULUS MATERIAL – Resource Use

2. Description of the scale of effect Options 1, 2, 3, 4, 5	3. Total (environmental) impact
<p>The direct fuel consumption from activities offshore and onshore is captured within the ‘Energy and Emissions’ category. This ‘Resource Use’ category focusses on the use of other resources.</p> <p>For the GBS Brent B and D Minicell Annulus material, 5 decommissioning options are considered:</p> <p>Option 1: Mobilise and re-inject in a ‘new’ drilled subsea well away from site            Option 2: Mobilise and retrieve to vessel and dispose onshore.            Option 3: Cap or cover <i>in situ</i> using sand and coarse gravel.            Option 4: Leave <i>in situ</i> and improve natural biodegradation by adding chemicals. Monitored Natural Attenuation, MNA            Option 5: Leave <i>in situ</i> for natural biodegradation</p> <p>No H<sub>2</sub>S scavenger would be used for any option.</p> <p>Options 1 and 2:            There is a volume of seawater required to mobilise the sediment (~5,000 m<sup>3</sup>) for these options but seawater is a widely available resource, and thus is an insignificant impact.</p> <p>Option 3:            Approximately 700 tonnes of sand and bentonite would be required for the capping agent, a relatively small volume of a widely available resource (and only ~2% of the volumes required for GBS cell contents Option 3), hence insignificant impact. The amount of sand and gravel produced in UK in 2010 is 47,167,000 tonnes [2].</p> <p>Option 4:            Approximately 330 t of bio-stimulation material such as nitrate, potassium nitrate and urea would need to be added to the minicells to aid degradation of hydrocarbons. These volumes are small and only a fraction (~3%) of that required for the cell contents, and will have insignificant impact.</p> <p>Option 5: There are no other resources used in Option 5, hence no impact.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X<sub>1,2,3,4,5</sub></p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Options 1,2,3,4 5: ‘Insignificant / No impact’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p> <div style="text-align: center;">  <p style="font-size: small;">Value or sensitivity: Low, Medium, High</p> <p style="font-size: small;">Scale of effect: High, Medium, Low/None, Medium, High</p> <p style="font-size: x-small;">Very large positive impact Large positive impact Moderate positive impact Small positive impact Insignificant: no impact Small negative impact Moderate negative impact Large negative impact Very large negative impact</p> </div>

## SEABED DRILL CUTTINGS - Resource use

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 1: Leave in place</b></p> <p>There are no resources used in this option, therefore there is no impact.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: 'No impact'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> <div style="border: 1px solid black; padding: 5px;"> </div>

## BRENT A SEABED DRILL CUTTINGS – Resource Use

2A. Description of the scale of effect	3A. Total (environmental) impact
<p><b>Brent A Seabed Drill Cuttings Options 1, 2, 3, 4</b></p> <p>The four available options for decommissioning the Brent A seabed drill cuttings are:</p> <ul style="list-style-type: none"> <li>• <b>Option 1:</b> Dredge, transfer to Brent C topsides and treat and discharge water and solids to sea</li> <li>• <b>Option 2:</b> Dredge, transfer to vessel and transport slurry to shore for treatment and disposal</li> <li>• <b>Option 3:</b> Dredge to vessel, transfer to Brent C topsides; water treated and discharged to sea, solids to shore</li> <li>• <b>Option 4:</b> Dredge to vessel and re-inject into a new well</li> </ul> <p>The impact resulting from direct fuel consumption for these options is captured within the 'Energy and Emissions' category. This 'Resource Use' category focusses on the use of other resources, but in these options there are few resources used and therefore the impact is estimated to be 'insignificant'.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center; margin-left: 200px;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p><b>Options 1, 2, 3, 4: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> <div style="text-align: center; border: 1px solid black; padding: 5px; margin-top: 10px;"> </div>

## CELL TOP DRILL CUTTINGS – Resource Use

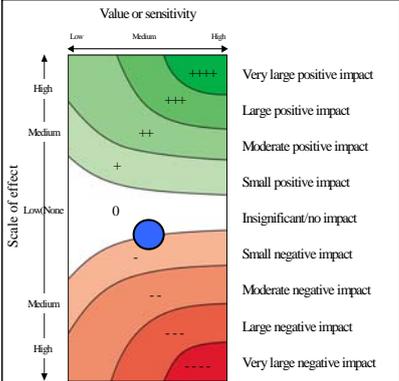
2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Cell Top Drill Cuttings Options 1, 2, 3, 4, 5, 6</b></p> <p>The six available options for decommissioning the GBS cell top drill cuttings are:</p> <ul style="list-style-type: none"> <li>• Option 1: Re-locate small amounts locally by water jetting into the water column</li> <li>• Option 2: Dredge, transfer to Brent C topsides and treat and discharge water and solids to sea</li> <li>• Option 3: Dredge, transfer to vessel and transport slurry to shore for treatment and disposal</li> <li>• Option 4: Dredge to vessel, transfer to Brent C topsides; water treated and discharged to sea, solids to shore</li> <li>• Option 5: Dredge to vessel and re-inject into a new well</li> <li>• Option 6: Leave <i>in situ</i></li> </ul> <p>The impact from direct fuel consumption for this option is captured within the 'Energy and Emissions' category. This 'Resource Use' category focusses on the use of other resources. For Options 1 and 6, no resources would be used and therefore there would be no impact. For Options 2, 3, 4 and 5, some chemicals may be added to the slurry on the vessel, however these volumes are considered insignificant.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Options 1, 6: 'No impact'</b> <b>Options 2, 3, 4, 5: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> <div style="text-align: center;"> </div>

## TRI-CELL DRILL CUTTINGS - Resource use

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 1: Leave in place</b></p> <p>In this option there will be no resources used as the tri-cell drill cuttings are left <i>in situ</i>; therefore, there is no impact.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center; margin-left: 200px;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: ‘No impact’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> <div style="text-align: center; border: 1px solid black; padding: 5px; margin-top: 10px;"> <p style="font-size: small; margin: 0;">Value or sensitivity</p> <p style="font-size: x-small; margin: 0;">Low    Medium    High</p> <p style="font-size: x-small; margin: 0;">High</p> <p style="font-size: x-small; margin: 0;">Medium</p> <p style="font-size: x-small; margin: 0;">Low/None</p> <p style="font-size: x-small; margin: 0;">Medium</p> <p style="font-size: x-small; margin: 0;">High</p> <p style="font-size: x-small; margin: 0;">Scale of effect</p> <p style="font-size: x-small; margin: 0;">++++ Very large positive impact</p> <p style="font-size: x-small; margin: 0;">+++ Large positive impact</p> <p style="font-size: x-small; margin: 0;">++ Moderate positive impact</p> <p style="font-size: x-small; margin: 0;">+ Small positive impact</p> <p style="font-size: x-small; margin: 0;">0 Insignificant/no impact</p> <p style="font-size: x-small; margin: 0;">- Small negative impact</p> <p style="font-size: x-small; margin: 0;">-- Moderate negative impact</p> <p style="font-size: x-small; margin: 0;">--- Large negative impact</p> <p style="font-size: x-small; margin: 0;">---- Very large negative impact</p> </div>



## WELLS – Resource Use

2. Description of the scale of effect Option 1: Plugging and Abandonment	3. Total (environmental) impact
<p>The impact due to fuel consumption from activities offshore and onshore to P&amp;A the wells is captured within the 'Energy and Emissions' category.</p> <p>Cement slurry will be used for cement plugs, with an estimated volume of 9,100 tonnes (17 m<sup>3</sup> per barrier per well). There will be some chemical additives that are considered inert or low toxicity. Chemicals will be specified in the Well Abandonment Programme and will be typical of platform operational inventories.</p> <p>For Option 1, the scale of effect is estimated to be 'low negative' as the resources used are not significant. The overall impact is therefore estimated to be 'insignificant-small negative'.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p>----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: 'Insignificant – small negative'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle\ellipse.</p>  <p>The diagram is a 2D matrix with 'Scale of effect' on the vertical axis (High, Medium, Low/None) and 'Value or sensitivity' on the horizontal axis (Low, Medium, High). The matrix is divided into nine regions, each with a different color and impact level: Very large positive impact (dark green, ++++), Large positive impact (medium green, +++), Moderate positive impact (light green, ++), Small positive impact (pale green, +), Insignificant/no impact (white, 0), Small negative impact (pale orange, -), Moderate negative impact (orange, --), Large negative impact (dark orange, ---), and Very large negative impact (red, ----). A blue circle is positioned in the 'Insignificant/no impact' region, centered around the '0' label.</p>

<sup>1</sup> DNV GL, *Energy and Emissions Report for the Brent Field Decommissioning EIA*, Rev 5, DNV GL Report No.: 187KVXJ-3, 2016.

<sup>2</sup> British Geological Survey, *United Kingdom Mineral Statistics*, 2013. Website: <http://www.bgs.ac.uk/mineralsuk/statistics/downloads/MineralsProducedInTheUnitedKingdom.pdf> [Accessed November 2015]

## 1.3 HAZARDOUS SUBSTANCES

**Category: All facilities**

**Consequence evaluation for: Hazardous substances**

### 1. General description of the receiving environment (situation and characteristics)

This set of matrices focusses on the release of hazardous substances to the environment, whether the hazardous substances are present on the facility and are being removed (such as those on the topsides) or whether any hazardous substances are needed during decommissioning (such as the consumption of H<sub>2</sub>S scavenger during the decommissioning of the cell contents).

The receiving environment in this instance depends on where the hazardous substance is released (if at all).

The receiving environment could be either:

- offshore at the Brent Field: 'low-medium' sensitivity as described in, for example, 'Marine', or
- onshore (as further described in 'Onshore' matrices):
  - relatively 'high' sensitivity for Able yard, where topsides and upper jacket will be transferred
  - 'medium' sensitivity (with some uncertainty) is assumed for onshore locations that are currently unknown.

#### Evaluation of the value:

Low Medium High

|-----|-----|

X X X

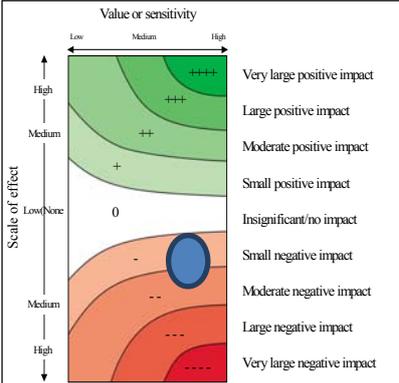
## TOPSIDES – Hazardous Substances

2. Description of the scale of effect Option 1: Complete Removal (single piece by SLV)	3. Total (environmental) impact
<p>This matrix covers the hazardous substances and wastes present on the topsides. Non-hazardous waste is dealt with in 'Waste'.</p> <p>Many different types of materials, including potentially hazardous materials, have been used in the construction and operation of the Brent Field platforms over the years. When the topsides are decommissioned, the materials become wastes. The hazardous wastes that will be generated when decommissioning the topsides are detailed in the ES, and briefly discussed below. There are, however, no materials present on the topsides which are not typical of offshore industrial platforms and with which specialised contractors are not currently familiar.</p> <p>Prior to commencement of the removal of the topsides, a planned and managed programme of topsides draining will be conducted. The programme includes work to Drain, Purge and Vent (DPV) topsides piping systems, vessels, tanks and other receptacles and containers. This is to remove hydrocarbons, other contaminants and wastes, as appropriate, to ensure that the topsides and topsides modules can be prepared and made ready for removal. After the completion of the DPV the topside production facilities will be, as far as reasonable practical, free of free-flowing hydrocarbons (but will not be hydrocarbon-free). Shell will implement 'positive isolation' to prevent any remaining hydrocarbons from migrating between systems and areas of the platform. This means that at important or critical locations, pipework and systems will be severed and blanked-off to create a physical air gap between components. This is to enable all hydrocarbons which could not be drained during the DPV to be managed. DPV (and any hazardous substances used during DPV) will take place prior to the start of decommissioning and are outside the scope of this EIA because they are preparatory works.</p> <p>The following discusses some of the hazardous materials found on the topsides (see ES for more detail):</p> <ul style="list-style-type: none"> <li>• Diesel, heli-fuel and residual hydrocarbons – these will be DPV prior to decommissioning.</li> <li>• Pyrophoric Scale (FeS) – not identified however requires verification after CoP.</li> <li>• Asbestos surveys have identified some asbestos on the topsides and it is being managed. It is possible that asbestos may have also been used on pipe gaskets, valve bonnet packing and other places, however insufficient information is currently available, and further surveys necessary. These surveys will be conducted onshore after the topsides have been removed by SLV.</li> <li>• NORM – There are some uncertainties in the weight of the NORM present on the topsides; some areas can only be quantified once accessible. An appraisal study was undertaken by Aberdeen Radiation Protection Services in 2007 (ARPS, Shell's federal radiological protection advisors for the Brent Decommissioning Project). The report discusses the possible types of radioactive contamination on Brent D, and specifically concentrates on NORM scale. It was concluded that the Brent D topsides are contaminated by various types of radioactivity including NORM scale, and potentially Pb-210 in the seawater system, gas system and flares. NORM scale is most likely to represent the largest quantity of contamination. NORM has since been estimated at Brent A, B and C (see ES main report). NORM will be further surveyed, quantified and managed onshore after removal of the topsides by SLV.</li> <li>• Topside Paint – further study is required to estimate the volumes and types of paint present and hazards they present. It is known that Lead chromate paints, Isocyanate paints, Anti fouling paints containing tributyl tin (TBT), zinc primers and coal tar enamels are present.</li> <li>• Mercury – there are a significant number of fluorescent tubes on the topsides (containing mercury).</li> <li>• Residual H/C – residual inventories will be DPV prior to removal.</li> <li>• Drains (Hazardous Areas) – the residual volume of sludge and liquids at CoP will be minimised further by DPV prior to topsides removal.</li> <li>• Topside Chemicals: Bulk chemicals are used in oil and gas recovery and processing, including methanol, Triethylene Glycol (TEG), corrosion inhibitor, anti-scale chemicals, oxygen scavenger (ammonium bisulphite), demulsifier, anti-foam, hydrogen sulphide scavenger, biocide, foams used in the firefighting systems, and diatomaceous earth used in water injection filter pre-coat systems. Most of these chemicals are delivered to the platforms in 2.7 m<sup>3</sup> IBCs (Intermediate Bulk Containers). It is planned that they will all be run down at CoP and that only minimal volumes will be present on the topsides when they are lifted off. The largest inventory of topside chemicals will be the residual TEG (triethylene glycol). (PTO).</li> </ul>	

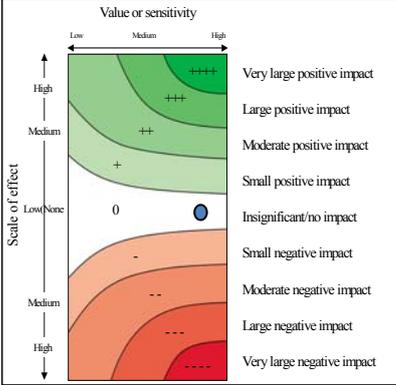
## TOPSIDES – Hazardous Substances

2. Description of the scale of effect Option 1: Complete Removal (single piece by SLV)	3. Total (environmental) impact
<p>(contd.)</p> <p>As the topsides will be removed in a single piece by SLV, much of the removal and management of hazardous substances from topsides will be performed onshore at Able UK’s ASP facility in Teesside, which is a safer environment than offshore.</p> <p>To assess the impacts from potential hazardous discharges to the environment, the following factors have been considered:</p> <ul style="list-style-type: none"> <li>• The type and amount and hazardous nature of recovered material</li> <li>• Hazardous materials disposed of to landfill</li> <li>• Effects on natural resources</li> <li>• Potential releases both on and offshore</li> </ul> <p>The following mitigation measures are assumed to be in place when managing the hazardous materials from the topsides:</p> <ul style="list-style-type: none"> <li>• Hazardous wastes will be handled by registered hazardous waste management contractors, and taken to the ASP onshore waste management facility which is licensed to manage wastes. Wastes will be tracked and logged from offshore to final recycling/disposal onshore, with hazardous waste consignment notes completed and kept for a minimum of three years. Hazardous waste management procedures will be followed.</li> <li>• Shell hazardous waste procedures are strictly followed.</li> <li>• All relevant offshore and onshore legislation is adhered to, including all local and national waste regulations, and any special requirements for exporting hazardous waste if necessary.</li> <li>• Apply Shell auditing requirements and contractor selection procedures</li> <li>• Relevant monitoring and audit practices are applied</li> <li>• Spill contingency arrangements are in place</li> <li>• ‘Cleaning Acceptance Certificates’ and where appropriate ‘NORM Decontamination Certificates’ are completed. The certificates will serve to communicate the final condition of each vessel/system.</li> <li>• Full tracking and logging of all materials to final reuse, recycling or disposal onshore.</li> <li>• Detailed surveys of hazardous materials on the topsides, including asbestos, pyrophoric scale, mercury and NORM will be performed by Able onshore. Specific plans will be updated and implemented to manage hazardous wastes in line with legislative requirements and good practice. NORM will be managed in line with OGP Guidelines for the management of NORM in the oil and gas industry [1]. Shell will monitor the UK NORM disposal routes to ensure they are capable of handling NORM waste arising from the decommissioning programme.</li> <li>• Shell will ensure adequate surveying assessment of the topsides to identify substances hazardous to health such as mercury, either in process equipment, or through dismantlement processes. The following additional activities would be initiated through the agreed interfacing arrangements with Shell’s disposals contractor: <ul style="list-style-type: none"> <li>○ Operational and HSE support to the initial surveying of the topsides upon arrival onshore</li> <li>○ Participation in an ongoing audit schedule which includes specialist support where required (Occupational Hygienist, HSE Advisor)</li> <li>○ Sharing of relevant Shell standards &amp; procedures (as per interface arrangements and documentation)</li> <li>○ Spaces or equipment contaminated with mercury will be marked and unauthorised access prohibited. Specialist contractors will be engaged to remove any steel impregnated with mercury and will be disposed of by a Specialist Waste Management Contractor. If recycling or reclamation is not possible, mercury-contaminated steel will be disposed of by burial at an approved, secure landfill.</li> <li>○ Periodically sample dust onsite and analyse for mercury, and take appropriate actions (e.g. use of dust collecting vehicles) if dust is found to be contaminated. (contd.)</li> </ul> </li> </ul>	

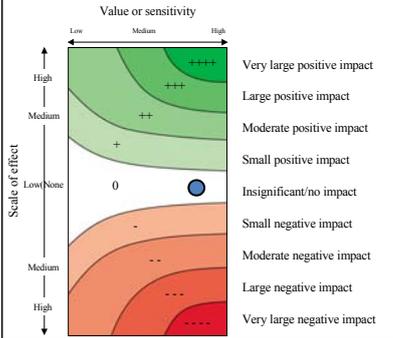
## TOPSIDES – Hazardous Substances

2. Description of the scale of effect <b>Option 1: Complete Removal (single piece by SLV)</b>	3. Total (environmental) impact
<p>(contd.)</p> <p>Due to pre-decommissioning activities, residual hydrocarbon substances will be minimal, therefore creating a negligible impact. Hazardous materials such as asbestos will be sealed, packed, labelled and removed for onshore disposal by licensed contractor. At another decommissioned platform, asbestos was found in much larger volumes compared to Brent, and this leads to uncertainty in the Brent asbestos inventory. Shell will survey comprehensively once the topsides arrive onshore,</p> <p>The overall evaluation of the scale of effect is estimated to be ‘low-medium negative’, with a ‘small-moderate negative’ impact for the reasons described more fully in the ES main report. All operations will be managed onshore at a licensed site and there are no wastes present that are not typical of offshore operations.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p>----- ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p><b>Option 1: ‘Small-moderate negative’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle\ellipse.</p> 

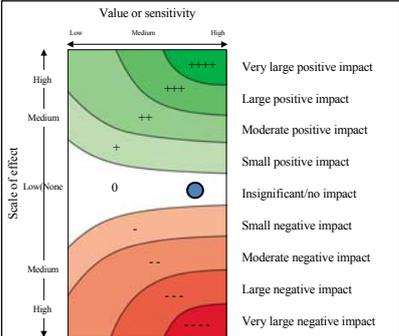
## BRENT A UPPER JACKET- Hazardous Substances

2. Description of the scale of effect <b>Option 1: Removal in one piece to approx. - 84.5m LAT using SLV</b>	3. Total (environmental) impact
<p>There is little use or generation of hazardous substances during the decommissioning of the jacket. The diamond wire cutting/ abrasive water jet cutting techniques do not utilize any hazardous substances or chemicals. Therefore, there is 'no impact' from this option.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p>----- ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: 'No impact'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

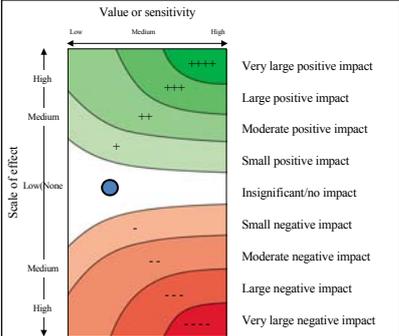
## BRENT A JACKET FOOTINGS - Hazardous Substances

2. Description of the scale of effect <b>Option 1: Complete removal by SSCV in several pieces, after cuttings the piles externally</b>	3. Total (environmental) impact
<p>Preparations for lifting the footings would require the dredging of a significant volume of drill cuttings and marine sediment; the associated impact is assessed in 'Marine' and 'Legacy' matrices.</p> <p>There is no use or generation of any other significant hazardous substances in this option. The diamond wire cutting/ abrasive water jet cutting techniques do not utilize any hazardous substances or chemicals. No radioactive isotopes were used when the jacket-pile system was installed at the Brent. Therefore, there is 'no impact' from this option.</p> <p><b>Evaluation of scale of effect:</b>            High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: 'No impact'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

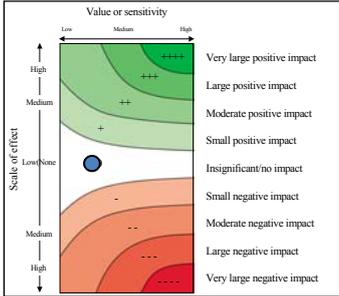
## BRENT A JACKET FOOTINGS - Hazardous Substances

<b>2. Description of the scale of effect</b> <b>Option 2: Complete removal by SSCV in several pieces, after cutting the piles internally</b>	<b>3. Total (environmental) impact</b>
<p>Preparations for lifting the footings would not require any dredging, and there is no use or generation of any significant hazardous substances in this option.</p> <p>The diamond wire cutting/ abrasive water jet cutting techniques do not utilize any hazardous substances or chemicals. No radioactive isotopes were used when the jacket-pile system was installed at the Brent Field.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 2: ‘No impact’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle\ellipse.</p> 

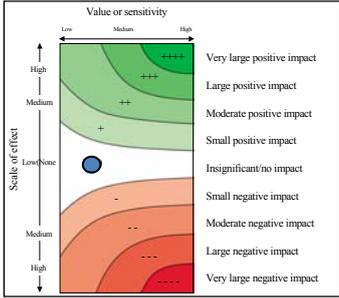
## BRENT A JACKET FOOTINGS - Hazardous Substances

2. Description of the scale of effect <b>Option 3: Leave <i>in situ</i></b>	3. Total (environmental) impact
<p>Footings are left <i>in situ</i>, so there are very few activities and there is no impact for this category.</p> <p><b>Evaluation of scale of effect:</b>            High neg.    Medium neg.    Low/none    Medium pos.    High pos.             ----- ----- ----- -----   <span style="margin-left: 250px;">X</span></p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 3: 'No impact'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle\ellipse.</p> 

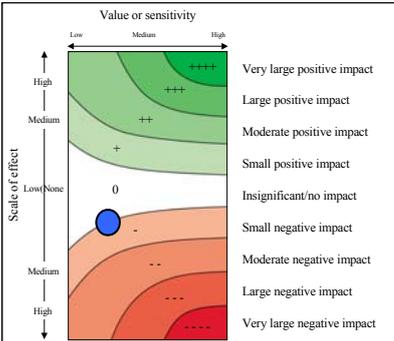
## GBS – Hazardous Substances

2. Description of the scale of effect <b>Option 1 and 2: Partial removal and Leave <i>in situ</i></b>	3. Total (environmental) impact
<p>The GBS contains some hazardous substances but they are assessed elsewhere, as follows:</p> <ul style="list-style-type: none"> <li>• Cell contents (see GBS cell contents matrices below)</li> <li>• Seabed/ cell-top drill cuttings (see drill cuttings matrices below)</li> <li>• Waste in drilling legs and minicell annulus (see minicell and drilling leg matrices)</li> </ul> <p>No hazardous substances will be used to decommission the GBS under Options 1 or 2, therefore there will be ‘no impact’ associated with these options.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X<sub>1,2</sub></p>	<p>1) and 2) are combined in the impact matrix.</p> <p><b>Options 1 and 2: ‘No impact’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle\ellipse.</p> 

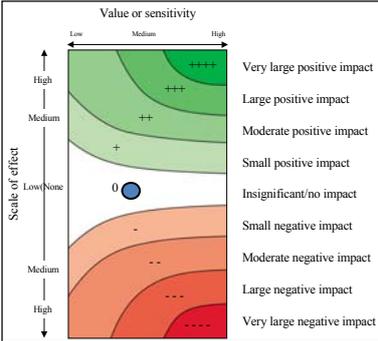
## GBS ATTIC OIL – Hazardous Substances

2. Description of the scale of effect <b>Option 1: Recover to Shore</b>	3. Total (environmental) impact
<p>Approximately 680 m<sup>3</sup> of H<sub>2</sub>S scavenger will be used during the removal of attic oil. Sodium chlorite, a form of bleach and a chemical hazardous to the environment, would likely be used. It may also be necessary to use wax solvent to facilitate the movement and transfer of the attic oil, but this is currently unknown.</p> <p>However, neither chemical would be released to the environment unless there was an accident (see 'Environmental Risk'), and the consumption of these chemicals is addressed under 'Resource use'. Hence there is no impact under this category.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: 'No impact'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle\ellipse.</p> 

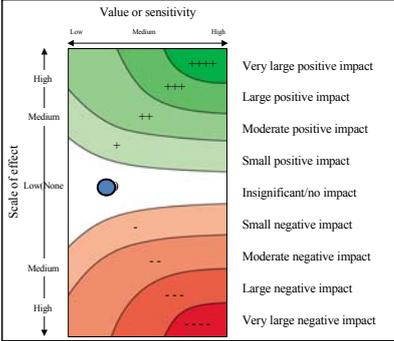
## GBS CELL CONTENTS – Hazardous Substances

2. Description of the scale of effect Option 1: Mobilise to vessel and re-inject into a new well	3. Total (environmental) impact																								
<p>As the cell contents are within an enclosed concrete structures (GBS), they are not exposed to the surrounding environment. Impacts from recovering the cell sediment are covered within other matrices ('Waste Management', 'Onshore', 'Environmental risk of Accidents'). Hence the impact of the presence of hazardous substances in the cell contents is not assessed here; this assessment focusses on hazardous substances used (if any) during the management of the decommissioning option and whether any are exposed to the environment.</p> <p>Approximately 10,000 t H<sub>2</sub>S scavengers would be used in Options 1-4. Sodium chlorite, a form of bleach would likely be used, and it is a chemical that is hazardous to the environment, particularly in the large quantities involved. However, it would not be released to the environment unless there was an accident (see 'ERA'). The consumption of chemicals is addressed under 'Resource use'.</p> <p>Chemicals used and discharged to the environment when drilling the 4 new wells would be typical of those used when drilling wells in the North Sea. Drilling muds are water based muds (WBM) and in addition to the base fluid, a variety of standard chemicals would be added to the mud: viscosifiers, emulsifiers, biocides, lubricants, wetting agents, corrosion inhibitors, surfactants, detergents, caustic soda (NaOH), salts (NaCl, CaCl<sub>2</sub>, KCl), organic polymers and fluid loss control agents.</p> <p>Shell has assessed the chemical hazard assessment and risk management (CHARM) algorithms that are used as part of OSPAR Harmonised Offshore Chemical Notification for use and discharge of chemicals used offshore. The CHARM assessment includes toxicity, biodegrading and bioaccumulation. The hazard quotient (HQ) which is the ratio of Predicted Effect Concentration against Predicted No Effect Concentration (PEC:PNEC) of the chemicals are rated as Gold and Silver, which indicates the lowest hazard.</p> <table border="1"> <thead> <tr> <th>Minimum HQ value</th> <th>Maximum HQ value</th> <th>Colour banding</th> <th></th> </tr> </thead> <tbody> <tr> <td>&gt;0</td> <td>&lt;1</td> <td>Gold</td> <td rowspan="5">Lowest hazard    Highest hazard</td> </tr> <tr> <td>≥1</td> <td>&lt;30</td> <td>Silver</td> </tr> <tr> <td>≥30</td> <td>&lt;100</td> <td>White</td> </tr> <tr> <td>≥100</td> <td>&lt;300</td> <td>Blue</td> </tr> <tr> <td>≥300</td> <td>&lt;1000</td> <td>Orange</td> </tr> <tr> <td>≥1000</td> <td></td> <td>Purple</td> <td></td> </tr> </tbody> </table> <p>The inorganic substances and hydraulic fluids are assigned a HQ grouping A-E. Group A is based on aquatic toxicity and sediment toxicity, and includes products considered to have the greatest potential environmental hazard, Group E having the least. The majority of the chemicals have been assessed to be in Groups E and D (least environmental effects) with a few emulsifiers in the B band.</p> <p>As this is a controlled and risk-assessed inventory, and because all chemicals will be used under permit, the overall impact is estimated to be 'insignificant-small negative'.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	Minimum HQ value	Maximum HQ value	Colour banding		>0	<1	Gold	Lowest hazard    Highest hazard	≥1	<30	Silver	≥30	<100	White	≥100	<300	Blue	≥300	<1000	Orange	≥1000		Purple		<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: 'Insignificant-small' negative</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 
Minimum HQ value	Maximum HQ value	Colour banding																							
>0	<1	Gold	Lowest hazard    Highest hazard																						
≥1	<30	Silver																							
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≥100	<300	Blue																							
≥300	<1000	Orange																							
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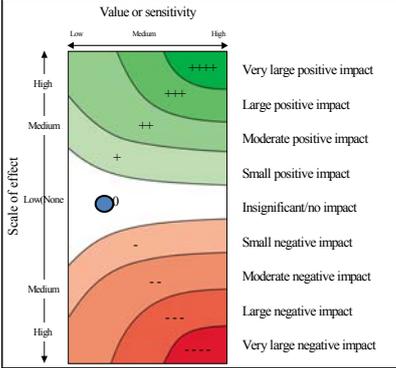
# GBS CELL CONTENTS – Hazardous Substances

2. Description of the scale of effect <b>Option 2: Mobilise and retrieve to vessel, transport to shore for treatment</b>	3. Total (environmental) impact
<p>As the cell contents are within an enclosed concrete structures (GBS), these substances are not exposed to the surrounding environment. Impacts from recovering the cell sediments are covered within other matrices ('Waste Management', 'Onshore', 'Environmental Risk of Accidents'). Hence the impact of the presence of hazardous substances in the cell contents is not assessed here; this assessment focusses on hazardous substances used (if any) during the management of the decommissioning option and whether any are exposed to the environment.</p> <p>The only chemicals used in this option are H<sub>2</sub>S scavengers (see Option 1 for more detail) but there would not be any release to the environment unless there was an accident (see 'ERA'). The consumption of chemicals is addressed under 'Resource use'.</p> <p>The slurry from the GBS cells would be transferred to a tanker offshore for temporary storage and transported to shore to a suitable treatment facility. Shell would only engage a licensed and responsible onshore facility. Onshore, the oil, water and solids would be separated. The water would be treated and discharged to sea under permit conditions. The solids may require further treatment prior to disposal at a suitable landfill site. The solid waste left after treatment may contain some NORM and this must be considered when selecting criteria for a landfill to dispose of the waste. This impact is covered in 'Waste'.</p> <p>Overall there is estimated to be 'no impact' associated with this option.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 2: 'No impact'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle\ellipse.</p> 

## GBS CELL CONTENTS – Hazardous Substances

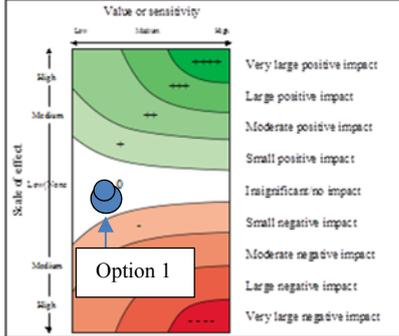
<b>2. Description of the scale of effect</b> <b>Option 3: Cap or Cover <i>in situ</i> in the cells using (e.g.) mixture of sand and/or gravel</b>	<b>3. Total (environmental) impact</b>
<p>As the cell contents are within an enclosed concrete structures (GBS), these substances are not exposed to the surrounding environment. In this option, the cell contents remain <i>in situ</i> and eventual exposure of the cell contents to the environment is covered within 'Legacy' matrix. Hence the impact of the presence of hazardous substances in the cell contents is not assessed here; this assessment focusses on hazardous substances used (if any) during the management of the decommissioning option and whether any are exposed to the environment.</p> <p>In addition to the H<sub>2</sub>S scavengers (see Option 1), this option needs between approximately 3,500-5,500 tonnes of nutrients (e.g. calcium nitrate salts) for all 3 GBS to help remediate the THC. But there would not be any release to the environment of any of these materials unless there was an accident (see 'ERA'). The use of chemicals is addressed under 'Resource use'.</p> <p>Quantities of sand and gravel would also be required, but these substances are not hazardous in nature.</p> <p>Overall there is estimated to be 'no impact' associated with this option.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p>----- ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 3: 'No impact'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

## GBS CELL CONTENTS – Hazardous Substances

2. Description of the scale of effect <b>Option 4: Leave <i>in situ</i> in the cells and treat with MNA</b>	3. Total (environmental) impact
<p>As the cell contents are within an enclosed concrete structures (GBS), these substances are not exposed to the surrounding environment. In this option, the cell contents remain <i>in situ</i> and eventual exposure of the cell contents to the environment is covered within 'Legacy' matrix. Hence the impact of the presence of hazardous substances in the cell contents is not assessed here; this assessment focusses on hazardous substances used (if any) during the management of the decommissioning option and whether any are exposed to the environment.</p> <p>Approximately 10,400-16,400 tonnes of nitrate and phosphate nutrients would be required for the 3 GBS, in addition to the same volumes of H<sub>2</sub>S scavengers used in option 1. But there would not be any release to the environment unless there was an accident (see 'ERA'). Management controls will be in place when handling the nutrients and a risk assessment will be conducted. The use of chemicals is addressed under 'Resource use'.</p> <p>During the process the fluid displaced by the introduction of this material would pass upwards to the surface vessel via the annulus between the inner and outer pipes. On the vessel it would be collected and returned to shore for treatment and disposal (see 'Waste' for assessment of displaced fluids).</p> <p>Overall there is estimated to be 'no impact' associated with this option.</p> <p><b>Evaluation of scale of effect:</b>            High neg.    Medium neg.    Low/none    Medium pos.    High pos.             ----- ----- ----- -----   <span style="margin-left: 250px;">X</span></p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 4: 'No impact'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p>  <p>The diagram is a 2D matrix with 'Scale of effect' on the vertical axis (High, Medium, Low/None) and 'Value or sensitivity' on the horizontal axis (Low, Medium, High). The matrix is divided into colored regions representing different impact levels: Very large positive impact (dark green), Large positive impact (medium green), Moderate positive impact (light green), Small positive impact (pale green), Insignificant/no impact (white), Small negative impact (pale orange), Moderate negative impact (light orange), Large negative impact (medium orange), and Very large negative impact (dark orange/red). A blue circle is positioned in the 'Insignificant/no impact' region, centered around the 'Low/None' sensitivity and 'Medium' scale of effect.</p>



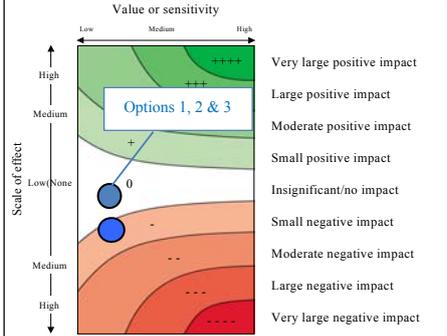
# GBS Drilling Leg Material – Hazardous Substances

2. Description of the scale of effect Options 1, 2, 3, 4, 5	3. Total (environmental) impact
<p>For the Brent B and D GBS drilling legs material, 5 decommissioning options are considered:</p> <p>Option 1: Mobilise and re-inject in a ‘new’ drilled subsea well away from site            Option 2: Mobilise and retrieve to vessel and dispose onshore.            Option 3: Cap or cover <i>in situ</i> using sand and coarse gravel.            Option 4: Leave <i>in situ</i> and improve natural biodegradation by adding chemicals. Monitored Natural Attenuation, MNA            Option 5: Leave <i>in situ</i> for natural biodegradation</p> <p>Note for Options 1,2,3 and 4 there are further sub-options considered:</p> <ul style="list-style-type: none"> <li>Options 1a, 2a, 3a, 4a: these options are applicable to GBS Brent B only, with Brent B topsides in place, and used to facilitate access to the drilling legs.</li> <li>Options 1b, 2b, 3b, 4b: these options are applicable to both GBS Brent B and D (post-topsides removal) so access to the drilling legs will be from a SSCV.</li> </ul> <p>But whichever combination of sub-options is selected, they would result in a similar impact, so the assessment below just details Options 1-5. Accidental releases of chemicals to the environment are addressed under ‘ERA’. The consumption of chemicals is addressed under ‘Resource use’. No H<sub>2</sub>S scavenger would be used for any option.</p> <p>Option 1:            No chemicals would be released to the environment apart from the chemicals used and discharged during the drilling of new wells. Chemicals used would be typical of those used in the North Sea when drilling wells and will be risk-assessed and controlled under a permit. Hence, the impact is estimated to be ‘insignificant’.</p> <p>Option 2:            The slurry from the GBS drilling legs would be transferred to a tanker offshore and transported to shore to a suitable treatment facility. Shell would only engage a licensed and responsible onshore facility. Onshore, the oil, water and solids would be separated. The water would be treated and discharged to sea under permit conditions. The solids may require further treatment prior to disposal at a suitable landfill site. The solid waste left after treatment may contain some NORM and this must be taken into account when selecting criteria for a landfill to dispose of the waste. This impact is covered in ‘Waste’, hence there is ‘no impact’ under this category.</p> <p>Option 3:            Quantities of sand and gravel would be required, but these substances are not hazardous in nature, therefore there is ‘no impact’ under this category.</p> <p>Option 4: This option needs between 0.2–201 tonnes of nutrients (e.g. nitrate) to help remediate the THC. But there would not be any release to the environment of any of these materials unless there was an accident (see ‘ERA’). The use of chemicals is addressed under ‘Resource use’. Hence there is no impact under this category.</p> <p>Option 5: There are no hazardous substances used in Option 5, hence there will be ‘no impact’.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p>----- ----- ----- ----- ----- </p> <p style="text-align: center;">X<sub>1</sub>X<sub>2,3,4,5</sub></p>	<p>) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: ‘Insignificant’</b>  <b>Options 2,3,4,5: ‘No impact’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p> 





## BRENT A SEABED DRILL CUTTINGS - Hazardous Substances

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Brent A Seabed Drill Cuttings: Options 1, 2, 3 &amp; 4</b></p> <p>The impact of hazardous substances such as the oil contained within the Brent A drill cuttings is assessed and captured in the matrices for ‘Marine’, ‘Waste’ and ‘Legacy’. As such this matrix focusses on the hazardous substances used in the management of options.</p> <p>For removal of the Brent A seabed cuttings piles under Options 1, 2 and 3, it is not anticipated that any hazardous substances will be used in the operations.</p> <p>In Option 1 the drill cuttings slurry will be treated on the Brent C topsides and disposed of to sea. In Options 2 and 3, the separated and processed drill cuttings powder (approximately 5,000 m<sup>3</sup> after treatment) will be disposed to landfill. Following thermal desorption, the processed powder will have a residual oil content of approximately 0.3 to 0.5% by weight (this is below the OSPAR 2000/3 specified concentration of 1% for discharge to sea [<b>Error! Bookmark not defined.</b>], and relevant to Option 1). The management and disposal of the wastes will be carried out in accordance with relevant legislative requirements, and the impact is captured within ‘Waste’ and ‘Marine’. There may also be a need to use viscosity-improver (as registered for use in UKCS) to assist in the pumping, transport and treatment of the slurry. The overall impact for Options 1 – 3 is therefore estimated to be ‘insignificant’ provided that operational procedures and legislative requirements are met.</p> <p>Chemicals will be added to the drill cuttings slurry in Option 4, in order to raise the viscosity to ensure the degraded solids remain in suspension during the injection process. The chemicals will be typical of those used in North Sea drilling operations, including: viscosifiers, emulsifiers, biocides, lubricants, wetting agents, corrosion inhibitors, surfactants, detergents, caustic soda (NaOH), salts (NaCl, CaCl<sub>2</sub>, KCl), organic polymers and fluid loss control agents. All chemicals used will be registered for use in the UKCS. In addition, Water Based Mud (WBD) will be used in accordance with OSPAR regulations. As the drilling and re-injection operations are typical of offshore operations and will be controlled via BEIS’s Offshore Environmental Permitting System, under which Shell will apply for necessary chemical permits, the overall impact is estimated to be ‘small negative’.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X4    X1,2,3</p>	<p><b>Options 1, 2 &amp; 3: ‘Insignificant’</b></p> <p><b>Option 4: ‘Small negative’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p> 

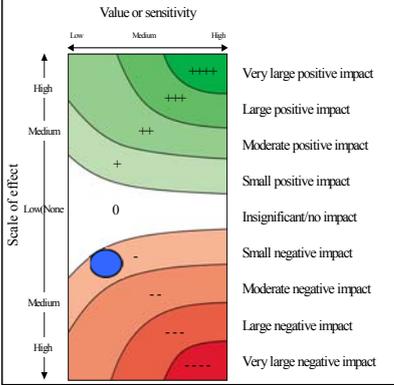
## SUBSEA STRUCTURES AND DEBRIS – Hazardous Substances

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 1: Complete Removal</b></p> <p>The SSIV, PLEM and VASP subsea structures were in contact with production fluids and may contain some residual hazardous materials such as NORM and mercury. The structures will be drained and flushed prior to decommissioning. Any residual hazardous materials can only be quantified once the structures are brought to shore and examined internally. No hazardous materials are believed to be contained in the PLEM protection structure, Brent A splitter box and all subsea debris, as they were not in direct contact with production fluids.</p> <p>All operations will be managed onshore at a licensed site and there are no wastes present that are not typical of offshore operations. The site will conduct detailed surveys onshore of hazardous materials present within the subsea structures. Following the surveys, specific plans will be updated (if necessary) and implemented to manage all hazardous wastes in line with legislative requirements and good practice [1], and the onshore site selected will be licensed and experienced in dealing with hazardous wastes.</p> <p>Additionally, Shell will develop and implement a specific management plan to manage risks from the materials brought to shore. Shell will monitor the UK NORM disposal routes to ensure they can handle any NORM waste arising.</p> <p>Due to the small volume of the subsea structures brought to shore (approximately 300 tonnes of steel from the 3 structures that could potentially contain residual hazardous substances), the impact is assessed to be ‘insignificant’ provided management controls are applied as above.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: ‘Insignificant’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p style="font-size: small; margin-top: 5px;">             Value or sensitivity: Low, Medium, High              Scale of effect: High, Medium, Low/None              Legend:              ++++ Very large positive impact              +++ Large positive impact              ++ Moderate positive impact              + Small positive impact              0 Insignificant/no impact              - Small negative impact              -- Moderate negative impact              --- Large negative impact              ---- Very large negative impact           </p> </div>

## WELLS – Hazardous Substances

2. Description of the scale of effect Option 1: Plugging and Abandonment	3. Total (environmental) impact
<p>To assess the impacts from potential hazardous discharges to the environment, the following factors are considered:</p> <ul style="list-style-type: none"> <li>• The type, amount and hazardous nature of substances used &amp; materials generated</li> <li>• Potential releases from on and offshore operations</li> </ul> <p>Note that the P&amp;A of the wells and re-injection operations are typical of offshore operations and will be managed under BEIS’s Offshore Environmental Permitting regime, under which Shell will apply for all the necessary chemical permits. P&amp;A operations requiring the use of chemicals will be covered by well intervention chemical permits (PON15Fs) with no planned discharges to sea. All mud and cementing chemicals are subject to control under the Offshore Chemical Notification Scheme (OCNS) and the Offshore Chemical (Pollution Prevention and Control) Regulations, 2002 (as amended).</p> <p>Hazardous waste will be managed in accordance with all legislative requirements, both offshore and onshore. Shell will only use registered hazardous waste management contractors for handling and managing hazardous wastes. Wastes will be tracked and logged from offshore to final recycling/disposal onshore, with hazardous waste consignment notes completed and kept for a minimum of three years. Hazardous waste management procedures will be followed.</p> <p><u>Chemicals:</u> Operations to P&amp;A wells involve a range of chemicals employed to stop the well flowing (“kill mud”), to make up cement plugs for the well, and to treat the well against corrosion and microbial contamination. Most of the chemicals used in these operations will remain in the well after it is plugged. Some chemicals may be returned to the platform from where they will be either pumped into an existing cutting re-injection well (CRI) or transferred to shore for treatment and disposal. The injection well will be the final well to be plugged and abandoned. Fluids and chemical returns from this final well will be contained (closed-loop on platform), and shipped to shore for treatment and disposal. P&amp;A operations requiring the use of chemicals will be covered by well intervention chemical permits (PON15Fs) with no planned discharges to sea. All mud and cementing chemicals planned for the wells are subject to control under the Offshore Chemical Notification Scheme (OCNS) and the Offshore Chemical (Pollution Prevention and Control) Regulations 2002. The majority of chemicals selected are category E or low RQ chemicals that have been selected to minimise hazards to the marine environment. Chemicals which contain components identified for substitution are included in the Substitution Chemical Technical Justification Report (Shell UK Ltd 2013) and have been subject to risk assessment. There remains the risk of accidental release of chemicals (see ‘ERA’ matrix). Some chemicals may be sent onshore for treatment and disposal.</p> <p><u>NORM:</u> Pipework such as well tubing that has been used to carry production fluids may be contaminated with scale containing NORM. There is estimated to be approximately 10 tonnes of NORM contaminated scale on the well tubulars. The activity of the scale exceeds 10 Bq/g so must be treated as radioactive waste and disposed of at a permitted site. Impact on the environment will be controlled by having an appropriate NORM waste management plan, and by ensuring that the onshore waste contractor has a regulated plan for the identification, removal and disposal of NORM scale. NORM will be managed in line with OGP Guidelines for the management of NORM [1]. Shell will monitor the UK NORM disposal routes to ensure they are capable of handling NORM waste arising from the decommissioning programme.</p>	

## WELLS – Hazardous Substances

2. Description of the scale of effect Option 1: Plugging and Abandonment	3. Total (environmental) impact
<p>(contd.)</p> <p><b>Well Fluids:</b> After the casings are cut, the remaining fluids in each well will be flushed with inhibited seawater or milling fluid. Displaced annular fluids (approximately 11,500 m<sup>3</sup>/well) will likely contain WBM/OBM and will either be shipped to shore for treatment or disposed offshore in compliance with relevant permits. If brought ashore, OBM/WBM fluids will be settled or dewatered/centrifuged such that solid waste is consolidated and remaining liquid is left to settle into 2 layers – water and oil. Solids will be sent to landfill, water sent to an effluent treatment plant and oil recycled. Any OBM (oily waste) will be contained and returned to shore for management and disposal, or disposed to sea under permit.</p> <p>There will be no chemicals used which are not typical of offshore industrial platforms and with which specialised contractors are not familiar. The above processes will be regulated via the use of permits and managed through the implementation of company procedures and audits. Additionally, they are risk assessed and are part of current platform operations. Additionally, well work over schemes and independent examination ensure that ‘Good Oilfield Practice’ and company standards are incorporated during well workovers. This contributes to risk reduction and prevention of loss of containment through application of the ALARP principle. The effect is evaluated as ‘low-medium negative’ and the overall impact is estimated to be ‘small negative’.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p>----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: ‘Small negative’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

<sup>1</sup> OGP, *Guidelines for the Management of Naturally Occurring Radioactive Material (NORM) in the Oil & Gas Industry*, Report No.: 412, Rev 2.0, March 2016.

<sup>2</sup> OSPAR, *Decision 2000/3 on the Use of Organic-Phase Drilling Fluids (OPF) and the Discharge of OPF-Contaminated Cuttings*, Annex 18, 26-30, June 2000.

## 1.4 WASTE MANAGEMENT

**Category: Topsides**

**Consequence evaluation for: Waste Management**

### 1. General description of the receiving environment (situation and characteristics)

The material assessment is based on the material inventory for the Brent Field topsides as summarised in the ES. The following points are taken into consideration during the assessment of non-hazardous material management.

- The type of recovered material.
- The amount of recovered material.
- The market value of the recyclable material.

Dismantling the topsides will generate considerable amounts of materials, which will be brought onshore to Able UK's ASP facility at Teesside, and will either be recycled or disposed of as waste. The vast majority of the non-hazardous materials from removal and disposal of the topsides will be reused or recycled. Able, the operator, has a 97% target for recycling set in the contract to help optimise waste management [1]. It is assumed that local and national regulations will be applied to ensure that any environmental impacts from the disposal of non-recyclable materials is minimised. The nearby Seaton Meadows Landfill, also operated by Able, is permitted and will be used for the disposal of some waste streams.

Approximately 76,700 tonnes of carbon steel, plus smaller volumes of alloy and stainless steel from the four topsides will be brought onshore for recycling. This volume represents the bulk of the topsides material and is valuable. Considerable amounts of other non-hazardous waste materials are also found on the topsides:

- Aluminium: 515 tonnes;
- Brass, bronze, tin and concrete: 16 tonnes;
- Concrete;
- Wood: 70 tonnes;
- Glass: 20 tonnes;
- Plastic and rubber: 190 tonnes.

These materials will either be recycled or disposed of as waste.

The evaluation of waste concentrates on the types and amounts of waste generated. All systems will be drained, purged and vented (DPV) prior to the commencement of any offshore dismantling activity and there will be no free-flowing hydrocarbon residues in utility systems and tanks.

The overall value of the recyclable material is assessed to be 'medium' because the bulk of materials generated will be steel, which has value if recycled. Similarly, other metals such as copper and brass also have value. Hazardous waste from the topsides are covered in the 'Hazardous Substances' category.

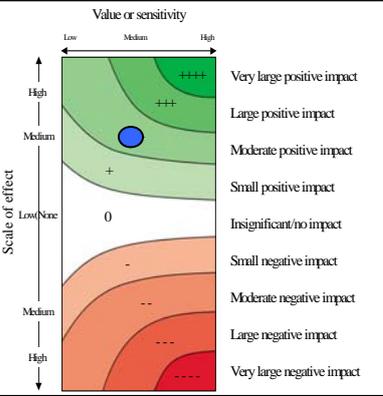
#### **Evaluation of value:**

Low Medium High

|-----|-----|

X

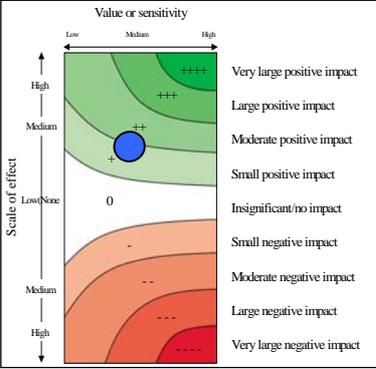
## TOPSIDES – Waste Management

2. Description of the scale of effect <b>Option 1: Complete removal</b>	3. Total (environmental) impact
<p>Hazardous wastes from the topsides are covered in the Hazardous Substances category.</p> <p>The vast majority of the non-hazardous materials from the topsides are recyclable, hence minimising the volume of waste which needs to be sent to landfill. Furthermore, the bulk of the recyclable materials are metals of value, including more than 76,700 tonnes of carbon steel from the four topsides (plus 2,150 t of external steel). It therefore dominates the ‘moderate positive’ impact allocated to this waste management category.</p> <p>In 2013 in the UK, approximately 4.7 million tonnes of steel scrap were exported and approximately 4 million tonnes of steel scrap were consumed for steelmaking [2]. Although 76,700 tonnes of carbon steel from the four topsides represents only a small fraction of this national quantity, the decommissioning of the Brent Field topsides is still likely to be one of the biggest individual contributors of recycled steel in the UK during the duration of the project.</p> <p>Non-recyclable, non-hazardous waste material will also be generated by topsides decommissioning. These materials will be handled and disposed of by waste processing contractors within the boundaries of relevant national and local consent limits. Shell will also apply stringent contractor selection and audit procedures, thus ensuring that the environmental impact arising from the disposal on non-recyclable materials is minimised. Previous experience of major decommissioning projects in the North Sea demonstrates that the impact potential can be effectively controlled and mitigated [3]. In addition, there is a minimum target of 97% for re-use and recycling of materials brought onshore for the BDP [1].</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p><b>Option 1: ‘Moderate positive’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse</p>  <p>The diagram is a 2D matrix with 'Value or sensitivity' on the x-axis (Low, Medium, High) and 'Scale of effect' on the y-axis (High, Medium, Low/None, Medium, High). The matrix is divided into regions of impact: Very large positive (++++), Large positive (+++), Moderate positive (+), Small positive (+), Insignificant/no impact (0), Small negative (-), Moderate negative (--), Large negative (---), and Very large negative (----). A blue circle is located in the 'Moderate positive (+)' region, centered around the 'Medium' value on the x-axis and the 'Medium' value on the y-axis.</p>

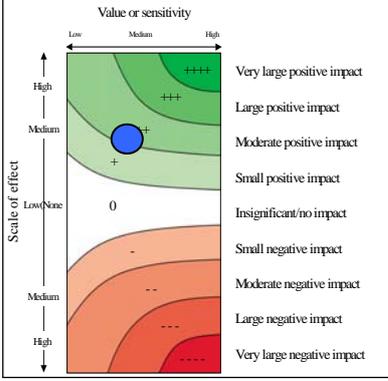
## BRENT A JACKET – Waste Management

<p><b>Category: Jacket</b></p> <p><b>Consequence evaluation for: Waste Management</b></p>
<p><b>1. General description of the receiving environment (situation and characteristics)</b></p> <p>This evaluation of waste management concentrates on the types and amounts of waste generated. The major types of waste generated from the jacket are:</p> <ul style="list-style-type: none"> <li>• Steel (from jacket, piles, conductors and risers)</li> <li>• Concrete (from pile grout)</li> <li>• Marine growth</li> <li>• Smaller quantities of zinc and aluminium (anodes).</li> </ul> <p>The Brent A jacket will be brought onshore to the Able ASP facility at Teesside, and materials will either be recycled or disposed of as waste. The vast majority of the non-hazardous materials on the jacket constitute steel, which is valuable and will be recycled. Shell estimate that approximately 84% of the recovered total mass of material will be recycled. Local and national regulations will be applied to ensure that any environmental impacts from the disposal of non-recyclable materials is minimised. The nearby Seaton Meadows Landfill, also operated by Able, is permitted and will be used for the disposal of some of the waste streams.</p> <p>The removal of the Brent A upper jacket will generate approximately 8,400 tonnes of recyclable steel and marine growth (approximately 1,600 tonnes). The removal of the jacket footings will generate approximately 14,850 tonnes of recyclable steel, 5,200 tonnes of grout, 1,130 tonnes of marine growth and 155 tonnes of metal anodes.</p> <p>The overall value of the recyclable material is assessed to be ‘medium’ because the bulk of materials generated will be steel, which has value if recycled.</p> <p><b>Evaluation of value:</b></p> <p>Low Medium High</p> <p> ----- ----- </p> <p style="text-align: center;">X</p>

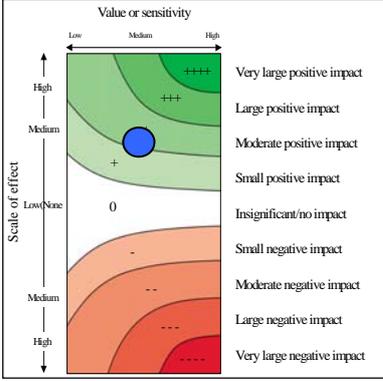
## BRENT A UPPER JACKET – Waste Management

2. Description of the scale of effect <b>Option 1: Removal in one piece to approx. -84.5m LAT using SLV</b>	3. Total (environmental) impact
<p>In the removal of the upper jacket, approximately 8,400 tonnes of steel (about a third the steel in the jacket, conductors and piles) will be recovered to shore for recycling. Able’s contracted recycling target is 97%; this will have an environmental benefit. The remainder of the jacket steel will be left <i>in situ</i>, together with all the concrete.</p> <p>There will also be approximately 1,600 tonnes of marine growth attached to the recovered steel, which will require management after transporting to shore. Able has experience of handling marine growth from decommissioned oil and gas facilities. The marine growth will be disposed of at the local Seaton Meadows licensed landfill site, which is also operated by Able. Odour at the site boundary will be monitored (see ‘Onshore’ matrices) periodically to confirm that there is no impact (the site is large and residents are located a considerable distance away so odour impact is not anticipated).</p> <p>Shell will establish and implement a plan for monitoring and auditing the waste management contractor. Shell will ensure the contractor acts in accordance with duty of care, other legal requirements and contract conditions, and will review Able’s waste management documentation and procedures.</p> <p>The overall impact is considered to have a ‘small-moderate’ positive impact from a material management perspective, as the weight of steel recycled is much greater than the weight of marine growth requiring disposal.</p> <p><b>Evaluation of scale of effect:</b>            High neg.    Medium neg.    Low/none    Medium pos.    High pos.             ----- ----- ----- -----   <span style="margin-left: 250px;">X</span></p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: ‘Small-moderate positive’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p>  <p>The diagram is a 2D matrix with 'Scale of effect' on the vertical axis (High, Medium, Low/None) and 'Value or sensitivity' on the horizontal axis (Low, Medium, High). The matrix is divided into nine impact categories, each with a color-coded region and a symbol: Very large positive impact (++++, dark green), Large positive impact (+++, medium green), Moderate positive impact (++, light green), Small positive impact (+, pale green), Insignificant/no impact (0, white), Small negative impact (-, pale orange), Moderate negative impact (--, light orange), Large negative impact (---, medium orange), and Very large negative impact (----, dark orange/red). A blue circle is located in the 'Moderate positive impact' region, centered around the '++' symbol.</p>

## BRENT A JACKET FOOTINGS – Waste Management

2. Description of the scale of effect <b>Option 1: Complete removal by SSCV in several pieces, after cuttings the piles externally</b>	3. Total (environmental) impact
<p>This option involves removal of the Brent A jacket footings by cutting them externally in several pieces to 3 m below the seabed by SSCV. This will result in the following types of waste:</p> <ul style="list-style-type: none"> <li>• Approximately 14,850 tonnes of the steel (from the jacket, piles and conductors) will be recovered for recycling onshore at the ASP facility; this will have an environmental benefit.</li> <li>• There will also be a significant quantity of substructure concrete removed (from grout used in piles and in conductor/casings) and brought to shore (approximately 5,200 tonnes). Re-use of grout would be done where possible, although this may not be practical in all instances. For the purposes of this assessment it is assumed that most is re-used (e.g. as bottoming for roads/harbours/quays). If this is not the case, the impact would become more negative.</li> <li>• There are also approximately 1,130 tonnes of marine organic waste that has grown on the jacket during the time it has been located at sea. Odour at the site boundary should be monitored periodically to confirm that there is no impact (the site is large and residents are located a considerable distance away so odour impact is not anticipated). The marine growth will be disposed of at a suitable licensed landfill site.</li> <li>• There will also be approximately 155 tonnes of zinc and aluminium in anodes that will be recycled, with a positive benefit.</li> </ul> <p>Although there are some significant positive impacts (from recycling steel), this significant positive impact is reduced by the lower 'value' of grout, and by the quantities of marine growth requiring disposal.</p> <p>Overall it is considered that impacts are 'small-moderate positive' provided the receiving location can re-use the grout in the local market.</p> <p>Note: impacts from removing drill cuttings at jacket footings and generating wastes are dealt with under Drill Cuttings.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: 'Small-moderate positive'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p>  <p>The diagram is a 2D matrix with 'Scale of effect' on the vertical axis (High at top, Low/None at bottom) and 'Value or sensitivity' on the horizontal axis (Low on left, High on right). The matrix is divided into several impact levels: Very large positive impact (++++), Large positive impact (+++), Moderate positive impact (++) with a blue circle, Small positive impact (+), Insignificant/no impact (0), Small negative impact (-), Moderate negative impact (--), Large negative impact (---), and Very large negative impact (----).</p>

## BRENT A JACKET FOOTINGS – Waste Management

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 2: Complete removal by SSCV in several pieces, after cutting the piles internally</b></p> <p>This option involves the removal of the Brent A jacket footings by cutting them internally in several pieces to 3 m below the seabed by SSCV, and will generate the same volumes of waste as detailed in Brent A jacket footings Option 1.</p> <p>Although there are some significant positive impacts (from recycling steel), this significant positive impact is reduced by the lower ‘value’ of grout, and by the quantities of marine growth requiring disposal. Overall it is considered that impacts are “small/moderate positive” assuming that the Able yard can re-use the grout in the local market.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p>----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 2: ‘Small-moderate positive’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p>  <p>The diagram is a 2D matrix with 'Scale of effect' on the vertical axis (High, Medium, Low/None) and 'Value or sensitivity' on the horizontal axis (Low, Medium, High). The matrix is divided into nine impact levels: Very large positive impact (++++), Large positive impact (+++), Moderate positive impact (++) with a blue circle, Small positive impact (+), Insignificant/no impact (0), Small negative impact (-), Moderate negative impact (--), Large negative impact (---), and Very large negative impact (----).</p>

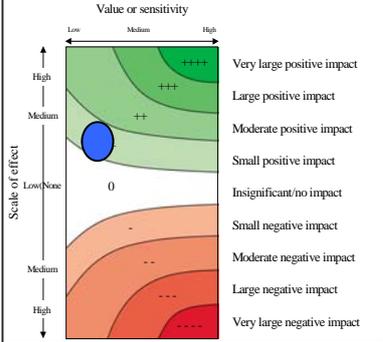
## BRENT A JACKET FOOTINGS – Waste Management

2. Description of the scale of effect <b>Option 3: Leave <i>in situ</i></b>	3. Total (environmental) impact
<p>The footings would be left <i>in situ</i> and no waste would be produced.</p> <p><b>Evaluation of scale of effect:</b>            High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 3: ‘No impact’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> <div style="border: 1px solid black; padding: 5px;"> <p style="text-align: center;">Value or sensitivity</p> <p style="text-align: center;">Low                  Medium                  High</p> <p>Scale of effect</p> <p>High</p> <p>Medium</p> <p>Low/None</p> <p>High</p> <p>Medium</p> <p>High</p> <p style="text-align: right;">           ++++ Very large positive impact            +++ Large positive impact            ++ Moderate positive impact            + Small positive impact            0 Insignificant/no impact            - Small negative impact            -- Moderate negative impact            --- Large negative impact            ---- Very large negative impact         </p> </div>

## GBS – Waste Management

<b>Category: GBS</b> <b>Consequence evaluation for: Waste Management (Non-hazardous wastes)</b>
<b>1. General description of the receiving environment (situation and characteristics)</b>
<p>The location of the onshore dismantling facility for the GBS legs has not yet been chosen, hence this evaluation of waste management concentrates on the types and amounts of waste generated.</p> <p>The major types of substructure waste from the GBS are:</p> <ul style="list-style-type: none"><li>• Concrete</li><li>• Metals (steel)</li><li>• Marine growth</li></ul> <p>Option 1 partial removal: there will be large quantities of waste/recyclable material, with approximately 37,917 t of concrete removed in total (this is approximately 5% of the total GBS concrete) plus approximately 9,382 t steel, plus 4,502 tonnes of steel from the Brent B and D upper conductors.</p> <p>Option 2 leave <i>in situ</i>: there will be no waste/recyclable material</p> <p>The overall value of the recyclable material is assessed to be relatively 'low', because the bulk of any materials generated will be concrete.</p> <p><b>Evaluation of value:</b></p> <p>Low Medium High</p> <p> ----- ----- </p> <p>X</p>

## GBS – Waste Management

2. Description of the scale of effect <b>Option 1: Remove legs in one piece down to approx. -55 m LAT</b>	3. Total (environmental) impact
<p>Option 1 involves removing the GBS legs to a depth of -55 m below sea level; this will result in the following types of waste.</p> <ul style="list-style-type: none"> <li>Although the vast majority of the GBS substructure would remain <i>in situ</i>, the weight of the recovered GBS legs brought to shore would be significant: approximately 37,917 tonnes of concrete from all 3 GBS. Recycling of concrete (after crushing) would be done where possible, although this may not be practical in all instances (see below). For the purposes of this assessment, re-use is assumed.</li> <li>However, it is possible that concrete with a potentially high saline content is not suitable for recycling for non-marine applications, but if it is uncontaminated it may possibly be re-used as a filling material for road construction or as an additive in the production of new concrete. Therefore, the fate of concrete material brought to shore from the marine environment is not assured.</li> <li>Smaller quantities of reinforcing steel would be recovered for recycling with approximately 9,382 tonnes from GBS legs, plus 4,502 tonnes of steel from the upper parts of the recovered conductors.</li> <li>There will also be some marine organic waste which has grown on the GBS legs during their lifetime underwater. This must be dealt with shortly after transporting to shore to avoid odour problems with the local community. The sea disposal of significant volumes of marine growth at the demolition yard would lead to a local concentration of organic waste in the water and seabed; therefore, this method is not recommended when demolishing the substructures. The marine growth will most probably be disposed of at a suitable waste disposal site.</li> </ul> <p>Assuming recycling of the concrete and steel, there would be a 'small positive' impact.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: 'Small positive'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p>  <p>The diagram is a 2D matrix with 'Value or sensitivity' on the x-axis (Low to High) and 'Scale of effect' on the y-axis (High to Low/None). The matrix is divided into nine impact categories: Very large positive impact (++++), Large positive impact (+++), Moderate positive impact (++) in the top half; Insignificant/no impact (0) in the middle; and Small negative impact (---), Moderate negative impact (----), Large negative impact (-----), Very large negative impact (-----) in the bottom half. A blue circle is positioned in the 'Small positive impact' region, indicating the total impact for Option 1.</p>





## GBS CELL CONTENTS – Waste Management

**Category: GBS Cell Contents/Drilling legs/Minicells**

**Consequence evaluation for: Waste Management**

### 1. General description of the receiving environment (situation and characteristics)

This evaluation of waste management concentrates on the types and amounts of waste generated. The major type of waste from the GBS cell contents, drilling legs and minicells is the large volume of watered-down oily sediment (slurry). The overall value of the material is assessed to be relatively 'low', because the bulk of the material generated will not have any useful purpose, although it is accepted that the sediment does contain oil, which has higher value.

Attic oil and interphase material, which contain more oil than the oil within the cell sediment, is dealt with separately under the Attic Oil matrices.

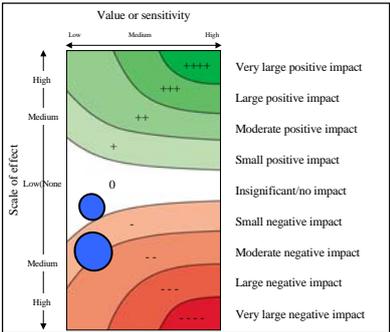
#### **Evaluation of value:**

Low Medium High

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X

## GBS CELL CONTENTS – Waste Management

2. Description of the scale of effect Options: 1, 2, 3, 4, 5	3. Total (environmental) impact
<p>There are 5 options for managing the cell contents:</p> <ul style="list-style-type: none"> <li>• Option 1: Mobilise, retrieve to vessel and re-inject down new well</li> <li>• Option 2: Mobilise, retrieve to vessel and take to shore for treatment.</li> <li>• Option 3: Cap/ Cover <i>in situ</i></li> <li>• Option 4: Leave <i>in situ</i> + MNA</li> <li>• Option 5: Leave <i>in situ</i></li> </ul> <p>Note that attic oil and interphase material will be recovered from Brent B and D (12-14,000 m<sup>3</sup>) for all decommissioning options and this will have a positive effect as waste oil will be recycled. However, this is addressed within the Attic Oil matrices and not these Cell Contents matrices.</p> <p>Option 1: Large quantities of waste will be generated (in the region of 600,000m<sup>3</sup> of slurry for all three GBS, plus an additional 640,000 m<sup>3</sup> of cell water) and re-injected in new wells within the Brent Field. Compliance with OSPAR requirements should be confirmed to ensure that this waste can be discharged down new wells. Although Option 1 would generate large volumes of waste, the potential for seepage from the injection wells to the marine environment is captured within 'Legacy', atmospheric emissions are captured in 'E &amp; E' and the potential for spills during operations is captured within 'ERA'; hence there is insignificant environmental impact allocated within this category as re-injection of waste from drilling and production offshore is a well proven waste management practice.</p> <p>Option 2: A large quantity of waste will be generated (in the region of 600,000m<sup>3</sup> of slurry for all three GBS plus an additional 640,000 m<sup>3</sup> of cell water) and transported to shore for treatment. Treated water will be discharged to sea and solids to landfill. Option 2 is allocated a 'medium negative' scale of effect owing to the significant volumes involved, the need to transport to shore and treat, then discharge treated water and dispose of the solid waste to a disposal site. The solids waste (after treatment) may contain some Naturally Occurring Radioactive Material (NORM), and this must be considered when selecting the landfill. If this option was selected, Shell should check capacity of landfills to accommodate NORM waste volumes. There will conversely be some benefit from the volume of oil recovered.</p> <p>Options 3 and 4: Approximately 16,000-35,000 m<sup>3</sup> of wastewater would be generated in Options 3 and 4 by displacement, due to the introduction of the materials (such as nutrients and/or capping agent) into the cells. The wastewater would be recovered to the surface vessel and transported onshore for treatment and disposal, or treated offshore prior to overboard discharge in accordance with regulatory standards. The pre-treated wastewater would contain only ~0.1% hydrocarbons (~50 m<sup>3</sup> in total), so the volumes and contaminant concentrations involved would not be large, hence a 'low' scale of effect is allocated.</p> <p>Option 5 involves few operations and wastes generated are considered insignificant.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p>----- ----- ----- ----- </p> <p>                  X<sub>2</sub>    X<sub>1,3,4,5</sub></p>	<p>1) and 2) are combined in the impact matrix.</p> <p><b>Options 1,3,4,5: 'Insignificant'</b></p> <p><b>Options 2: 'Small-moderate negative'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p> 



## GBS MINICELL ANNULUS MATERIAL – Waste Management

2. Description of the scale of effect Options 1, 2, 3, 4, 5	3. Total (environmental) impact
<p>For the GBS Brent B and D Minicell annulus material, 5 decommissioning options are considered:</p> <ul style="list-style-type: none"> <li>Option 1: Mobilise and re-inject in a ‘new’ drilled subsea well away from site</li> <li>Option 2: Mobilise and retrieve to vessel and dispose onshore.</li> <li>Option 3: Cap or cover <i>in situ</i> using sand and coarse gravel.</li> <li>Option 4: Leave <i>in situ</i> and improve natural biodegradation by adding chemicals. Monitored Natural Attenuation, MNA</li> <li>Option 5: Leave <i>in situ</i> for natural biodegradation</li> </ul> <p>Option 1: waste will be generated (~5,000m<sup>3</sup> of slurry for Brent B and D minicells) and re-injected in new wells within the Brent Field (compliance with OSPAR requirements should be confirmed to ensure that this waste can be discharged down new wells). The potential for seepage from the injection wells to the marine environment is captured within ‘Legacy’, atmospheric emissions are captured in ‘E &amp; E’ and the potential for spills during operations is captured within ‘ERA’; hence there is insignificant environmental impact allocated within this category as re-injection of waste from drilling/production offshore is a well proven waste management practice.</p> <p>Option 2: slurry waste will be generated (~5,000m<sup>3</sup> of slurry for Brent B and D minicell annulus) and transported to shore for dewatering and treatment. Treated water will be discharged to sea and solids to landfill. Option 2 is allocated a ‘low negative’ scale of effect (insignificant impact) owing to the relatively small volumes of dilute slurry involved.</p> <p>Options 3 and 4: Small volumes of wastewater would be generated by displacement due to the introduction of the materials (such as nutrients and/or capping agent) into the cells. The wastewater would be recovered and transported onshore for treatment and disposal. The wastewater is small in volume and would only contain ~0.1% hydrocarbons, so the volumes and contaminant concentrations involved are small, hence there is insignificant impact.</p> <p>Option 5: Involves no operations, hence no wastes generated.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X<sub>1,2,3,4,5</sub></p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Options 1,2,3,4,5: ‘Insignificant’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p> <div style="text-align: center;"> <p style="font-size: small;">Value or sensitivity: Low    Medium    High</p> <p style="font-size: small;">Scale of effect: High, Medium, Low, High</p> <p style="font-size: x-small;">Very large positive impact Large positive impact Moderate positive impact Small positive impact Insignificant no impact Small negative impact Moderate negative impact Large negative impact Very large negative impact</p> </div>

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## DRILL CUTTINGS – SEABED, CELL TOPS, TRI-CELLS

**Category: Drill Cuttings on Seabed, Cell Tops and Tri-Cells**

**Consequence evaluation for: Waste Management**

**1. General description of the receiving environment (situation and characteristics)**

The evaluation of waste management concentrates on the types and amounts of waste generated during the dredging of drill cuttings. The waste generated during recovery of the drill cuttings is watered-down oily sludge. The overall value of the material is assessed to be 'low', because the bulk of any material generated will not have any useful purpose.

**Evaluation of value:**

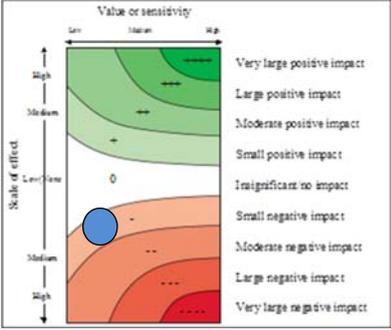
Low Medium High

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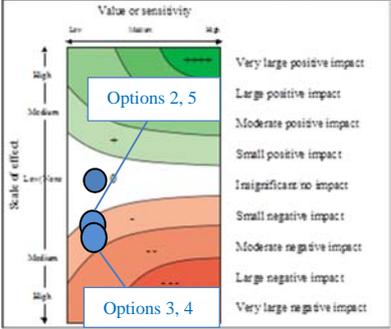
X



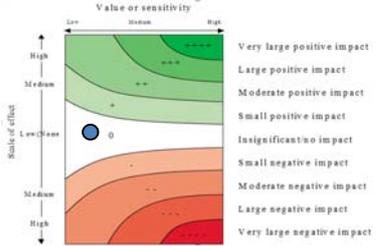
## BRENT A SEABED DRILL CUTTINGS – Waste Management

2B. Description of the scale of effect Brent A seabed drill cuttings Options 1, 2, 3, 4	3E. Total (environmental) impact
<p>For the Brent A jacket, two decommissioning options are to be considered, partial removal and complete removal. For complete removal of the jacket footings (Option 1), the seabed drill cuttings at Brent A will need to be removed by dredging to enable the Brent A jacket footings to be cut. There are 4 options available to manage these drill cuttings.</p> <ul style="list-style-type: none"> <li>Option 1: Dredge, treat on the Brent C topsides and discharge to sea (oil to shore).</li> <li>Option 2: Dredge and return entire volume of slurry to shore for treatment.</li> <li>Option 3: Dredge, dewater from Brent C topsides and transfer solids onshore for treatment.</li> <li>Option 4: Dredge and re-inject into a new well. Re-injection of recovered historic drill cuttings is not believed to have been carried out before in UKCS; the UK regulator is understood to agree to it in principle.</li> </ul> <p>All 4 options involve the handling and treatment of approximately 80,000 m<sup>3</sup> of slurry waste after the approximately 8,000 m<sup>3</sup> drill cuttings and contaminated seabed have been diluted with seawater during the dredging process. After dredging, this waste is handled differently between options; the issues are:</p> <ul style="list-style-type: none"> <li>The volume generated and the composition; this is the key issue and is the same for all 4 options; hence all options are allocated similar scores on this basis. The volume of slurry involved is significant, but bearing in mind that the slurry contains less than 1% oil and that drill cuttings have been handled and managed by the oil and gas industry for decades, a small negative impact is allocated. Onshore, Marine and Legacy impacts are captured elsewhere within the relevant matrices.</li> <li>Options 2 and 3 consume landfill space of treated solids. The slurry will be dewatered to approximately 25,000 m<sup>3</sup> to minimise the quantity sent to landfill. After treatment, the solid waste may contain residual contamination (e.g. heavy metal contamination may persist beyond thermal treatment), and this must be considered when selecting a landfill to dispose of the waste. Shell will use a licensed landfill to dispose of the treated cuttings. The Brent cuttings volumes are relatively small compared to annual onshore processing capacity in the UK/Norway that is regularly received from the drilling of offshore wells, therefore the usage of landfill space is considered small. Shell will audit waste management to ensure duty of care and other waste management requirements are satisfied.</li> <li>Options 1, 2 &amp; 3 have some small benefits owing to the recovery of a relatively small volume of oil after processing (approximately 315 t).</li> </ul> <p>Overall the waste impact of Options 1-4 is estimated to be ‘small negative’.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Options 1- 4: ‘Small negative’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p> 

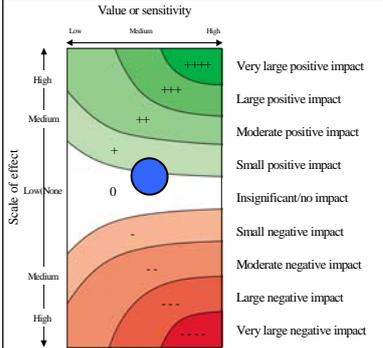
## CELL TOP DRILL CUTTINGS – Waste Management

2. Description of the scale of effect GBS Cell Top Drill Cuttings: Options 1, 2, 3, 4, 5, 6	3. Total (environmental) impact
<p>For the drill cuttings on the GBS cell tops, five decommissioning options are considered:</p> <ul style="list-style-type: none"> <li>Option 1: Partial removal via water jetting into the water column.</li> <li>Option 2: Treat and discharge from Brent C topsides.</li> <li>Option 3: Return dredged material to shore for treatment.</li> <li>Option 4: Transfer to Brent C topsides, dewater offshore, solids returned to shore for treatment.</li> <li>Option 5: Reinject into a new well.</li> <li>Option 6: Leave <i>in situ</i></li> </ul> <p>Note that Option 1 is only relevant to Brent B and D as the drill cuttings on Brent C are mostly located against the external conductors, and water jetting might destabilise the cuttings.</p> <p>For all options, the impact of dredging upon the marine environment is covered in “Marine”.</p> <p>The main activities with potential for waste impacts relate to Options 2, 3, 4 and 5 as they will all require the handling and management of approximately 134,000 m<sup>3</sup> of slurry waste (dredging will increase the drill cuttings volume by a factor of ten as a considerable volume of seawater is retrieved along with the drill cuttings).</p> <p>Option 1 involves the displacement by water jetting of a much smaller volume of drill cuttings from the Brent B and D cell tops, approximately 60 m<sup>3</sup>.</p> <p>As Option 6 involves leaving the cell top drill cuttings <i>in situ</i> for natural degradation, this option has no associated waste impacts.</p> <p>The overall evaluation of the scale of effect of waste impacts as a result of the cell top drill cuttings decommissioning activities is found to be ‘low’ for Option 1 owing to the small volume involved, and ‘low-medium negative’ for Options 2, 3, 4 and 5 as:</p> <ul style="list-style-type: none"> <li>they all involve the management of the same large volume of dilute waste slurry</li> <li>the slurry contains &lt;1% oil</li> <li>the slurry is a waste that has been handled and managed by the oil and gas industry for decades.</li> </ul> <p>A slightly more negative extent is allocated for Options 3 and 4 because they will use domestic waste disposal landfill capacity. The Brent cuttings volumes are relatively small compared to annual processing capacity in the UK/Norway that are regularly received onshore from the drilling of offshore wells, so the usage of landfill area is considered small. The solid waste after treatment may contain residual contamination, and this must be considered when selecting a landfill to dispose of the waste. The transport of the waste onshore is captured within ‘Onshore’.</p> <p>Options 2, 3 and 4 also conversely have positive benefits owing to the recovery of volumes of oil after processing (approximately 4,000 t).</p> <p>The evaluation assumes that all these activities will be undertaken under responsible management and controls. The overall waste impact of Options 2-5 is estimated to be ‘small negative’.</p> <p><b>Evaluation of the scale of effect</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p>----- ----- ----- ----- ----- </p> <p>                  X<sub>3,4</sub> X<sub>2,5</sub>    X<sub>1,6</sub></p>	<p>1) and 2) are combined in the impact matrix.</p> <p><b>Options 1 &amp; 6: ‘No impact’</b> <b>Options 2-5: ‘Small negative’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p> 

## TRI-CELLS DRILL CUTTINGS – Waste Management

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 1: Leave in place (<i>in situ</i>) for natural degradation</b></p> <p>No waste will be generated for the tri-cell drill cuttings as they will be left <i>in situ</i>.</p> <p><b>Evaluation of scale of effect:</b>            High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: ‘No impact’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p>  <p>The diagram is a 2D matrix. The vertical axis is labeled 'Scale of effect' with levels 'High', 'Medium', and 'Low/None'. The horizontal axis is labeled 'Value or sensitivity' with levels 'Low', 'None', and 'High'. The matrix is divided into green (positive) and red (negative) zones. Impact levels are listed on the right: Very large positive, Large positive, Moderate positive, Small positive, Insignificant/no, Small negative, Moderate negative, Large negative, Very large negative. A small blue circle with '0' is located in the 'Low/None' row and 'None' column.</p>

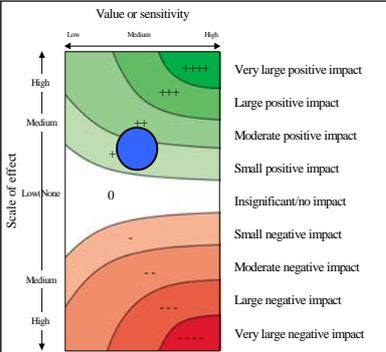
## SUBSEA STRUCTURES AND DEBRIS – Waste Management

<p><b>Category: Subsea structures and debris</b></p> <p><b>Consequence evaluation for: Waste Management</b></p>	
<p><b>1. General description of the receiving environment (situation and characteristics)</b></p> <p>The onshore locations of the dismantling site have not yet been chosen, hence this evaluation of waste management concentrates on the types and amounts of waste generated.</p> <p>The major types of waste generated from collection of the subsea structures and debris are:</p> <ul style="list-style-type: none"> <li>• Steel (from SSIV, SPAR protection cover and PLEM, umbilical splitter, VASP and scaffolding)</li> <li>• Grout</li> </ul> <p>Option 1: Complete removal: approximately 1,000t of waste steel (recyclable) and 500t grout.</p> <p>The overall value of the recyclable material is assessed to be ‘medium’ because the bulk of materials generated will be steel, which has value if recycled.</p> <p><b>Evaluation of value:</b></p> <p>Low Medium High</p> <p> ----- ----- </p> <p>X</p>	
<p><b>2. Description of the scale of effect</b></p> <p><b>Option 1: Complete Removal</b></p> <p>Approximately 1,000 tonnes of steel will be recovered for recycling; this will have an environmental benefit. There will also be approximately 500 tonnes of grout recovered, and the intention is also for this to be recycled.</p> <p>Once the onshore dismantling location is known, Shell will consider local re-use markets to increase the likelihood of re-use of grout.</p> <p>Shell will visit the onshore site and will establish and implement a plan for monitoring and auditing the waste management contractor. Shell will ensure the contractor acts in accordance with duty of care, other legal requirements and contract conditions, and will review waste management documentation and procedures.</p> <p>This impact is ‘insignificant-small positive’ from a material management perspective as there are only relatively small volumes of material involved.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg. Medium neg. Low/none Medium pos. High pos.</p> <p> ----- ----- ----- ----- </p> <p>X</p>	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix.</p> <p><b>Option 1: ‘Insignificant-small positive’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

## WELLS – Waste Management

<p><b>Category: Wells</b></p> <p><b>Consequence evaluation for: Waste Management</b></p>
<p><b>1. General description of the receiving environment (situation and characteristics)</b></p> <p>This evaluation of waste management concentrates on the types and amounts of waste generated. The main types of waste generated from the P&amp;A of wells are:</p> <ul style="list-style-type: none"> <li>• Steel (from conductors, casings, tubings, subsea wellheads)</li> <li>• Marine growth. It is expected that some more firmly attached marine growth, such as mussels, will be transported to shore with the conductor pipe.</li> <li>• NORM (from tubings). Pipework such as well tubing that has been used to carry production fluids may be contaminated with scale containing NORM; this is considered within 'Hazardous Substances'.</li> <li>• Well fluids (OBM, WBM and segregated water). This is considered in 'Hazardous substances'.</li> </ul> <p>The overall value of the recyclable material is assessed to be 'medium' because the bulk of waste materials generated will be steel, which has value if recycled.</p> <p><b>Evaluation of value:</b>            Low Medium High             ----- -----                       X</p>

## WELLS – Waste Management

2. Description of the scale of effect <b>Option 1: Plugging and Abandonment</b>	3. Total (environmental) impact
<p>Approximately 40,000 tonnes of steel will be recovered for recycling, which will have an environmental benefit. Conversely, quantities of marine growth, NORM scale and mud fluids may be generated that require handling and management. Concrete and cement will not be recovered.</p> <p>Marine growth is present on the Brent C conductors and will be removed. The marine growth removed onshore will be treated following appropriate local regulations governing the treatment, storage and transport of waste. Disposal options for marine growth vary, however, common disposal methods include sending to landfill and composting. Minimal impact on the environment will be ensured by requiring the waste contractor to have a regulated plan for the removal and disposal of marine growth onshore.</p> <p>Up to approximately 11,500 m<sup>3</sup> of OMB/WMB well fluids will be generated, and transported to shore for treatment, with treated water discharged to sea, dewatered solids to landfill and oil is recycled. This is considered in 'Hazardous substances'.</p> <p>The overall impact is considered to have a 'small-moderate positive' impact from a material management perspective owing to the significant quantity of steel that will be recycled, which is the dominant beneficial impact. Shell will establish and implement a plan for monitoring and auditing the waste management contractor. Shell will ensure the contractor acts in accordance with duty of care, other legal requirements and contract conditions, and will review waste management documentation and procedures.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: 'Small-moderate positive'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p>  <p>The diagram is a 2D matrix with 'Value or sensitivity' on the x-axis (Low to High) and 'Scale of effect' on the y-axis (High to Low/None). The matrix is divided into seven horizontal bands representing impact levels: Very large positive impact (++++), Large positive impact (+++), Moderate positive impact (++) with a blue circle, Small positive impact (+), Insignificant/no impact (0), Small negative impact (-), Moderate negative impact (--), Large negative impact (---), and Very large negative impact (----).</p>

<sup>1</sup> Shell U.K. Limited, *Technical Document: Decommissioning the Brent Platform Topsides*, Document No.: BDE-F-SUB-AA-5801-00001, 2014.

<sup>2</sup> Bureau of International Recycling, *World Steel Recycling in Figures 2009-2013: Steel scrap – a raw material for steelmaking*, 2014.

<sup>3</sup> Nesse and Moltu, Frigg Cessation Project. *Environmental Footprint and EIA Comparison*, SPE 157361, Rev 01, September 2012.

## 1.5 PHYSICAL

**Category: Topsides /Jacket/ GBS/ Attic Oil/ Cell Contents/ Drilling Leg and Minicell Annulus/ Drill Cuttings/ Subsea Structures and Debris/ Wells**

**Consequence evaluation for: Physical**

### 1. General description of the receiving environment (situation and characteristics)

The baseline description for Physical is the same for all facilities.

In the context of this impact assessment, physical impacts relate to changes as a result of the project such as anchor pits or dredging. The aim is to cover the offshore activities related to the decommissioning project activities. Impacts that relate to both 'Physical' and 'Onshore' are only covered under 'Onshore' impacts, including inshore impacts. Marine biological environment (e.g. habitat, biota, fish) impacts are covered under 'Marine'.

#### *Physical features in the Brent Field area*

Water depths around the Brent Field platforms range from 137.8 m Lowest Astronomical Tide (LAT) to 144.6 m LAT. The average seabed gradients are less than 0.1° [1].

Seabed sediments over much of the North Sea are sand or mud, or a mixture of the two. Broad-scale sediment distribution indicates that the area in Quadrant 211, where the Brent Field is located, is dominated by sand. Recent seabed surveys around the Brent platforms indicate that the sediments predominantly comprise sand with occasional clay exposures and scattered cobbles/boulders up to 0.4 m high.

A debris survey conducted by Gardline Geosurvey in 2006 [2] covering the Brent Field and platforms found evidence of extensive trawling and anchoring activity in the form of trawl scars, anchor pull-out pits and scars throughout the survey area (15 km x 4 km).

No pockmarks were identified within the survey area, and all seabed depressions were attributed to anchoring or construction activity. The seabed sediments within the Brent area are not conducive to the formation of pockmarks or other fluid or gas escape features. No bedrock occurs at seabed within the Brent area and the sedimentary sequence is expected to be more than 400 m thick. No reef structures were identified within the survey area.

#### *Other (wreck /cables/ military activities)*

Within the Brent area no wrecks have been identified that are of any significance or dangerous to navigation. No identified areas dedicated for military activities nor do any known subsea cables exist near the Brent facilities.

The overall physical value of the area is assessed to be 'low'.

#### **Evaluation of the value:**

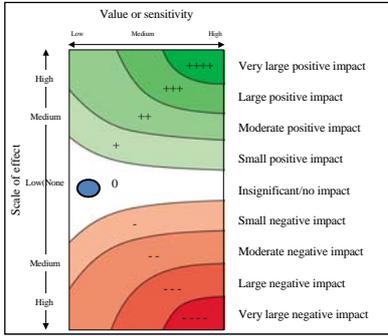
Low Medium High

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X

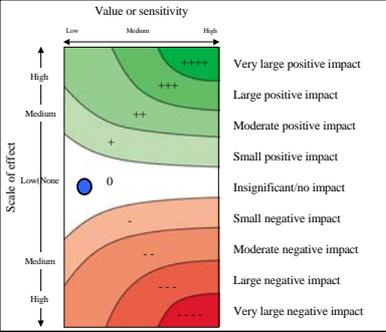


## BRENT A UPPER JACKET – Physical

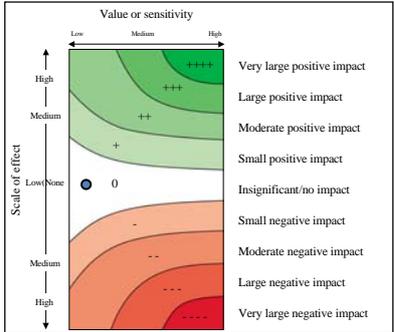
2. Description of the scale of effect <b>Option 1: Removal in one piece to approx. -84.5m LAT using SLV</b>	3. Total (environmental) impact
<p>The removal of the Brent A upper jacket will have no physical impact on the seabed as the SLV will operate on DP and there is no need for an offshore flotel for temporary accommodation, hence there will be no associated impacts from anchor pits. The evaluation of the scale of effect is found to be 'none' for Option 1.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: 'No impact'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p> 



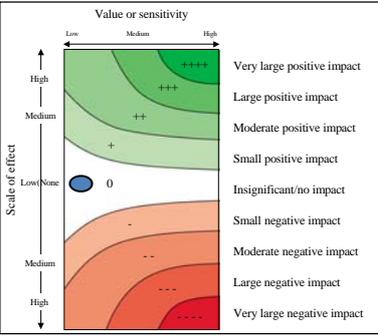
## BRENT A JACKET FOOTINGS – Physical

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 2: Complete removal by SSCV in several pieces, after cutting the piles internally</b></p> <p>In this option, the jacket piles would be cut internally, so the removal of large volumes of drill cuttings and seabed sediment would be unnecessary, and the associated physical impacts to the seabed (described in Brent A jacket footings Option 1) would not occur.</p> <p>Also, the SSCV and DSV vessels would operate on DP, and there is no flotel accommodation required, hence there will be no disturbances to the seabed as a result of (e.g.) anchor pits.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 2: ‘No impact’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p> 

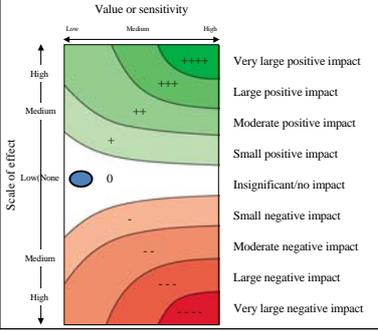
## BRENT A JACKET FOOTINGS – Physical

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 3: Leave <i>in situ</i></b></p> <p>The footings are left <i>in situ</i>, hence there are no physical impacts.</p> <p><b>Evaluation of scale of effect:</b>            High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 3: ‘No Impact’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p> 

## GBS – Physical

2. Description of the scale of effect Options: 1 and 2: Partial removal, and Leave <i>in situ</i>	3. Total (environmental) impact
<p>For the GBS two decommissioning options are considered:</p> <ul style="list-style-type: none"> <li>Option 1: partial removal of the legs in a single piece down to around -55 m clear water depth below LAT.</li> <li>Option 2: leave <i>in situ</i>.</li> </ul> <p>Vessel data from Shell confirms that no flotel will be required during GBS decommissioning.</p> <p>For GBS Option 1, a large SSCV, ROVSV, a tug and barge will be required, and these vessels can cause disturbance to the seabed as a result of anchor pits. However, the use of Dynamic Positioning (DP) will be employed which will have no physical disturbance to the seabed. The use of DP will on the other hand create noise disturbance to the marine environment, and consume energy which are covered under separate environmental categories (see 'Marine' for underwater noise impacts).</p> <p>There will be very little offshore operations during GBS Option 2, thus there will be no physical impacts.</p> <p>The overall evaluation of physical impacts as a result of GBS decommissioning activities is found to be 'no impact' for both Options 1 and 2.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Options 1 &amp; 2: 'No impact'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

## GBS ATTIC OIL – Physical

2. Description of the scale of effect Option 1: Recover to Shore	3. Total (environmental) impact
<p>No flotel will be required during decommissioning, and vessels will operate on DP so they will not cause any physical disturbance to the seabed by anchor pits. There are thus no physical impacts from this option.</p> <p>The use of vessels on DP will, on the other hand, create noise disturbance to the marine environment, and consume energy which are covered under separate environmental categories.</p> <p><b>Evaluation of scale of effect:</b> High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: ‘No impact’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 







## DRILL CUTTINGS – Physical

**Category: Physical effects**

**Consequence evaluation for: Seabed, Cell top and Tri-Cells Drill Cuttings**

### 1. General description of the receiving environment (situation and characteristics)

The drill cuttings piles are located at the base of Brent A Jacket, at the base of the GBS, as well as on top of GBS storage cells.

#### Seabed Drill Cuttings

The volumes of the piles at the seabed range from 6,300 m<sup>3</sup> at Brent A to 2,230 m<sup>3</sup> at Brent D and the heights of the piles range from 4 to 11 m. The environment on the seabed is fairly stable and it is not likely that any storms can create forces at the seabed that will significantly disturb the drill cuttings from one day to another. However, reduction of the piles does occur over the years and mappings indicate a reduction of 40-60% over the last 20 years. Erosion due to the natural conditions is to be expected, but the GBS are likely to some extent protect the piles from water current forces.

#### Cell Top Drill Cuttings

Drill cuttings and debris (such as scaffolding) are found on the GBS cell tops in varying degrees, some of which must be cleaned in order to access the GBS cells. To avoid dispersion of contaminants, there is an effort to keep the disturbance of the cell top drill cuttings to a minimum.

Brent C has the largest volume of cell top drill cuttings (due to its external conductors), with a total of approximately 7,735 m<sup>3</sup>. Brent B and D are estimated at 1,890 m<sup>3</sup> and 3,790 m<sup>3</sup> respectively.

#### Tri-Cells Drill Cuttings

Brent B and Brent D are believed to have about 12,480 m<sup>3</sup> and 13,510 m<sup>3</sup> of drill cuttings respectively accumulated in the tri-cells. These are considered to be an 'extension' of the exposed cell top drill cuttings. There are no tri-cells drill cuttings found in Brent C as the tri-cells are closed.

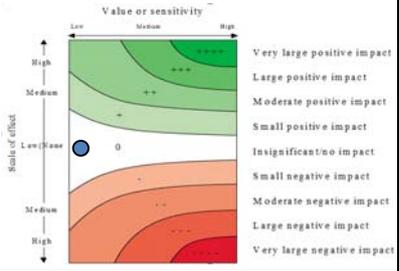
#### **Evaluation of the value:**

Low Medium High

|-----|-----|

X

## SEABED DRILL CUTTINGS – Physical

2. Description of the scale of effect <b>Option 1: Leave <i>in situ</i></b>	3. Total (environmental) impact
<p>There will be no operations if drill cuttings are left in place, so there are no physical impacts from activities.</p> <p>The volume and footprint of the piles will gradually diminish over time. The modeling results indicate that after 1,000 years the physical persistence of the piles at the seabed is further reduced by 35-74 % of the present situation. Brent A pile has the highest reduction and Brent B has the lowest value. This impact is assessed within 'Legacy'.</p> <p><b>Evaluation of scale of effect:</b>            High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: 'No impact'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

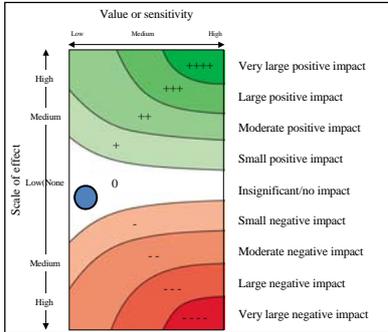








## WELLS – Physical

2. Description of the scale of effect Option 1: Plugging and Abandonment	3. Total (environmental) impact
<p>There is only Option 1: P&amp;A 146 wells.</p> <p>During P&amp;A, there will be no anchoring and hence no impacts on the seabed as a result of anchor pits (from use of vessels). All P&amp;A will be from existing platforms, hence there should be not be any physical impacts outside the footprint of the installations.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: ‘Insignificant’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p> 

<sup>1</sup> BMT Cordah, *Brent Decommissioning Project Environmental Setting Including Brent Field, Transportation Route, Transfer Area and Onshore Destination*, Shell Doc. No.: BDE-F-GEN-HE-7753-00010, Rev A05, September 2015.

<sup>2</sup> Gardline Geosurvey, *Brent Debris and Habitat Survey UKCS Block 211/29*, Volume I, Shell EPE Report: ED-2006-034, Rev 02, January 2007.

## 1.6 MARINE ENVIRONMENT

**Category: All Facilities (Topsides/Jacket/GBS/Attic Oil/Cell Contents/Drilling Leg and Minicell Annulus/Drill Cuttings/Subsea Structures and Debris/Wells)**

**Consequence evaluation for Marine environment**

### 1. General description of the receiving environment (situation and characteristics)

The assessments below depict short-term impacts to the marine environment as a result of the Brent Field decommissioning programme; long-term impacts are captured under 'Legacy'. The information below is summarised from the 2015 BMT Cordah Environmental Baseline study [1].

#### Marine Environment at the Brent Field

**The benthic communities** (seabed communities) in this region of the Northern North Sea comprise species typical of the deep water and soft, fine sediments at this latitude in the North Sea; the seabed communities are diverse and abundant. Data from benthic surveys around the Brent Field indicate that characteristic infaunal species associated with this region of the North Sea include the polychaete *Owenia fusiformis* (tube worm), *Thyasira spp* (bivalve mollusc) and *Myriochele spp.* (polychaete worm). The benthic communities around the Brent Field were analysed as part of environmental surveys in 1990 and 1994. Analysis of these historic survey data indicated that the benthic fauna was affected up to a few hundred metres from the Brent platforms with a zone of slight benthic disturbance extending 500 m to 800 m from the platform. Stations more than 800 m from the Brent A platform showed diverse benthic communities indicative of undisturbed conditions, typical of the East Shetland Basin. More recent surveys conducted by Gardline in 2007 [2,3] found some ecological impacts due to contamination, and that the fauna community appeared to be relatively uniform between stations. None of the species identified were of statutory conservation significance. There are also **corals** present as fouling growth on the installation legs, not native on soft bottom seabed.

**Fish:** Two types of fish species are commonly found in the vicinity of the Brent Field: pelagic species (which occur in shoals swimming in mid-water, typically making extensive seasonal movements or migrations between sea areas) and demersal species (which live on or near the seabed). The Brent Field is located within spawning and nursery grounds used by 13 fish species, during different parts of the year. The Brent Field is located within spawning grounds used by cod (January to April), haddock (February to May), Norway pout (January to April), saithe (January to April), sandeel (November to February) and whiting (February to June). Pelagic species typically have pelagic eggs that are released into the water column to be fertilised. Spawning grounds are dynamic features of fish life history and are rarely fixed in one location from year to year. Therefore, the information on the fish spawning areas represents the widest known distribution given current knowledge. Nursery grounds are used throughout the year by all 13 fish species, potentially making it impossible to avoid an operational period coincident with the presence of juvenile fish.

**Plankton:** The planktonic communities are composed of a both phytoplankton and zooplankton, with a variety of species within both categories. The most common phytoplankton groups are the diatoms, dinoflagellates (e.g. *Ceratium spp*) and the smaller flagellates. Together they are responsible for most of the primary production of the North Sea. The zooplankton community are dominated by neritic (coastal) and intermediate (mixed water) species.

**Seabirds:** 25 seabird species breed in the UK and on mainland North Sea coastlines, including fulmar, cormorant, northern gannet, skua, gull, tern and auk. The overall vulnerability of seabirds to oil pollution in the Brent area is 'low', however for the months of January, March, July and between September to November, some blocks show seabird vulnerability is 'high'.

**Marine mammals:** Harbour porpoises (Annex II species) and white-sided dolphins have been recorded in the area, while minke whales and killer whales have been recorded in surrounding quadrants. There are 2 species of pinnipeds (seals) which reside in UK waters, the common or harbour seal, and the grey seal. Both species breed in the UK; however, their distribution at sea is constrained by their need to return periodically to land.

#### **Marine protected areas:**

The nearest SCI to the Brent Field is the Pobie Bank Reef, 85 km away. The closest MPA is the NE Faroe Shetland Channel NCMPA, located approximately 110 km to the north-west. There are no designated SCA close to Brent Field.

#### Nearshore and Inshore Marine Environment

The nearshore and inshore marine environment close to the ASP onshore facility is more sensitive than at the Brent Field, and is near several sites with a protected conservation status (Ramsar, SPA, SSSI, Nature Reserve), owing primarily to the presence of birds and seals. The proposed transit route passes directly through the North-East of Farnes Deep MCZ, an area of 492 km<sup>2</sup> of varied ecosystem. Further details to be found in the Environmental Setting (Section 6) of the ES.

(contd.)

## TOPSIDES – Marine Environment

**Category: Topsides /Jacket/ GBS/ Attic Oil/ Cell Contents/ Drilling Leg and Minicell Annulus/ Drill Cuttings/ Subsea Structures and Debris/ Wells**

**Consequence evaluation for: Physical**

### 1. General description of the receiving environment (situation and characteristics)

(contd.)

#### **Summary**

Because the offshore environment at the Brent Field is typical of other North Sea installations and does not contain any particularly sensitive habitats or species, it is allocated a 'low-medium' value. The nearshore environment is allocated a relatively 'high' value due to its proximity to several environmentally protected areas. The value category for nearshore is only relevant for the Brent Field topsides and jacket, where it is known that they will be brought to the ASP facility.

#### **Evaluation of the value:**

Low Medium High

|-----|-----|

X

X

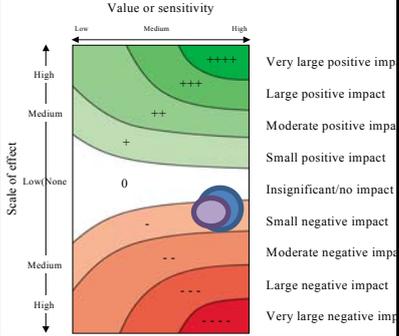
## TOPSIDES – Marine Environment

2. Description of the scale of effect Option 1: Complete Removal by SLV	3. Total (environmental) impact
<p>The complete removal of topsides has some potential for impacting the Marine environment.</p> <p>The following issues are considered:</p> <ol style="list-style-type: none"> <li>1. Effects on benthic fauna from anchor handling</li> <li>2. Underwater noise</li> <li>3. Introduction of alien species from marine vessels</li> <li>4. Disturbance to seabed during transfer of topsides from SLV to cargo barge.</li> <li>5. Risk of corkscrew injuries to seals</li> </ol> <ol style="list-style-type: none"> <li>1. The main potential for effect on the benthic community is from anchor handling on the seabed during marine operations, but the topsides will be removed by SLV using dynamic positioning (DP).</li> <li>2. Removal of topsides involves marine operations for a period of time in the area. There will be periods with increased traffic to and from the installations, however with small/insignificant effect from noise on the marine life. Underwater noise from operations on installations and pipelines has been modelled. The results (DNV GL <i>Environmental Noise Analysis for the Brent Field Decommissioning</i> [4]) indicate that acoustic noise will have small negative effect on marine mammals both at the Brent Field and because of nearshore SLV operations. The environmental noise is primarily dominated by noise from shipping activity and cutting activity. Ranges for injury and behavioural disturbance were estimated according to several peer decision criteria. The affected area was compared with sightings of cetaceans in vicinity of the Brent and Penguin fields to obtain an indication of the number of individuals that might be affected. Based on the observed density of cetaceans in the area it is unlikely that any individual will experience auditory injury in the form of Temporary Threshold Shift (TTS) or Permanent Threshold Shift (PTS).</li> </ol> <p>Noise levels that could cause PTS were found to occur typically within ~10 metres of noise source for cetaceans and ~30 metres of noise source for pinnipeds. Levels that could cause TTS were found typically to occur within ~60 metres of noise source for cetaceans and ~300 metres of noise source for pinnipeds. Worst case noise levels that could cause PTS were found to occur within ~20 metres for cetaceans and ~60 metres for pinnipeds. Worst case levels that could cause TTS were found to occur within ~200 metres for cetaceans and ~1,300 m for pinnipeds. Mild behavioural disturbance for cetaceans were estimated out to ~1,200 m.</p> <p>There is little data available about the presence of seals in the Brent Field. However, since pinnipeds are shore based, and as the site is 180 km from the coast it is unlikely that significant numbers of seals would be found in the area.</p> <p>Fish are assumed to move away as a result of the strongest noise sources; this is however a temporary effect. Therefore, acoustic noise is only estimated to have a 'small negative' impact on fish (purple dot).</p> <ol style="list-style-type: none"> <li>3. Movement of vessels during decommissioning operations will generally be local, vessels will have a ballast water management plan and will follow IMO guidelines on ballast water management [5]. The likelihood of introducing alien species from ballast water or ship hulls is therefore considered to be "low".</li> </ol> <p>(contd.)</p>	

## TOPSIDES – Marine Environment

2. Description of the scale of effect Option 1: Complete Removal by SLV (contd.)	3. Total (environmental) impact
<p>4. Disturbance to seabed during transfer of topsides from SLV to cargo barge.</p> <p>The topsides will be transferred from the SLV to a cargo barge at a transfer location 10 km offshore during an operation that will take 2 days, during which time the SLV will operate using DP. The 12 DP thrusters on the SLV could potentially disturb the seabed. At the transfer site, the SLV will have a draft of approximately 25 m, and operations will occur in a water depth of 35 m. The thrusters do not extend down below the bottom of the hull but are located a little way up the sides of the hull. So the thrusters would be at least 10 m above the seabed while operating at the transfer location. The seabed at the transfer location is not thought to be contaminated, or to contain any unique benthic species, based on the information available (ES Section 6).</p> <p>The disturbance of the seabed at the transfer location by the DP thrusters has not been modelled. The transfer operations are expected to result in localised temporary increases in turbidity. Because the sediments involved are not contaminated, and the benthic species present are not unique, the impact is considered to be small negative. Also, the nature of the marine sediment at the transfer location suggests that sediment disturbance is normal for the area.</p> <p>5. Risk of corkscrew injuries:</p> <p>Several international and national conservation areas (Ramsar, SPA, SSSI, NNRs) occur within a 40 km radius of the near shore transfer location. The ASP facility is located adjacent to the Teesmouth and Cleveland Coast RAMSAR/SPA site which overlaps with Teesmouth National Nature Reserve (NNR), the location of the only regular breeding colony of common (harbour) seals on England’s NE coast.</p> <p>The marine operations will take place in June, a period associated with the highest density of common seal present in the area due to seal pupping. The area is accordingly considered to be of high importance for common seal and moderate importance for grey seal at the time the operation is planned (“high value” and “moderate value” cf. assessment methodology).</p> <p>The proposed transfer location is located 10 km from the Teesmouth NNR, and the transport route to the disposal site passes important pupping areas for common seal. The area is however not classified as a Special Area of Conservation (SAC) for either the common or grey seal. The nearest common and grey seal SAC areas to the ASP facility are located approximately 60 nautical miles away.</p> <p>According to criteria by the Statutory Nature Conservation Agency (SNCA) [6], the marine activities will take place within a “low risk” area (i.e. &gt;30 nm from nearest common seal SAC and &gt; 4 nm from a grey seal SAC).</p> <p>(contd.)</p>	

# TOPSIDES – Marine Environment

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 1: Complete Removal by SLV (contd.)</b></p> <p>But nearshore operations with SLV and assisting tugs working on DP may still present a risk of corkscrew injuries. The risk is mainly associated with the transfer operation, as it is assumed that DP will be used only periodically by the harbour tugs during transport of the barge to shore. It is reasonable to assume that seals in general will not be attracted to the vessel due to marine noise from the propulsion and propeller. Exceptions may however occur. One reason for seal injuries may be due to a stationary vessel stopping, starting and reversing its propellers while working on DP. This may increase the opportunities for animals to approach propellers and be drawn into them when they start rotating [7]. The marine operations will take place in a period with high seal density in the area and corkscrew injuries to seals are a possibility that cannot be discounted. But the risk of corkscrew injuries will be limited to marine operations of relatively short duration (approx. 2-3 days per topside). The probability for seal fatality is thus low for such a limited activity and negative impacts on seal populations due to near shore activities are considered unlikely.</p> <p>Able confirm that there have been no incidents of corkscrew injuries to seals in connection with previous marine operations related to their plant activities. To reduce the potential for corkscrew injuries, Shell will consider establishing a Seal Corkscrew Injury Monitoring Scheme, which comprises:</p> <ul style="list-style-type: none"> <li>• Use of seal observers to identify and scare away seals during marine operations with vessels working on DP</li> <li>• Consider the use of tug boats without ducted propellers during transport through the channel</li> </ul> <p>Note: JNCC have more recently stated that there is now incontrovertible evidence that corkscrew injuries can be caused by grey seal predation on young seals and seal pups. Based on the latest information it is considered very likely that the use of vessels with ducted propellers may not pose any increased risk to seals over and above normal shipping activities and therefore mitigation measures and monitoring may not be necessary in this regard, although all possible care should be taken near major seal breeding and haul-out sites to avoid collisions.</p> <p>Summary: The main contributor to the environmental impact is from the risk of corkscrew injuries to seals nearshore, where the environmental sensitivity is higher. The risk is ‘small negative’.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: ‘Small negative</b></p> <p>The environmental impact from noise on the marine environment is estimated to be “<b>small negative</b>” (purple dot).</p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p> 

## BRENT A UPPER JACKET – Marine Environment

2. Description of the scale of effect Option 1: Removal in one piece to approx. -84.5m LAT, using SLV	3. Total (environmental) impact
<p>Removal of the upper jacket to approx. -84.5m LAT has some potential to affect the marine environment. The following issues are considered:</p> <ol style="list-style-type: none"> <li>1. Effects on benthic fauna</li> <li>2. Underwater noise</li> <li>3. Introduction of alien species from marine vessels</li> <li>4. Disturbance to seabed during transfer of topsides from SLV to cargo barge.</li> <li>5. Risk of corkscrew injuries to seals</li> </ol> <p>1. One of the risks to the benthic community is usually from anchor handling on the seabed during marine operations, but the SLV will operate using dynamic positioning, thus no impact. Also, there is unlikely to be a need for temporary flotel accommodation, hence there would be no ‘anchoring’ impact on the benthic community.</p> <p>Protection offered to <i>Lophelia Pertusa</i> (<i>L. Pertusa</i>) may have implications for fouling removal measures but current opinion from conservation bodies suggests that <i>L. Pertusa</i> on North Sea installations is an artefact resulting from the presence of man-made structures in the sea, and so the colonies are not of significant conservation interest, hence their removal is not considered significant. The idea of turning steel jacket substructures into artificial reefs has been studied by Mackay, but “no positive effects” were foreseen [8].</p> <p>2. Removal of the upper jacket involves marine operations for a period of time in the area. There will be periods with increased traffic to and from the installations, however with small/insignificant effect from noise on the marine life. Underwater noise from operations on installations and pipelines has been modelled. The results [4] indicate that acoustic noise will have small negative effect on marine mammals (purple dot) both at the Brent Field and as a result of nearshore SLV operations. The environmental noise is primarily dominated by noise from shipping activity and cutting activity. Ranges for injury and behavioural disturbance were estimated and the affected area was compared with sightings of cetaceans in vicinity of the Brent and Penguin fields to obtain an indication of the number of individuals that might be affected. Based on the observed density of cetaceans in the area it is unlikely that any individual will experience auditory injury in the form of Temporary Threshold Shift (TTS) or Permanent Threshold Shift (PTS). There is little data available about the presence of seals around the Brent Field. However, since pinnipeds are shore based, and as the site is 180 km from the coast it is unlikely that significant numbers of seals would be found in the area. Fish are assumed to move away as a result of the strongest noise sources; this is however a temporary effect. Therefore, acoustic noise is only estimated to have a ‘small negative’ impact on fish (purple dot).</p> <p>3. Movement of vessels during decommissioning operations will generally be local, vessels will have a ballast water management plan and will follow IMO guidelines on ballast water management [5]. The likelihood of introducing alien species from ballast water or ship hulls is therefore considered to be low.</p> <p>(contd.)</p>	

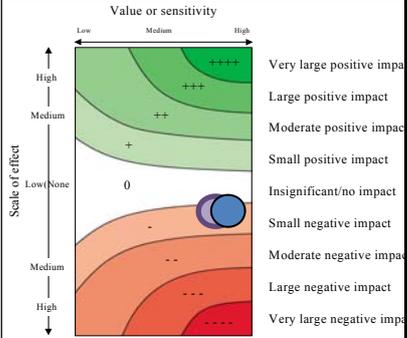


## BRENT A JACKET FOOTINGS – Marine Environment

2. Description of the scale of effect <b>Option 1: Complete removal by SSCV in several pieces, after cutting the piles externally</b>	3. Total (environmental) impact
<p>Complete removal of the jacket footings in several large pieces to ca.-3m below seabed has some potential to affect the marine environment:</p> <ol style="list-style-type: none"> <li>1. Excavation of seabed to access jacket footings</li> <li>2. Effects on benthic fauna, including fouling on the installation</li> <li>3. Introduction of alien species from marine vessels</li> <li>4. Underwater noise</li> </ol> <p>1. Excavation of seabed to access jacket footings</p> <p>One of the biggest potential risks to the marine environment would be from the disturbance of drill cuttings and seabed sediment to enable jacket piles to be cut. The effect of removing the drill cutting pile (and any contaminated seabed sediment) at Brent A is covered under ‘drill cuttings’, so only the excavation of the clean seabed sediment is assessed here, but it should be noted that the two impacts will overlap.</p> <p>After dredging the majority of the Brent A drill cuttings pile and associated contaminated sediment, the clean seabed sediment would be excavated around the legs to enable access for the removal of the jacket footings. A pit would be excavated around each of the 8 legs; Shell estimate that each pit would be approximately 4 m deep and 42 m diameter. This would result in the excavation of some 23,750 m<sup>3</sup> of clean seabed sediment, or essentially the removal of a 4 m thick layer of seabed sediment from within the whole footprint of the jacket. The excavated sediment would be discharged to adjacent seabed areas and used to backfill the preceding pit to provide the required 3m burial over the tops of the cut steel piles. This will likely result in a residual part-backfilled excavation at the jacket footprint, plus some adjacent heaps of relocated seabed sediment (perhaps reaching up to 1 m high).</p> <p>The long term impact upon fisheries is considered within ‘Legacy’, and the physical impact to the seabed is addressed within ‘Physical’. The impact to the marine environment is considered below.</p> <p>This disturbance of cuttings could lead to “small-moderate negative” impact on the marine environment owing to turbulence and the smothering of organisms. The turbidity is known to cover the breathing functions (gill and skin) and feeding functions of local organisms. The re-located sediment will settle in the local environment and smother the benthos over a hectare or two. These effects however are not considered of major significance because there are no species identified in the area which are of statutory conservation interest (the communities comprise tube worms and molluscs, which are not unique in nature). However, the area disturbed is not insignificant in size and will take years to recover, so a small-moderate negative impact is allocated.</p> <p>2. Anchor handling and marine fouling</p> <p>Another risk to the benthic community is from anchor handling on the seabed during marine operations; however, the SSCV and DSV will likely operate using dynamic positioning so there will be no impacts. There is no need for temporary flotel accommodation, hence there would be no ‘anchoring’ impact on the benthic community.</p> <p>Protection offered to <i>Lophelia Pertusa</i> may have implications for fouling removal measures but current opinion from conservation bodies suggests that <i>L.Pertusa</i> on North Sea installations is an artefact resulting from the presence of man-made structures in the sea, and so the colonies are not of significant conservation interest, hence their removal is not considered significant. The idea of turning steel jacket substructures into artificial reefs has been studied by Mackay, but “no positive effects” were foreseen [8].</p> <p>(contd.)</p>	



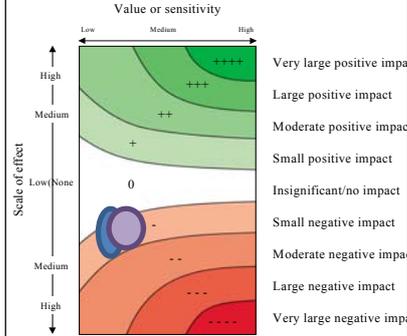
# BRENT A JACKET FOOTINGS – Marine Environment

2. Description of the scale of effect <b>Option 2: Complete removal by SSCV in several pieces, after cutting the piles internally</b>	3. Total (environmental) impact
<p>This option, complete removal of the jacket footings after cutting the piles internally, has much lower potential for impacting the marine environment than Brent A jacket footings Option 1.</p> <p>This is because the piles would be cut internally so there is no need to dredge the drill cuttings pile and excavate the seabed to access the jacket footings.</p> <p>Consequently, the impact to the marine environment is much lower as the excavation was the main contributor to the impact allocated for Brent A jacket footings Option 1.</p> <p>Items 1-4 listed in Brent A jacket footings Option 1 remain relevant for Option 2, with a smaller impact allocated.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 2: ‘Small negative’</b></p> <p>The environmental impact from noise on the marine environment is estimated to be “<b>small negative</b>” (purple dot).</p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p> 

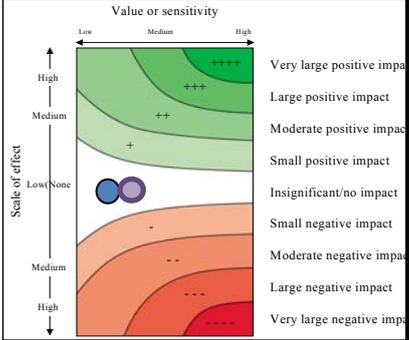
# BRENT A JACKET FOOTINGS – Marine Environment

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 3: Leave <i>in situ</i></b></p> <p>There are no activities and no marine impacts.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 3: ‘No impact’</b></p> <p>The environmental impact from noise on the marine environment is estimated to be “no impact” (purple dot).</p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p> <div style="border: 1px solid black; padding: 5px;"> <p style="text-align: center;">Value or sensitivity</p> <p style="text-align: center;">Low                      Medium                      High</p> <p style="text-align: center;">Scale of effect</p> <p style="text-align: center;">High</p> <p style="text-align: center;">Medium</p> <p style="text-align: center;">Low/None</p> <p style="text-align: center;">Medium</p> <p style="text-align: center;">High</p> <p style="text-align: right;">Very large positive impact Large positive impact Moderate positive impact Small positive impact Insignificant/no impact Small negative impact Moderate negative impact Large negative impact Very large negative impact</p> </div>

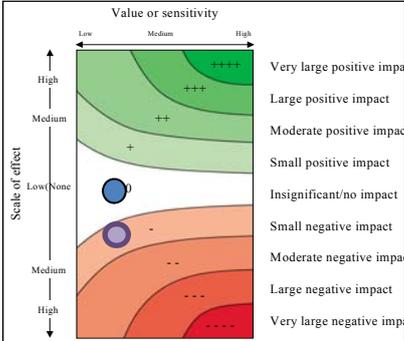
## GBS – Marine Environment

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 1: Remove legs in one piece, down to approx. -55 m LAT</b></p> <p>The following issues have potential to affect the marine environment:</p> <ul style="list-style-type: none"> <li>• Effects on benthic fauna, including fouling on the installation</li> <li>• Effects from planned discharges</li> <li>• Underwater noise</li> <li>• Introduction of alien species from marine vessels</li> </ul> <p>The main potential for effect on the benthic community is from anchor handling on the seabed during marine operations. However, the vessels will be operating using dynamic positioning, (DP) which will have no effect on benthic communities.</p> <p>Partial removal of the GBS will result in the discharge of concrete slurry created during the cutting of the substructure. These effects will be more of a physical impact than a chemical impact from the characteristics of the concrete slurry. The degradation of concrete is a slow process and the associated impact is evaluated to be minor. The total extent of discharges to sea during partial removal of the GBS are expected to be low, and the environmental effects are estimated to be insignificant.</p> <p>Drill cuttings on the cell tops would likely be removed to create adequate working space for any cell access activities. Associated impacts are considered under “Drill Cuttings Cell Tops”.</p> <p>Protection offered to <i>Lophelia Pertusa</i> may have implications for fouling removal measures but current opinion from conservation bodies suggests that <i>L. Pertusa</i> on North Sea installations is an artefact resulting from the presence of man-made structures in the sea, and so the colonies are not of significant conservation interest, hence their removal is not considered significant. The idea of turning the GBS substructures into artificial reefs has been studied by Mackay, but “no positive effects” were foreseen [8].</p> <p>Removing the GBS legs down to -55 m LAT involves marine operations for a period of time in the area. There will be periods with increased traffic to and from the installations, however with only a small/insignificant effect from noise on the marine life. Underwater noise from operations on installations and pipelines has been modelled. The results [4] indicate that acoustic noise will have a ‘small negative’ effect on marine mammals (purple dot). The environmental noise is primarily dominated by noise from shipping activity and cutting activity. Ranges for injury and behavioural disturbance were estimated according to several peer decision criteria. The affected area was compared with sightings of cetaceans near the Brent and Penguin Fields to obtain an indication of the number of individuals that might be affected. Based on the observed density of cetaceans in the area it is unlikely that any individual will experience auditory injury in the form of Temporary Threshold Shift (TTS) or Permanent Threshold Shift (PTS). There is little data available with regard to the presence of seals in the area of the Brent Field. However, since pinnipeds are shore-based, and as the site is 180 km from the coast it is unlikely that significant numbers of seals would be found in the area. Fish are assumed to move away as a result of the strongest noise sources; this is however a temporary effect.</p> <p>Movement of vessels during decommissioning operations will be local, vessels will have a ballast water management plan and will follow IMO guidelines on ballast water management [5]. The likelihood of introducing alien species from ballast water or ship hulls is therefore considered to be ‘low / none’.</p> <p>The combined scale of effect for both underwater noise and marine is considered low-medium negative.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p>----- ----- ----- ----- -----</p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: ‘Small negative’</b></p> <p>The environmental impact from noise on the marine environment is estimated to be “<b>small negative</b>” (purple dot).</p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

# GBS – Marine Environment

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 2: Leave <i>in situ</i></b></p> <p>The structures will degrade over several hundred years, and mainly constitute an obstacle with a hard-bottom effect for local organisms. When finally degraded, the structure on the seabed will represent a reef-like solid substrata in a homogenous area of sand, and attract the settlement of hard-bottom species of organisms. This is covered under 'Legacy'.</p> <p>Hence there is no short-term marine impact or underwater noise impact as a result of this option.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 2: 'No impact'</b></p> <p>The environmental impact from noise on the marine environment is estimated to be <b>"no impact"</b> (purple dot).</p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p> 

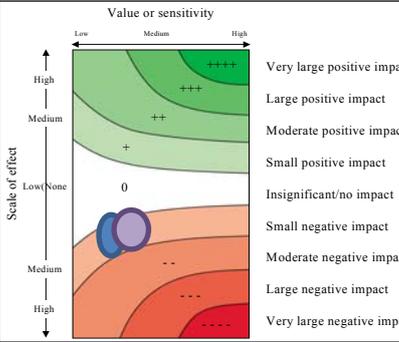
# GBS ATTIC OIL – Marine Environment

2. Description of the scale of effect <b>Option 1: Recover to Shore</b>	3. Total (environmental) impact
<p>During marine operations to remove the GBS attic oil, there will be no impact to the benthic community from anchor handling on the seabed because vessels will operate using dynamic positioning. There is also no need for flotel accommodation, hence there would be no ‘anchoring’ impact to the benthic community.</p> <p>Removing the attic oil involves marine operations for a period of time in the area. There will be periods with increased traffic to and from the installations, with small and local disturbance effects from noise on marine life. The overall noise impact is estimated to be ‘small negative’.</p> <p>Chemicals (H<sub>2</sub>S scavenger and possibly wax solvent) would be used although there would be no discharge to the marine environment. Accidental release of chemicals (or attic oil) is captured elsewhere (see ‘Environmental Risk’).</p> <p>There is therefore estimated to be ‘no impact’ overall to the marine environment.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p>----- ----- ----- ----- ----- </p> <p style="text-align: center;">X<sub>noise</sub>    X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: ‘No impact’</b></p> <p>The environmental impact from noise on the marine environment is estimated to be “<b>small negative</b>” (purple dot).</p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p> 

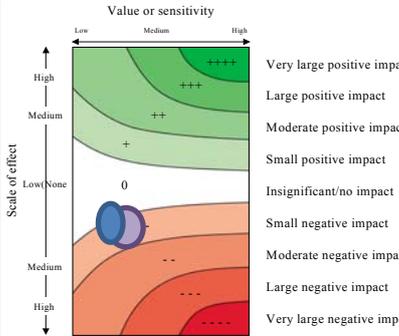
## GBS CELL CONTENTS – Marine Environment

2. Description of the scale of effect Option 1: Mobilise to vessel and reinject into a new well	3. Total (environmental) impact
<p>Option 1, mobilise to vessel and re-inject into a new well in the Brent Field, has potential to affect the marine environment. The following issues are considered:</p> <ul style="list-style-type: none"> <li>• Effects on benthic fauna</li> <li>• Effects from planned discharges</li> <li>• Effects from drilling</li> <li>• Underwater noise</li> <li>• Introduction of alien species from marine vessel</li> </ul> <p>During marine operations, there will be no impact to the benthic community from anchor handling on the seabed because vessels will operate using dynamic positioning, and there is also no need for flotel accommodation.</p> <p>There will be drill cuttings generated when drilling new wells, and also chemicals will be used. The effect from chemicals use will depend on the amount and type of chemicals, but planned discharges will be subject to a discharge permit application (the impact of chemicals use is considered within ‘Hazardous Substances’ and impacts due to spillage are captured within ‘ERA’).</p> <p>Cell access will be achieved subsea via a small hole in cell tops and connected by a flexible pipe-in-pipe to the surface allowing the attic oil to be pumped from the cells, the recovered attic and residual oil as well as interphase material will be dealt with. Water is pumped to circulate the oily water and removed via flexible hose to a vessel (see ‘GBS Attic Oil’).</p> <p>The debris and drill cuttings within the defined work area on top of the GBS cell domes need to be removed to provide sufficient working space for subsequent operations (the impacts of this are captured within “drill cuttings cell tops”).</p> <p>After removing the cell water, a larger hole is cut (~5 m) on the cell tops by high pressure abrasive cutting. Concrete caps would be removed and a fabricated steel lid arrangement would be put in place. This lid would move from cell to cell. A “mobilisation tool” (e.g. suction dredger) is deployed into each cell from a DPROV Support Vessel, and the mobilised slurry (mixture of sediment and all the oily water in the cell) is transported via a flexible pipe up to the vessel. The sediment phase will be mobilised and fluidized inside the cells via the same access point and pumped to the vessel via the same conduit. The slurry would be transferred by floating hose to a tanker for temporary storage and then transported by the tanker to the selected injection well location. The slurry is pumped by a slurrification package (comprising of degassing / shearing vessel, holding vessel, grinder and transfer pumps) on the vessel into a newly drilled waste disposal well (the existing wells <i>in situ</i> at the platform are not suitable for receiving the slurry). For Option 1, 4 new wells will be drilled about 1 km from the platform, within the Brent Field. It is expected that one new well is drilled for each platform plus a spare well (for back-up, resting and switching to expedite operations of re-injection wells. Chemicals such as viscosifier, O<sub>2</sub> scavenger and H<sub>2</sub>S scavenger may need to be added before the slurry is pumped down the well. If the slurry requires volume shrinkage to optimise reinjection rates or well configuration, separated water will be treated to the regulators’ prescribed discharge levels before being disposed of overboard. Under Option 1, no long distance transportation is required as all content phases are disposed of downhole but the duration time is longer due to limitation of flowrate associated with the processing on the vessel or the re-injection. The effect of this operation is considered to have an ‘insignificant’ impact on the marine environment unless there is a spill (see ‘ERA’ or seepage from the wells in the long-term (see ‘Legacy’).</p> <p>(contd.)</p>	

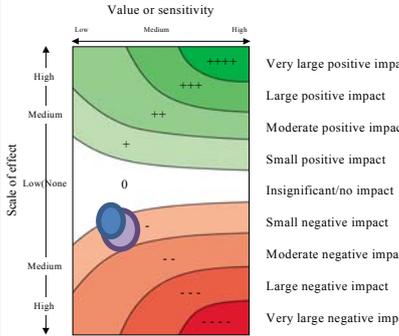
## GBS CELL CONTENTS – Marine Environment

<p><b>2. Description of the scale of effect</b></p> <p><b>Option 1: Mobilise to vessel and reinject into a new well</b></p>	
<p>This option involves marine operations for a period of time in the area. There will be periods with increased traffic to and from the installations, however with small/insignificant effect from noise on the marine life. Underwater noise from operations on installations and pipelines has been modelled. The results [4] indicate that acoustic noise will have small negative effect on marine mammals. The environmental noise is primarily dominated by noise from shipping activity and cutting activity. Ranges for injury and behavioural disturbance were estimated according to several peer decision criteria. The affected area was compared with sightings of cetaceans in vicinity of the Brent Field to obtain an indication of the number of individuals that might be affected. Based on the observed density of cetaceans in the area it is unlikely that any individual will experience auditory injury in the form of Temporary Threshold Shift (TTS) or Permanent Threshold Shift (PTS). There is little data available about the presence of seals around the Brent Field. However, since pinnipeds are shore based, and as the site is 180 km from the coast it is unlikely that significant numbers of seals would be found in the area. Fish are assumed to move away as a result of the strongest noise sources; this is however a temporary effect. Therefore, acoustic noise is only estimated to have a ‘small negative’ impact on fish (purple dot).</p> <p>Movement of vessels during decommissioning operations will be local, vessels will have a ballast water management plan and will follow IMO guidelines on ballast water management [5]. The likelihood of introducing alien species from ballast water or ship hulls is therefore considered to be insignificant.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.   Medium neg.   Low/none   Medium pos.   High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: ‘Small negative’</b></p> <p>The environmental impact from noise on the marine environment is estimated to be “<b>small negative</b>” (purple dot)</p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p> 

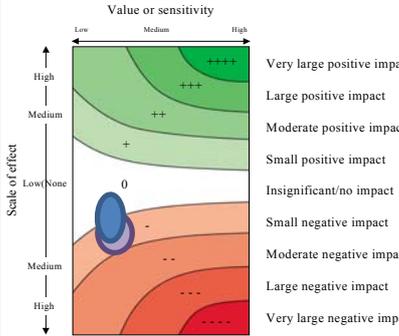
## GBS CELL CONTENTS – Marine Environment

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 2: Mobilise and retrieve to vessel, transport to shore for treatment</b></p> <p>Mobilise and retrieve to vessel and dispose onshore has potential to affect the marine environment. The following issues are considered:</p> <ul style="list-style-type: none"> <li>• Effects on benthic fauna</li> <li>• Effects from planned discharges</li> <li>• Underwater noise</li> <li>• Introduction of alien species from marine vessel</li> </ul> <p>During marine operations, there will be no impact to the benthic community from anchor handling on the seabed because vessels will operate using dynamic positioning, and there is also no need for flotel accommodation.</p> <p>The debris and drill cuttings within the defined work area on top of the GBS cell domes need to be removed to provide sufficient working space for subsequent operations, and this is captured within “Drill cuttings cell tops”.</p> <p>Cell access will be achieved subsea via a small hole in cells’ tops and connected by a flexible pipe-in-pipe to the surface allowing the attic oil to be pumped from the cells, the recovered attic and residual oil as well as interphase material will be dealt with (see Attic Oil matrices).</p> <p>After removing the cell water, a larger hole is cut (5 m in diameter) on the cell tops by high pressure abrasive cutting. Concrete caps would be removed and a fabricated steel lid arrangement would be put in place. This steel lid would be re-used from cell to cell. A “mobilisation tool” (e.g. suction dredger) is deployed into each cell from a DPROV Support Vessel or equivalent, and the mobilised slurry (mixture of sediment and water in the cell) is transported via a flexible pipe up to the vessel. The sediment phase will be mobilised and fluidized inside the cells via the same access point and pumped to the vessel via the same conduit. The slurry is back loaded to tankers to take to shore. The cells will be left open to sea (there will be very little oil left in the cells). The possible spill volume that will leak out before shutdown of process will have a minor local effect on the marine environment. This operation is considered to have an insignificant impact on the marine environment unless there is a spill (see ‘Environmental Risk from Accidents’).</p> <p>Option 2 involves marine operations for a period of time in the area. There will be periods with increased traffic to and from the installations, however with small/insignificant effect from noise on the marine life. Underwater noise from operations on installations and pipelines has been modelled. The results [4] indicate that acoustic noise will have small negative effect on marine mammals. The environmental noise is primarily dominated by noise from shipping activity and cutting activity. Ranges for injury and behavioural disturbance were estimated according to several peer decision criteria. The affected area was compared with sightings of cetaceans in vicinity of the Brent and Penguin fields to obtain an indication of the number of individuals that might be affected. Based on the observed density of cetaceans in the area it is unlikely that any individual will experience auditory injury in the form of Temporary Threshold Shift (TTS) or Permanent Threshold Shift (PTS). There is little data available about the presence of seals around the Brent Field. However, since pinnipeds are shore based, and as the site is 180 km from the coast it is unlikely that significant numbers of seals would be found in the area. Fish are assumed to move away as a result of the strongest noise sources; this is however a temporary effect.</p> <p>Movement of vessels during decommissioning operations will be local, vessels will have a ballast water management plan and will follow IMO guidelines on ballast water management [5]. The likelihood of introducing alien species from ballast water or ship hulls is therefore considered to be insignificant.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p>----- ----- ----- ----- ----- </p> <p style="text-align: center;"><math>X_{noise,X}</math></p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 2: ‘Insignificant - small negative’</b></p> <p>The environmental impact from noise on the marine environment is estimated to be “<b>small negative</b>” (purple dot)</p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipse.</p> 

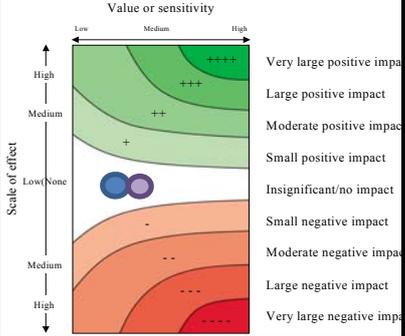
## GBS CELL CONTENTS – Marine Environment

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 3: Cap and cover <i>in situ</i> in the cells using (e.g.) mixture of sand/gravel</b></p> <p>Cap and cover <i>in situ</i> in the cells using (e.g.) mixture of sand/gravel has potential to affect the Marine environment. The following issues are considered:</p> <ul style="list-style-type: none"> <li>• Effects on benthic fauna</li> <li>• Effects from planned discharges</li> <li>• Underwater noise</li> <li>• Introduction of alien species from marine vessel</li> </ul> <p>During marine operations, there will be no impact to the benthic community from anchor handling on the seabed because vessels will operate using dynamic positioning, and there is also no need for flotel accommodation.</p> <p>The debris and drill cuttings within the defined work area on top of the GBS cell domes need to be removed to provide sufficient working space for subsequent operations, and this is captured within “Drill cuttings cell tops”.</p> <p>Cell sediment will be capped <i>in situ</i>. Cell access will be achieved subsea via a small hole in cell tops and connected by a flexible pipe-in-pipe to the surface allowing the attic oil to be pumped from the cells. The recovered attic and residual oil as well as interface material is examined in the ‘Attic Oil’ matrices.</p> <p>Capping agent (sand and gravel) is inserted on top of the sediment using small diameter tubing, from a DPROV Support Vessel. The volume of capping agent is estimated (all 3 GBS) to be approximately 12,000 m<sup>3</sup>. The bulk of water will be treated if necessary, <i>in situ</i> using MNA on completion of the sediment capping. This would involve the application of nutrients and electron acceptors into the cells. The access hole is closed (i.e. valve is closed). Wastewater displaced as a result of the introduction of capping medium and nutrients into the cells will be treated to regulators’ prescribed discharge levels and discharged overboard (see ‘Waste’). Possible spills to the marine environment are dealt with in ‘ERA’.</p> <p>Option 3 involves marine operations for a period of time in the area. There will be periods with increased traffic to and from the installations, however with small/insignificant effect from noise on the marine life. Underwater noise from operations on installations and pipelines has been modelled. The results [4] indicate that acoustic noise will have small negative effect on marine mammals. The environmental noise is primarily dominated by noise from shipping activity and cutting activity. Ranges for injury and behavioural disturbance were estimated according to several peer decision criteria. The affected area was compared with sightings of cetaceans in vicinity of the Brent and Penguin fields to obtain an indication of the number of individuals that might be affected. Based on the observed density of cetaceans in the area it is unlikely that any individual will experience auditory injury in the form of Temporary Threshold Shift (TTS) or Permanent Threshold Shift (PTS). There is little data available about the presence of seals around the Brent Field. However, since pinnipeds are shore based, and as the site is 180 km from the coast it is unlikely that significant numbers of seals would be found in the area. Fish are assumed to move away as a result of the strongest noise sources; this is however a temporary effect.</p> <p>Movement of vessels during decommissioning operations will be local, vessels will have a ballast water management plan and will follow IMO guidelines on ballast water management [5]. The likelihood of introducing alien species from ballast water or ship hulls is therefore considered to be insignificant.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;"><math>X_{noise,X}</math></p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 3: ‘Insignificant - small negative’</b></p> <p>The environmental impact from noise on the marine environment is estimated to be “<b>small negative</b>” (purple dot)</p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p> 

## GBS CELL CONTENTS – Marine Environment

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 4: Leave <i>in situ</i> in cells and natural biodegradation by MNA</b></p> <p>Leaving the cell contents <i>in situ</i> for natural degradation by MNA (Monitored Natural Attenuation) has potential to affect the Marine environment. The following issues are considered:</p> <ul style="list-style-type: none"> <li>• Effects on benthic fauna</li> <li>• Effects from planned discharges</li> <li>• Underwater noise</li> <li>• Introduction of alien species from marine vessel</li> </ul> <p>During marine operations, there will be no impact to the benthic community from anchor handling on the seabed because vessels will operate using dynamic positioning, and there is also no need for flotel accommodation.</p> <p>The debris and drill cuttings on top of the GBS cell domes need to be removed to provide sufficient working space for subsequent operations, and this is captured within “Drill cuttings cell tops”.</p> <p>Cell access will be achieved subsea via a small hole (using cold cutting) in cell tops and connected by a flexible pipe-in-pipe to the surface allowing the attic oil to free flow from the cells (see ‘Attic Oil’ matrices).</p> <p>The bulk of water will be treated <i>in situ</i> using monitored natural attenuation. This will involve the application of nutrients and electron acceptors into the cells. Any fluid displaced because of the introduction of volumes of nutrients into the cells, will either be treated to regulators’ prescribed discharge levels and will be discharged overboard, or will travel upwards to the surface vessel via the annulus between the inner and outer pipes. Once on the vessel, the wastewater would be collected and transported onshore for treatment and disposal (see ‘Waste’ and ‘Onshore’). MNA will require subsequent visits to monitor effectiveness of the administered treatment. The potential discharges from this operation will be of little volume and is therefore considered to have “insignificant” effect, unless there is a spill (see ‘Environmental Risk from Accidents’).</p> <p>Option 4 involves marine operations for a period of time in the area. There will be periods with increased traffic to and from the installations, however with small/insignificant effect from noise on the marine life. Underwater noise from operations on installations and pipelines has been modelled. The results [4] indicate that acoustic noise will have small negative effect on marine mammals. The environmental noise is primarily dominated by noise from shipping activity and cutting activity. Ranges for injury and behavioural disturbance were estimated according to several peer decision criteria. The affected area was compared with sightings of cetaceans in vicinity of the Brent and Penguin fields to obtain an indication of the number of individuals that might be affected. Based on the observed density of cetaceans in the area it is unlikely that any individual will experience auditory injury in the form of Temporary Threshold Shift (TTS) or Permanent Threshold Shift (PTS). There is little data available about the presence of seals around the Brent Field. However, since pinnipeds are shore based, and as the site is 180 km from the coast it is unlikely that significant numbers of seals would be found in the area. Fish are assumed to move away as a result of the strongest noise sources; this is however a temporary effect.</p> <p>Movement of vessels during decommissioning operations will be local, vessels will have a ballast water management plan and will follow IMO guidelines on ballast water management [5]. The likelihood of introducing alien species from ballast water or ship hulls is therefore considered to be insignificant.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- ----- </p> <p style="text-align: center;"><math>X_{noise, X}</math></p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 4: ‘Insignificant - small negative’</b></p> <p>The environmental impact from noise on the marine environment is estimated to be “<b>small negative</b>” (purple dot).</p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p> 

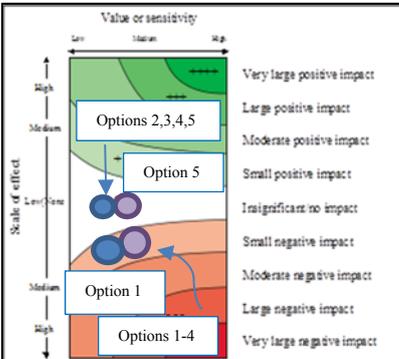
## GBS CELL CONTENTS – Marine Environment

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 5: Leave <i>in situ</i> in the cells for natural degradation</b></p> <p>Option 5, leaving the cell contents <i>in situ</i> for natural degradation has a low potential for effect on the marine environment as there are no activities (apart from post-decom surveys). Attic oil and interphase material will have been removed as part of a separate programme of work (see ‘Attic Oil’ matrices).</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 5: ‘Insignificant’</b></p> <p>The environmental impact from noise on the marine environment is estimated to be <b>“insignificant”</b> (purple dot)</p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p> 

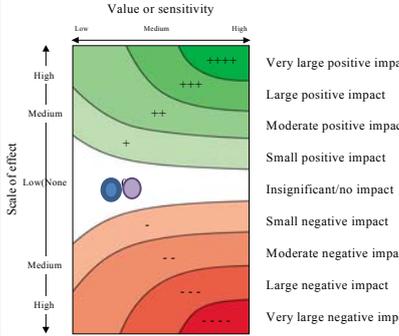
# GBS DRILLING LEG MATERIAL – Marine Environment

2. Description of the scale of effect Option 1,2,3,4,5	3. Total (environmental) impact
<p>For the GBS Drilling leg material, five decommissioning options are considered:</p> <ul style="list-style-type: none"> <li>Option 1: Mobilise and re-inject in a ‘new’ drilled subsea well away from site</li> <li>Option 2: Mobilise and retrieve to vessel and treat and dispose onshore</li> <li>Option 3: Cap or cover in situ</li> <li>Option 4: Leave in situ and enhance natural biodegradation (Monitored Natural Attenuation MNA)</li> <li>Option 5: leave in situ for natural degradation.</li> </ul> <p>Note for Options 1,2,3 and 4 there are further sub-options considered:</p> <ul style="list-style-type: none"> <li>Options 1a, 2a, 3a, 4a: these options are applicable to GBS Brent B only, with Brent B topsides in place and used to facilitate access to the drilling legs.</li> <li>Options 1b, 2b, 3b, 4b: these options are applicable to both GBS Brent B and D (post-topsides removal) so access to the drilling legs will be from a SSCV.</li> </ul> <p>But whichever combination of sub-options is selected, they would result in the similar impact, so the assessment below just details Options 1-5. For all options, the activities are like those for the GBS Cell Contents decommissioning options, but the volumes of material and oil load involved are much smaller.</p> <p>Note:</p> <ul style="list-style-type: none"> <li>Accidental releases of chemicals to the environment in the event of an accident are addressed under ‘ERA’.</li> <li>The consumption of chemicals is addressed under ‘Resource use’. No H<sub>2</sub>S scavenger would be used for any option.</li> <li>For all options, there will be no impact to the benthic community from anchor handling on the seabed because marine vessels will operate using dynamic positioning, and there is also no need for flotel accommodation.</li> </ul> <p>Option 1: The impact for GBS drilling legs material Option 1 is considered ‘small negative’ mainly because it would involve the drilling of new wells, which would generate drill cuttings, and may involve the discharge of chemicals (albeit subject to discharge permit). See GBS cell contents Option 1 for further description on the nature of impacts.</p> <p>Option 2,3,4: The impacts from GBS drilling legs material Options 2, 3 and 4 are considered ‘Insignificant’, as although the options involve the removal and transportation of the contaminated material, there should be no release of it to the marine environment unless there is some spillage (see ‘ERA’ matrices).</p> <p>The movement of vessels during decommissioning operations will be local, vessels will have a ballast water management plan and will follow IMO guidelines on ballast water management [5], so the likelihood of introducing alien species from ballast water or ship hulls is therefore considered to be insignificant.</p> <p>Option 5: In this option, leaving the material <i>in situ</i> for natural degradation has little potential for short term effect on the marine environment as there are very few activities, hence it is an ‘insignificant’ impact.</p> <p>Note: Options 1-4 would also have a temporary ‘small negative’ disturbance effect on marine mammals due to underwater noise from shipping and cutting activity.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p>----- ----- ----- ----- ----- </p> <p style="text-align: center;">X<sub>1</sub>X<sub>2,3,4,5</sub></p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: ‘Small negative’</b> <b>Option 2,3,4,5: ‘Insignificant’</b></p> <p>The environmental impact from noise on the marine environment is considered as “small negative” for Options 1-4 and “insignificant” for Option 5, purple dot)</p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p>

# GBS MINICELL ANNULUS MATERIAL – Marine Environment

2. Description of the scale of effect Option 1,2,3,4,5	3. Total (environmental) impact
<p>For the GBS Minicell Annulus material, five decommissioning options are considered:</p> <ul style="list-style-type: none"> <li>Option 1: Mobilise and re-inject in a ‘new’ drilled subsea well away from site</li> <li>Option 2: Mobilise and retrieve to vessel and treat and dispose onshore</li> <li>Option 3: Cap or cover in situ</li> <li>Option 4: Leave in situ and enhance natural biodegradation (Monitored Natural Attenuation MNA)</li> <li>Option 5: leave in situ for natural degradation.</li> </ul> <p>For all options, the activities are like those for the GBS Cell Contents decommissioning options, but the volumes of material and oil load involved are much smaller (&lt;1%).</p> <p>Note:</p> <ul style="list-style-type: none"> <li>Accidental releases of chemicals to the environment in the event of an accident are addressed under ‘ERA’.</li> <li>The consumption of chemicals is addressed under ‘Resource use’. No H<sub>2</sub>S scavenger would be used for any option.</li> <li>For all options, there will be no impact to the benthic community from anchor handling on the seabed because marine vessels will operate using dynamic positioning, and there is also no need for flotel accommodation.</li> </ul> <p>Option 1: The impact for Option 1 is considered ‘small negative’ mainly because it would involve the drilling of new wells, which would generate drill cuttings, and may involve the discharge of chemicals (albeit subject to discharge permit). See GBS cell contents Option 1 for further description on the nature of impacts.</p> <p>Option 2,3,4: The impacts from Options 2, 3 and 4 are considered ‘Insignificant’, as although the options involve the removal and transportation of the contaminated material, there should be no release of it to the marine environment unless there is some spillage (see ‘ERA’ matrices). The movement of vessels during decommissioning operations will be local, vessels will have a ballast water management plan and will follow IMO guidelines on ballast water management [5], so the likelihood of introducing alien species from ballast water or ship hulls is therefore considered to be insignificant.</p> <p>Option 5: In this option, leaving the material <i>in situ</i> for natural degradation has little potential for short term effect on the marine environment as there are very few activities, hence it is an ‘insignificant’ impact.</p> <p>Note: Options 1-4 would also have a temporary ‘small negative’ disturbance effect on marine mammals due to underwater noise from shipping and cutting activity.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p>----- ----- ----- ----- ----- </p> <p style="text-align: center;">X<sub>1</sub>X<sub>2,3,4,5</sub></p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: ‘Small negative’</b> <b>Options 2,3,4,5: ‘Insignificant’</b></p> <p>The environmental impact from noise on the marine environment is considered as “<b>small negative</b>” for Options 1-4 and “<b>insignificant</b>” for Option 5, purple dot)</p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p> 

# SEABED DRILL CUTTINGS – Marine Environment

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 1: Leave <i>in situ</i> for natural degradation</b></p> <p>Leaving the drill cuttings in place will imply further natural degradation of the hydrocarbons in the material but other pollutants are less degradable. The benthic fauna will respond to the local conditions and the faunal community will reflect the level of pollutants and physical parameters. The fauna composition is expected to develop into similar pattern as in the neighbouring areas as the pollutant levels gradually diminish.</p> <p>The average amount of oil loss from the four piles on the seabed has been calculated as less than 10 tonnes per year. This volume can be compared to the annual oil volume in the produced water discharges at Brent which in 2009 was 61.1 tonnes of oil (from Brent B). Hence the oil loss from the piles is low compared to other sources in the area.</p> <p>There will possibly be a long-term effect on the benthic fauna (although limited in area) from the pollutants, but not likely any measurable effects on the water column living organisms. But this marine impact is captured in ‘Legacy’ matrices.</p> <p>Leaving the drill cuttings <i>in situ</i> will have no significant short-term marine or underwater noise impacts.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: ‘Insignificant’</b></p> <p>The environmental impact from noise on the marine environment is estimated to be <b>“insignificant”</b> (purple dot)</p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p> 

## BRENT A SEABED DRILL CUTTINGS – Marine Environment

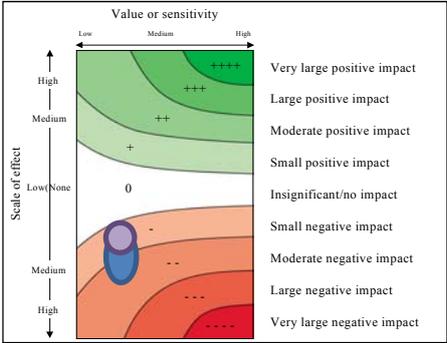
2A. Description of the scale of effect	3A. Total (environmental) impact
<p><b>Brent A Seabed Drill Cuttings: Option 1: Dredge, transfer to Brent C topsides and treat and discharge water and solids to sea</b></p>	
<p>To create access for the complete removal of the Brent A jacket footings (Option 1), drill cuttings and contaminated seabed surrounding the piles would require removal (Shell assumes that the first 25 cm of seabed sediment is contaminated by the drill cuttings and will remove this portion). Under Option 1, the drill cuttings would be removed by suction dredger and lift pump onto a vessel for storage prior to being transferred for processing on the Brent C topsides. Note that the impacts described here will overlap with the marine impacts resulting from the excavation of the seabed as described in the complete removal of the jacket footings (Option 1).</p> <p>Approximately 80,000 m<sup>3</sup> of slurry would be generated from dredging the seabed drill cuttings and contaminated seabed, as the cuttings to water ratio in the dredging operation is estimated to be 1:10.</p> <p>The seawater would be separated and processed on the topsides to below 30 ppm oil in water content as required by OSPAR regulations [9] and discharged to sea. Solid drill cuttings would be treated on the topsides via thermal desorption into a powder, to 0.3-0.5 % oil by weight (below the OSPAR standard of 1.0 % oil by weight [10]) and discharged to sea. Recovered oil would be sent to shore for recycling.</p> <p>The BMT modelling of the impact of human disturbances on the Brent C cuttings cell top piles [11] assumes that 775 m<sup>3</sup> (10%) of the dredged volume (7,750 m<sup>3</sup>) is released to sea during dredging. These modelling results can provide proxy information for the possible dispersal and eventual fate of cuttings lost during dredging of a similar volume of the seabed cuttings pile at Brent A. Although it should be noted that dredging at the cell top level of 60 m will result in a much wider distribution of released cuttings than seabed dredging. The modelling results of dredging the Brent C cell top cuttings indicated a wide distribution of the particles and the settlement on the seabed generated in general a very thin layer (&lt;1 mm). The seabed area with predicted effects of THC on the fauna (PEC:PNEC ≥ 1) was 15.9 km<sup>2</sup> and the cuttings from the cell tops dredging generated a thin layer (average and the maximum thickness of re-deposited cuttings is 0.2 and 6 mm respectively). An area of 33 km<sup>2</sup> was influenced by sedimentation, but re-deposition with a layer thickness &gt; 1 mm covered a much smaller area of about 0.07 km<sup>2</sup>.</p> <p>The dredging activities will temporarily result in increased turbidity. The particles may influence the breathing functions (gill and skin) and feeding functions of local organisms. The effect will be relatively localised provided normal mitigation measures are adopted, such as good operational procedures and the use of best available and well maintained equipment to give the lowest spreading potential. It is recommended that Shell should consider monitoring to document the situation and “footprint” the area.</p> <p>The polluted water and sediment from the dredging operation will be treated to remove the key contaminant (oil) before discharge to prevent any subsequent significant effects on organisms living in the water column. The remaining concentrations of other substances in the treated water should be monitored to further ensure the emissions discharged are within any necessary conditions. The discharge of cleaned water following treatment is considered to have a limited effect on the water living organisms.</p> <p>(contd.)</p>	







# BRENT A SEABED DRILL CUTTINGS – Marine Environment

<b>2D. Description of the scale of effect</b> <b>Brent A Seabed Drill Cuttings: Option 4: Dredge to vessel and re-inject into a new well</b>	<b>3D. Total (environmental) impact</b>
<p>Under Option 4, a new remote subsea well would be drilled for Cuttings Re-injection (CRI). The total slurry volume of 80,000 m<sup>3</sup> would be transported to the new well for processing prior to injection.</p> <p>There is potential for short-term impact to the marine environment from the following two operations:</p> <ul style="list-style-type: none"> <li>• Dredging, and</li> <li>• Drilling of an injection well</li> </ul> <p>Like Options 1-3, the dredging activities for removal of drill cuttings will cause some of the sediments to be re-suspended. No offshore discharge of cuttings is expected, as the cuttings slurry will be injected downhole.</p> <p>There could be some localised disturbance to the local marine environment during drilling and completion of the well, including physical disturbance. Drilling and injection activities will be subject to a permit but will still produce drill cuttings that will settle on the seabed, and result in some localised impact. Chemicals will also be added to the slurry for injection purposes, but there should not be any impact from the use of chemicals upon the marine environment as they should remain within the newly drilled well. Planned discharges, if any, will be subject to a discharge permit application.</p> <p>The scale of effect is estimated to be ‘small-medium negative’, due to drilling activities and localised impacts during dredging activities. The overall impact to the marine environment is estimated to be ‘small-moderate negative’, as marine impacts will be temporary and localised.</p> <p>A ‘small negative’ impact is anticipated from underwater noise generated during the well drilling, dredging and cuttings removal process.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p>                  X           X<sub>noise</sub></p>	<p>1) and 2) are combined in the impact matrix.</p> <p><b>Option 4: ‘Small-moderate negative’</b></p> <p>The environmental impact from noise on the marine environment is considered as “<b>small negative</b>” (purple dot).</p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p> 

## GBS CELL TOP DRILL CUTTINGS – Marine Environment

<b>2. Description of the scale of effect</b> <b>GBS Cell Top Drill Cuttings: Option 1: Partially relocate cuttings locally by water jetting into water column</b>	<b>3. Total (environmental) impact</b>
<p>Some of the drill cuttings on top of the GBS cells require removal to provide sufficient working space for subsequent operations. Under Option 1, the drill cuttings would be removed by displacing the cuttings to the water column by water jetting. This operation would be performed at a height of 60 m. This option is only valid for the Brent B and D GBS.</p> <p>Water jetting of drill cuttings causes sediments to be re-suspended and released to the marine environment, with resulting temporarily increased turbidity and re-settlement of contaminated solids. The particles can cover the breathing functions (gill and skin) and feeding functions of local organisms. Marine life, such as pelagic fish, may become exposed to suspended solids (e.g., fine particles that may interfere with respiration) and toxic substances associated with the suspended particles or dissolved into the surrounding water.</p> <p>In 2015, BMT modelled the possible effects from dredging of Brent C cell top cuttings [11]. The highest volume of cell top cuttings is located at this platform. In the modelled scenario, the effects of dredging of cell top cuttings (7,753 m<sup>3</sup>) over a 65 day period and with 10 % loss to the water (775 m<sup>3</sup>) was predicted. In this case the cuttings were released into the water at the cell top level.</p> <p>The modelling results indicated a wide distribution of particles, and settlement on the seabed generated (in general) a very thin layer (&lt; 1 mm). An area of 33 km<sup>2</sup> was influenced by sedimentation, with 0.07 km<sup>2</sup> with a layer greater than 1 mm. A seabed area of 15.9 km<sup>2</sup> had an initial THC concentration above the threshold for negative impacts on the benthic fauna (i.e. PEC:PNEC &gt; 1).</p> <p>The benthic fauna will be influenced by the settling of particles and contaminants, but how significant this will be, depends on the amount of re-sedimentation and concentration of contaminants. This is likely to be most significant close to the site and less as the distance increases (as modelled, [11]). The species have different capabilities and tolerance to overcome such conditions. In general, marine benthic fauna have a good capability of settling into available habitats. The timescale for re-colonisation will be very dependent on the local environmental conditions, not least the sediment composition at the Brent Field. Some species tolerate poor conditions better than others and may settle within months. After a year or two several species may be present and a community of opportunistic species may develop. Over a 4-10 year period, the fauna composition may have recovered into a community of normal or low disturbance [13,14].</p> <p>Based on the assessment, fish and zooplankton were predicted to be affected close to the platform and there is a possible toxicological effect within the water column, but the effect on individuals will be relatively local and temporary. The distribution of marine species in the North Sea is generally very wide and effects on the population level from water jetting is not expected.</p> <p>However, in comparison to the 2015 BMT modelling, the total quantities of cell tops drill cuttings that will be water jetted under Option 1 are very small (60 m<sup>3</sup>, less than 8% of the loss to the water modelled in the dredging scenario described above). The overall environmental impact of Option 1 on the marine environment is considered to be ‘small negative’.</p> <p>(contd.)</p>	



## GBS CELL TOP DRILL CUTTINGS – Marine Environment

<b>2. Description of the scale of effect</b> <b>GBS Cell Top Drill Cuttings: Option 2: Dredge, transfer to Brent C topsides and treat and discharge water and solids to sea</b>	<b>3. Total (environmental) impact</b>
<p>The drill cuttings on top of the GBS cell tops may require removal to provide sufficient working space for subsequent operations. In Option 2 the drill cuttings will be removed by dredging, transferred to the Brent C topsides for treatment and offshore discharge of treated water and solids. The entire cell tops volume will require dredging, which at Brent B, C and D is approximately 1,900 m<sup>3</sup>, 7,700 m<sup>3</sup> and 3,800 m<sup>3</sup> respectively. A large amount of polluted drill cuttings slurry will be generated offshore for treatment on the topsides. In total the 13,400 m<sup>3</sup> of cuttings may generate approximately 134,000 m<sup>3</sup> of slurry.</p> <p>BMT's 2015 modelling of the impact of dredging 7,735 m<sup>3</sup> of the Brent C cell top cuttings pile [11] assumed that about 10% of the dredged volume will be released to sea during the operation. The re-deposition of the cuttings from cell tops with a layer thickness &gt; 1 mm will cover an area of about 71,425 m<sup>2</sup> and the average and the maximum thickness of re-deposited cuttings is 0.2 and 6 mm respectively. The modelled seabed area with Predicted Environmental Effect Concentrations of THC with PEC &gt;PNEC was 15.9 km<sup>2</sup> as a result of the operations. In the water column, the concentration of contaminants in the cuttings were modelled to exceed the thresholds for total water column/zooplankton in 1.3 million m<sup>3</sup> of water and to a maximum distance of 4.2 km. The duration of such concentrations (i.e. PEC:PNEC &gt; 1) in the water column was 1,007 hours. Note: these modelling results represent data from operations at Brent C; similar but lower impacts will also occur at Brent B and D as the volumes dredged are smaller.</p> <p>The dredging will cause some of the sediments to be re-suspended at all three locations, with resulting turbidity. The particles can cover the breathing functions (gill and skin) and feeding functions of local organisms. The effect will be relatively localised provided normal mitigation measures are adopted.</p> <p>The benthic fauna will be impacted by the settling of particles and contaminants, but how significant this will depend on the amount of re-sedimentation and concentration of contaminants. This is likely to be most significant close to the site and less as the distance increases (as modelled, [11]). The species have different capabilities and tolerance to overcome such conditions. In general, marine benthic fauna have a good capability of settling into available habitats. The timescale for re-colonisation will be very dependent on the local environmental conditions, not least the sediment composition at the Brent Field. Some species tolerate poor conditions better than others and may settle within months. After a year or two several species may be present and a community of opportunistic species may develop. Over a 4-10 year period, the fauna composition may have recovered into a community of normal or low disturbance [13,14].</p> <p>The polluted water and sediment from dredging is treated before discharge to prevent any subsequent significant effects on the water column living organisms from oil. The remaining concentrations of other substances in the treated water should be monitored to further ensure the emissions discharged are within any necessary conditions.</p> <p>The treated solids discharged from the topsides will settle to the seabed; however, their distribution and impact were not included in BMT's modeling. The dispersion of these particles is likely to be significant if they are released at the sea surface level and less if they are released at the seabed. The effect will be similar to the settling of cuttings that are dispersed during dredging operations, but may result in an add-on effect. The effect on the seabed will mainly be smothering of the fauna and possibly some influence on the particle size distribution in the top sediment. Since the discharged cuttings are cleaned there should be insignificant effects from remaining pollutants.</p> <p>(contd.)</p>	





## GBS CELL TOP DRILL CUTTINGS – Marine Environment

### 2. Description of the scale of effect

#### GBS Cell Top Drill Cuttings: Option 4: Dredge to vessel, transfer to Brent C topsides; water treated and discharged to sea, solids to shore

As with Option 2, the drill cuttings would be removed by suction dredger and lift pump onto a vessel. The slurry would then be transferred to the Brent C topsides for separation. Once separated, the liquid would be treated to less than 30 ppm oil in water content in accordance with OSPAR regulations [9], and discharged to sea. Separated solids would then be transported to shore for treatment.

The same volume of material will be dredged as in Options 2 and 3. The dredging will cause some of the sediments to be re-suspended and released to the marine environment, with resulting turbidity. The particles may cover the breathing functions (gill and skin) and feeding functions of local organisms. The effect will be relatively localised provided normal mitigation measures are adopted such as good operational procedures and the use of best available and well maintained equipment to give the lowest spreading potential. It is recommended that Shell should consider monitoring to document the situation and “footprint” the area.

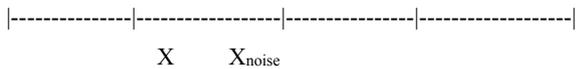
However, as the processing of cuttings solids would be completed onshore under Option 4, there will be no offshore discharge of treated solids to sea (only treated water will be returned to sea). The non-hydrocarbon substances in the treated water should be monitored to further ensure the emissions discharged are within any necessary conditions.

The impact (from the release during dredging) to the local marine environment will be similar to Option 2 and 3, and the extent of effect is estimated to be ‘medium negative’, resulting in a ‘small-moderate negative’ impact.

A ‘small negative’ impact is anticipated from underwater noise generated during the dredging and removal process.

#### Evaluation of scale of effect:

High neg.    Medium neg.    Low/none    Medium pos.    High pos.



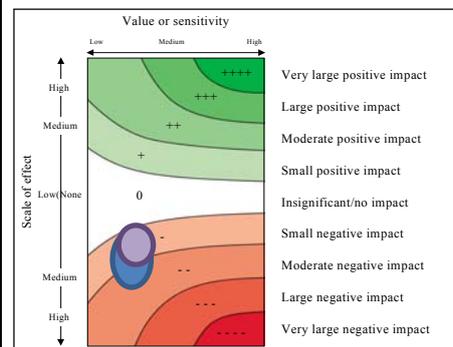
### 3. Total (environmental) impact

1) and 2) are combined in the impact matrix.

#### Option 4: ‘Small-moderate negative’

The environmental impact from noise on the marine environment is considered as “**small negative**” (purple dot).

The uncertainty of the total impact is highlighted by the size of the circles/ellipses.



## GBS CELL TOP DRILL CUTTINGS – Marine Environment

### 2. Description of the scale of effect

#### GBS Cell Top Drill Cuttings: Option 5: Dredge to vessel and re-inject into a new well

Under Option 5, a new subsea well would be drilled for Cuttings Re-injection (CRI).

As with the other options, the same volume of cell top drill cuttings would be removed by suction dredger and lift pump onto a vessel. The slurry would then be transported to the new well for processing prior to injection.

There is potential for impact to the marine environment from two elements of the process under Option 5:

- Dredging, and
- Drilling of a new well

Like Options 2-4, the dredging activities for removal of drill cuttings will cause some of the sediments to be re-suspended. The water column will temporarily be influenced by particles and associated contaminants and the seabed by the settled solids. The effect will be relatively localised provided normal mitigation measures are adopted. No offshore discharge of cuttings is expected, as the cuttings slurry will be injected downhole.

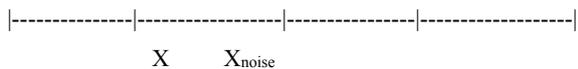
There could be some localised disturbance to the local marine environment during drilling and completion of the well. Drilling activities will be subject to a permit but will still produce drill cuttings that will settle on the seabed, and result in some localised impact. Chemicals will also be added to the slurry for injection purposes, but there should not be any impact from the use of chemicals upon the marine environment as they should remain within the newly drilled well. Planned discharges from the drilling will be subject to a discharge permit application.

The scale of effect is estimated to be ‘medium negative’, due to drilling activities and localised impacts during dredging activities. The overall impact to the marine environment is estimated to be ‘small-moderate negative’, as marine impacts will be temporary and localised.

A ‘small negative’ impact is anticipated from underwater noise generated during the well drilling, dredging and cuttings removal process.

#### Evaluation of scale of effect:

High neg.    Medium neg.    Low/none    Medium pos.    High pos.



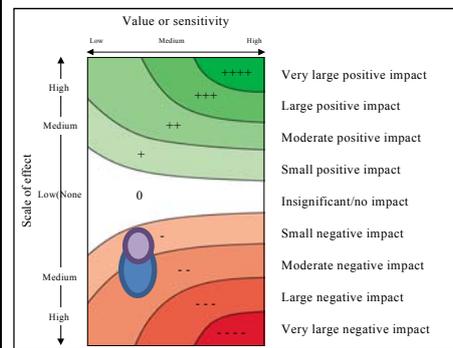
### 3. Total (environmental) impact

**1) and 2) are combined in the impact matrix.**

#### Option 5: ‘Small-moderate negative’

The environmental impact from noise on the marine environment is considered as “**small negative**” (purple dot).

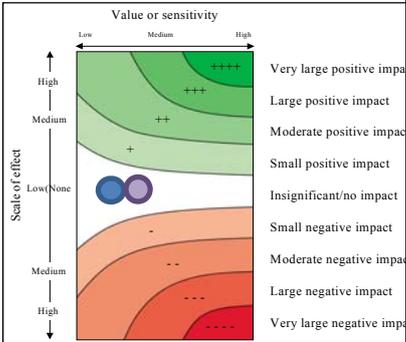
The uncertainty of the total impact is highlighted by the size of the circles/ellipses.



## GBS CELL TOP DRILL CUTTINGS – Marine Environment

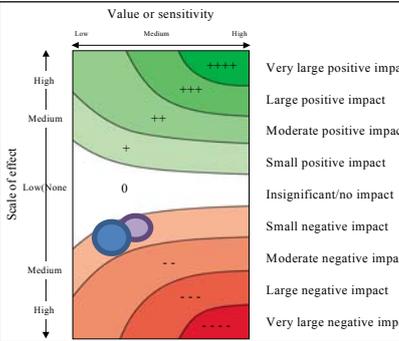
2. Description of the scale of effect	3. Total (environmental) impact
<p><b>GBS Cell Top Drill Cuttings: Option 6: Leave <i>in situ</i></b></p> <p>Option 6 involves leaving the GBS cell top drill cuttings <i>in situ</i> for natural degradation, and therefore will have no impacts to the marine environment or from underwater noise.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p><b>1) and 2) are combined in the impact matrix.</b></p> <p style="text-align: center;"><b>Option 6: ‘No impact’</b></p> <p>The environmental impact from noise on the marine environment is considered as <b>“no impact”</b> (purple dot).</p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p style="text-align: center; font-size: small;">Value or sensitivity</p> </div>

# TRI-CELL DRILL CUTTINGS – Marine Environment

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 1: Leave <i>in situ</i></b></p> <p>As the tri-cell drill cuttings have only a limited area exposed to the ambient water, there will be insignificant impact upon the marine environment in the short-term. The tri-cell cuttings will ultimately be exposed to the sea with eventual GBS collapse, and this is captured within ‘Legacy’.</p> <p>Leaving the tri-cells drill cuttings <i>in situ</i> will have no underwater noise impacts.</p> <p>There is no impact on the marine environment from leaving the tri-cell drill cuttings <i>in situ</i>.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: ‘No impact’</b></p> <p>The environmental impact from noise on the marine environment is estimated to be “no impact” (purple dot)</p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p> 



# WELLS – Marine Environment

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 1: Plugging and Abandonment</b></p> <p>Plugging and abandonment activities have potential to impact the marine environment. These aspects are discussed below:</p> <p><u>Cement Slurry</u></p> <p>During cementing operations, there is potential that work may be aborted due to unforeseeable circumstances (e.g. mechanical/electrical failure) following or during preparation of the cement mix. This may result in unplanned discharge of cement slurry to sea, but it is very unlikely and the volumes involved would be small (~17.5 m<sup>3</sup> during abandonment). Any cement disposed to sea will comprise inert materials and low toxicity additives. As the slurry falls through the water column it will disperse and be diluted as it descends to the seabed. Thus, contingency disposal of this nature is not expected to have a significant effect on deterioration in water quality or on benthos, and will be reported to the regulator.</p> <p><u>Marine Growth</u></p> <p>Brent C conductors are considered in this ES together with the wells. Brent C conductors are likely to be colonised by marine growth (e.g. seaweed, cold water coral). Shell have not inspected the wells for marine growth, so have no records; it is assumed, worst case, that some marine growth is present. During decommissioning these colonies are considered as waste. Well conductor pipes will be raised onto the platform drill floor, and during this process much of the marine growth may become detached and fall to sea, where it will decompose naturally. Efforts will be made to remove further amounts manually on the drill floor and return directly to sea.</p> <p><u>Well Fluids</u></p> <p>When the casings are cut, the remaining fluids in the well will be displaced using inhibited seawater (seawater which has been treated with chemicals such as hydrogen sulphide (H<sub>2</sub>S) scavengers, biocide etc.), or milling fluid consisting of polymers and inhibited seawater, and weighted with barite. It is expected that displaced annular fluids (fluids remaining between the wellbore and the steel casing, or remaining between casing strings, from drilling operations) are likely to be mainly water-based mud (WBM), but some oil-based mud (OBM) may be encountered (estimated to be approximately 25-80 m<sup>3</sup>/well). These fluids (and associated seawater/milling fluids) will be either shipped to shore for treatment and disposal, or disposed of offshore, either to sea or via CRI, in compliance with the relevant permits (samples will be analysed for oil content to ensure discharge is within acceptable limits). If brought ashore, the OBM/WBM fluids will be settled or dewatered/centrifuged, and wastewater treated in an effluent treatment plant and discharged to sea under appropriate permit conditions. Oil will be recycled.</p> <p><u>Underwater noise from Explosives Use</u></p> <p>Explosives will not be used for well head removal but explosives may be used within the well reservoir to perforate well casings during P&amp;A. An explosive charge will be used in the well far below the seabed to cut/punch the tubing. During this procedure, the well is full of fluid and the process is controlled by well pressure control equipment; nothing will be released to the environment. The energy from the explosive charge would be absorbed by the ~1.8 km of well fluid sitting above the charge and is not expected to generate any levels of underwater noise that would cause concern for the marine environment. If there is a need to use explosives during P&amp;A, discussions would be held with JNCC/BEIS and any necessary licenses obtained. Shell will use a hydrophone to measure the actual noise on the first use of explosives. Shell will use findings to determine if MMO and PAM are required for future perforations and develop a plan to manage noise if appropriate.</p> <p>The overall impact on the marine environment for wells plugging and abandonment Option 1 is estimated to be ‘small negative’.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: ‘Small negative’</b></p> <p>The environmental impact from noise on the marine environment is estimated to be “<b>small negative</b>” (purple dot)</p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p> 

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- <sup>1</sup> BMT Cordah, *Brent Decommissioning Project Environmental Setting Including Brent Field, Transportation Route, Transfer Area and Onshore Destination*, Shell Doc. No.: BDE-F-GEN-HE-7753-00010, Rev A05, September 2015.
- <sup>2</sup> Gardline Environmental Limited, *Brent Decommissioning Feasibility Study UKCS Block 211, Brent A, Brent B, Brent C and Brent South. Pre-decommissioning Environmental Survey Report*, Shell Doc. No. BDE-F-GEN-HX-7880-00001, Rev 3, 6 April 2011.
- <sup>3</sup> Gardline Environmental Limited, *Brent Decommissioning Feasibility Study UKCS Block 211, Brent D. Pre-decommissioning Environmental Survey Report*, Shell Doc. No. BDE-D-GEN-HX-7880-00001, Rev 5, 6 April 2011.
- <sup>4</sup> DNV GL, *Environmental Underwater Noise Analysis for the Brent Field Decommissioning*, Rev 7, 26 May 2015.
- <sup>5</sup> International Maritime Organisation, *Guidelines and guidance documents related to the implementation of the international convention for the control and management of ships' ballast water and sediments*, 2004.  
<http://www.imo.org/en/OurWork/Environment/BallastWaterManagement/Documents/Compilation%20of%20relevant%20Guidelines%20and%20guidance%20documents%20-%20October%202015.pdf>
- <sup>6</sup> Statutory Nature Conservation Agency (SNCA), *Guidance for staff advising on the potential risk of seal corkscrew injuries*, April 2012.
- <sup>7</sup> Thompson et. al, *Report on recent seal mortalities in UK waters caused by extensive lacerations*, Report to Scottish Government, Sea Mammal Research Unit, University of St Andrews, St Andrews, October 2010.
- <sup>8</sup> Mackay Consultants, *Brent Decommissioning: Fisheries Socio-Economic Effects*, Shell Doc. No. BDE-F-GEN-HE-0702-00003, Revision R03, November 2014.
- <sup>9</sup> OSPAR, *Recommendation 2001/1 for the Management of Produced Water from Offshore Installations*.
- <sup>10</sup> OSPAR, *Decision 2000/3 on the Use of Organic-Phase Drilling Fluids (OPF) and the Discharge of OPF-Contaminated Cuttings*, Annex 18, 26-30 June 2000.
- <sup>11</sup> BMT Cordah, *Effects of Human Disturbance on the Brent Alpha and Brent Charlie Cuttings Piles with Additional Modelling*, Shell Doc. No.: BDE-C-SUB-HE-0702-00004, November 2015.
- <sup>12</sup> BMT Cordah, *Long Term Fate and Effects of Cutting Piles at Brent Alpha and Brent Charlie*, Shell Doc. No.: BDE-F-GEN-HE-0702-00009, March 2016.
- <sup>13</sup> Bakke, T., Klungsoyr J. & Sanni S, *Environmental impacts of produced water and drilling waste discharges from the Norwegian offshore petroleum industry*, Marine Environmental Research, September 2013.
- <sup>14</sup> UKOOA Drill Cuttings Initiative, Research and Development Programme, *Faunal colonisation of drill cuttings pile based on literature review*, Doc No.: 43925-001-403, 1999.



## 1.7 ENVIRONMENTAL RISK FROM ACCIDENTS

**Category: Topsides/Jacket/GBS/Attic Oil/Cell Contents/Drilling Leg and Minicell Annulus/Drill Cuttings/Subsea Structures and Debris/Wells**

**Consequence evaluation for: Environmental Risk from accidents**

### 1. General description of the receiving environment (situation and characteristics)

This description is relevant to all facilities.

'Environmental risk from accidents' refers to potential accidents during the decommissioning activities that could impact the environment. This EIA considers environmental risk from accidents in a high level and qualitative manner, and is not a quantitative environmental risk assessment. Risk is a combination of the likelihood of an environmental event (e.g. spill) and its associated consequence.

Some failures will have the potential to impact the environment through operations going wrong (such as lifting or a collision) resulting in spillages of oil or chemicals (from vessels or broken pipelines) or misplaced disposal (dropped objects/module). Spillage during refueling is a potential environmental risk, however Shell do not plan to refuel during offshore decommissioning operations.

There are currently a number of live hydrocarbon pipelines and other critical equipment on the seabed of the Brent Field area that can potentially be affected, and that have potential to cause major environmental impact should they be cracked by a heavy dropped object during the BDP and transfer to shore. The 500 m safety zone will apply around each platform during decommissioning activities, as required by law, and there will be no live pipelines in the safety zone during the decommissioning operations. The FLAGS pipeline will be re-routed for the purposes of the BDP. However, vessels leaving the Brent Field in transit to shore will be carrying significant cargo (parts of platforms or pipelines) and may cross live pipelines on route.

No especially environmentally sensitive habitats have been identified in the Brent Field area. The ASP facility near Hartlepool has been selected to dismantle the topsides and jacket, and is near several environmentally sensitive sites (Ramsar, SPA, SSSI). As such, the overall value is assessed to be (similar to the 'Marine' category) 'low to medium' at the Brent Field and towards 'high' for the nearshore environment approaching the ASP facility. The value category for nearshore is only relevant for the Brent Field topsides and jacket, which will be brought to the ASP facility. The two values are represented below.

#### Evaluation of the value:

Low	Medium	High
----- -----		
X	X	

## TOPSIDES - Environmental Risk from Accidents

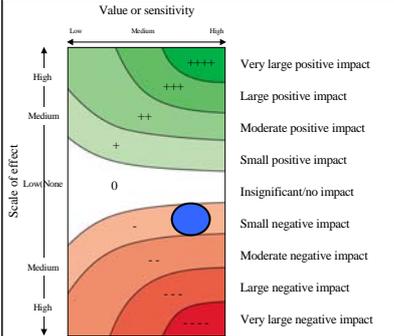
2. Description of the scale of effect Option 1: Complete Removal by SLV	3. Total (environmental) impact
<p>For the topsides only one decommissioning option is considered – complete removal in one piece using SLV. Examples of major accidents related to the decommissioning of the topsides at Brent A, B, C and D are as follows, and are discussed below:</p> <ol style="list-style-type: none"> <li>1. Dropped objects/Topside topples during transit from Brent Field</li> <li>2. Dropped objects/Topside topples during transfer operations at Brent Field or nearshore location</li> <li>3. Spillages onshore while dismantling.</li> <li>4. Ship collision and subsequent oil spill</li> </ol> <p>There will be no refueling at the Brent Field during the decommissioning programme, hence there will be no associated environmental risk from potential spills.</p> <p>1 &amp; 2. Dropped objects or topside topples into sea during transit or transfer</p> <p>Prior to decommissioning all accessible free-flowing hydrocarbons will be removed from topsides systems (drain, purge and vent, DPV). So even in the unlikely event that the topsides toppled into the sea during transit or transfer operations, while pollution would result, the environmental consequence would be local as there will only be small volumes remaining in the topsides after DPV. The associated risk is small.</p> <p>However, if the topsides dropped and landed on a live hydrocarbon pipe or a sensitive environmental area, the consequence could be significant. If such an unlikely event did occur (the topsides will be strengthened to allow single lift to be undertaken safely), it would most likely happen during the more difficult activities such as the topsides transfer operations, and there are no live hydrocarbon pipes (at the time of decommissioning) or protected sensitive sites located within the immediate vicinity of the Brent platforms or at the near-shore transfer location. There is a possibility that the topsides could land on the GBS cells (applicable for Brent B, C and D) and expose the cell contents, causing moderate environmental impact, but the risk remains small as it is very unlikely.</p> <p>It is possible, but even less likely, that the topsides could topple to sea during transit of the topsides past a sensitive site/live hydrocarbon pipe, either inshore or offshore, such as at North East of Farnes Deep MCZ, when the environmental consequences could be significant. But the likelihood is very low so the risk is small.</p> <p>Note: accidents involving dropped objects are relatively rare – DNV GL’s technical database for dropped load frequencies for offshore units (based on UKCS experience), indicates a drop frequency (per lift) using other devices (other than the platform crane or the lifting system in the drilling derrick) of around <math>6 \times 10^{-7}</math> (per lift operation) for a mobile unit for loads over 100 tonnes<sup>1</sup>.</p> <p>3. Spillages during onshore dismantling can also occur, however the topsides will be drained and will not contain free-flowing hydrocarbons, so any spills would likely be small and easily accommodated by the drainage arrangements on the ASP facility.</p> <p>(contd.)</p>	

<sup>1</sup> It is recognised that this data does not explicitly cover decommissioning activities or the weights involved with SLV operations, though it does cover a range of lifting activities.

## TOPSIDES - Environmental Risk from Accidents

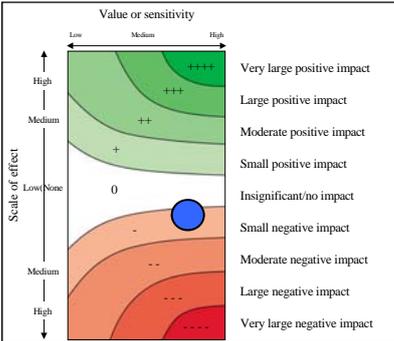
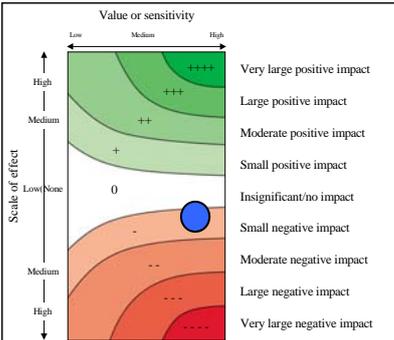
2. Description of the scale of effect Option 1: Complete removal by SLV (contd.)	3. Total (environmental) impact
<p>(contd.)</p> <p>4. Large spillages (with significant impact from e.g. oil spill) could occur from a vessel collision with a Brent platform or from a vessel/vessel collision. The shipping density is low at the Brent Field, but the shipping density is higher at the nearshore transfer location, and also the surrounding environmental sensitivity is higher due to the proximity of protected conservation areas. The SLV will hold significant quantities of both marine diesel (assumed around half of its maximum capacity of 3,800 m<sup>3</sup>) for use in UK waters, and heavy fuel oil (HFO) (assumed around half of its maximum capacity of 14,900 m<sup>3</sup>) for transit in international waters. However, the likelihood of any of this inventory being accidentally released has been considered by Shell as negligible. The fuel tanks on the SLV are surrounded by 3 m of water ballast tanks (below and on the sides), and there are void tanks above. They are therefore in effect double-skinned. Therefore, the SLV would have to be travelling at considerable speed for there to be sufficient energy for an impact from a vessel to the side of the SLV to penetrate both bulkheads. If a collision with a vessel occurred during the transfer operations, it would likely be at a very slow speed and highly unlikely to cause a rupture of any of the fuel tanks. The manoeuvres of all vessels, both at the Brent Field and the nearshore transfer site, will be very carefully controlled and at low speeds.</p> <p>Shell has considered the potential risk of a spill of marine diesel from one of the harbour tugs. During the operation to lift and transfer the topsides at the Brent Field there is a low probability that vessel collisions (with other vessels or with the GBS) may result in a spill of diesel fuel to sea. Modelling previously performed to support the Brent Field oil pollution emergency plan OPEP indicates that at the Brent Field location a spill of 2,695 m<sup>3</sup> of diesel (a larger volume than is normally held in a single vessel fuel tank) could cross the median line within 3 hours but would be likely to disperse and evaporate within 9 hours and would not reach the UK or Norwegian coastlines.</p> <p>Along the transit route and at the transfer site it is also possible that an accident could damage a fuel tank on a supporting vessel, such as one of the harbor tugs. Shell used stochastic and deterministic oil spill trajectory modelling to model a worst case scenario for an instantaneous release of 200 m<sup>3</sup> of diesel (the total fuel inventory for a tug) at the transfer site. Stochastic modelling determines the progress of an oil slick towards the shore under average wind and current conditions over a period of time. The deterministic modelling indicates the likely time for beaching under constant onshore wind conditions. The results of the stochastic model run suggested that there was a &lt;1% probability of diesel fuel reaching the shore under the modelled conditions. The results of the deterministic modelling suggested that under a wind condition of 16 knots at 260° there was no probability of the diesel beaching and that it would be likely to disperse in approximately 8 hours. When the model was run again using an onshore wind of 21 knots, there was again no probability of the diesel beaching.</p> <p>The Brent Field OPEP will be valid for the lift of the topsides onto the SLV. Once on the vessel, the OPEP will become obsolete for the topsides (although still valid for the rest of the field) and the management of spills will fall under the SLV Ship Oil Pollution Emergency Plan (SOPEP), regulated by the Maritime and Coastguard Agency (MCA). The SOPEP covering the transportation and transfer of the topsides will be reviewed by Shell when in place to ensure that the response strategy and control mechanisms are robust. There will be a bridging document between Shell and AllSeas which will include emergency response procedures. Shell will be responsible for ensuring that AllSeas emergency response procedures are robust regarding the SLV which will include reviewing and auditing their procedures and the mechanisms put in place to test the emergency response procedures. Such accidents are very rare; hence the risk is considered to be small.</p> <p>(contd.)</p>	

## TOPSIDES - Environmental Risk from Accidents

2. Description of the scale of effect Option 1: Complete removal by SLV (contd.)	3. Total (environmental) impact
<p>It should be noted that certain offshore activities for GBS Option 2, leave <i>in situ</i>, (removal of significant external steel, installation of concrete caps on the legs and installation of AtoN) are included in the topsides programme of work. A derogation study report by Atkins [1] considered GBS Option 2, and states that the capping and AtoN installation is feasible. There is not considered to be any significant additional environmental risk from these operations.</p> <p><b>Summary</b></p> <p>In summary, the overall environmental risk from accidents as a result of 4 topsides removal and decommissioning is found to be 'small negative' as a combination of the above. The assessment is made on the basis that the mitigation measures listed in the ES are applied. Once the decommissioning option is selected, a risk assessment will be carried out by Shell that includes the examination of environmental risk, and the identification of specific management controls.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: 'Small negative'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle \ ellipse.</p> 



## BRENT A JACKET FOOTINGS - Environmental Risk from Accidents

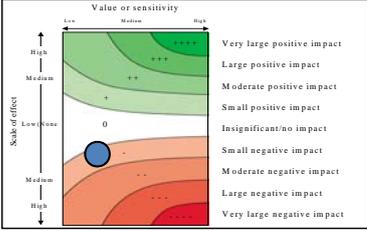
<p><b>2. Description of the scale of effect</b>  <b>Option 1: Complete removal by SSCV in several pieces, after cuttings the piles externally</b></p>	<p><b>3. Total (environmental) impact</b></p>
<p>The environmental risk is similar ('small negative') but smaller to that described for Brent A upper jacket Option 1 because the sections of footings would be smaller and lighter than the whole upper jacket and they would be removed by conventional SSCV and transported on conventional cargo barge.</p> <p><b>Evaluation of scale of effect:</b>  High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- -----   <span style="margin-left: 150px;">X</span></p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: 'Small negative'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle \ ellipse.</p> 
<p><b>2. Description of the scale of effect</b>  <b>Option 2: Complete removal by SSCV in several pieces, after cutting the piles internally</b></p>	<p><b>3. Total (environmental) impact</b></p>
<p>The environmental risk is similar ('small negative') but smaller to that described for Brent A upper jacket Option 1 because the sections of footings would be smaller and lighter than the whole upper jacket and they would be removed by conventional SSCV and transported on conventional cargo barge.</p> <p><b>Evaluation of scale of effect:</b>  High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- -----   <span style="margin-left: 150px;">X</span></p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 2: 'Small negative'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle \ ellipse.</p> 

## BRENT A JACKET FOOTINGS - Environmental Risk from Accidents

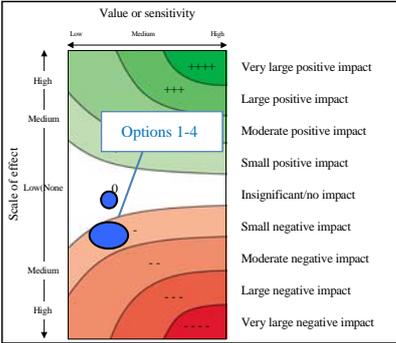
2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 3: Leave <i>in situ</i></b></p> <p>The jacket footings are left <i>in situ</i>, with no operations, hence there is no impact.</p> <p><b>Evaluation of scale of effect:</b>            High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 3: ‘No impact’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle \ ellipse.</p> <div style="border: 1px solid black; padding: 5px;"> <p style="text-align: center;">Value or sensitivity</p> <p style="text-align: center;">Low                      Medium                      High</p> <p style="text-align: center;">↑</p> <p>High                      Very large positive impact            Large positive impact            Moderate positive impact            Small positive impact</p> <p style="text-align: center;">Low/None                      0                      Insignificant/no impact</p> <p style="text-align: center;">↓</p> <p>Medium                      Small negative impact            Moderate negative impact            Large negative impact            Very large negative impact</p> <p style="text-align: center;">High</p> </div>



## GBS ATTIC OIL - Environmental Risk from Accidents

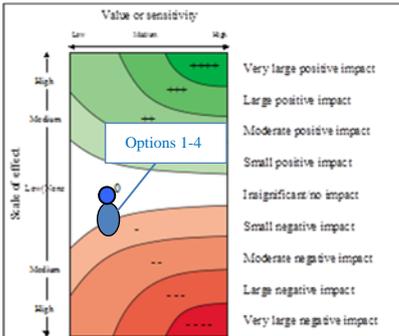
2. Description of the scale of effect Option 1: Recover to Shore	3. Total (environmental) impact
<p>All the attic oil (12-14,000 m<sup>3</sup>) will be removed in this option. Environmental risks during operations include:</p> <ul style="list-style-type: none"> <li>• Vessel collision and oil spill. The accidental release of fuel as a result of a vessel collision near the coastline in a sensitive location (where the consequence is likely to be higher) would be the worst case oil spill scenario. But the operations only involve a relatively small number of vessel movements, particularly near shore. Given the detailed planning and consultation that will take place to establish routes, and the stringent surveying, navigational and operational controls that apply to vessels, the likelihood of such a collision and subsequent spill occurring is very low, hence the risk is small.</li> <li>• There is also a risk of spillage of attic oil during the various transfer operations at the Brent Field. The likelihood of a spill is higher than the nearshore oil spill scenario described above because there are significant volumes involved, it is a non-standard operation and because there are two stages in the transfer operations (albeit the consequence would be smaller because the Brent Field is less sensitive than nearshore). Shell will undertake detailed planning and risk assessment for the transfer operations (e.g. bow tie analysis to identify the critical elements to be managed) to ensure that the risks are managed to be ALARP. The transfer procedure includes a sequence of pressure and leak testing of the equipment prior to use. In addition, an ROV will always be on station to provide a real-time video link during the operations.</li> <li>• There is also a risk of spilling H<sub>2</sub>S scavenger (sodium chlorite) into the marine environment during the injection process. The scavenger is an environmentally hazardous bleach, although the volume involved during the operation (680 m<sup>3</sup>) is significantly less than that required for the cell sediment decommissioning operations. Volumes of wax solvent may also be necessary to inject to facilitate transfer of the attic oil. Strict controls would be implemented by Shell to minimise risks to ALARP.</li> </ul> <p>The main driver of environmental risk for this option is considered to be from spillage of attic oil during transfer operations, because there are large volumes involved, it is an environmentally hazardous substance, and the operations involved are non-standard. The impact is estimated to be 'small negative' (as it is normal to handle significant volumes of hazardous chemicals during offshore activities) provided that Shell implement strict management measures to demonstrate and ensure that the risks are ALARP.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: 'Small negative'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circles \ ellipses.</p>  <p>The diagram is a 2D matrix with 'Value of sensitivity' on the x-axis (Low to High) and 'Scale of effect' on the y-axis (High to Low). The matrix is divided into two main regions: a green region for positive impacts and a red region for negative impacts. The green region is further divided into 'Very large positive impact', 'Large positive impact', 'Moderate positive impact', and 'Small positive impact'. The red region is divided into 'Insignificant/no impact', 'Small negative impact', 'Moderate negative impact', 'Large negative impact', and 'Very large negative impact'. A blue circle is located in the 'Small negative impact' zone, representing the estimated impact for Option 1. Ellipses of varying sizes are scattered throughout the matrix, representing uncertainty in the impact assessment.</p>

## GBS CELL CONTENTS - Environmental Risk from Accidents

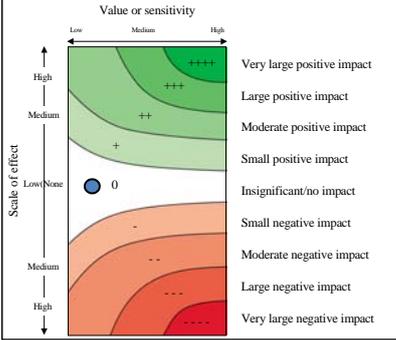
2. Description of the scale of effect (Brent B/C/D) Options: 1, 2, 3, 4, 5	3. Total (environmental) impact
<p>For the GBS cell sediments, 5 decommissioning options are considered.</p> <ul style="list-style-type: none"> <li>Option 1: retrieve to vessel and re-inject to a new drilled well</li> <li>Option 2: retrieve to vessel, transport to shore for treatment</li> <li>Option 3: cap <i>in situ</i> in cells using a mixture of sand and gravel</li> <li>Option 4: leave in the cells for natural degradation and treat by MNA (Monitored Natural Attenuation)</li> <li>Option 5: leave in the cells for natural degradation</li> </ul> <p>Approximately 12-14,000 m<sup>3</sup> of attic oil and interphase material is removed in all options, but the associated environmental risks are covered in the Attic Oil matrices. Environmental risks during operations include:</p> <ul style="list-style-type: none"> <li>Vessel collision and oil spill. The accidental release of fuel as a result of a vessel collision near the coastline would be the worst case oil spill scenario. Options 1 and 2 have a higher risk of oil/diesel spill than Options 3 and 4 because Option 1 involves the largest number of vessel movements of all the decommissioning options, while Option 2 would involve more operations near shore (where the consequence is likely to be higher) than the other options. But given the detailed planning and consultation that will take place to establish vessel tow routes, the stringent surveying, navigational and operational controls that apply to vessels, the likelihood of such a collision/ spill occurring is very low, hence the risk is low.</li> <li>In Options 1 and 2, there is also a risk of spillage of diluted cell sediment (1:15) or cell water during the various transfer operations (and from near shore operations for Option 2). Although the likelihood of a spill is higher than the oil spill scenario (because it involves non-standard operations), the risk is lower because the slurry is dilute such that the consequence would be much lower (and because similar planning/risk assessment would also be conducted of all transfer operations).</li> <li>There is also a risk of spilling H<sub>2</sub>S scavenger (sodium chlorite) into the marine environment during the injection process. The scavenger is an environmentally hazardous bleach and is required in significant volumes (9,700 m<sup>3</sup>) for Options 1-4 (none is required for Option 5).</li> <li>Large volumes of nutrients (calcium nitrate and sodium hexametaphosphate) would be required for injection into the cells for Option 3 (up to 5,500 t) and Option 4 (up to 16,400 t) to react within the three GBS. The nutrients could have an impact upon the marine environment if they were spilt in large quantities during the process of injection into the cells, but as they are relatively benign chemicals, the environmental risk is considered lower than that for sodium chlorite. Regardless, strict controls would need to be implemented by Shell to ensure there are no spillages.</li> </ul> <p>The main driver of environmental risk is considered by DNV GL to be from spillage of sodium chlorite before or during the injection process (the chlorite will react after injection to less harmful substances). This is because there are large volumes involved, it is an environmentally hazardous substance, and the operations involved are non-standard. The risk is thus considered similar for Options 1-4 (the same volume of chlorite is required) and 'small negative' impact is allocated (it is normal during offshore activities to handle significant volumes of hazardous chemicals) providing that Shell implement strict management measures to ensure that the likelihood of a spill is very low. Activities handling Option 5 involve much fewer activities than the other options, with insignificant environmental risk.</p> <p>Whichever option is selected will require an environmental risk assessment to be conducted of operations to demonstrate that all the necessary barriers are in place to mitigate the environmental risk to acceptable levels.</p> <p>Note: the long-term risk of leakage from wells is captured in 'Legacy'.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X<sub>1,2,3,4</sub>    X<sub>5</sub></p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Options 1-4: 'Small negative'</b> <b>Option 5: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circles \ ellipses.</p> 



## GBS MINICELL ANNULUS MATERIAL – Environmental Risk from Accidents

2. Description of the scale of effect Option 1,2,3,4,5	3. Total (environmental) impact
<p>For the GBS minicell annulus material, five decommissioning options are considered:</p> <ul style="list-style-type: none"> <li>• Option 1: Mobilise and re-inject in a ‘new’ drilled subsea well away from site</li> <li>• Option 2: Mobilise and retrieve to vessel and treat and dispose onshore</li> <li>• Option 3: Cap or cover <i>in situ</i></li> <li>• Option 4: Leave <i>in situ</i> and enhance natural biodegradation (Monitored Natural Attenuation MNA)</li> <li>• Option 5: leave <i>in situ</i> for natural degradation.</li> </ul> <p>For all GBS minicell annulus options the environmental risk from accidents will be similar in nature to those presented by GBS cell sediment decommissioning options. But the risks will be lower because there is much less vessel activity and the volumes of contaminated and hazardous materials involved are much smaller (the minicells contain only 1% of GBS cell contents volume and &lt;0.5% of the oil load) and because no H<sub>2</sub>S scavenger would be used for any option. GBS cell contents Option 1, 2, 3 and 4 were assessed as ‘small’ impact, and the impact for GBS Minicells Options 1, 2, 3 and 4 is considered ‘insignificant-small’.</p> <p>Option 5 impact presents ‘Insignificant’ risk because there are very few activities.</p> <p>Note: the long-term risk of leakage from wells is captured in ‘Legacy’.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X<sub>1-4</sub>    X<sub>5</sub></p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Options 1-4: ‘Insignificant-small negative’</b></p> <p style="text-align: center;"><b>Option 5: ‘Insignificant’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p> <div style="text-align: right;">  </div>

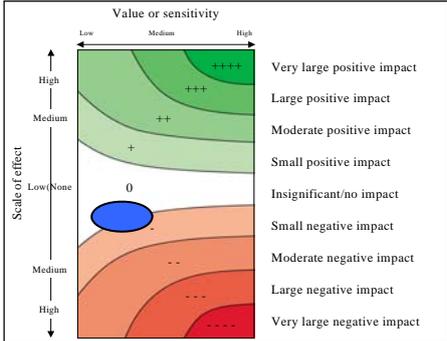
## SEABED DRILL CUTTINGS - Environmental Risk from Accidents

2. Description of the scale of effect (Seabed drill cuttings)	3. Total (environmental) impact
<p><b>Option 1: Leave <i>in situ</i></b></p> <p>For the drill cuttings on the seabed, the decommissioning option is to leave <i>in situ</i> for natural degradation.</p> <p>This involves no offshore activities and consequently the risk of environmental accidents is very low.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X<sub>1</sub></p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: 'No impact'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circles \ ellipses.</p> 

## BRENT A SEABED DRILL CUTTINGS – Environmental Risk from Accidents

2. Description of the scale of effect Brent A Seabed Drill Cuttings: Options 1, 2, 3, 4	3. Total (environmental) impact
<p>For removal of the Brent A seabed cuttings piles, the following 4 options are considered:</p> <ul style="list-style-type: none"> <li>• Option 1: Treat and discharge from Brent C topsides</li> <li>• Option 2: Return all dredged material to shore</li> <li>• Option 3: De-water dredged material on Brent C topsides and transfer solids onshore</li> <li>• Option 4: Cuttings re-injection at a remote location</li> </ul> <p>Risks of accidents to the environment include:</p> <ul style="list-style-type: none"> <li>• Spillage: DNV GL estimates the quantity of oil in the seabed cuttings piles in the ES. After dredging, the slurry will have been diluted tenfold such that the oil content is less than 1%. Therefore, should a small spill occur during removal and transfer operations, the environmental impact would be low. Spills nearshore would present a greater risk owing to potentially increased sensitivities.</li> <li>• Vessel collision: given the relative low frequency of vessel transits for all options, and the assumption that strict operational procedures will be in the place, the risks are considered manageable.</li> </ul> <p>Under all 4 options, the drill cuttings and associated contaminated sediment (approximately 8,000 m<sup>3</sup>) would be removed by suction dredger and lift pump to the ROVSV controlling the operations; this would generate approximately 80,000 m<sup>3</sup> of slurry.</p> <p>The ROVSV is unlikely to have sufficient storage capacity onboard for this volume of material and as such, the slurry would be transferred to a tanker with sufficient capacity. There is a risk of spills during dredging and removal operations, including use of a floating hose for transfer to a vessel and/or topsides in each option respectively. However, the risk is estimated to be low because (as stated above) the oil content of the slurry is less than 1%, dredging operations are well established, and it is assumed that strict operational procedures would be put in place to minimise this risk. Periods of high seabird vulnerability should be avoided if possible.</p> <p>Risks specific to the individual decommissioning options are discussed below.</p> <p>Under Option 1, the slurry would be processed and treated seawater and solids (as processed powder) would be discharged back to sea. Recovered oil (estimated 430 t) would be contained within closed tanks (e.g. IBCs) thus restricting the likelihood of spillage, and transferred to shore via the platform support vessel. The extent of environmental risk is thus estimated to be 'low'.</p> <p>As the drilling cuttings are brought to shore in Options 2 and 3, there is a risk of spills in a potentially sensitive onshore/nearshore environment, lending to a slightly higher risk than Option 2. However, given the limited number of transits, operational and safety procedures, and the low oil content of the slurry (separated solids in Option 3), the extent of environmental risk is estimated to be 'low'.</p> <p>In Options 1 and 3, the recovered slurry would be processed on the Brent C topsides, irrespective of which platform the slurry originated from. This would entail more offshore transfer operations to Brent C; however, the impact is not expected to increase significantly as a result.</p> <p>(contd.)</p>	

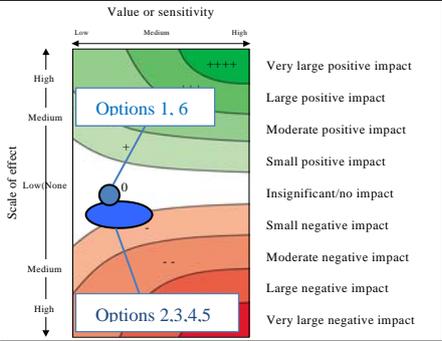


<b>2. Description of the scale of effect</b> <b>Brent A Seabed Drill Cuttings: Options 1, 2, 3, 4 (contd.)</b>	<b>3. Total (environmental) impact</b>
<p>Option 4 includes similar environmental risk of spills during transfer activities as per Options 1, 2, 3, plus additional risk of leaks from the newly drilled subsea well; pipe and/or vessel during injection operations (see 'Legacy' for the capture of long-term risk of leakage). It is understood that Shell are currently using waste disposal wells at the Brent platforms, and no historical leakage issues have been reported. The seawater: solids ratio will be reduced to 5:1 (i.e. a 50% reduction in seawater), to create an appropriate injection slurry. There will be some additional vessels for Option 4 as compared to the other options, including a MDU rig, anchor handler and PSV.</p> <p>Although there are differences between the decommissioning options, the environmental risk is considered to be similar for all options ('insignificant-small negative') because vessel operations are not extensive and the material handled is low in oil content.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1, 2, 3, 4: 'Insignificant – small negative'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p> 

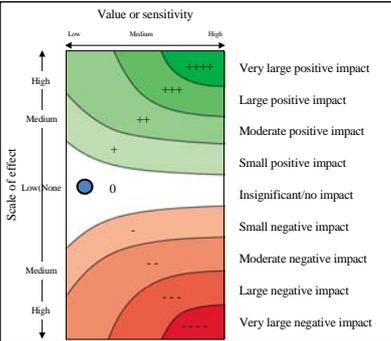
## CELL TOP DRILL CUTTINGS - Environmental Risk from Accidents

2. Description of the scale of effect GBS Cell Top Drill Cuttings: Options 1, 2, 3, 4, 5, 6	3. Total (environmental) impact
<p>For removal of the GBS cell top drill cuttings, the following 5 options are considered in this assessment:</p> <ul style="list-style-type: none"> <li>Option 1: Partial removal via water jetting.</li> <li>Option 2: Treat and discharge from Brent C topsides.</li> <li>Option 3: Return dredged material to shore for treatment.</li> <li>Option 4: Transfer to Brent C topsides, dewater offshore, solids returned to shore for treatment.</li> <li>Option 5: Re-inject into a new well.</li> <li>Option 6: Leave <i>in situ</i>.</li> </ul> <p>Option 1 involves few activities and consequently the risks for an environmental accident are low. Additionally, as Option 6 involves leaving the cell top drill cuttings pile <i>in situ</i>, there will be no potential for environmental risk from accidents as there are no activities.</p> <p>Risks of accidents to the environment for Options 2, 3, 4 and 5 include:</p> <ul style="list-style-type: none"> <li>Spillage: DNV GL estimates the quantity of oil in the cell top cuttings piles in the ES. After dredging, the slurry will be diluted tenfold such that the oil content is less than 1%. Therefore, should a small spill occur during removal and transfer operations, the environmental impact would be low. Spills nearshore would present a greater risk owing to potentially increased sensitivities.</li> <li>Vessel collision: given the relative low frequency of vessel transits for all options, and the assumption that strict operational procedures will be in the place, the risks are considered manageable.</li> </ul> <p>These options are discussed individually below.</p> <p>In Options 2, 3, 4 and 5, the cell top drill cuttings would be removed by suction dredger and lift pump to the ROVSV controlling the operations. A total of approximately 134,000 m<sup>3</sup> of slurry would be generated from the three platforms. There is a risk of spills during dredging and removal operations, including use of a floating hose for transfer to a vessel and/or topsides in each option respectively. However, the environmental risk is estimated to be low because (as stated above) the oil content of the slurry is less than 1%, the operations are well established, and it is assumed that strict operational procedures will be put in place to minimise this risk. Periods of high seabird vulnerability should be avoided.</p> <p>The slurry would be processed under Option 2 and recovered oil would be contained within closed tanks (e.g. IBCs) thus restricting the likelihood of spillage, and transferred to shore via the platform support vessel. The extent of environmental risk is thus estimated to be 'low negative'.</p> <p>As the drilling cuttings are brought to shore in Options 3 and 4, there is a risk of spills in more sensitive onshore/nearshore environment, lending to a slightly higher risk than Option 2. However, given the limited number of transits, operational procedures, and the low oil content of the slurry (thickened sludge in Option 4), the extent of environmental risk is estimated to be 'low negative'.</p> <p>In Options 2 and 4, the recovered slurry would be processed on the Brent C topsides, irrespective of which platform the slurry originated from. This would entail more offshore transfer operations to Brent C; however, the impact is not expected to increase significantly as a result.</p> <p>Option 5 includes similar environmental risk of spills during removal and transfer activities of dredged slurry, plus an additional risk of leaks from the newly drilled subsea well, pipe and/or vessel during injection operations (see 'Legacy' for the capture of long-term risk of seepage from wells).</p> <p>(contd.)</p>	

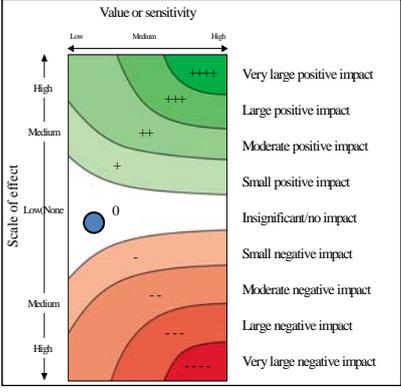
## GBS CELL TOP DRILL CUTTINGS – Environmental Risk from Accidents

2. Description of the scale of effect GBS Cell Top Drill Cuttings: Options 1, 2, 3, 4, 5, 6 (contd.)	3. Total (environmental) impact
<p>It is understood that Shell are currently using waste disposal wells at the Brent platforms, and no historical leakage issues have been reported. There will be some additional vessels for Option 5 as compared to the other options, including a MDU rig, anchor handler and PSV, however these are not extensive. Although there are differences between the options, the environmental risk is estimated to be similar for options 2, 3, 4 and 5 ('insignificant-small negative') as vessel operations are not large and the material handled is low in oil content.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X<sub>2,3,4,5</sub> X<sub>1,6</sub></p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: 'Insignificant'</b></p> <p style="text-align: center;"><b>Options 2, 3, 4 and 5: 'Insignificant-small negative'</b></p> <p style="text-align: center;"><b>Option 6: 'No impact'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p> 

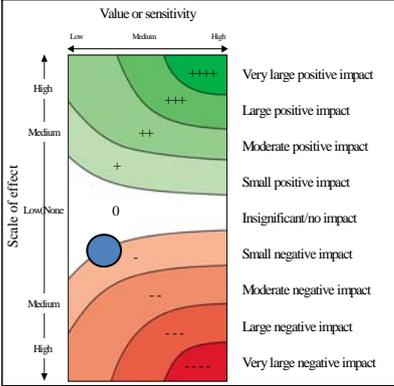
## TRI-CELL DRILL CUTTINGS - Environmental Risk from Accidents

2. Description of the scale of effect (Tri-Cell drill cuttings)	3. Total (environmental) impact
<p><b>Option 1: Leave in Place</b></p> <p>For the drill cuttings accumulated in the Brent B and D tri-cells the decommissioning option is to leave <i>in situ</i> for natural degradation.</p> <p>This involves no activities and consequently the risks of environmental accidents are none.</p> <p>The overall evaluation of the extent of environmental risk from accidents as a result of the decommissioning activities is found to be 'no impact'.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: 'No impact'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circles \ ellipses.</p> 

## SUBSEA STRUCTURES AND DEBRIS - Environmental Risk from Accidents

2. Description of the scale of the effect <b>Option 1: Complete Removal</b>	3. Total environmental impact
<p>For the subsea structures and debris, there is only one option: completely remove to shore. There is a risk of accidents during vessel operations; the total vessel days are as follows:</p> <ul style="list-style-type: none"> <li>Recovery of all debris and grout bags (MSV) around the Brent platform 500m zones, recovery of large anchor blocks assembly at Brent B and trawl sweep of all cleared areas is estimated to be 14 days in total.</li> <li>Recovery of subsea structures (DSV) i.e. Brent B SSIV, SPAR protection cover, SPAR PLEM, Brent A umbilical splitter and VASP is estimated to be 40 days.</li> </ul> <p>This level of vessel activity (54 days) is not significant and could be part of a campaign activity. Such lifting operations are routine and even in the unlikely event of an object falling while being lifted, it would have negligible environmental impact. The overall evaluation of the extent of environmental risk from accidents as a result of this option is found to be 'low'.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

## WELLS - Environmental Risk from Accidents

2. Description of the scale of the effect Option 1: Plugging and Abandonment	3. Total environmental impact
<p>There is only one option to decommission the Brent Field wells: P&amp;A.</p> <p>This activity is carried out from the existing Brent platforms with the existing drilling equipment and during the platform operational modes. Any vessels used are for transportation of recovered cement slurry, tubings, casings and subsea wellheads to shore. This level of vessel activity is not significant and could be part of a campaign activity or during routine operations, so there will be little increased risk of accidents.</p> <p>The environmental risk from accidents associated with plugging and abandonment of wells will be lower than those experienced during the drilling of the production wells due to lower pressure and low flow rate. Activities will be part of the platform operations and will take place within a well-defined plug and abandon process with risk assessment and relevant permits in place. While the P&amp;A operations will help ensure that there is no discharge of chemicals and fluids to sea, there remains an inherent risk of accidental release but it is low as activities are part of a closed loop system (via platform).</p> <p>At present, Brent D wells have completed plugging and abandon and there have been no reports of any environmental accidents.</p> <p>The overall environmental risk from this option is considered to be 'insignificant-small negative'. Long term risk to the environment as a result of seepage from the wells is evaluated in 'Legacy' matrices.</p> <p><b>Evaluation of scale of effect:</b>            High neg.    Medium neg.    Low/none    Medium pos.    High pos.             ----- ----- ----- -----   <span style="margin-left: 200px;">X</span></p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: 'Insignificant-small negative'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

<sup>1</sup> Atkins, *Shell UK Limited Brent D Platform Derogation Study Summary Report*, Report No.: 5074582-001-ER-01, Issue 2, 14 May 2009.

## 1.8 EMPLOYMENT

**Category: Topsides/Jacket/GBS/Attic Oil/Cell Contents/Drilling Leg and Minicell Annulus/Drill Cuttings/Subsea Structures and Debris/Wells**

**Consequence evaluation for: Employment**

### 1. General description of the receiving environment (situation and characteristics)

This assessment considers the employment generated from decommissioning each of the facilities in the BDP.

The 2016 Oil and Gas UK economic report [1] states that the UK's oil and gas sector currently supports employment for approximately 330,000 people. Analysis demonstrates that each £billion spent by the industry in the UKCS currently delivers between 20 - 25,000 jobs, depending on the balance of spending between capital investment and operational costs. This equates to be about £22 billion.

The report states that in 2015, over £1billion was spent on decommissioning and this is expected to increase to around £2billion in 2017. Beyond this, decommissioning spend will depend on the industry's ability to manage its ageing assets so that they remain economically viable even if low oil prices prevail. [1]

The key activities that would create employment as part of the BDP are onshore preparation works, offshore operations, vessel operations and onshore disposal works.

Some onshore work will be done at the Able Seaton Port facility in Teesside, on the northeast coast of England, which has been awarded the contract for the disposal/recycling of the Brent A, B and D topsides and the Brent A upper jacket. The location and contracts for the onshore dismantling and disposal of the remaining Brent facilities have not yet been decided.

UKCS oil and gas production are both currently declining and this has implications on levels of activity and employment. Currently levels of employment in UK oil and gas are 27% less than in 2014 (most of this decline has been onshore). As such, any employment created by the BDP should temporarily help to slow down the rate of decline and also have indirect employment benefits in surrounding areas. As such employment is allocated a 'medium' value.

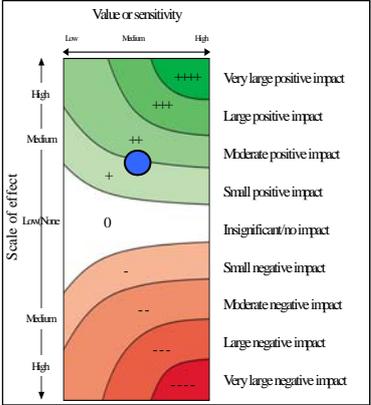
#### Evaluation of the value:

Low Medium High

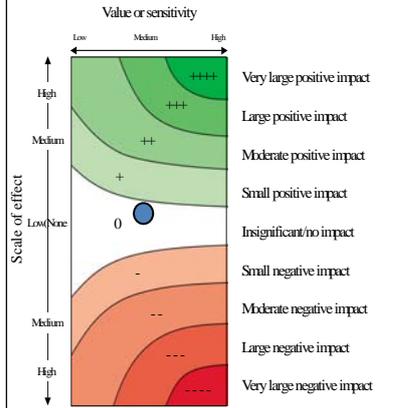
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## TOPSIDES - Employment

2. Description of the scale of effect Option 1: Complete Removal using SLV	3. Total (environmental) impact																		
<p>Shell commissioned an independent report to estimate the employment generated by the BDP. As part of this study, a factor was derived for the Brent project of £250,000 per new job per year. This factor was then applied by Shell to estimate the employment generated for each of the decommissioning options.</p> <p>Shell estimates that the complete removal of the four topsides by SLV will generate approximately 1,030 man-years of work. As the topsides will be dismantled at the Able Seaton Port onshore facility in Teesside, there will also be some indirect employment benefits for the supply chain in the local area.</p> <table border="1"> <thead> <tr> <th colspan="6">Employment Impact Categories (DNV GL)</th> </tr> <tr> <th>Effect</th> <th>None /Insignificant</th> <th>Small positive</th> <th>Small – moderate positive</th> <th>Moderate positive</th> <th>Large</th> </tr> </thead> <tbody> <tr> <td>Man-Years</td> <td>0-400</td> <td>400-1,000</td> <td>1,000-3,000</td> <td>3,000-9,000</td> <td>&gt;9,000</td> </tr> </tbody> </table> <p>The overall impact is estimated to be ‘small-moderate positive’ as per the arbitrary employment impact table above.</p> <p><b>Evaluation of scale of effect:</b>            High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	Employment Impact Categories (DNV GL)						Effect	None /Insignificant	Small positive	Small – moderate positive	Moderate positive	Large	Man-Years	0-400	400-1,000	1,000-3,000	3,000-9,000	>9,000	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: ‘Small-moderate positive’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 
Employment Impact Categories (DNV GL)																			
Effect	None /Insignificant	Small positive	Small – moderate positive	Moderate positive	Large														
Man-Years	0-400	400-1,000	1,000-3,000	3,000-9,000	>9,000														

## BRENT A UPPER JACKET - Employment

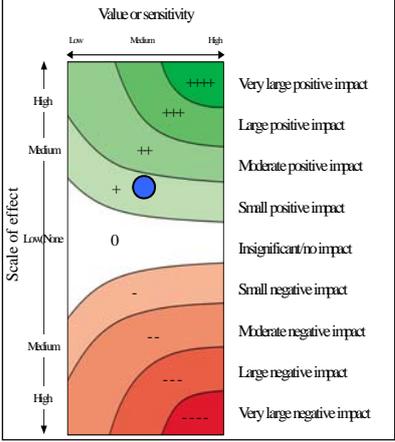
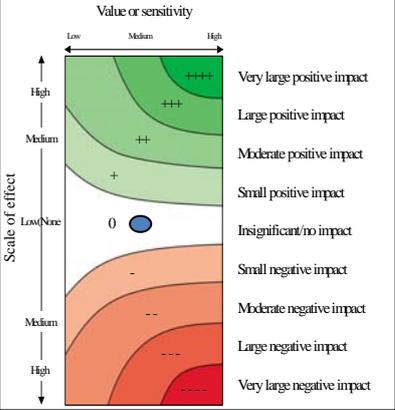
2. Description of the scale of effect <b>Option 1: Removal in one piece to approx. -84.5m LAT using SLV</b>	3. Total (environmental) impact																		
<p>Shell commissioned an independent report to estimate the employment generated by the BDP. As part of this study, a factor was derived for the Brent project of £250,000 per new job per year. This factor was then applied by Shell to estimate the employment generated for each of the decommissioning options.</p> <p>Shell estimates that the complete removal of the Brent A upper jacket will generate 371 man-years of work. As the upper jacket will be dismantled at the Able Seaton Port onshore facility in Teesside, there will also be some (although likely minor) indirect employment benefits for the supply chain in the local area.</p> <table border="1"> <thead> <tr> <th colspan="6">Employment Impact Categories (DNV GL)</th> </tr> <tr> <th>Effect</th> <th>None /Insignificant</th> <th>Small positive</th> <th>Small – moderate positive</th> <th>Moderate positive</th> <th>Large</th> </tr> </thead> <tbody> <tr> <td>Man-Years</td> <td>0-400</td> <td>400-1,000</td> <td>1,000-3,000</td> <td>3,000-9,000</td> <td>&gt;9,000</td> </tr> </tbody> </table> <p>The overall impact is estimated to be ‘insignificant’ as per the arbitrary employment impact table above.</p> <p><b>Evaluation of scale of effect:</b>            High neg.    Medium neg.    Low/none    Medium pos.    High pos.             ----- ----- ----- -----   <span style="margin-left: 250px;">X</span></p>	Employment Impact Categories (DNV GL)						Effect	None /Insignificant	Small positive	Small – moderate positive	Moderate positive	Large	Man-Years	0-400	400-1,000	1,000-3,000	3,000-9,000	>9,000	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: ‘Insignificant’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 
Employment Impact Categories (DNV GL)																			
Effect	None /Insignificant	Small positive	Small – moderate positive	Moderate positive	Large														
Man-Years	0-400	400-1,000	1,000-3,000	3,000-9,000	>9,000														



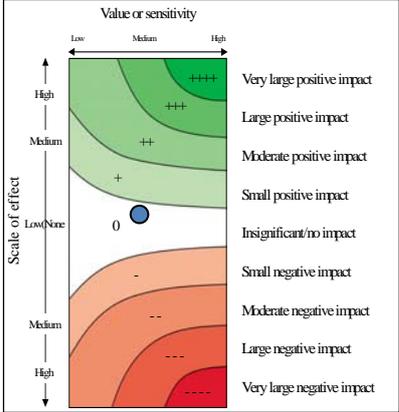
## BRENT A JACKET FOOTINGS - Employment

2. Description of the scale of effect <b>Option 3: Leave <i>in situ</i></b>	3. Total (environmental) impact																		
<p>Shell commissioned an independent report to estimate the employment generated by the BDP. As part of this study, a factor was derived for the Brent project of £250,000 per new job per year. This factor was then applied by Shell to estimate the employment generated for each of the decommissioning options.</p> <p>Shell estimates that Brent A jacket footings Option 3 will generate 14 man-years of work.</p>	<p>1) and 2) are combined in the impact matrix.</p> <p><b>Option 3: ‘Insignificant’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p>																		
<table border="1" style="width: 100%; text-align: center;"> <thead> <tr> <th colspan="6">Employment Impact Categories (DNV GL)</th> </tr> <tr> <th>Effect</th> <th>None /Insignificant</th> <th>Small positive</th> <th>Small – moderate positive</th> <th>Moderate positive</th> <th>Large</th> </tr> </thead> <tbody> <tr> <td>Man-Years</td> <td>0-400</td> <td>400-1,000</td> <td>1,000-3,000</td> <td>3,000-9,000</td> <td>&gt;9,000</td> </tr> </tbody> </table>	Employment Impact Categories (DNV GL)						Effect	None /Insignificant	Small positive	Small – moderate positive	Moderate positive	Large	Man-Years	0-400	400-1,000	1,000-3,000	3,000-9,000	>9,000	
Employment Impact Categories (DNV GL)																			
Effect	None /Insignificant	Small positive	Small – moderate positive	Moderate positive	Large														
Man-Years	0-400	400-1,000	1,000-3,000	3,000-9,000	>9,000														
<p>The overall impact is estimated to be ‘insignificant’ as per the arbitrary employment impact table above.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>																			

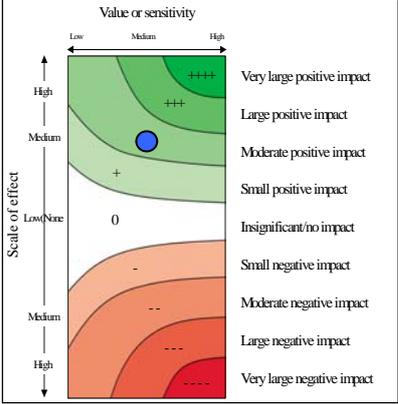
# GBS - Employment

<p><b>2. Description of the scale of effect</b>  <b>Option 1: Remove legs in one piece down to approx. -55 m LAT</b></p> <p>Shell commissioned an independent report to estimate the employment generated by the BDP. As part of this study, a factor was derived for the Brent project of £250,000 per new job per year. This factor was then applied by Shell to estimate the employment generated for each of the decommissioning options.</p> <p>Shell estimates that GBS Option 1 will generate 885 man-years of work. Depending on the location of the onshore disposal facility, partial removal of the GBS would benefit the local community.</p> <table border="1"> <thead> <tr> <th colspan="6">Employment Impact Categories (DNV GL)</th> </tr> <tr> <th>Effect</th> <th>None /Insignificant</th> <th>Small positive</th> <th>Small – moderate positive</th> <th>Moderate positive</th> <th>Large</th> </tr> </thead> <tbody> <tr> <td>Man-Years</td> <td>0-400</td> <td>400-1,000</td> <td>1,000-3,000</td> <td>3,000-9,000</td> <td>&gt;9,000</td> </tr> </tbody> </table> <p>The overall impact is estimated to be ‘small positive’ as per the arbitrary employment impact table above.</p> <p><b>Evaluation of scale of effect:</b>            High neg.    Medium neg.    Low/none    Medium pos.    High pos.             ----- ----- ----- ----- -----   <span style="margin-left: 300px;">X</span></p>	Employment Impact Categories (DNV GL)						Effect	None /Insignificant	Small positive	Small – moderate positive	Moderate positive	Large	Man-Years	0-400	400-1,000	1,000-3,000	3,000-9,000	>9,000	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: ‘Small positive’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 
Employment Impact Categories (DNV GL)																			
Effect	None /Insignificant	Small positive	Small – moderate positive	Moderate positive	Large														
Man-Years	0-400	400-1,000	1,000-3,000	3,000-9,000	>9,000														
<p><b>2. Description of the scale of effect</b>  <b>Option 2: Leave in situ</b></p> <p>Shell commissioned an independent report to estimate the employment generated by the BDP. As part of this study, a factor was derived for the Brent project of £250,000 per new job per year. This factor was then applied by Shell to estimate the employment generated for each of the decommissioning options.</p> <p>Shell estimates that GBS Option 2 will generate 5 man-years of work.</p> <table border="1"> <thead> <tr> <th colspan="6">Employment Impact Categories (DNV GL)</th> </tr> <tr> <th>Effect</th> <th>None /Insignificant</th> <th>Small positive</th> <th>Small – moderate positive</th> <th>Moderate positive</th> <th>Large</th> </tr> </thead> <tbody> <tr> <td>Man-Years</td> <td>0-400</td> <td>400-1,000</td> <td>1,000-3,000</td> <td>3,000-9,000</td> <td>&gt;9,000</td> </tr> </tbody> </table> <p>The overall impact is estimated to be ‘insignificant’ as per the arbitrary employment impact table above.</p> <p><b>Evaluation of scale of effect:</b>            High neg.    Medium neg.    Low/none    Medium pos.    High pos.             ----- ----- ----- ----- -----   <span style="margin-left: 300px;">X</span></p>	Employment Impact Categories (DNV GL)						Effect	None /Insignificant	Small positive	Small – moderate positive	Moderate positive	Large	Man-Years	0-400	400-1,000	1,000-3,000	3,000-9,000	>9,000	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 2: ‘Insignificant’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 
Employment Impact Categories (DNV GL)																			
Effect	None /Insignificant	Small positive	Small – moderate positive	Moderate positive	Large														
Man-Years	0-400	400-1,000	1,000-3,000	3,000-9,000	>9,000														

## GBS ATTIC OIL - Employment

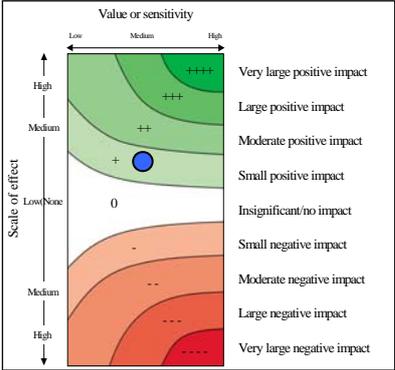
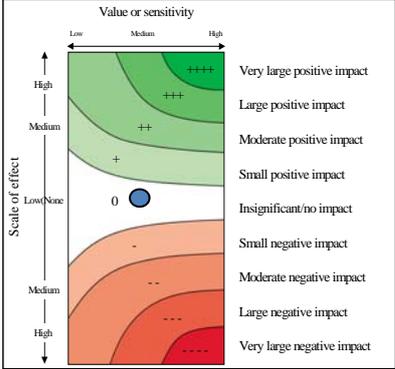
2. Description of the scale of effect Option 1: Recover to Shore	3. Total (environmental) impact																		
<p>Shell commissioned an independent report to estimate the employment generated by the BDP. As part of this study, a factor was derived for the Brent project of £250,000 per new job per year. This factor was then applied by Shell to estimate the employment generated for each of the decommissioning options.</p> <p>Shell estimates that the removal of the GBS attic oil will generate 312 man-years of work.</p> <table border="1"> <thead> <tr> <th colspan="6">Employment Impact Categories (DNV GL)</th> </tr> <tr> <th>Effect</th> <th>None /Insignificant</th> <th>Small positive</th> <th>Small – moderate positive</th> <th>Moderate positive</th> <th>Large</th> </tr> </thead> <tbody> <tr> <td>Man-Years</td> <td>0-400</td> <td>400-1,000</td> <td>1,000-3,000</td> <td>3,000-9,000</td> <td>&gt;9,000</td> </tr> </tbody> </table> <p>The overall impact is estimated to be 'insignificant' as per the arbitrary employment impact table above.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p>----- ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	Employment Impact Categories (DNV GL)						Effect	None /Insignificant	Small positive	Small – moderate positive	Moderate positive	Large	Man-Years	0-400	400-1,000	1,000-3,000	3,000-9,000	>9,000	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 
Employment Impact Categories (DNV GL)																			
Effect	None /Insignificant	Small positive	Small – moderate positive	Moderate positive	Large														
Man-Years	0-400	400-1,000	1,000-3,000	3,000-9,000	>9,000														

## GBS CELL CONTENTS- Employment

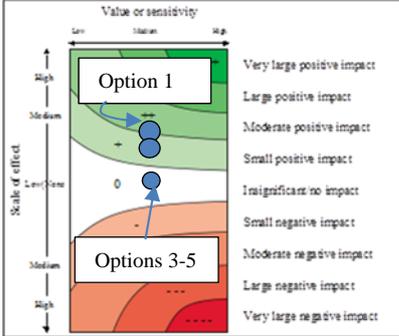
2. Description of the scale of effect	3. Total (environmental) impact																		
<p><b>Option 1: Mobilise, retrieve to vessel and re-inject down new well</b></p> <p>Shell commissioned an independent report to estimate the employment generated by the BDP. As part of this study, a factor was derived for the Brent project of £250,000 per new job per year. This factor was then applied by Shell to estimate the employment generated for each of the decommissioning options.</p> <p>Shell estimates that GBS cell contents Option 1 will generate 6,035 man-years of work.</p> <table border="1" style="width: 100%; text-align: center;"> <thead> <tr> <th colspan="6">Employment Impact Categories (DNV GL)</th> </tr> <tr> <th>Effect</th> <th>None /Insignificant</th> <th>Small positive</th> <th>Small – moderate positive</th> <th>Moderate positive</th> <th>Large</th> </tr> </thead> <tbody> <tr> <td>Man-Years</td> <td>0-400</td> <td>400-1,000</td> <td>1,000-3,000</td> <td>3,000-9,000</td> <td>&gt;9,000</td> </tr> </tbody> </table> <p>The overall impact is estimated to be 'moderate positive' as per the arbitrary employment impact table above.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	Employment Impact Categories (DNV GL)						Effect	None /Insignificant	Small positive	Small – moderate positive	Moderate positive	Large	Man-Years	0-400	400-1,000	1,000-3,000	3,000-9,000	>9,000	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: 'Moderate positive'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 
Employment Impact Categories (DNV GL)																			
Effect	None /Insignificant	Small positive	Small – moderate positive	Moderate positive	Large														
Man-Years	0-400	400-1,000	1,000-3,000	3,000-9,000	>9,000														



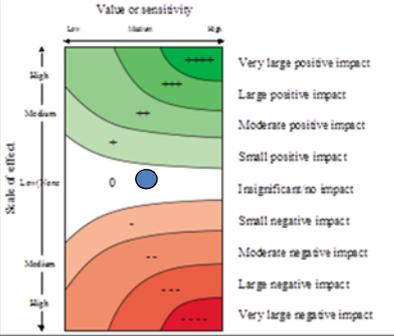
# GBS CELL CONTENTS- Employment

<p><b>2. Description of the scale of effect</b>  <b>Option 4: Leave <i>in situ</i> and treat with MNA</b></p>	<p><b>3. Total (environmental) impact</b></p>																		
<p>Shell commissioned an independent report to estimate the employment generated by the BDP. As part of this study, a factor was derived for the Brent project of £250,000 per new job per year. This factor was then applied by Shell to estimate the employment generated for each of the decommissioning options.                  Shell estimates that GBS cell contents Option 4 will generate 728 man-years of work.</p> <table border="1"> <thead> <tr> <th colspan="6">Employment Impact Categories (DNV GL)</th> </tr> <tr> <th>Effect</th> <th>None /Insignificant</th> <th>Small positive</th> <th>Small – moderate positive</th> <th>Moderate positive</th> <th>Large</th> </tr> </thead> <tbody> <tr> <td>Man-Years</td> <td>0-400</td> <td>400-1,000</td> <td>1,000-3,000</td> <td>3,000-9,000</td> <td>&gt;9,000</td> </tr> </tbody> </table> <p>The overall impact is estimated to be ‘small positive’ as per the arbitrary employment impact table above.</p> <p><b>Evaluation of scale of effect:</b>                  High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- -----   <span style="margin-left: 300px;">X</span></p>	Employment Impact Categories (DNV GL)						Effect	None /Insignificant	Small positive	Small – moderate positive	Moderate positive	Large	Man-Years	0-400	400-1,000	1,000-3,000	3,000-9,000	>9,000	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 4: ‘Small positive’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 
Employment Impact Categories (DNV GL)																			
Effect	None /Insignificant	Small positive	Small – moderate positive	Moderate positive	Large														
Man-Years	0-400	400-1,000	1,000-3,000	3,000-9,000	>9,000														
<p><b>2. Description of the scale of effect</b>  <b>Option 5: Leave <i>in situ</i></b></p>	<p><b>3. Total (environmental) impact</b></p>																		
<p>Shell commissioned an independent report to estimate the employment generated by the BDP. As part of this study, a factor was derived for the Brent project of £250,000 per new job per year. This factor was then applied by Shell to estimate the employment generated for each of the decommissioning options.                  Shell estimates that GBS cell contents Option 5 will generate 33 man-years of work.</p> <table border="1"> <thead> <tr> <th colspan="6">Employment Impact Categories (DNV GL)</th> </tr> <tr> <th>Effect</th> <th>None /Insignificant</th> <th>Small positive</th> <th>Small – moderate positive</th> <th>Moderate positive</th> <th>Large</th> </tr> </thead> <tbody> <tr> <td>Man-Years</td> <td>0-400</td> <td>400-1,000</td> <td>1,000-3,000</td> <td>3,000-9,000</td> <td>&gt;9,000</td> </tr> </tbody> </table> <p>The overall impact is estimated to be ‘insignificant’ as per the arbitrary employment impact table above.</p> <p><b>Evaluation of scale of effect:</b>                  High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- -----   <span style="margin-left: 300px;">X</span></p>	Employment Impact Categories (DNV GL)						Effect	None /Insignificant	Small positive	Small – moderate positive	Moderate positive	Large	Man-Years	0-400	400-1,000	1,000-3,000	3,000-9,000	>9,000	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 5: ‘Insignificant’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 
Employment Impact Categories (DNV GL)																			
Effect	None /Insignificant	Small positive	Small – moderate positive	Moderate positive	Large														
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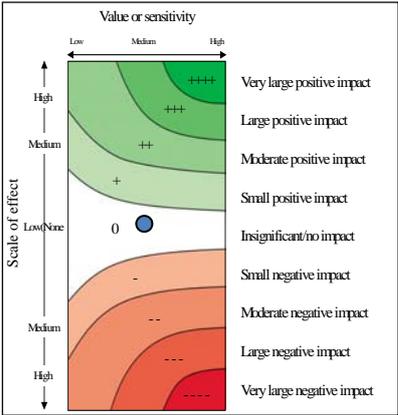
## GBS DRILLING LEG MATERIAL – Employment

2. Description of the scale of effect Options 1, 2, 3, 4, 5	3. Total (environmental) impact																		
<p>For the GBS Brent B and D drilling legs material, 5 decommissioning options are considered:</p> <p>Option 1: Mobilise and re-inject in a ‘new’ drilled subsea well away from site            Option 2: Mobilise and retrieve to vessel and dispose onshore.            Option 3: Cap or cover <i>in situ</i> using sand and coarse gravel.            Option 4: Leave <i>in situ</i> and improve natural biodegradation by adding chemicals (Monitored Natural Attenuation, MNA)            Option 5: Leave <i>in situ</i></p> <p>Note for Options 1,2,3 and 4 there are further sub-options considered:</p> <ul style="list-style-type: none"> <li>Options 1a, 2a, 3a, 4a: these options are applicable to GBS Brent B only, with Brent B topsides in place and used to facilitate access to the drilling legs.</li> <li>Options 1b, 2b, 3b, 4b: these options are applicable to both GBS Brent B and D (post-topsides removal) so access to the drilling legs will be from a SSCV.</li> </ul> <p>Options 1b-4b generate more employment than Options 1a-4a (which all have ‘insignificant’ employment benefit), and therefore the man-years for Options 1b-4b are presented below.</p> <p>Shell commissioned an independent report to estimate the employment generated by the BDP. As part of this study, a factor was derived for the Brent project of £250,000 per new job per year. This factor was then applied by Shell to estimate the employment generated for each of the decommissioning options.</p> <p><b>Option 1b:</b>            Shell estimates that GBS drilling legs Option 1b will generate 1,219 man-years of work. A ‘small-moderate positive’ employment impact is estimated.</p> <p><b>Option 2b:</b>            Shell estimates that GBS drilling legs Option 2b will generate 758 man-years of work. A ‘small positive’ employment impact is estimated.</p> <p><b>Option 3b:</b>            Shell estimates that GBS drilling legs Option 3b will generate 291 man-years of work. An ‘insignificant’ employment impact.</p> <p><b>Option 4b:</b>            Shell estimates that GBS drilling legs Option 4b will generate 309 man-years of work. An ‘insignificant’ employment impact.</p> <p><b>Option 5:</b>            This option is not expected to generate any employment as there are no operations.</p>	<p>1) and 2) are combined in the impact matrix.</p> <p><b>Option 1: ‘Small-moderate positive’</b>  <b>Option 2: ‘Small positive’</b>  <b>Options 3-5: ‘Insignificant’ or ‘No impact’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p> 																		
<table border="1"> <thead> <tr> <th colspan="6">Employment Impact Categories (DNV GL)</th> </tr> <tr> <th>Effect</th> <th>None /Insignificant</th> <th>Small positive</th> <th>Small – moderate positive</th> <th>Moderate positive</th> <th>Large</th> </tr> </thead> <tbody> <tr> <td>Man-Years</td> <td>0-400</td> <td>400-1,000</td> <td>1,000-3,000</td> <td>3,000-9,000</td> <td>&gt;9,000</td> </tr> </tbody> </table> <p><b>Evaluation of scale of effect:</b>            High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X<sub>3,4,5</sub> X<sub>1,2</sub></p>		Employment Impact Categories (DNV GL)						Effect	None /Insignificant	Small positive	Small – moderate positive	Moderate positive	Large	Man-Years	0-400	400-1,000	1,000-3,000	3,000-9,000	>9,000
Employment Impact Categories (DNV GL)																			
Effect	None /Insignificant	Small positive	Small – moderate positive	Moderate positive	Large														
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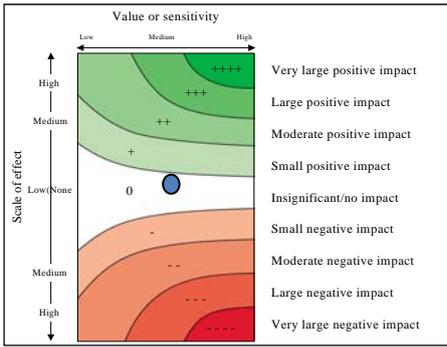
## GBS MINICELL ANNULUS MATERIAL – Employment

2. Description of the scale of effect Options 1, 2, 3, 4, 5	3. Total (environmental) impact																		
<p>For the GBS Brent B and D drilling legs material, 5 decommissioning options are considered:</p> <p>Option 1: Mobilise and re-inject in a ‘new’ drilled subsea well away from site            Option 2: Mobilise and retrieve to vessel and dispose onshore.            Option 3: Cap or cover <i>in situ</i> using sand and coarse gravel.            Option 4: Leave <i>in situ</i> and improve natural biodegradation by adding chemicals (Monitored Natural Attenuation, MNA)            Option 5: Leave <i>in situ</i> for natural biodegradation</p> <p>Shell commissioned an independent report to estimate the employment generated by the BDP. As part of this study, a factor was derived for the Brent project of £250,000 per new job per year. This factor was then applied by Shell to estimate the employment generated for each of the decommissioning options.</p> <p>Option 1:            Shell estimates that GBS minicell annulus Option 1 will generate 335 man-years of work. An ‘insignificant’ employment impact.</p> <p>Option 2:            Shell estimates that GBS minicell annulus Option 2 will generate 124 man-years of work. An ‘insignificant’ employment impact.</p> <p>Option 3:            Shell estimates that GBS minicell annulus Option 3 will generate 107 man-years of work. An ‘insignificant’ employment impact.</p> <p>Option 4:            Shell estimates that GBS minicell annulus Option 4 will generate 99 man-years of work. An ‘insignificant’ employment impact.</p> <p>Option 5:            This option is not expected to generate any employment as there are no operations associated with this option.</p>	<p>1) and 2) are combined in the impact matrix.</p> <p><b>Options 1-5: ‘Insignificant’ or ‘No impact’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p>																		
<table border="1"> <thead> <tr> <th colspan="6">Employment Impact Categories (DNV GL)</th> </tr> <tr> <th>Effect</th> <th>None /Insignificant</th> <th>Small positive</th> <th>Small – moderate positive</th> <th>Moderate positive</th> <th>Large</th> </tr> </thead> <tbody> <tr> <td>Man-Years</td> <td>0-400</td> <td>400-1,000</td> <td>1,000-3,000</td> <td>3,000-9,000</td> <td>&gt;9,000</td> </tr> </tbody> </table> <p><b>Evaluation of scale of effect:</b>            High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X<sub>1-5</sub></p>	Employment Impact Categories (DNV GL)						Effect	None /Insignificant	Small positive	Small – moderate positive	Moderate positive	Large	Man-Years	0-400	400-1,000	1,000-3,000	3,000-9,000	>9,000	
Employment Impact Categories (DNV GL)																			
Effect	None /Insignificant	Small positive	Small – moderate positive	Moderate positive	Large														
Man-Years	0-400	400-1,000	1,000-3,000	3,000-9,000	>9,000														

## SEABED DRILL CUTTINGS - Employment

2. Description of the scale of effect	3. Total (environmental) impact																		
<p><b>Option 1: Leave in Place</b></p> <p>Shell commissioned an independent report to estimate the employment generated by the BDP. As part of this study, a factor was derived for the Brent project of £250,000 per new job per year. This factor was then applied by Shell to estimate the employment generated for each of the decommissioning options.</p> <p>Shell estimates that leaving the Brent A seabed drill cuttings <i>in situ</i> will generate 15 man-years of work. There will be very little activity in this option, with only some monitoring of the seabed.</p> <table border="1"> <thead> <tr> <th colspan="6">Employment Impact Categories (DNV GL)</th> </tr> <tr> <th>Effect</th> <th>None /Insignificant</th> <th>Small positive</th> <th>Small – moderate positive</th> <th>Moderate positive</th> <th>Large</th> </tr> </thead> <tbody> <tr> <td>Man-Years</td> <td>0-400</td> <td>400-1,000</td> <td>1,000-3,000</td> <td>3,000-9,000</td> <td>&gt;9,000</td> </tr> </tbody> </table> <p>The overall impact is estimated to be ‘insignificant’ as per the arbitrary employment impact table above.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	Employment Impact Categories (DNV GL)						Effect	None /Insignificant	Small positive	Small – moderate positive	Moderate positive	Large	Man-Years	0-400	400-1,000	1,000-3,000	3,000-9,000	>9,000	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: ‘Insignificant’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 
Employment Impact Categories (DNV GL)																			
Effect	None /Insignificant	Small positive	Small – moderate positive	Moderate positive	Large														
Man-Years	0-400	400-1,000	1,000-3,000	3,000-9,000	>9,000														

## BRENT A SEABED DRILL CUTTINGS – Employment

2A. Description of the scale of effect Category: Brent A Seabed Drill Cuttings: Options 1, 2, 3, 4	3A. Total (environmental) impact												
<p>Shell commissioned an independent report to estimate the employment generated by the BDP. As part of this study, a factor was derived for the Brent project of £250,000 per new job per year. This factor was then applied by Shell to estimate the employment generated for each of the decommissioning options.</p> <p>There options to decommission the Brent A seabed drill cuttings are presented in turn below.</p> <p>Option 1: Shell estimates that Brent A seabed drill cuttings Option 1 will generate 230 man-years of work. An ‘insignificant’ employment impact.</p> <p>Option 2: Shell estimates that Brent A seabed drill cuttings Option 2 will generate 88 man-years of work. An ‘insignificant’ employment impact.</p> <p>Option 3: Shell estimates that Brent A seabed drill cuttings Option 3 will generate 145 man-years of work. An ‘insignificant’ employment impact.</p> <p>Option 4: Shell estimates that Brent A seabed drill cuttings Option 4 will generate 208 man-years of work. An ‘insignificant’ employment impact.</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Options 1-4: ‘Insignificant’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p> 												
<b>Employment Impact Categories (DNV GL)</b>													
<table border="1"> <thead> <tr> <th>Effect</th> <th>None /Insignificant</th> <th>Small positive</th> <th>Small – moderate positive</th> <th>Moderate positive</th> <th>Large</th> </tr> </thead> <tbody> <tr> <td>Man-Years</td> <td>0-400</td> <td>400-1,000</td> <td>1,000-3,000</td> <td>3,000-9,000</td> <td>&gt;9,000</td> </tr> </tbody> </table>		Effect	None /Insignificant	Small positive	Small – moderate positive	Moderate positive	Large	Man-Years	0-400	400-1,000	1,000-3,000	3,000-9,000	>9,000
Effect	None /Insignificant	Small positive	Small – moderate positive	Moderate positive	Large								
Man-Years	0-400	400-1,000	1,000-3,000	3,000-9,000	>9,000								
<p>The overall impact is estimated to be ‘insignificant’ as per the arbitrary employment impact table above.</p>													
<p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X<sub>1-4</sub></p>													

## CELL TOP DRILL CUTTINGS - Employment

### 2. Description of the scale of effect

**Category: GBS Cell Top Drill Cuttings: Options 1, 2, 3, 4, 5, 6**

Shell commissioned an independent report to estimate the employment generated by the BDP. As part of this study, a factor was derived for the Brent project of £250,000 per new job per year. This factor was then applied by Shell to estimate the employment generated for each of the decommissioning options.

For the GBS cell top drill cuttings, 6 decommissioning options are considered, and each is considered in turn below.

#### Option 1:

Under Option 1, a small volume of drill cuttings would be water jetted from the cell tops of the GBS, approximately 60 m<sup>3</sup> total for Brent B and D. Shell estimates that GBS cell top drill cuttings Option 1 will generate 3 man-years of work. An 'insignificant' employment impact.

Under Options 2-5, a total of about 13,400 m<sup>3</sup> of cell top drill cuttings would require dredging from all 3 GBS (a total of approximately 134,000 m<sup>3</sup> of slurry would be generated), in addition to offshore and onshore processing time for each option respectively.

#### Option 2:

Shell estimates that GBS cell top drill cuttings Option 2 will generate 396 man-years of work. An 'insignificant' employment impact.

#### Option 3:

Shell estimates that GBS cell top drill cuttings Option 3 will generate 221 man-years of work. An 'insignificant' employment impact.

#### Option 4:

Shell estimates that GBS cell top drill cuttings Option 4 will generate 302 man-years of work. An 'insignificant' employment impact.

#### Option 5:

Shell estimates that GBS cell top drill cuttings Option 4 will generate 436 man-years of work. An 'insignificant' employment impact.

#### Option 6:

The cell top drill cuttings would remain *in situ* under Option 6, therefore this option is not expected to generate any significant employment as there are very few operations (except for post-decommissioning monitoring). Shell estimates that Option 6 will generate 15 man-years of work, an 'insignificant' employment impact.

#### Employment Impact Categories (DNV GL)

Effect	None /Insignificant	Small positive	Small – moderate positive	Moderate positive	Large
Man-Years	0-400	400-1,000	1,000-3,000	3,000-9,000	>9,000

#### Evaluation of scale of effect:

High neg.    Medium neg.    Low/none    Medium pos.    High pos.

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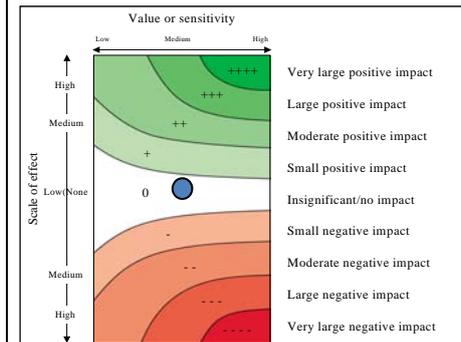
X<sub>1-6</sub>

### 3. Total (environmental) impact

1) and 2) are combined in the impact matrix.

#### Options 1-6: 'Insignificant'

The uncertainty of the total impact is highlighted by the size of the circles/ellipses.

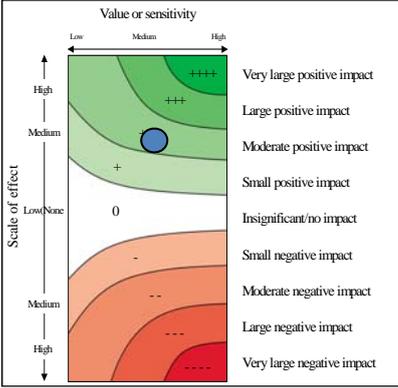


## TRI-CELLS DRILL CUTTINGS - Employment

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 1: Leave <i>in situ</i></b></p> <p>There will be no activity for this option as the tri-cell drill cuttings will be left <i>in situ</i>, therefore, this option is estimated to have 'no impact' on employment.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: 'No impact'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p style="font-size: small; margin-top: 5px;">             Value or sensitivity: Low, Medium, High              Scale of effect: High, Medium, Low/None, High              Legend:              ++++ Very large positive impact              +++ Large positive impact              ++ Moderate positive impact              + Small positive impact              0 Insignificant/no impact              - Small negative impact              -- Moderate negative impact              --- Large negative impact              ---- Very large negative impact           </p> </div>



## WELLS - Employment

2. Description of the scale of effect Option 1: Plugging and Abandonment	3. Total (environmental) impact																		
<p>Shell commissioned an independent report to estimate the employment generated by the BDP. As part of this study, a factor was derived for the Brent project of £250,000 per new job per year. This factor was then applied by Shell to estimate the employment generated for each of the decommissioning options.</p> <p>Shell estimates that P&amp;A of the wells will generate 3,841 man-years of work. There will be indirect employment benefits for the supply chain and, depending on the location of any onshore disposal activities, a benefit to the local community.</p> <p>The P&amp;A of wells contributes the largest employment impact of the BDP.</p> <table border="1"> <thead> <tr> <th colspan="6">Employment Impact Categories (DNV GL)</th> </tr> <tr> <th>Effect</th> <th>None /Insignificant</th> <th>Small positive</th> <th>Small – moderate positive</th> <th>Moderate positive</th> <th>Large</th> </tr> </thead> <tbody> <tr> <td>Man-Years</td> <td>0-400</td> <td>400-1,000</td> <td>1,000-3,000</td> <td>3,000-9,000</td> <td>&gt;9,000</td> </tr> </tbody> </table> <p>The overall impact is estimated to be 'moderate positive' as per the arbitrary employment impact table above.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	Employment Impact Categories (DNV GL)						Effect	None /Insignificant	Small positive	Small – moderate positive	Moderate positive	Large	Man-Years	0-400	400-1,000	1,000-3,000	3,000-9,000	>9,000	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: 'Moderate positive'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle\ellipse.</p> 
Employment Impact Categories (DNV GL)																			
Effect	None /Insignificant	Small positive	Small – moderate positive	Moderate positive	Large														
Man-Years	0-400	400-1,000	1,000-3,000	3,000-9,000	>9,000														

<sup>1</sup> Oil and Gas UK, *Economic Report 2016*. Website: <http://oilandgasuk.co.uk/product/economic-report-2016/> <Accessed October 2016>.



## 1.9 LEGACY IMPACTS

**Category: Topsides/Jacket/GBS/Attic Oil/Cell Contents/Drilling Legs and Minicell Annulus/Drill Cuttings/Subsea Structures & Debris/Wells**

**Consequence evaluation for: Legacy Impacts**

### 1. General description of the receiving environment (situation and characteristics)

For 'Legacy' the key items of interest are marine, fisheries and shipping. The sensitivity of the area is considered to be 'low-medium' because:

- The marine environment in the Brent Field is typical of the Northern North Sea and contains no unique species of particular conservation concern. See 'Marine' matrices for more information.
- Compared to other North Sea areas, the Brent Field area does not have a high commercial fishing value. See 'Fisheries' matrices for more information.
- There are relatively low numbers of vessels using shipping routes near the Brent platform. See 'Shipping' matrices for more information.

The legacy assessments have been conducted on the basis that this situation remains similar in the future.

#### Evaluation of value:

Low Medium High

|-----|-----|

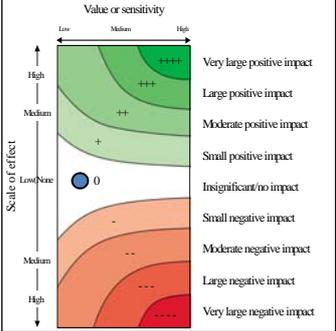
X

## TOPSIDES - Legacy

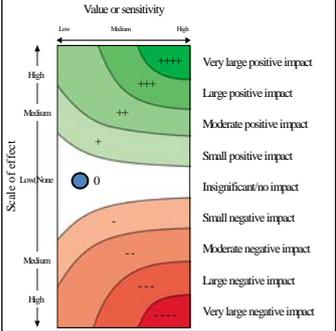
2. Description of the scale of effect Topsides: Option 1 – Complete Removal	3. Total (environmental) impact
<p>Topsides will be completely removed by SLV. There will be no legacy impacts. Waste has been assessed within the 'Waste' and 'Hazardous Substances' matrices.</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: No impact</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> <div style="border: 1px solid black; padding: 5px;"> <p style="text-align: center;">Value or sensitivity</p> <p style="text-align: center;">Low      Medium      High</p> <p style="text-align: center;">Scale of effect</p> <p style="text-align: center;">High</p> <p style="text-align: center;">Medium</p> <p style="text-align: center;">Low/None</p> <p style="text-align: center;">0</p> <p style="text-align: center;">Medium</p> <p style="text-align: center;">High</p> <ul style="list-style-type: none"> <li>++++ Very large positive impact</li> <li>+++ Large positive impact</li> <li>++ Moderate positive impact</li> <li>+ Small positive impact</li> <li>0 Insignificant/no impact</li> <li>- Small negative impact</li> <li>-- Moderate negative impact</li> <li>--- Large negative impact</li> <li>---- Very large negative impact</li> </ul> </div>



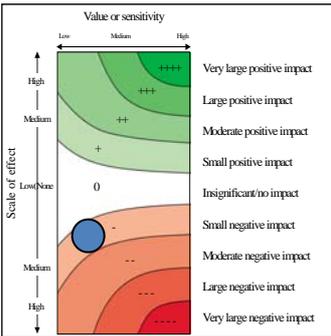
# BRENT A JACKET FOOTINGS – Legacy

<b>2. Description of the scale of effect</b> <b>Option 1: Complete removal by SSCV in several pieces, after cuttings the piles externally</b>	<b>3. Total (environmental) impact</b>
<p>The jacket footings will be completely removed under Option 1, so they will not present any legacy impact to fisheries, as they will no longer present an obstruction.</p> <p>However, to enable the jacket piles to be cut externally to permit the removal of the jacket, the drill cuttings and the seabed sediment would need to be removed. The effect of removing the drill cutting pile at Brent A is covered under ‘drill cuttings’, so only the excavation of the clean seabed sediment is assessed here. After dredging the entire Brent A drill cuttings pile, the clean seabed sediment would be excavated around the legs to expose the jacket footings, to enable cutting the piles below the sea floor. A pit would have to be excavated around each leg in turn to gain access for cutting the piles; Shell estimate that each pit would be approximately 4 m deep and 42 m diameter. This would result in the excavation of some 25,175 m<sup>3</sup> of natural seabed sediment in total and, essentially the removal of a 4 m thick layer of the seabed sediment from within the whole footprint of the jacket.</p> <p>Shell assumes that the first 25 cm of seabed sediment is contaminated by the drill cuttings, and will remove this portion (approximately 1,425 m<sup>3</sup>) with the drill cuttings above it when dredging. The remaining 23,750 m<sup>3</sup> will be dredged but not recovered, and will be discharged to adjacent seabed areas or preferably used to back-fill the preceding pit to provide the required 3 m burial over the tops of the cut steel piles. This will likely result in a residual part-filled excavation at the jacket footprint, plus some adjacent heaps of relocated seabed sediment (perhaps reaching up to 1 m high).</p> <p>The excavation and the heaps of clean sediment have potential to cause problems to fishing gear. The pit will naturally re-fill but it will take years, and similarly the ‘heaps’ will slowly degrade but again over years, resulting in a small-moderate negative impact owing to the potential long term impact upon fishermen. To minimise the impact (if this option is selected) an over-trawl survey would be conducted and the heaps should be monitored to ensure that levels do not exceed 1m in height.</p> <p>There are thus two activities which are generating impacts in opposite directions: removing the physical structure of the jacket will remove the legacy impact, while the negative effect of excavating the seabed will gradually diminish over time. As the first impact has greater certainty and is a long-term impact, and the second is uncertain and is a more medium-term impact (and can also be mitigated as suggested above), only the dominant and long-term legacy impact is considered in this matrix. Therefore, legacy is estimated to have ‘no impact’. Short-term marine impacts are presented in ‘Marine’.</p> <p><b>Evaluation of scale of effect:</b>            High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- -----             X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: ‘No impact’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle\ellipse.</p> 

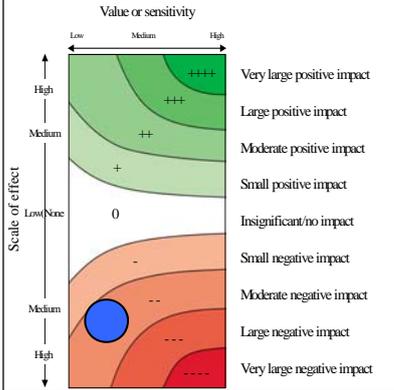
## BRENT A JACKET FOOTINGS - Legacy

<b>2. Description of the scale of effect</b> <b>Option 2: Complete removal by SSCV in several pieces, after cutting the piles internally</b>	<b>3. Total (environmental) impact</b>
<p>There is no legacy impact, because the Brent A jacket is completely removed, and there is no excavation of the drill cutting piles (as in Option 1).</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 2: ‘No impact’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle\ellipse.</p> 

## BRENT A JACKET FOOTINGS - Legacy

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 3: Leave <i>in situ</i></b></p> <p>Under this option, the jacket footings will remain in place, and can result in legacy impacts to fisheries and the marine environment.</p> <p>Shell's earliest estimated prediction [1] of the collapse of the lighter external jacket elements such as the bracings is approximately 30 - 40 years. The main legs, nodes and pontoon legs would last much longer, even after the loss of the structural support provided by the lighter members, and it might take up to 250 years before the main legs start to collapse. Parts of the foundation piles may remain protruding from the seabed for more than 500 years.</p> <p>The long-term consequences for the fisheries in the Brent area are difficult to predict, because they are dependent on how the fisheries in this area will develop in the future. However, assuming that in the future the fishery is comparable to today, the legacy impact on fishermen will continue as present, and as such leaving the jacket footings in place is estimated to have a 'small negative' scale of effect on the fisheries. The jacket steel substructure, footings and anodes will eventually degrade and corrode, creating "litter" on the seabed, which will restrict trawling in the area for hundreds of years. However, the value of the catch is assumed to only increase (if the Brent facilities were completely removed) by 0.1% of the projected annual catch of £7 million per year, which would only be approximately £7,000 per year [2]. Hence the socio-economic impact upon fisheries is small.</p> <p>It should be noted that this EIA does not examine safety risks to fishermen, which were studied by Anatec [3], which examined potential fishing gear interactions with Brent A steel jacket footings. It concluded that the risk to pelagic fishing gear (mackerel catch) will decrease over time as the lower part of the jacket collapses. The majority of the safety risk is from demersal trawling gear that sweeps the seabed. This risk may deter fishing in the area even if the Safety Zone is removed; hence there would be the same small socio-economic impact as described in the paragraph above.</p> <p>Also, over time the decommissioned structure may attract fish, a positive socioeconomic impact, and attract fishing vessels. This is not considered so great that it changes the small negative impact allocated above.</p> <p>Degradation of the jacket will also have some environmental impact upon benthic organisms; however as most of the jacket structure is inert in nature this is expected to be a limited and localised impact. There will be numerous small disturbances from the small, light items falling onto the drill cuttings pile (e.g. bracings), and infrequent larger disturbances caused by the impact of a large jacket items falling onto the pile. Disturbances will be spaced out over a long period of some 500 years, with significant gaps between disturbances. Each disturbance would impact the local water-column, and a thin new layer of re-settled cuttings will impact the local benthos (which is not unique in nature). This impact would not have any noticeable effect on populations; DNV GL considers it a small negative impact.</p> <p>Also, as anodes are designed to corrode within the marine environment, impacts will be no different than if the structure remained operating with anodes in place – i.e. negligible.</p> <p>The overall legacy impact as a result of the partial removal of the Brent A jacket footings in Option 3 is estimated to be 'small negative', with the small negative commercial impact upon fisheries and the small negative impact upon the marine environment from the collapse of the jacket footings being the main contributors.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 3: 'Small negative'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle\ellipse.</p> 

# GBS – Legacy

<p><b>2. Description of the scale of effect</b></p> <p><b>Option 1: Remove legs in one piece down to approx. -55 m LAT</b></p>	<p><b>3. Total (environmental) impact</b></p>
<p>In Option 1 the GBS legs will be partially removed. Removing the legs will give -55 m clear water depth below LAT, permitting surface navigation, which is beneficial to shipping. However, if there is a continuation of the safety zone for the purposes of protecting fishing vessels (see below), then ships will also be restricted.</p> <p>The remaining leg sections will start to degrade approximately 1,000 years after decommissioning, after which the legs are assumed to degrade linearly from their initial height to the height of the caissons between 1,000 to 3,000 years.</p> <p>There will thus remain a legacy impact to fishermen because the GBS will still present an obstacle to fishing as well as an increased risk of fishing vessel gear snagging on the legs (as the GBS are no longer visible), both in the short-term and in the long-term after collapse of the structures. The long-term consequences for the fisheries in the Brent area are difficult to predict, because they are dependent on how the fisheries in this area will develop in the future. Assuming that in the future, the fishery will be present to a comparable extent as it is today, leaving the concrete substructures in place is estimated to have a small impact on the fisheries, as although it restricts trawling for hundreds of years, the value of the catch is assumed to only increase (if the Brent facilities were completely removed) by 0.1% of the projected annual catch of £7 million pa, which is only approximately £7,000 pa [2]. However, currently the exclusion zone in the Brent area affects trawling fisheries. This is because trawl vessels begin deflection manoeuvres very early to avoid moving into the exclusion area, which implies that an area larger than the actual exclusion zone is unavailable, but the socioeconomic impact remains small. Leaving the substructures in place will, in the long-term perspective, imply a continued occupation of the area. This is because Shell will apply for a continuation of the safety zone for the purposes of protecting fishing vessels. This is following an assessment by Anatec to quantify the safety risk to fishermen due to the long-term presence and slow deterioration of the GBS [4]. If the safety zones were removed immediately after decommissioning, this would increase the risk of fishing gear snagging on the legs by 54% (Anatec) [4].</p> <p>It should be noted that smaller vessels fishing with net gear operating in the surface layers would not necessarily be completely hindered by the presence of the remaining parts of the GBS structure (while trawling vessels would be completely hindered). But with the continuation of the safety zone, all fishing vessels would be excluded.</p> <p>When the remaining GBS substructures finally collapse onto the seabed, they will represent a reef-like solid substrata in a homogenous area of sand, and attract the settlement of hard-bottom species of organisms (accepting that concrete is less attractive than steel to such species). This constitutes a change in the natural environment where the debris falls away from the GBS, similar to a large shipwreck on the seafloor (although another perspective may see the settlement of hard-bottom species as positive). Additionally, the falling debris will disturb the marine environment.</p> <p>Overall the impact is estimated to be ‘moderate negative’ due to a combination of very long-term small restrictions to ships and fishing vessels, and localised impacts to the marine environment. This is a similar impact to Option 2, because although ships can pass safely over the GBS remains, they will not be permitted as Shell will apply for a continuation of the safety zone (to protect fishermen). Effectively, the legacy impact becomes much the same as Option 2.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg. Medium neg. Low/none Medium pos. High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p><b>Option 1: ‘Moderate negative’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle\ellipse.</p> 

## GBS – Legacy

2. Description of the scale of effect Option 2: Leave <i>in situ</i>	3. Total (environmental) impact
<p>The 3 GBS will remain in place for Option 2. The GBS legs are expected to remain largely intact for 250 years, when leg sections in the ‘splash zone’ will start to degrade and fall away. Submerged leg sections will remain largely intact until after approximately 750 years when they may become weaker. Degradation of the legs to the caisson is expected to occur after approximately 1,000 years.</p> <p>In accordance with UK regulations, the 500 m safety zones around the platforms must be retained until the structure no longer projects above the surface of the sea. At the time when the legs have degraded below sea level, Shell will apply to the regulator for a continuance of the 500 m safety zone for the purposes of protecting both shipping and fishing vessels.</p> <p>Option 2 will result in legacy impacts to shipping, fisheries and to the marine environment, as follows.</p> <ul style="list-style-type: none"> <li>• The long term consequences for the fisheries in the Brent area are difficult to predict, because it is dependent on how the fisheries in this area will develop in the future. However, assuming that in the future, the fishery will be present to a comparable extent as it is today, leaving the concrete substructures in place is estimated to have a ‘small negative’ impact on the fisheries, as although it restricts trawling for hundreds of years, the value of the catch is assumed to only increase (if the Brent facilities were completely removed) by 0.1% of the projected annual catch of £7 million per year, which would be only approximately £7,000 per year [2]. Today the 500 m exclusion zone around the Brent platforms affects trawling fisheries in particular. This is because trawl vessels have to begin deflection manoeuvres very early to avoid moving into the exclusion area, which implies that an area larger than the actual exclusion zone is unavailable. Leaving the substructures in place will, in the long-term perspective, imply a continued occupation of an area.</li> <li>• Note that safety risks to fishermen are not covered in this EIA, but are detailed within a report by Anatec, covering the PLL (Potential Loss of Life) risk at 3 different stages of the GBS timeline [4]. As the legs degrade, the risk from fishing gear snagging on the legs increases, because they become no longer visible. Fisherman (if permitted entry to the area) would need to use awareness charts, electronic plotters, sonar and FishSAFE (where fitted) to identify the proximity of the hidden subsea installations.</li> <li>• The free passage of ships in the area will be restricted for several hundred years due to the presence of the GBS substructures. Their mere presence will restrict larger vessels from passing the area nearby, and thereby exclude the full use of the area with associated small but long-term socioeconomic impact.</li> <li>• The presence of the GBS legs will also to some extent pose a risk for collisions with ships (and associated environmental risks due to oil spills), although the annual ship collision frequency results by Anatec [4] are below the historical average ship collision frequency for offshore installations on the UKCS. Although the safety zone would remain in place, unless there is 100% compliance with it, Option 2 would continue to present some risk of ship collision with the GBS legs, and this could potentially result in a major accident with associated environmental consequences. An analysis of the possibility of a major collision with the GBS legs was conducted [4] which estimated that a collision with a Brent structure would result in ten or more fatalities once every 1.1 million years. Although the study was safety-focussed, such a major collision could also potentially result in significant environmental consequences (e.g. oil spill). As such an event is very unlikely, the environmental risk is small.</li> <li>• A technical and environmental risk assessment by COWI [5] estimated the probability of 1.9 % for Technical Project Failure (TPF)<sup>1</sup> from the potential sinking of passing vessels due to collision with the GBS legs over the 250 year period after decommissioning. But the vast majority of this risk related to minor or moderate environmental impacts, and there was a zero probability of a severe impact. (contd)</li> </ul>	

<sup>1</sup> Technical Project Failure (TPF) indicates an incident not catered for by contingency planning and which requires significant reengineering or unrecoverable failure.

# GBS – Legacy

## 2. Description of the scale of effect

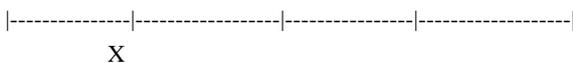
### Option 2: Leave *in situ* (contd.)

- As the installations will be left unmanned, there will be no human resources (and no ERRV (Emergency Response and Rescue Vessel) to warn any vessel on a collision course, as there is when in operation. The following mitigation measures will be implemented:
  - Adequate monitoring/ maintenance of the structures. Shell has confirmed that they will perform 4 structural monitoring surveys post-decommissioning, at 50, 150, 250 and 350 years' post decommissioning.
  - Suitable navigational aids and lights will be fitted to the GBS in line with guidance from BEIS and the lighthouse authority. The navigation aid will also transmit an AIS code. The installation of these items is part of the topsides programme of work, however their long-term maintenance and monitoring will fall under the GBS monitoring programme. When the GBS legs degrade near/ below sea level, the locations will be marked by buoys which transmit light. The buoys may also have enhanced primary radar reflectivity and/ or transmit codes to passing ships.
  - The continued existence of the safety zones, the marking of the new status of the 4 platforms on Admiralty Charts, the issuing of Notices to Mariners, and the inclusion of all platforms on the FishSAFE system as well as formal notifications to the UK Hydrographic Office and the Maritime and Coastguard Agency will all ensure that other users of the sea are notified and fully aware of the presence and condition of any residual platform material that remains within the field.
  - Periodic reviews will be carried out following decommissioning to monitor if the vessel activity changes are in-line with the Anatec study predictions.
  - The GBS structures will degrade over several hundred years, and mainly constitute an obstacle with a hard-bottom effect for local organisms. Once degraded, the structure on the seabed will represent a reef-like solid substrata in a homogenous area of sand, and attract the settlement of hard-bottom species of organisms. This constitutes a change in the natural environment where the debris falls away from the GBS, similar to a large shipwreck on the seafloor (although another perspective may see the settlement of hard-bottom species as positive). The Norwegian Institute of Marine Research noted (for another decommissioning study) [ 6 ] that after 35 years of operation, installations become part of the ecosystem. It is therefore their opinion that leaving concrete substructures in place will not significantly harm the fish resources or other marine fauna. This is also the view taken in a study conducted by Multiconsult for the Norwegian regulator [ 7 ]. However, it remains a habitat change, and additionally, the falling debris will disturb the marine environment.
  - This option will have a long-term visual impact upon shipping, fisheries and other passing vessels. The issue is not considered significant.
  - It should be noted that leaving the steel fittings and equipment inside the GBS legs may make it more difficult to cut and remove partially collapsed legs in the future, if or when it becomes necessary.

Overall the legacy impact is considered to be 'moderate negative' when taking into account the combined (and very long-term) small impacts to fisheries, shipping and the marine environment. The exposure of GBS cell contents after GBS degradation is considered in the 'Cell Contents' matrices. The disturbance of the cell top and seabed drill cuttings during GBS degradation is considered within the ES 'Cumulative Impacts'.

#### Evaluation of scale of effect as a combination of the above:

High neg.    Medium neg.    Low/none    Medium pos.    High pos.

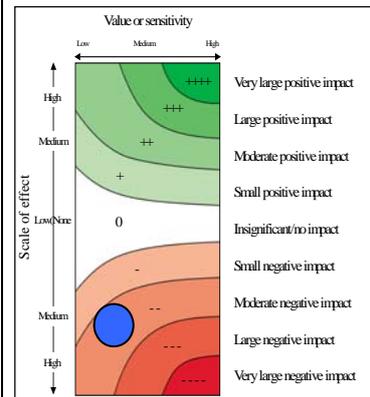


## 3. Total (environmental) impact

1) and 2) are combined in the impact matrix.

### Option 2: 'Moderate negative'

The uncertainty of the total impact is highlighted by the size of the circle\ellipse.



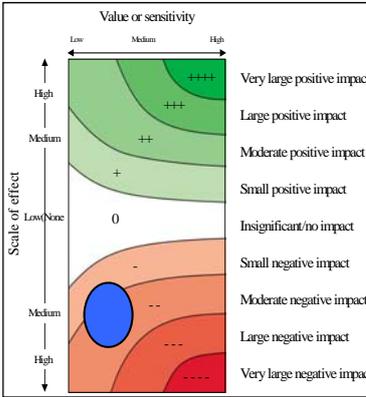








## GBS CELL CONTENTS – Legacy

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 4: Leave <i>in situ</i> in the cells and treat with MNA</b></p> <p>Legacy effects will be similar, but a little lower than, Option 5: leave <i>in situ</i> scenario, because MNA will speed up oil degradation in both water and sediment. However, the degree to which contaminants within the sediment are degraded has some limitations because only the top 20/30 cm are treated. But it is in the cell sediment where the vast majority of the pollutant load is located. If the sediment is 4 m thick, and if MNA is effective only on the top 20-30 cm, then MNA is only expected to reduce the impact to the marine environment by perhaps 10% compared against Option 5.</p> <p>The impact is considered small-moderate negative based on analytical results ('moderate negative' based on worst case modelling). Please refer to Option 5 for more detail.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p>----- ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 4: 'Small- moderate negative'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle\ellipse.</p>  <p>The diagram is a 2D matrix with 'Scale of effect' on the vertical axis (High, Medium, Low/None) and 'Value or sensitivity' on the horizontal axis (Low, Medium, High). The matrix is divided into nine impact levels: Very large positive impact (++++), Large positive impact (+++), Moderate positive impact (++) in the top-right quadrant; Insignificant/no impact (0) in the middle; Small positive impact (+) in the top-left quadrant; Small negative impact (-), Moderate negative impact (--), Large negative impact (---), and Very large negative impact (----) in the bottom half. A blue circle is drawn in the 'Moderate negative impact' region, centered around the intersection of 'Medium' sensitivity and 'Medium' scale of effect.</p>

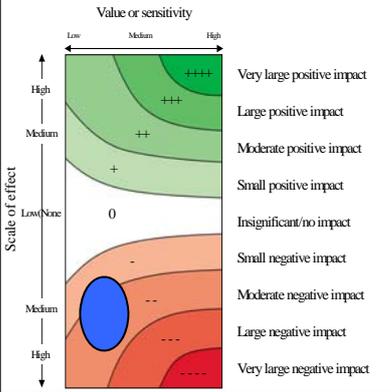
## GBS CELL CONTENTS – Legacy

2. Description of the scale of effect Option 5: Leave <i>in situ</i> in the cells	3. Total (environmental) impact
<p>The overall legacy impact as a result of GBS cell content decommissioning activities under Option 5 is estimated to be “small-moderate negative” based on the analytical results (‘moderate negative’ based on the initial worst case values modelled by BMT), due to the contributing factors discussed below.</p> <p><b>Initial Assessment of worst case impacts to the marine environment</b></p> <p>BMT Cordah modelled the exposure of 14 contaminants contained within the cell water (approximately 100,000 m<sup>3</sup> cell water) and cell sediment (up to 12,960 m<sup>3</sup>) from one GBS, should an accident occur following a collision or from collapse of the GBS legs, an unlikely worst case occurrence [8]. In reality, the GBS are more likely to degrade over a long period of time, resulting in a more gradual exposure of cell contents.</p> <p>Instantaneous release was modelled (i.e. the release event itself is not modelled), and concentrations of a range of 14 contaminants were predicted during a modelling period of 14 days. The results showed that maximum PEC exceeded the PNEC for many substances. The modelling was deliberately conservative, assuming, for example, high initial concentrations (e.g. in the worst case scenario, the oil content of the cell sediment was assumed to be more than 30%, three times greater than initially predicted and twice the average concentration identified in the CSP), instantaneous release and no biodegradation. Refinement of these assumptions is very likely to show that the impact is overstated by these results. Conversely, the total volume of cell water in the GBS is greater than that modelled; as is the volume of cell sediment in Brent B and D (Brent C is lower).</p> <p>DNV GL then conducted a semi-quantitative risk assessment [9] based on the modelling results produced by BMT Cordah for both cell water and cell sediment release.</p> <p>For the impact of a worst case 101,900 m<sup>3</sup> <b>cell water release</b> viewed in isolation, DNV GL considers that:</p> <ul style="list-style-type: none"> <li>• When taking into account the instability of hydrogen sulphide in alkaline environments such as seawater (pH 8.2), the acute impact from this toxic substance would likely be minor.</li> <li>• The modelled impact from copper, zinc and benzene also appear overly conservative because complexation of metals and biodegradation of benzene have not been considered. Hence acute impacts are expected to be minor.</li> <li>• Released amounts of bioaccumulating substances, mainly PCBs (1.2 kg released in worst case scenario) and mercury (0.2 kg released in worst case scenario) are too small to represent a threat to high trophic levels.</li> </ul> <p>For the impact of a worst case 12,960 m<sup>3</sup> release of <b>cell sediment release</b> only, DNV GL considers that:</p> <ul style="list-style-type: none"> <li>• The chemically impacted seabed area as a result of a worst case release event would reach up to 1.7 km<sup>2</sup> (Phenanthrene) at each platform 10 years after release (without considering biodegradation).</li> <li>• The area impacted from physical stressors: burial, altered grain size and oxygen depletion is estimated to be smaller than the chemically impacted area.</li> <li>• The biodegradation rates of most of the hydrocarbons released are expected to be relatively quick based on the modelled prediction that contaminated sediments will mostly form thin layers (&lt;1 cm) on the seafloor. For more complex hydrocarbons (particularly Benzo[a]pyrene), biodegradation will be slow, possibly decades, until non-toxic sediment concentrations are achieved. The impacted seafloor area is nevertheless too small to affect the regional benthic fauna.</li> </ul> <p>(Contd.)</p>	

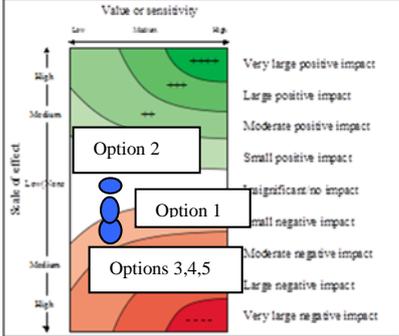
## GBS CELL CONTENTS – Legacy

2. Description of the scale of effect Option 5: Leave <i>in situ</i> in the cells (contd.)	3. Total (environmental) impact
<ul style="list-style-type: none"> <li>A potential concern from a cell sediment release is from bioaccumulating and prioritised substances which may give rise to delayed toxic effects in high trophic levels. The major portion of released mercury will accumulate in sediments where it will become susceptible to methylation and subsequent release to the water column. The rate of methylmercury release has not been modelled, however the released amount of mercury (261 kg in a worst case scenario) is not considered sufficient to have any measurable effects in high trophic levels including humans. Benzo[a]pyrene would be released in significant amounts in a worst case scenario (10.7 tonnes); however metabolism of this substance in vertebrates such as fish will hinder bioaccumulation in high trophic levels. Furthermore, benzo[a]pyrene has limited mobility and would largely remain adsorbed to the sediments on the seafloor.</li> </ul> <p><b>A combined release of cell water and sediment</b> would not significantly alter the total risk of assessed substances. The amount of bio-accumulating and persistent substances released with cell water, which are likely to accumulate in marine sediments, is small compared to what would be released with cell sediments. Leakage of hydrocarbons from sediment to the water column would be slow and the impact on water column resources would be very local.</p> <p><i>Updated assessment based on analytical samples of cell sediment from Brent D</i></p> <p>Analytical results of cell water and cell sediment samples show that, with the exception of THC and mercury in cell water, the actual concentrations of contaminants inside the GBS cells are lower than estimated and assessed, in many cases significantly lower. As a result, in the updated assessment the THC in cell water and sediments is likely to represent the largest potential impact from a major release of GBS cell content.</p> <ul style="list-style-type: none"> <li>The modelled impact reaches up to 17 km from the discharge point, lasting for up to 173 hours as a result of a worst case cell water release. A significant portion of the oil released with cell water is predicted to reach the sea surface where it could potentially impact seabirds, but assessment shows the (credible case) risk to seabirds to be negligible, and similarly that the environmental consequences for coastal habitats are negligible.</li> <li>For a worst case cell sediment release (scenario 14), the modelled impact from highest measured THC concentration in sediments after 1 year reaches 250 m from the discharge point (impact area 0.05 km<sup>2</sup>), a much smaller impact than predicted in the initial worst case studies discussed above.</li> </ul> <p>Impacts could be larger for a dynamic release of sediment (as opposed to a static release), and this is discussed in the main report.</p> <p>(contd.)</p>	

## GBS CELL CONTENTS – Legacy

2. Description of the scale of effect Option 5: Leave <i>in situ</i> in the cells (contd.)	3. Total (environmental) impact
<p><b>Conclusions</b></p> <p>In conclusion, based on modelling results and using estimates of released substance concentrations, a major release of cell water and sediment from a GBS will pollute the local environment but is not expected to induce any measurable effects on the regional level. Effects on water column resources would be restricted to acute and transient effects close to the release point. A major sediment release would result in an impacted area that is comparable to the area of seabed around each platform which is currently contaminated by historic drill cuttings (although this impacted area will likely have recovered by the time cell contents are released). The released amounts of persistent, bioaccumulating and toxic substances (PCBs, organic mercury, TBT, and to some extent B[a]P) have potential to biomagnify in marine food webs in theory, but results show that environmental impact is small owing to the relatively small amounts of bioaccumulating substances involved.</p> <p>It should be noted that there are three GBS that contain cell water and cell sediment, all of which will become exposed to the marine environment (at different times) in the long term future if they are left <i>in situ</i>. The cumulative impact from all three GBS (based on worst case modelling results) will be increased localised pollution and short-term acute effects (but most likely at different times), but there continues to be no expected measurable effects on the regional level. There will be some increased potential to bio-magnify in marine food webs in theory, but because the environmental impact remains small owing to the relatively small amounts of bioaccumulating substances involved, this is unlikely to have any measurable effects in high trophic levels including humans.</p> <p>DNV GL has also reviewed the literature on interacting effects from co-exposure to relevant contaminants but found no evidence for other effects than additive toxicity.</p> <p>Legacy impact after GBS degradation could also potentially result from NORM contamination present in the sediment. A study by ARPS [10] analysed the impact of a release of sediment containing NORM waste to the ocean floor. Both a fast release (lasting 1 year) and gradual release (lasting 250 years) were modelled using the UK Health Protection Agency assessment model. Results showed the maximum dose (to adults, children or infants) to be extremely low, approximately 5microSv/y or less. Hence the radiological impact of the release of sediment contaminated with waste would be very small to human health. In relation to impact upon the environment, the NORM levels of between 2-20 Bq in the sediment (based on a Brent Spar sediment sample) are typical of produced water in the oil and gas industry and would mostly only affect some sediment-dwelling organisms in the vicinity of the deteriorated GBS.</p> <p>Overall, the impact is estimated to be ‘small-moderate negative’ based on analytical results (‘moderate negative’ based on worst case modelling).</p> <p><b>Evaluation of the scale of effect</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p>----- ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 5: ‘Small - moderate negative’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

# GBS DRILLING LEG MATERIAL – Legacy

2. Description of the scale of effect Options 1, 2, 3, 4, 5	3. Total (environmental) impact
<p>For the GBS Brent B and D drilling legs material, 5 decommissioning options are considered:</p> <ul style="list-style-type: none"> <li>Option 1: Mobilise and re-inject in a ‘new’ drilled subsea well away from site</li> <li>Option 2. Mobilise and retrieve to vessel and dispose onshore.</li> <li>Option 3. Cap or cover in situ using sand and coarse gravel.</li> <li>Option 4. Leave in situ and improve natural biodegradation by adding chemicals. Monitored Natural Attenuation, MNA</li> <li>Option 5. Leave in situ for natural biodegradation</li> </ul> <p>Note for Options 1,2,3 and 4 there are further sub-options considered:</p> <ul style="list-style-type: none"> <li>Options 1a, 2a, 3a, 4a: these options are applicable to GBS Brent B only, with Brent B topsides in place and used to facilitate access to the drilling legs.</li> <li>Options 1b, 2b, 3b, 4b: these options are applicable to both GBS Brent B and D (post-topsides removal) so access to the drilling legs will be from a SSCV.</li> </ul> <p>But whichever combination of sub-options are selected, they would result in the same legacy impact, so the assessment below just refers to Options 1-5.</p> <p><b>Option1:</b> If this operation to remove the GBS drilling leg material and inject downhole is successful, and the drilling leg material remains within the well, then there will be no legacy impact. However, there is a small legacy risk that leakage could occur over time (leaks from wells do occur). Resulting impacts would be expected to be small and localised as leakage, if it happened, would likely take place over a long period of time, and be diluted. As the consequence would be small, and the likelihood of it happening small, the resulting risk is considered ‘insignificant-small’, provided the necessary engineering measures are implemented.</p> <p><b>Option 2:</b> For Option 2, as the material in the drilling legs is removed, the potential for offshore legacy impact to the marine environment is removed, hence no legacy impact. As the waste will only go to a licenced onshore facility such as a landfill, the onshore legacy impact will be effectively controlled and managed – this is addressed in ‘Waste’.</p> <p><b>Option 3:</b> Legacy effects will be similar to, but lower than, Option 5 because the cap over the legs will limit future exposure to the external marine environment after the GBS collapses. The effectiveness of the cap is difficult to predict particularly when the GBS starts to collapse and damage/disrupt the cap, so there is some uncertainty.</p> <p><b>Option4:</b> Legacy effects will be similar to, but lower than, Option 5 because MNA will speed up oil degradation.</p> <p><b>Option 5:</b> The release of contaminated material contained within the drilling legs of Brent B and D after the degradation of the GBS has potential for a negative legacy impact upon the marine environment. The materials in the drilling legs contain ~50 t of oil in total, which is only approximately 0.5% of the total oil load contained within the GBS cell contents. Hence the environmental impact upon exposure will be much lower (‘small negative’) than the GBS cell contents, with a much more localised and temporary impact upon benthic fauna. It is also possible that much of these oily materials will be prevented from entering the marine environment since they are located within the depths of the GBS such that when the GBS degrades over time, the oily contents may remain locked or buried under the GBS remains.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p>----- ----- ----- ----- ----- </p> <p style="text-align: center;">X3-5 X1 X2</p>	<p>1) and 2) are combined in the impact matrix.</p> <p><b>Option 1: ‘Insignificant - small negative’</b> <b>Option 2: ‘No impact’</b> <b>Option 3,4,5: ‘Small negative’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p> 



## DRILL CUTTINGS – Legacy

**Category: Seabed Drill Cuttings/Cell Top Drill Cuttings/Tri-cell drill cuttings**

**Consequence evaluation for: Legacy**

### 1. General description of the receiving environment (situation and characteristics)

The OSPAR 2006/5 criteria [11] must be met in order to leave the drill cuttings in place, i.e. where both the rate and persistence are below the threshold levels and no other discharges have contaminated the cuttings piles, they may be left *in situ* to degrade naturally. The OSPAR 2006/5 criteria consider:

- The rate of oil loss over time from each pile must be less than 10 tonnes per year;
- The persistence of the cuttings pile based on the area of the seabed where the concentration of oil in the sediment remains above 50 mg/kg compared to the threshold of 500 km<sup>2</sup>years.

Studies at the Brent Field have concluded that the five seabed drill cuttings piles are characterized to be below the OSPAR thresholds. These studies include laboratory experiments of the leaching potential of the hydrocarbons from the drill cuttings, the use of field survey data, and modelling of the fate of the piles. The volume of the seabed drill cuttings piles ranges from 2,230 m<sup>3</sup> at Brent D to 6,300 m<sup>3</sup> at Brent A, and the height of the piles ranges from 4 -11 m.

In the modelling, the amount of oil loss from the Brent A seabed pile was predicted to be between 0.4-3.8 tonnes per year, and the oil loss from the Brent C seabed pile was predicted to be 0.3-2.5 tonnes [12]. The modelled area persistence of Brent cuttings piles clearly indicates that the piles are well below the limit of 500 km<sup>2</sup>years. The Brent A pile (which is the largest seabed pile) had a persistence of 1.7-3.0 km<sup>2</sup>years after 1,000 years of degradation and the Brent C cell top cuttings 3.0-3.1 km<sup>2</sup>years after 1,000 years.

The seabed environment is fairly stable and it is not likely that any storms could create forces at the seabed that will significantly disturb the drill cuttings. However, reduction of the piles will occur over time and seabed mappings indicate a reduction of 40-60% over the last 20 years. Erosion due to natural causes is expected, but the GBS are likely to protect the piles from water current forces to some extent.

Drill cuttings are also located on the tops of the GBS cells. The volume of cell top drill cuttings ranges from 1,887 m<sup>3</sup> at Brent A to 7,735 m<sup>3</sup> at Brent C. Based on updated sampling of cuttings and modelling at Brent C cell top, the loss of oil exceeds the 10 tonne OSPAR threshold in the worst case scenario. As the cell top cuttings at Brent B and Brent D have significantly less volume and cover a significantly smaller area than Brent C, it is likely that the cell tops piles at Brent B and D satisfy the OSPAR 2006/5 thresholds.

Approximately 26,000 m<sup>3</sup> of tri-cell drill cuttings are found at Brent B and D as the cell tops are open to sea. There are no tri-cell drill cuttings at Brent C. Based on current knowledge; the tri-cell cuttings will stay relatively undisturbed until the GBS collapses. However, removal of the cell top cutting may increase leakage of pollutants from the tri-cells if they are exposed to the water column and not covered by top cell cuttings. The magnitude of leaking pollutants from the tri-cells is not known or modelled, but since the contact area to the water will be relatively small, loss of oil should be much less than for top cell cuttings. None of the decommissioning options for other Brent facilities will disturb the tri-cell cuttings and Shell believes that the Brent B and D tri-cell cuttings fall below the OSPAR thresholds, just like Brent B and D seabed and cell top drill cuttings. The loss of oil from cuttings is highest from newly exposed material and diminishes greatly over time when the surface concentration is reduced by loss to the water and degradation. When the GBS finally disintegrate and collapses the tri-cell cuttings will be partly covered by concrete and debris, but also disturbed and exposed to the marine environment.

The sensitivity of the area is considered 'low-medium' because of the relatively low environmental sensitivity of the area, the low number of vessels using shipping routes in close proximity to the Brent platforms and also because the Brent Field has a 'low-medium' value with respect to commercial fisheries. A description of the commercial fisheries in the vicinity of the Brent Field is provided in 'Fisheries', and a description of the benthic fauna is provided in 'Marine'.

### Evaluation of the value:

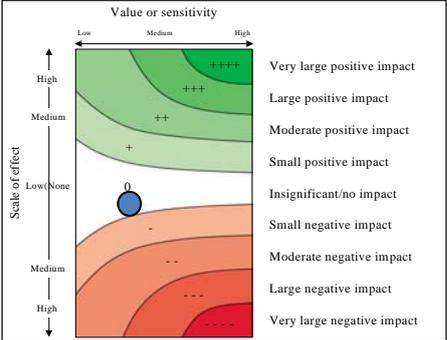
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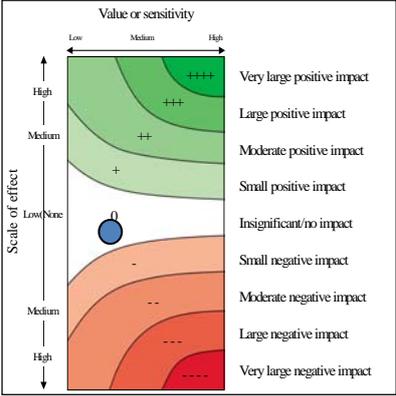
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## BRENT A SEABED DRILL CUTTINGS – Legacy

2A. Description of the scale of effect <b>Option 1: Dredge, transfer to Brent C topsides and treat and discharge water and solids to sea</b>	3A. Total (environmental) impact
<p>This option involves dredging approximately 8,000 m<sup>3</sup> (6,300 m<sup>3</sup> of drill cuttings and 1,425 m<sup>3</sup> of contaminated seabed) around the Brent A jacket and treating the slurry on the Brent C topsides. It is estimated that about 80,000 m<sup>3</sup> of slurry will be generated during the suction dredging (the cuttings to water ratio in the dredging operation is estimated to be 1:10).</p> <p>The short-term impact upon the marine environmental is considered within 'Marine'. The 10% of the drill cuttings, approximately 800 m<sup>3</sup>, that 'escape' the dredging process will settle eventually on the seabed and will have some potential for legacy impact, as they will remain in the marine environment.</p> <p>BMT's 2013 modelling [13] of the impacts from dredging indicated that the loss of oil was highest one year after the dredging (approximately 5.7 tonnes per year from Brent C seabed, and 4.6 tonnes per year at Brent A), and after ten years the loss of oil was reduced to 0.4 tonnes per year at Brent C seabed, and 0.01 tonnes/year at Brent A. All values fall below the OSPAR threshold for oil loss of 10 tonnes/year [11].</p> <p>The treated water and inert solids which are returned to the sea will have no legacy impacts. The operations and related discharges will have to be approved via permits.</p> <p>The legacy impact is therefore estimated to be 'insignificant'. Ultimately, the longer-term legacy impact (&gt;50 years) is 'no impact' owing to the beneficial effect of removing the majority of the seabed drill cuttings.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle\ellipse.</p>  <p>The diagram is a 2D matrix with 'Scale of effect' on the vertical axis (High, Medium, Low/None) and 'Value or sensitivity' on the horizontal axis (Low, Medium, High). The matrix is divided into seven impact levels, each with a corresponding color and symbol: Very large positive impact (++++, dark green), Large positive impact (+++, medium green), Moderate positive impact (++, light green), Small positive impact (+, pale green), Insignificant/no impact (0, blue circle), Small negative impact (--, light orange), Moderate negative impact (---, medium orange), Large negative impact (----, dark orange), and Very large negative impact (-----, red).</p>

## BRENT A SEABED DRILL CUTTINGS – Legacy

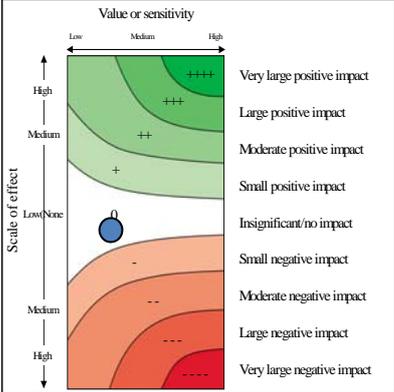
<b>2B. Description of the scale of effect</b> <b>Option 2: Dredge, transfer to vessel and transport slurry to shore for treatment and disposal</b>	<b>3B. Total (environmental) impact</b>
<p>Option 2 involves dredging approximately 8,000 m<sup>3</sup> (6,300 m<sup>3</sup> of drill cuttings and 1,425 m<sup>3</sup> of contaminated seabed) around the Brent A jacket and transferring to a vessel for transport to shore for treatment.</p> <p>Legacy impacts are very similar to those described in Option 1. As such the impact for Option 2 is considered to be 'insignificant'.</p> <p>It should be noted that the disposal of the slurry and solids will be at an approved and licensed onshore landfill. Also, the volumes disposed to landfill, after dewatering, will be relatively small (see 'Waste' matrices).</p> <p><b>Evaluation of scale of effect:</b>            High neg.    Medium neg.    Low/none    Medium pos.    High pos.             ----- ----- ----- -----   <span style="margin-left: 200px;">X</span></p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 2: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p> 



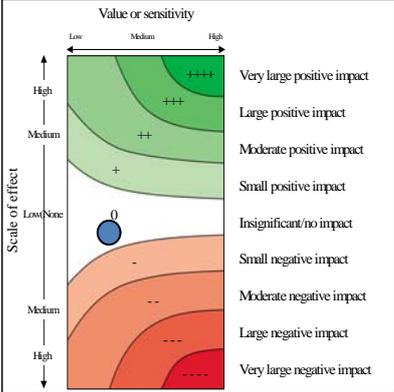




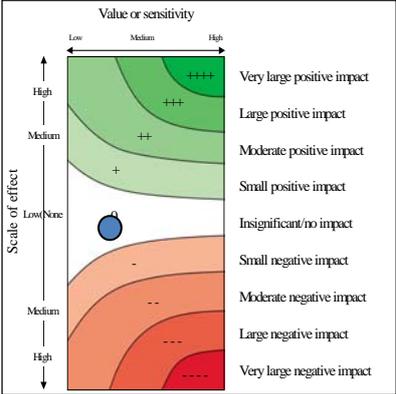
## GBS CELL TOP DRILL CUTTINGS – Legacy

<b>2B. Description of the scale of effect</b> <b>Option 2: Dredge, transfer to Brent C topsides and treat and discharge water and solids to sea</b>	<b>3B. Total (environmental) impact</b>
<p>Option 2 would involve removing the entire volume of GBS cell top drill cuttings (approximately 13,400 m<sup>3</sup> from all three GBS) by dredging, and treating them on the Brent C topsides before discharging treated water and inert solids back to sea. The 10% of the drill cuttings, approximately 1,340 m<sup>3</sup> in total, that ‘escape’ the dredging process will settle eventually on the seabed and will have some potential for legacy impact, as they will remain in the marine environment. The short-term impact upon the marine environment is considered within ‘Marine’.</p> <p>BMT modelled the loss of oil and persistence of the cuttings after dredging Brent C cell top cuttings [13]. The loss of cuttings (775 m<sup>3</sup>) into the water column during dredging that was modelled is similar to the largest cuttings volume that would be released at any of the GBS platforms (i.e. Brent C) during dredging. Hence, the modelling results are relevant. The modelled predictions indicate that the cuttings will be widely dispersed. The settled solids generate a thin layer on the seabed. The layer was too thin to be put into the model for estimation of loss of oil from the cuttings after the dredging and the persistence of the cuttings. However, this indicates that the cuttings were below the OSPAR thresholds after the dredging and dispersion. Also the results from other relevant cuttings disturbance scenarios support this conclusion. Since the Brent C cell top cuttings pile is the largest pile, similar conclusions can be drawn for Brent B and D.</p> <p>Hence, the legacy impact is assessed as ‘insignificant’. Also, the treated water and inert solids returning to the sea will have no legacy impacts.</p> <p>Ultimately, the longer-term legacy impact (&gt;50 years) is ‘no impact’ owing to the beneficial effect of removing the majority of the cell top drill cuttings.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 2: ‘Insignificant’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

## GBS CELL TOP DRILL CUTTINGS – Legacy

<b>2C. Description of the scale of effect</b> <b>Option 3: Dredge, transfer to vessel and transport slurry to shore for treatment and disposal</b>	<b>3C. Total (environmental) impact</b>
<p>Option 3 would involve removal of the entire volume of GBS cell top drill cuttings (approximately 13,400 m<sup>3</sup> from all three GBS) by dredging, transferring to a shuttle tanker and then transporting the slurry to shore for treatment.</p> <p>Legacy impacts are similar to those described in Option 2, ‘insignificant’.</p> <p>The treatment and disposal of the slurry/solids to landfill will be performed at an onshore facility licensed for handling such content of waste (see ‘Waste’ matrices).</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 3: ‘Insignificant’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p> 

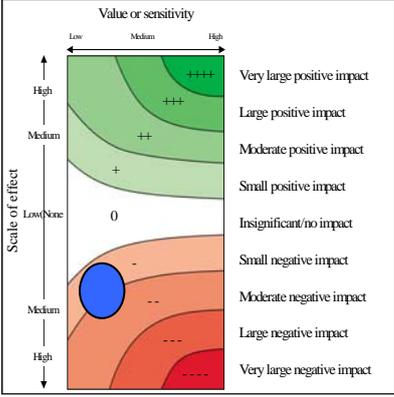
## GBS CELL TOP DRILL CUTTINGS – Legacy

<b>2D. Description of the scale of effect</b> <b>Option 4: Dredge to vessel, transfer to Brent C topsides; water treated and discharged to sea, solids to shore</b>	<b>3D. Total (environmental) impact</b>
<p>Option 4 would involve the removal of the entire volume of cell top drill cuttings (approximately 13,400 m<sup>3</sup> from all three GBS) by dredging to a vessel, dewatering offshore on the Brent C topsides, discharging the treated water to sea and transporting of solids to shore for treatment and disposal.</p> <p>The legacy impact is considered to be similar to Options 2 and 3, ‘insignificant’.</p> <p>The treatment and disposal of the solids on a landfill will be performed at a licensed onshore facility (see ‘Waste’ matrices).</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 4: ‘Insignificant’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p>  <p>The diagram is a 2D matrix with 'Value or sensitivity' on the x-axis (Low, Medium, High) and 'Scale of effect' on the y-axis (High, Medium, Low/None, Medium, High). The matrix is divided into colored regions representing different impact levels: Very large positive impact (dark green), Large positive impact (medium green), Moderate positive impact (light green), Small positive impact (pale green), Insignificant/no impact (white), Small negative impact (pale orange), Moderate negative impact (light orange), Large negative impact (medium orange), and Very large negative impact (dark orange/red). A blue circle is placed in the 'Insignificant/no impact' region, centered around the 'Low/None' sensitivity and 'Medium' scale of effect.</p>

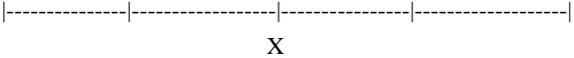
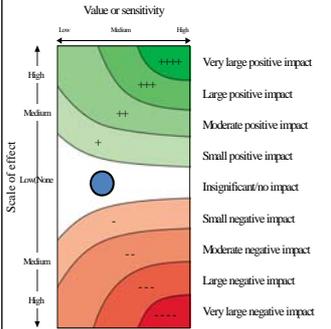




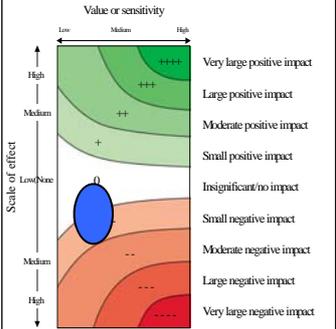
# TRI-CELL DRILL CUTTINGS – Legacy

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 1: Leave <i>in situ</i></b></p> <p>Shell believes the Brent B and D tri-cell cuttings fall below the oil loss and area persistence thresholds in OSPAR Recommendation 2006/5, just like Brent B and D seabed and cell top drill cuttings. Hence, Shell propose to leave the tri-cell drill cuttings <i>in situ</i>.</p> <p>The tri-cell cuttings material is expected to still be covered by cell top drill cuttings or have only a limited area exposed to the ambient water. Hence there will be insignificant impact until the GBS degrades and the tri-cell drill cuttings become exposed to the marine environment.</p> <p>The tri-cell cuttings may be exposed to the sea when the GBS degrade, when the impact should be similar as for the cell sediments (if left <i>in situ</i>), but possibly less because:</p> <ul style="list-style-type: none"> <li>• The limited sampling to date suggests that the maximum concentration of oil in the tri-cells is approximately 9.2%. The impact of the cell sediment release is based on 17.5% oil content (analytical results).</li> <li>• There are less drill cuttings in the Brent B and D tri-cells than in the cell sediments, and tri-cell drill cuttings are not present at Brent C.</li> <li>• Considered together, the above points suggest the total oil load within the tri-cell cuttings is less than half of that contained within the cell sediment.</li> <li>• As the tri-cell drill cuttings are contained within the body of the GBS structure, they are likely to be exposed to the marine environment by degrees, over a long period of time, because more than one wall needs to be breached. Some of the cuttings are likely to be ‘entombed’ within the GBS as it degrades.</li> </ul> <p>Conversely, some tri-cell cuttings may be exposed to the marine environment in a dynamic state and at a higher level than the cell sediment, and will thus travel further, albeit more dispersed. These issues are discussed further in the main report.</p> <p>As described in the legacy assessment of cell sediment (Option 5 – Leave in place), the modelling results show that a major static release of cell water and sediment from Brent GBS will pollute the local benthic environment to a distance of approximately 250 m from each platform but is not expected to induce any measurable effects on the population level. So when the drill cuttings in the tri-cell are exposed to the marine environment upon degradation of the GBS, they will similarly pollute the local environment and add to the area persistence.</p> <p>Hence the scale of effect of legacy impacts is estimated to be ‘medium negative’.</p> <p>The cumulative impacts from the combined exposure of tri-cells and cell contents is discussed in the ES Cumulative Impacts sections.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: ‘Small-moderate negative’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle\ellipse.</p> 

## SUBSEA STRUCTURES AND DEBRIS – Legacy

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 1: Complete removal</b></p> <p>The quantities involved are relatively small (approximately 1,000 tonnes steel and 500 tonnes grout). The subsea structures will be completely removed as will all visible debris. Hence, there is estimated to be an ‘insignificant’ legacy impact to fisheries (particularly trawlers).</p> <p>Over time the cutting piles will erode and may expose sections of debris not visible at the time of decommissioning. As Shell is responsible for the debris in perpetuity, risk-based monitoring (to be agreed with BEIS) will capture the ongoing status of the piles and any changes that may result in further mitigation.</p> <p><b>Evaluation of scale of effect:</b>            High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> 	<p>1) and 2) are combined in the impact matrix.</p> <p><b>Option 1: ‘Insignificant’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle\ellipse.</p> 

## WELLS – Legacy

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 1: Plugging and Abandonment</b></p> <p>Brent P&amp;A will be achieved in line with an approved Brent Field Abandonment Philosophy and by the establishment of formation isolations (barriers) such that the risk of any unplanned hydrocarbons from the wells to the surface is reduced to as low as reasonably practicable (ALARP). The wells will be plugged and abandoned by installing permanent cement barriers, set in pairs, with each barrier consisting of several hundred feet of cement. This will isolate the wells from the reservoir.</p> <p>However, there is still a legacy risk that potential leakage/seepage (weeps/seeps) could occur over time; leaks from wells do occur. Improved governance of the risk of seeps from abandoned wells is currently on the agenda of regulators and industry. It is expected that any weeps and seeps for the GBS wells at Brent B and D platforms would be contained as they are located internally within the GBS shafts, hence any seeps will stay contained as long as the shafts stay intact. When the shafts do collapse, the seeps would naturally go into the water. For the Brent A Jacket and Brent C, any seep would potentially go directly into the water independent of time.</p> <p>Exposure to the marine environment could result in local contamination of water by hydrocarbons and local effects on water living organisms (typically eggs/larvae or organisms with low mobility). Seeps are often near continuous, but with very low flow, and the local marine environment that will be impacted from any seep at the Brent Field contains no unique species.</p> <p>In the worst case scenario if the ‘flow’ is considerable, oil droplets on the sea surface may result, and the effects on seabirds should be considered. This probability is low and the risk is considered ‘negligible’, provided that efforts are made to ensure the 3 barriers have integrity.</p> <p>Most hydrocarbons will be subject to natural degradation, although the less degradable hydrocarbons may aggregate in sediments locally, disturbing local benthic fauna communities.</p> <p>Overall, impacts would be expected to be small and localised and on a limited scale, as leakage, if it happened, would likely be small, only be in isolated locations, and be diluted. The scale of effect is considered ‘low-medium’ negative.</p> <p>Shell UK will monitor the wells post P&amp;A to identify any seeps and will take appropriate mitigation action if necessary based on ALARP. Shell commit to implementing future P&amp;A procedures that come out of the current ongoing studies to reduce risk of seeps, where appropriate.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: ‘Insignificant-small negative’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle\ellipse.</p> 

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- <sup>1</sup> Shell UK Limited, *Technical Document Brent Alpha Jacket Decommissioning*, Shell Doc. No.: BDE-A-JKT-BA-5801-00001-R05.
- <sup>2</sup> Mackay Consultants, *Brent Decommissioning: Fisheries Socio-Economic Effects*, Shell Doc. No. BDE-F-GEN-HE-0702-00003, Revision R03, February 2011.
- <sup>3</sup> Anatec Ltd., *Assessment of Safety Risk to Fishermen from Derogated Footings of the Brent Alpha Steel Jacket (Technical Note)*, Shell Doc No. BDE-A-JKT-HX-0709-00003, Rev A01, 7 February 2014.
- <sup>4</sup> Anatec, *Assessment of Safety Risk to Mariners from Derogated GBSs in the Brent Field*, Shell Report No. BDE-F-GBS-HX-0709-00003, Rev 03, 13 July 2013.
- <sup>5</sup> COWI, *Brent Delta Technical & Environmental Risk Assessment Report*, Shell Report No.: BDE-D-GBS-AA-0709-00002, May 2011.
- <sup>6</sup> TOTAL E&P Norge AS, *Frigg Field Cessation Plan*, 9 May 2003, page 435.
- <sup>7</sup> Multiconsult, *Study of the environmental impact of disposing of concrete installations*, Report No.: 613546-RIM-RAP/001, 16 November 2011.
- <sup>8</sup> BMT Cordah, *GBS cell water and sediment modelling – Overarching report*, Shell Report No.: BDE-F-GBS-HE-0709-00012-001, 9 November 2012.
- <sup>9</sup> Det Norske Veritas Ltd., UK, *Impact Assessment of the Exposure of Brent Field GBS Cell Contents to the Marine Environment*, Shell Report No: BDE-F-GBS-HE-0709-00016, Rev 05, July 2016.
- <sup>10</sup> ARPS, *Assessment of the release of NORM contaminated sediment from Brent Delta Cells*, Shell Doc No.: BDE-D-GBS-HE-0702-00007, 2012.
- <sup>11</sup> OSPAR, *Recommendation 2006/5 on a Management Regime for Offshore Cuttings Piles*, June 2006.
- <sup>12</sup> BMT Cordah, *Long Term Fate and Effects of Cutting piles at Brent Alpha and Brent Charlie with Additional Modelling*, Shell Doc. No.: BDE-F-GEN-HE-0702-00009, March 2016.
- <sup>13</sup> BMT Cordah, *Effects of Human Disturbance on the Brent Alpha and Brent Charlie Cuttings Piles with Additional Modelling*, Shell Doc. No.: BDE-C-SUB-HE-0702-00004, November 2015.

## 1.10 FISHERIES

**Category: All Facilities (Topsides/Jacket/GBS/Attic Oil/Cell Contents/Drilling Legs and Minicell Annulus/Drill Cuttings/Subsea Structures and Debris/Wells)**

**Consequence evaluation for Fisheries**

### 1. General description of the receiving environment (situation and characteristics)

The assessments below cover only short-term impacts to fisheries as a result of the Brent Field decommissioning programme; long-term impacts are captured under 'Legacy'.

#### Marine Environment at the Brent Field

Marine Scotland is responsible for the management of Scotland's seas and reports statistical data from the International Council for the Exploration of the Seas (ICES) [1]. Two reports by Mackay Consultants summarise and assess the ICES statistical data [2,3]. The total value of the catch over the period 2000-2015 in rectangle 51F1 was approximately £75 million, with an annual average of less than £5 million. The total catch (in terms of weight and value) over the last 5 years is much lower than the preceding decade. It should be noted that these data reflect historic fluctuations in fisheries ecosystems and may not be representative of future statistics.

Fishing in ICES rectangle 51F1 was historically dominated by the mackerel fishery (a pelagic species), which accounted for 76% of the value of the catch over the period 2000-2015 and 84% of the catch weight. Demersal species including haddock, cod, saithe, monkfish and whiting accounted for the remaining value/weight. Although the mackerel fishery represents 84% of the catch weight, the UK mackerel quota can usually be caught in only a few weeks. Therefore, the majority of the fishing effort (e.g. the number of days fished) has been by the whitefish fleet. [3]

In the period 2010-2013, no mackerel were reported to be caught in rectangle 51F1. This reflects the changing nature of the mackerel fishery resulting from a northwards migration of the stock. Since the early 2000's, catches of mackerel in this area have declined as the focus of this fishery has shifted elsewhere [2]. A small mackerel catch was reported in 2014 and 2015, but this represented only 3% of the overall mackerel catch from 2000-2015 [1].

According to the Marine Scotland website [1], the value of demersal species caught in rectangle 51F1 in 2014 was approximately £0.95 million, representing a 'moderate' value. The value of pelagic species caught in rectangle 51F1 in 2014 was approximately £0.79 million, and the value of shellfish species was approximately £281, or a 'low' value. These categories are somewhat arbitrary and should only be used as an indication of the sensitivity of an area.

Projections of future fishing activity in the Brent area by Mackay [3] indicate the value of the mackerel fishery to be similar to the annual average from 2006-2009 in rectangle 51F1, of approximately £5 million. The future projection for the demersal fishery is an annual average value of approximately £2 million. Combining both the mackerel and demersal values gives an overall annual average of £7 million. This is similar to the 2000-2009 average of just under £6.8 million.

#### Fishing Vessel Activity

During decommissioning operations, access to locations used for fishing may be temporarily restricted. However, according to a 2014 study by Anatec of fishing vessel activity in ICES rectangle 51F1 [4], fishing vessel activity in the area is not significant and equates to a rough average of one vessel every other day in the vicinity of the platforms travelling at relatively slow speeds of under 5 knots. This was estimated as an average of 180 days per year from 2005 to 2011, with seasonal variations and April to May being the busiest months.

#### Nearshore Marine Environment

There will also be decommissioning operations at the transfer location, which is located in ICES rectangle 38E8, where there are spawning grounds for lemon sole (April-September) and Nephrops (January-December) and nursery grounds for whiting, cod, herring, plaice and spurdog [5]. The area around the transfer location is of 'low' to 'high' relative value (financial) for fishing. Fishing effort (days) is 'low' to 'moderate' and is dominated by demersal and shellfish fisheries [1].

#### Summary

In accordance with data from Marine Scotland, the marine fisheries at the Brent Field are allocated a 'low-medium' value. Fisheries in the nearshore environment are allocated a 'medium' value. The value category for nearshore is only relevant for the Brent Field topsides and jacket, which will be brought to the ASP facility.

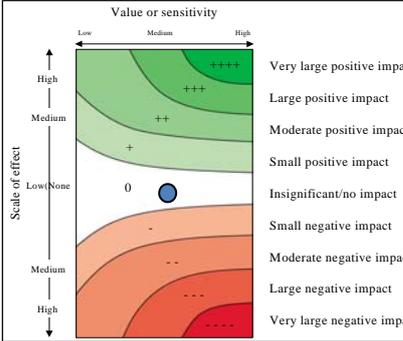
#### **Evaluation of the value:**

Low Medium High

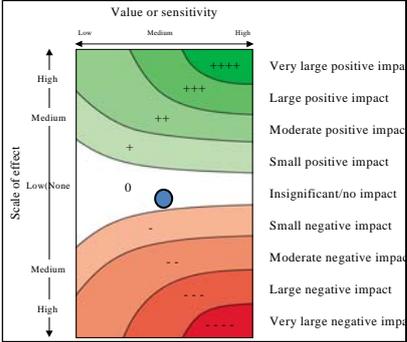
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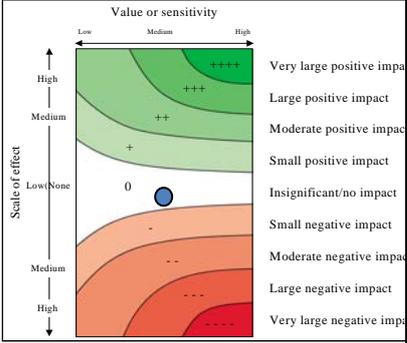
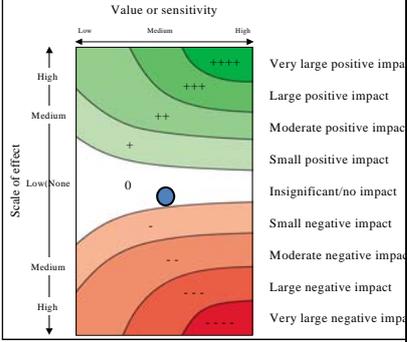
## TOPSIDES - Fisheries

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 1: Complete Removal</b></p> <p>Removal of topsides involves marine operations for a period of time in the area. The majority of this activity will be within a 500 m zone of the installations (field), and will not affect any fishing vessel. However, there might be periods with increased traffic to and from the installation, with an insignificant effect on the fisheries.</p> <p>As decommissioning operations at the nearshore transfer location will involve only a few vessels and will only take two days at the transfer location for each transfer operation, the impact to fisheries is estimated to be insignificant.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

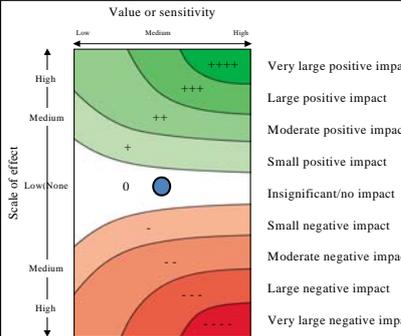
## BRENT A UPPER JACKET – Fisheries

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 1: Removal in one piece to approx. -84.5m LAT using SLV</b></p> <p>Removal of the upper jacket involves marine operations for a period of time in the area. The majority of this activity will be within a 500 m zone of the installations (field), and will not affect any fishing vessel. However, there might be periods with increased traffic to and from the installation, however this is considered to have only a minor effect on the fisheries.</p> <p>As decommissioning operations at the nearshore transfer location will involve only a few vessels and will only take approximately two days at the transfer location, the impact to fisheries nearshore is estimated to be ‘insignificant’.</p> <p>The long-term effect on fisheries of leaving the footings in place is captured within the ‘Legacy’ category for jacket footings Option 3.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: ‘Insignificant’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

# BRENT A JACKET FOOTINGS – Fisheries

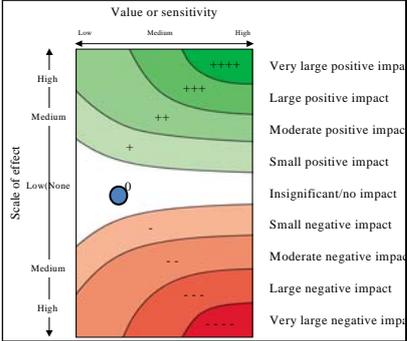
<p><b>2. Description of the scale of effect</b></p> <p><b>Option 1: Complete removal by SSCV in several pieces, after cuttings the piles externally</b></p>	<p><b>3. Total (environmental) impact</b></p>
<p>Removal of the jacket footings will involve marine operations for a period of time in the area. The majority of this activity will be within the 500 m zones of the installations, and will not affect any fishing vessel. However, there might be periods with increased traffic to and from the installation, this is estimated to have a 'low' scale of effect.</p> <p>As decommissioning operations will involve only a few vessels passing through the nearshore area and will only take two days at the transfer location, the impact to fisheries is estimated to be 'insignificant'.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 
<p><b>2. Description of the scale of effect</b></p> <p><b>Option 2: Complete removal by SSCV in several pieces, after cutting the piles internally</b></p>	<p><b>3. Total (environmental) impact</b></p>
<p>Removal of the jacket footings will involve marine operations for a period of time in the area. The majority of this activity will be within the 500 m zones of the installations, and will not affect any fishing vessel. However, there might be periods with increased traffic to and from the installation, this is estimated to have a 'low' scale of effect.</p> <p>As decommissioning operations will involve only a few vessels passing through the nearshore area and will take two days at the transfer location, the impact to fisheries is estimated to be 'insignificant'.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 2: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

## BRENT A JACKET FOOTINGS – Fisheries

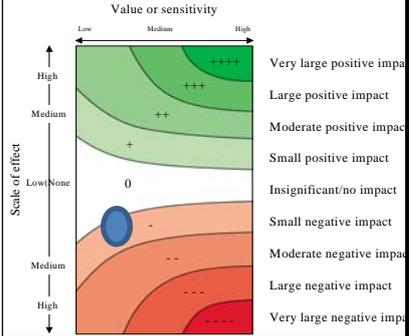
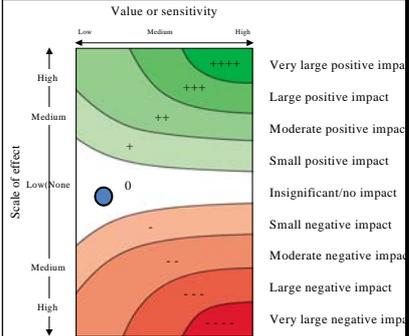
2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 3: Leave <i>in situ</i></b></p> <p>The footings are left <i>in situ</i>, so there are no activities, with no impact upon fisheries. The long-term effect on fisheries of leaving the footings in place is captured within 'Legacy'.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 3: 'No Impact'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 



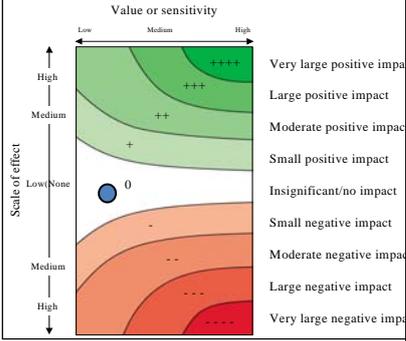
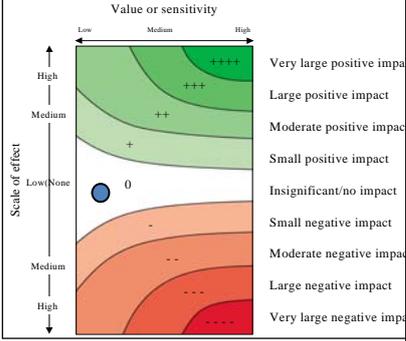
# GBS ATTIC OIL – Fisheries

2. Description of the scale of effect <b>Option 1: Recover to Shore</b>	3. Total (environmental) impact
<p>Recovering the attic oil will involve marine operations for a period of time in the area. The majority of this activity will be within the 500 m safety zone of the platforms, and thus will not affect any fishing vessels. There might be periods with slightly increased traffic to and from the installations, however this is considered to have an 'insignificant' impact on fisheries.</p> <p><b>Evaluation of scale of effect:</b>            High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

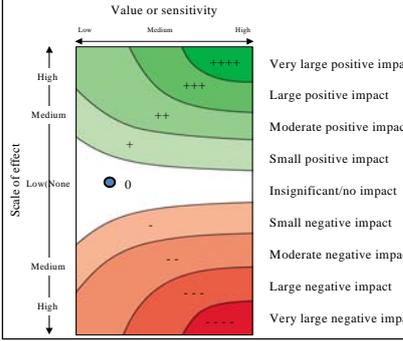
## GBS CELL CONTENTS – Fisheries

<p><b>2. Description of the scale of effect</b></p> <p><b>Option 1: Mobilise to vessel and re-inject into a new well</b></p> <p>Mobilising to vessel and reinject to new drilled wells away from site has some small potential to effect fisheries because the drilling rig mooring lines (if used) may extend some distance from the rig (up to 1,500 m) and may interfere for a temporary period of time. Hence the scale of effect is estimated to be ‘low-medium’.</p> <p>The overall impact to fisheries is estimated to be ‘small negative’.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix</p> <p style="text-align: center;"><b>Option 1: ‘Small negative’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 
<p><b>2. Description of the scale of effect</b></p> <p><b>Option 2: Mobilise and retrieve to vessel, transport to shore for treatment</b></p> <p>The effect of mobilisation, retrieval to vessel and disposal onshore is not estimated to have a significant effect on fisheries as the majority of necessary operations will be executed within the 500 m zone.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix</p> <p style="text-align: center;"><b>Option 2: ‘Insignificant’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

## GBS CELL CONTENTS – Fisheries

<p><b>2. Description of the scale of effect</b>  <b>Option 3: Cap and cover <i>in situ</i> in the cells using (e.g.) mixture of sand/gravel</b></p> <p>The effect of capping and covering the cell sediment is not estimated to have a significant effect on fisheries as the majority of necessary operations will be executed within the 500 m zone.</p> <p><b>Evaluation of scale of effect:</b>  High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix</p> <p style="text-align: center;"><b>Option 3: ‘Insignificant’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle \ ellipse.</p> 
<p><b>2. Description of the scale of effect</b>  <b>Option 4: Leave <i>in situ</i> in the cells and natural biodegradation by MNA (Monitored Natural Attenuation)</b></p> <p>Leaving the cell contents <i>in situ</i> with MNA is not estimated to have a significant effect on fisheries as the majority of necessary operations will be executed within the 500 m zone.</p> <p><b>Evaluation of scale of effect:</b>  High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix</p> <p style="text-align: center;"><b>Option 4: ‘Insignificant’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

## GBS CELL CONTENTS – Fisheries

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 5: Leave <i>in situ</i> in the cells for natural degradation</b></p> <p>Leaving the cell contents <i>in situ</i> is not estimated to have any effect on fisheries as there are very few operations, and any necessary operations will generally be executed within the 500 m zone.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix</p> <p style="text-align: center;"><b>Option 5: ‘No impact’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 



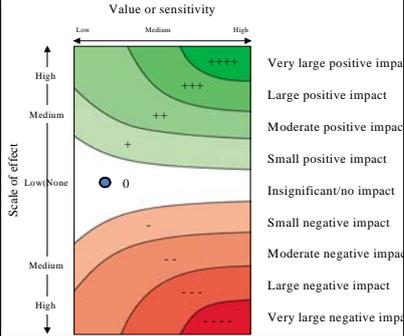




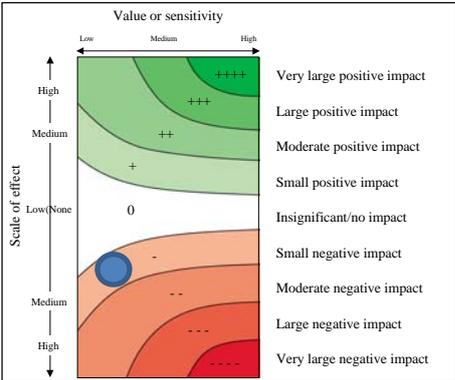




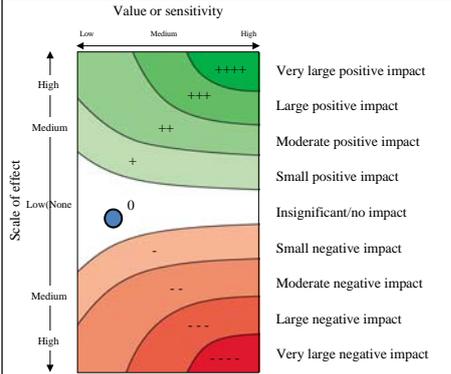
## TRI-CELL DRILL CUTTINGS - Fisheries

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 1: Leave <i>in situ</i> in the cells for natural degradation</b></p> <p>Leaving the tri-cell drill cuttings <i>in situ</i> is not estimated to have an impact on fisheries as there are no offshore operations expected for this option.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix</p> <p style="text-align: center;"><b>Option 1: ‘No impact’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

## SUBSEA STRUCTURES AND DEBRIS – Fisheries

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 1: Complete removal</b></p> <p>Removal Seabed Structures and Seabed Debris involves marine operations for a period of time in the area. The majority of this activity will be within the safety zones of the installations (field), and will not affect any fishing vessel. However, there might be periods with increased traffic to and from the installation, with small/insignificant effect on the fisheries.</p> <p>However, there should be some mitigation actions taken as follows to ensure no significant to fisheries:</p> <ul style="list-style-type: none"> <li>Any ditches/berms created in the seabed when removing subsea structures and debris should be back-filled as part of the operation if they are considered hazardous to fishermen.</li> <li>If wet storage takes place in areas outside the Exclusion Zones, mitigation may be required and this will require liaison with fishermen to agree details. Mitigation could involve a boat to warn fishermen or a temporary buoy in relevant areas. Also, Shell will ensure that wet storage will not take place in any drill cutting piles.</li> </ul> <p>The overall impact is therefore estimated to be 'small negative'.</p> <p>The effect from removing the steel substructures is positive in the long term to the fisheries in the Brent area, if all hindrances on the seabed are removed from the field. This positive impact is covered in 'Legacy'.</p> <p><b>Evaluation of scale of effect:</b></p> <p>Very neg.    Medium neg.    Low/none    Medium pos.    Very pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix</p> <p style="text-align: center;"><b>Option 1: 'Small negative'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

## WELLS – Fisheries

2. Description of the scale of effect <b>Option 1: Plugging and Abandonment</b>	3. Total (environmental) impact
<p>Removing the wells is considered to be a positive impact to fisheries in the Brent area in the long-term, as all hindrances on the seabed will be removed. This is captured in 'Legacy'. Impacts to the marine environment from underwater explosions are considered under 'Marine'.</p> <p>Plugging and abandonment of wells will involve operations for a long period of time in the Brent Field, but the operations take place from the existing platforms. Hence the vast majority of this activity will be within the safety zones of the installations, and will not affect any fishing vessel. There might be some periods with increased traffic to and from the installations, although this would likely be comparable with the current day, and is estimated to have an insignificant impact on fisheries.</p> <p><b>Evaluation of scale of effect:</b></p> <p>Very neg.    Medium neg.    Low/none    Medium pos.    Very pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix</p> <p style="text-align: center;"><b>Option 1: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

<sup>1</sup> Marine Scotland, *Fishing Effort and Quantity and Value of Landings by ICES Rectangle*, Website: <http://www.gov.scot/Topics/Statistics/Browse/Agriculture-Fisheries/RectangleData> > [Accessed July 2016].

<sup>2</sup> Mackay Consultants, *Brent Decommissioning: Fisheries Socio-Economic Effects*, Shell Doc. No. BDE-F-GEN-HE-0702-00003, Revision R03, February 2011.

<sup>3</sup> Mackay Consultants, *Brent Decommissioning: Fisheries Socio-Economic Effects*, Shell Doc. No. BDE-F-GEN-HE-0702-00003, Revision R03, November 2014.

<sup>4</sup> Anatec Ltd., *Assessment of Safety Risk to Fishermen from Derogated Footings of the Brent Alpha Steel Jacket (Technical Note)*, Shell Report No. BDE-A-JKT-HX-0709-00003, Rev A01, 07 February 2014.

<sup>5</sup> Ellis, J.R., Milligan, S.P., Readdy, L., Taylor, N. and Brown, M.J., *Spawning and nursery grounds of selected fish species in UK waters*. Sci. Ser. Tech. Rep., Cefas Lowestoft, 2012.

## 1.11 SHIPPING

### **Topsides/Jacket/GBS/Attic Oil/Cell Contents/Drilling Legs and Minicell Annulus/Drill Cuttings/Subsea Structures and Debris/Wells**

#### **1. General description of the receiving environment (situation and characteristics)**

Shipping traffic to European ports entering the Northern North Sea from the West generally traverse through the Pentland Firth or Fair Isle Channel between the Orkney and Shetland Islands. Therefore, the main shipping routes in the North Sea are predominantly well to the south of the Brent Field.

A study by Anatec in 2014 [1] found that a total of 24 shipping routes are trafficked by an estimated 686 ships per year passing within 10 nm of the Brent platforms. This corresponds to an average of 1-2 ships per day. Offshore vessels (by type) account for the largest constituent of vessels (44%) passing within 10 nm of the platforms, with tankers (28%), cargo vessels (25%) and ferries (3%) making up the remainder.

In the evaluation of the impact on shipping of the various decommissioning options, the following criteria were considered during the assessment:

- Proximity of shipping routes (closest point of approach) to the Brent platforms and frequency (total number) of ships traversing along these routes, their type and size
- Projected vessel utilisation for decommissioning activities based on vessel data provided by Shell, included in DNV GL's Energy and Emissions Report [2].

Due to the relatively low numbers of vessels using shipping routes in close proximity to the Brent platforms and navigational courses being clear of the offshore oil & gas development zones, shipping is considered to be of 'low' value in general. However, for topsides and jacket, it is known that they will be brought onshore to the ASP facility near Hartlepool, where the nearby shipping density is higher (see the main ES report for further detail). Hence a medium-high value is allocated for the topsides and jacket facilities.

The assessments below depict short-term impacts to shipping as a result of the Brent Decommissioning Programme (BDP). The long-term impact on shipping is covered in the legacy matrices.

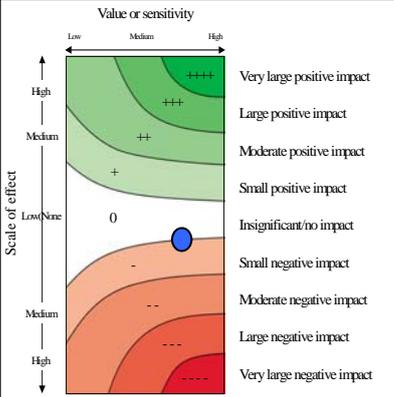
#### **Evaluation of the value:**

Low Medium High

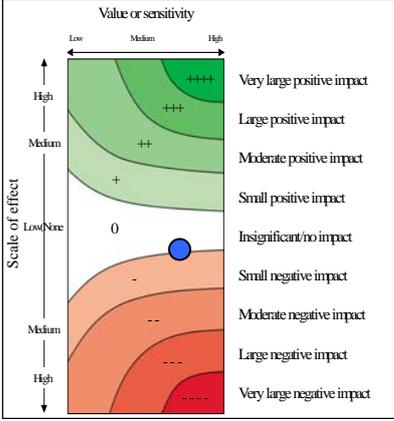
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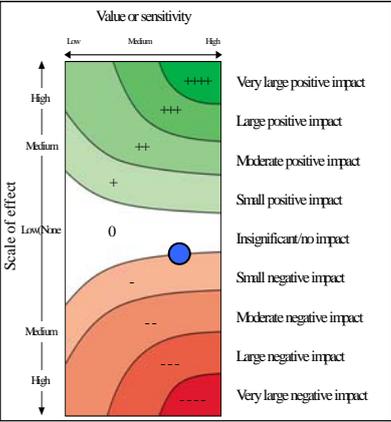
## TOPSIDES –Shipping

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 1: Complete Removal by SLV</b></p> <p>Shipping activity will increase during the removal of the topsides due to requirements for a Single Lift Vessel (SLV), Anchor Handling Tugs (AHT), tugs and barges. However, it is not anticipated that these operations will have any practical impact on shipping in the area and the impact for the Brent Field operations is therefore estimated to be insignificant.</p> <p>Shipping lanes will be traversed during transit of the topsides to shore, and the shipping density is much higher close to shore. But there is only one shipping transit per topside (i.e. 4 in total), so the transit is unlikely to cause any significant obstruction, provided the SLV route and the transfer location is planned and managed effectively.</p> <p>Overall an ‘insignificant-small negative’ impact is estimated.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p>----- ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p><b>Option 1: ‘Insignificant-small’ negative</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle\ellipse.</p> 

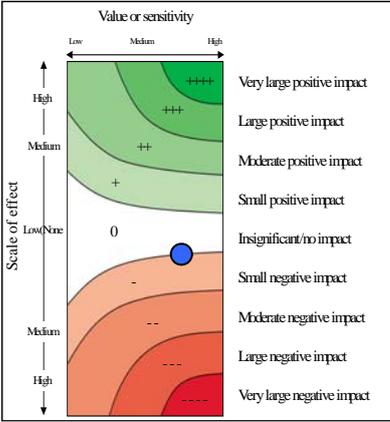
## BRENT A UPPER JACKET – Shipping

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 1: Removal in one piece to approx. -84.5m LAT using SLV</b></p> <p>Shipping activity will increase during the removal and transportation of the Brent A upper jacket due to the requirement for a SLV (one movement), AHT, tugs and dumb barge for this operation. As shipping activity will be limited to marine operations in the 500m zone and routes to and from shore for limited periods and relevant parties will be informed, it is not anticipated that these operations would have any practical impact on shipping and therefore the impact is estimated to be 'insignificant'.</p> <p>Shipping lanes will be traversed during transit of the Brent A jacket to shore, and the shipping density is much higher close to shore. But as there is only one SLV transit, it is unlikely to cause any significant obstruction, provided the SLV route and operations are planned, managed and communicated effectively.</p> <p>Overall an 'insignificant-small negative' impact is estimated.</p> <p><b>Evaluation of scale of effect:</b>            High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: 'Insignificant-small negative'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

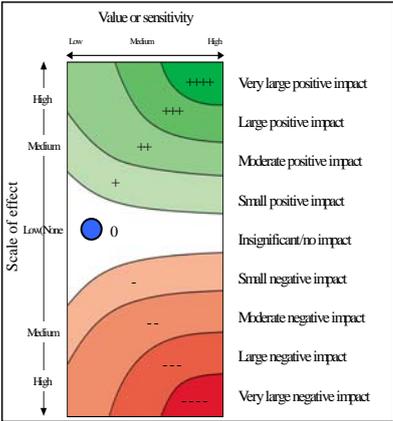
## BRENT A JACKET FOOTINGS – Shipping

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 1: Complete removal by SSCV in several pieces, after cuttings the piles externally</b></p> <p>Shipping activity will increase during the complete removal and transportation of the Brent A jacket footings to shore due to the requirement for MSV, SSCV, AHT, tugs and barge for the operations. As shipping activity will be limited to marine operations in the 500 m zone and routes to and from shore for limited periods and relevant parties will be informed, it is not anticipated that these operations would have any practical impact on shipping and the impact is therefore estimated to be insignificant.</p> <p>Shipping lanes will also be traversed during transit of the Brent A jacket footings to shore, where the shipping density is much higher. But as there are very few transits, it is unlikely to cause any significant obstruction, provided the route and operations are planned, managed and communicated effectively.</p> <p>Overall an ‘insignificant-small negative’ impact is estimated.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: ‘Insignificant-small negative’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle\ellipse.</p>  <p>The diagram is a 2D matrix with 'Scale of effect' on the vertical axis (High, Medium, Low/None) and 'Value or sensitivity' on the horizontal axis (Low, Medium, High). The matrix is divided into nine regions with corresponding impact levels: Very large positive impact (++++), Large positive impact (+++), Moderate positive impact (++), Small positive impact (+), Insignificant/no impact (0), Small negative impact (-), Moderate negative impact (--), Large negative impact (---), and Very large negative impact (----). A blue circle is positioned in the 'Insignificant/no impact' region, indicating the estimated impact level for Option 1.</p>

## BRENT A JACKET FOOTINGS – Shipping

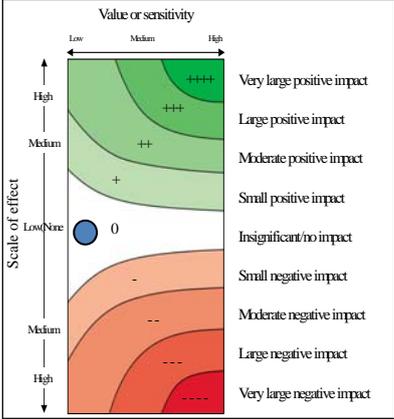
2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 2: Complete removal by SSCV in several pieces, after cutting the piles internally</b></p> <p>Shipping activity will increase during the complete removal and transportation of the Brent A jacket footings to shore due to the requirement for MSV, SSCV, AHT, tugs and barge for the operations. As shipping activity will be limited to marine operations in the 500m zone and routes to and from shore for limited periods and relevant parties will be informed, it is not anticipated that these operations would have any practical impact on shipping and the impact is therefore estimated to be insignificant.</p> <p>Shipping lanes will also be traversed during transit of the Brent A jacket footings to shore, where the shipping density is much higher. But as there are very few transits, it is unlikely to cause any significant obstruction, provided the route and operations are planned, managed and communicated effectively.</p> <p>Overall an ‘insignificant-small negative’ impact is estimated.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 2: ‘Insignificant-small negative’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle\ellipse.</p>  <p>The diagram is a 2D matrix with 'Scale of effect' on the vertical axis (High, Medium, Low/None) and 'Value or sensitivity' on the horizontal axis (Low, Medium, High). The matrix is divided into nine impact categories, each with a color-coded region: Very large positive impact (dark green, ++++), Large positive impact (medium green, +++), Moderate positive impact (light green, ++), Small positive impact (pale green, +), Insignificant/no impact (white, 0), Small negative impact (pale orange, -), Moderate negative impact (orange, --), Large negative impact (red-orange, ---), and Very large negative impact (dark red, ----). A blue circle is positioned in the 'Insignificant/no impact' region, centered around the '0' value.</p>

## BRENT A JACKET FOOTINGS – Shipping

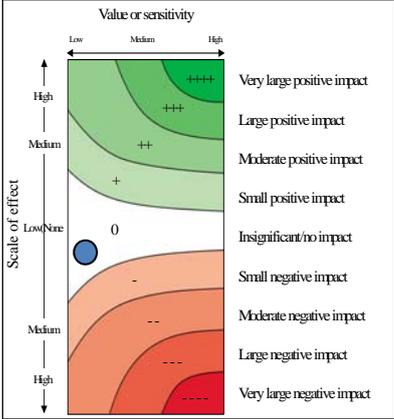
2. Description of the scale of effect <b>Option 3: Leave <i>in situ</i></b>	3. Total (environmental) impact
<p>As the jacket footings would be left <i>in situ</i> there would be no offshore, with no impact to shipping.</p> <p><b>Evaluation of scale of effect:</b>            High neg.   Medium neg.   Low/none   Medium pos.   High pos.             ----- ----- ----- -----   <span style="margin-left: 250px;">X</span></p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 3: ‘No impact’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle\ellipse.</p> 



## GBS – Shipping

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 2: Leave <i>in situ</i></b></p> <p>The installation of the concrete caps and the Navigational Aids on top of the GBS legs are performed within the Topsides programme of work. Therefore, there are no operational activities under Option 2 and therefore no impact to shipping.</p> <p>Note that the long-term impact to shipping is covered in 'Legacy'.</p> <p><b>Evaluation of scale of effect:</b>            High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 2: 'No impact'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle(ellipse).</p> 

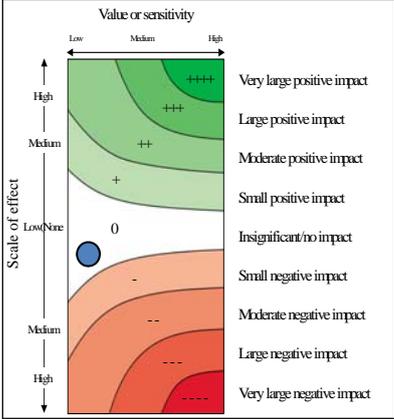
## GBS ATTIC OIL – Shipping

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 1: Recover to Shore</b></p> <p>Shipping activity will increase during operations to remove the GBS attic oil as vessels will be required to collect and transport the attic oil to shore. This will primarily be limited to marine operations within the 500 m safety zone of the platforms, and transit to and from shore for a limited period of time. It is therefore not anticipated that these operations will have any practical impact on shipping and thus the impact is estimated to be ‘insignificant’.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p><b>Option 1: ‘Insignificant’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

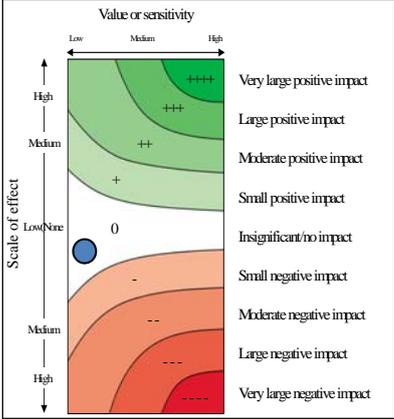




## GBS CELL CONTENTS – Shipping

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 3: Leave in Place and Capping</b></p> <p>Shipping activity in Option 3 will be limited to marine operations within the 500m zone and transit to and from port for a limited period. The use of vessels for this operation is not anticipated to have any practical impact on shipping and is therefore estimated to be ‘insignificant’.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 3: ‘Insignificant’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

## GBS CELL CONTENTS – Shipping

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 4: Leave in Place and MNA</b></p> <p>Shipping activity in Option 4 will be limited to marine operations within the 500m zone and transit to and from port for a limited period. The use of vessels for this operation is not anticipated to have any practical impact on shipping and is therefore estimated to be ‘insignificant’.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 4: ‘Insignificant’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle\ellipse.</p> 







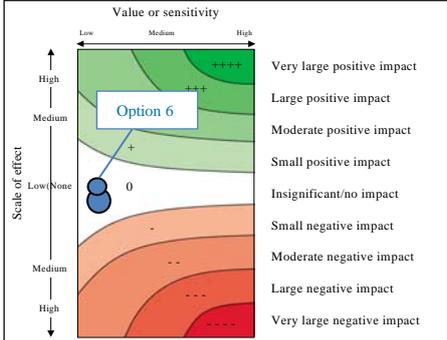
## SEABED DRILL CUTTINGS – Shipping

2. Description of the scale of effect	3. Total (environmental) impact
<p><b>Option 1: Leave <i>in situ</i></b></p> <p>Little shipping activity is required in this option, therefore the impact on shipping is estimated to be 'insignificant'.</p> <p><b>Evaluation of scale of effect:</b>            High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> <div style="border: 1px solid black; padding: 5px;"> <p style="text-align: center;">Value or sensitivity</p> <p style="text-align: center;">Low                  Medium                  High</p> <p style="text-align: center;">↑ High</p> <p style="text-align: center;">Medium</p> <p style="text-align: center;">Low/None</p> <p style="text-align: center;">↓ High</p> <p style="text-align: center;">Scale of effect</p> <p style="text-align: center;">0</p> <p style="text-align: center;">-    - -    - - -    - - - -</p> <p style="text-align: center;">+    + +    + + +    + + + +</p> <p style="text-align: center;">Small positive impact</p> <p style="text-align: center;">Moderate positive impact</p> <p style="text-align: center;">Large positive impact</p> <p style="text-align: center;">Very large positive impact</p> <p style="text-align: center;">Insignificant/no impact</p> <p style="text-align: center;">Small negative impact</p> <p style="text-align: center;">Moderate negative impact</p> <p style="text-align: center;">Large negative impact</p> <p style="text-align: center;">Very large negative impact</p> </div>

# BRENT A SEABED DRILL CUTTINGS – Shipping

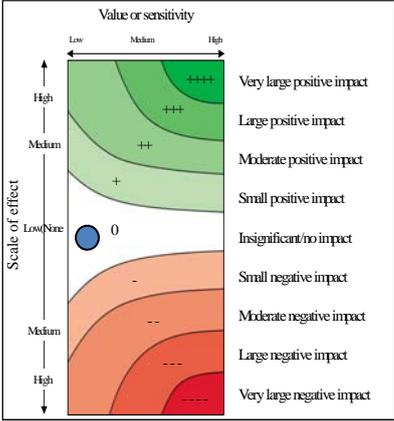
2A. Description of the scale of effect Category: Brent A Seabed Drill Cuttings: Options 1, 2, 3, 4	3A. Total (environmental) impact
<p>Under Option 1, shipping activity will be limited to marine operations of:</p> <ul style="list-style-type: none"> <li>• ROVSV to control the dredging operations,</li> <li>• Transfer of cuttings slurry to shuttle tanker (with tug) for transport to the Brent C topsides where the slurry will be processed on the platform.</li> <li>• Any recovered hydrocarbons will be shipped back to shore for use as fuel.</li> </ul> <p>As the slurry will be processed from Brent C, vessel movements will increase in the area for a limited time; however shipping activity will involve only a few vessels and will be mainly completed within the 500m zone. Therefore it is not anticipated that operations under Option 1 will have any practical impact on the free passage in the area and is estimated to be ‘insignificant’.</p> <p>Under Option 2, shipping activity will be limited to marine operations of:</p> <ul style="list-style-type: none"> <li>• ROVSV to control the dredging operations,</li> <li>• Transfer of the cuttings slurry to shuttle tanker (with tug) for transport to shore for treatment.</li> </ul> <p>Transit via shuttle tanker will result in increased traffic to and from shore with the potential to impact on shipping routes; however it is not anticipated that these operations will have any practical impact on the free passage in the area and is therefore estimated to be ‘insignificant’.</p> <p>Under Option 3, shipping activity will be limited to marine operations of:</p> <ul style="list-style-type: none"> <li>• ROVSV to control the dredging operations,</li> <li>• Transfer of cuttings slurry to a shuttle tanker (and tug) for transport to the Brent C topsides where the slurry will be dewatered. A shuttle tanker (and tug) will transport the dewatered solids to shore for treatment.</li> </ul> <p>These transits will result in increased traffic to and from shore with the potential to impact on shipping routes; however it is not anticipated that these operations will have any practical impact on the free passage in the area and is therefore estimated to be ‘insignificant’.</p> <p>Option 4: In addition to marine operations associated with dredging (ROVSV, shuttle tanker and tug), shipping activity will increase due to well drilling operations (mobile drilling rig, LWI vessel and PSV required). These activities will be limited to marine operations within the 500 m zone, and transit to and from the newly drilled well for a limited period of time. It is therefore not anticipated that these operations will not have any practical impact on the free passage and is therefore estimated to be ‘insignificant’.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p>----- ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Options 1,2,3,4: ‘Insignificant’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p>

# CELL TOP DRILL CUTTINGS – Shipping

2A. Description of the scale of effect Category: GBS Cell Top Drill Cuttings: Option 1,2,3,4,5,6	3A. Total (environmental) impact
<p>Under Option 1, shipping activity will be limited to marine operations within the 500 m zone for water jetting, and transit to and from port for a limited period. It is not anticipated that these operations will have any practical impact on the free passage in the area and is therefore estimated to be ‘insignificant’.</p> <p>Under Option 2, shipping activity will be limited to marine operations of:</p> <ul style="list-style-type: none"> <li>• ROVSV to control the dredging operations,</li> <li>• Transfer of the cuttings slurry to a shuttle tanker (with tug) for transport to the Brent C topsides where the slurry will be processed.</li> <li>• Any recovered hydrocarbons will be shipped back to shore for use as fuel.</li> </ul> <p>As the slurry will be processed from Brent C, vessel movements will increase in the area for a limited time; however shipping activity involves only a few vessels and will mainly be conducted within the 500 m zone. Therefore it is not anticipated that operations under Option 2 will have any practical impact on the free passage in the area and is estimated to be ‘insignificant’.</p> <p>Under Option 3, shipping activity will be limited to marine operations of:</p> <ul style="list-style-type: none"> <li>• ROVSV to control the dredging operations,</li> <li>• Transfer of cuttings slurry to shuttle tanker (with tug) for transport to shore for treatment.</li> </ul> <p>Transits via shuttle tanker will result in some limited increase in traffic to and from shore with the potential to impact on shipping routes; however it is not anticipated that these operations will have any practical impact on the free passage in the area and is therefore estimated to be ‘insignificant’.</p> <p>Under Option 4, shipping activity will be limited to marine operations of:</p> <ul style="list-style-type: none"> <li>• ROVSV to control the dredging operations,</li> <li>• Transfer of cuttings slurry to shuttle tanker (and tug) for transport to the Brent C topsides where the slurry will be dewatered. A shuttle tanker (and tug) will transport the dewatered solids to shore for treatment.</li> </ul> <p>These transits will result in increased traffic to and from shore with the potential to impact on shipping routes; however it is not anticipated that these operations will have any practical impact on the free passage in the area and is therefore estimated to be ‘insignificant’.</p> <p>In addition to marine operations associated with dredging (ROVSV, shuttle tanker and tug), shipping activity will increase under Option 5 due to well drilling operations (mobile drilling rig, LWI vessel and PSV required). These activities will be limited to marine operations within the 500 m zone, and transit to and from the newly drilled well for a limited period. It is not anticipated that these operations will not have any practical impact on the free passage and is therefore estimated to be ‘insignificant’.</p> <p>There are not estimated to be any impacts to shipping as a result of Option 6 as the cell top drill cuttings will remain <i>in situ</i>.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p>----- ----- ----- ----- ----- </p> <p style="text-align: center;">X X<sub>6</sub></p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Options 1, 2, 3, 4, 5: ‘Insignificant’</b> <b>Option 6: ‘No impact’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circles/ellipses.</p>  <p>The diagram is a 2D matrix with 'Scale of effect' on the vertical axis (High, Medium, Low/None) and 'Value or sensitivity' on the horizontal axis (Low, Medium, High). The matrix is divided into colored zones representing impact levels: Very large positive (green), Large positive (light green), Moderate positive (yellow-green), Small positive (yellow), Insignificant/no impact (white), Small negative (light orange), Moderate negative (orange), Large negative (red-orange), and Very large negative (red). Option 6 is represented by a small blue circle with a '0' inside, located in the 'Insignificant/no impact' zone at the 'None' level of effect and 'None' level of sensitivity.</p>



## SUBSEA STRUCTURES AND DEBRIS – Shipping

2. Description of the scale of effect <b>Option 1: Complete Removal</b>	3. Total (environmental) impact
<p>Shipping activity will increase temporarily during the removal and recovery of subsea structures and debris due to the requirement for DSV, ROVSVs AHT and a trawler for marine operations. It is not anticipated that these operations would have any practical impact on shipping and is therefore estimated to be 'insignificant'.</p> <p><b>Evaluation of scale of effect:</b>            High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: 'Insignificant'</b></p>  <p>The diagram is a 2D matrix with 'Scale of effect' on the vertical axis (Low/None, Medium, High) and 'Value or sensitivity' on the horizontal axis (Low, Medium, High). The matrix is color-coded: green for positive impacts and red for negative impacts. Impact levels are indicated by symbols: ++++ (Very large positive), +++ (Large positive), ++ (Moderate positive), + (Small positive), 0 (Insignificant/no impact), - (Small negative), -- (Moderate negative), --- (Large negative), ---- (Very large negative).</p>



## 1.12 PIPELINES – ONSHORE IMPACTS

### Category: Pipelines – Groups 1 and 2

#### 1. General description of the receiving environment (situation and characteristics)

##### Evaluation of value:

Recovered pipelines and associated materials (e.g. plastics) will be taken onshore to fully licensed waste management sites for further dismantling and recycling of materials. Shell UK will only use onshore facilities that are licensed to receive decommissioning wastes.

The location of the onshore dismantling facility for pipelines has not yet been announced. It is difficult to assess the overall value (conservation and economic value) of the area without having knowledge of the onshore dismantling location. The following issues would need to be considered:

- Location of the facility.
- Proximity to local population.
- Timing and duration of dismantling operations.
- Recovery period from impacts.
- Value / sensitivity of surrounding environment / resources.

It is assumed that Shell UK's selection procedures will ensure the suitability of the onshore dismantling location and take the above issues into consideration. It is assumed that all dismantling sites will operate within agreed licensing conditions (e.g. regarding noise levels, dust, odour, hours of operation, lighting, road traffic, etc.).

The potential onshore impacts from decommissioning pipelines are summarised as follows:

- Noise and emissions from onshore transport to the processing site, and any onward transport required for recycling or disposal. This may be by road or rail transport.
- Localised noise, dust and emissions associated with processing and cutting of pipelines.
- Potential exposure to dust and pipeline materials when removing anodes, concrete and coatings.
- Localised odour issues from recovered marine growth (if any).

In comparison to topsides and other Brent Field structures, the processing of pipelines for recycling is, in general, a more manageable process given the volume of materials involved.

Given that the location of the dismantling facility is currently unknown, the value or sensitivity is an area of uncertainty, as the proximity of sites to sensitive receptors and habitats is unknown. For the purpose of the assessment it is assumed that processing facilities are established and will not require expansion in order to handle decommissioned pipelines. Therefore, the overall value with regards to conservation and economic value is assessed to be 'medium'. However, given that the onshore location has not yet been announced, the value could range from 'low' to 'high'.

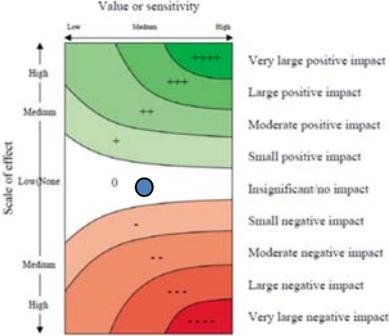
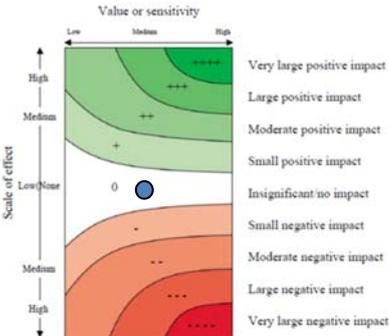
##### Evaluation of value:

Low Medium High

|-----|-----|

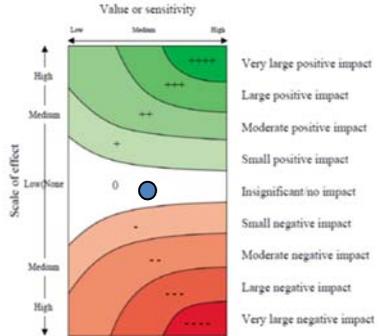
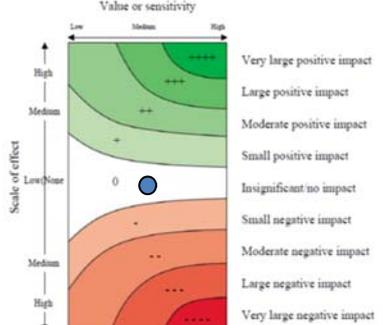
X

## PIPELINES –Onshore Impacts

2. Description of the scale of effect - Subgroup 1A <b>Option 1: Leave in trench</b>	3. Total (environmental) impact
<p>None of the pipelines or concrete mattresses in subgroup 1A will be recovered. There is no potential for onshore impact.</p> <p><b>Evaluation of scale of effect:</b> High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- -----  X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: ‘No impact’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle.</p> 
<p><b>2. Description of the scale of effect - Subgroup 1B</b> <b>Option 2: Recover by cut and lift</b></p> <p>Pipelines in subgroup 1B comprise 71 tonnes of steel, 66 tonnes of concrete (including mattresses) and 190 tonnes of plastics and protective coatings. From the total weight of 327 tonnes, all material will be recovered with no material being left <i>in situ</i>. As a comparison, the removal of the topsides will result in 75,000 tonnes of steel being processed onshore. Given that dismantling facilities will operate within license conditions and will take appropriate steps to limit exposure of site personnel, the potential onshore impact of processing this small volume of material is estimated to be ‘insignificant’.</p> <p><b>Evaluation of scale of effect:</b> High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- -----  X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 2: ‘Insignificant’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle.</p> 



## PIPELINES - Onshore Impacts

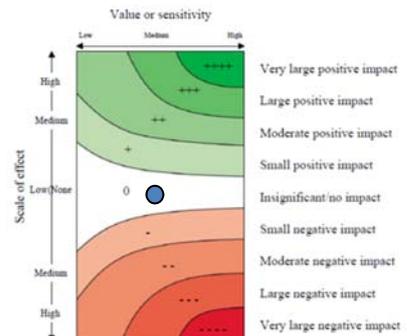
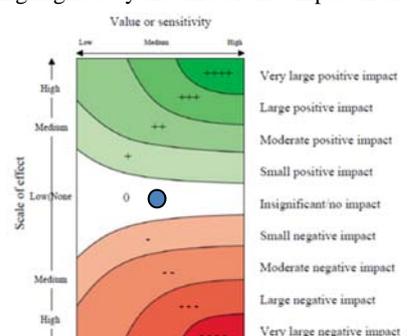
2. Description of the scale of effect - Subgroup 2A Option 2: Leave tied-in at platforms, trench & backfill non-platform ends	3. Total (environmental) impact
<p>The three pipelines in subgroup 2A are 6.4 km long in total and comprise 2,577 tonnes of steel, concrete and protective coating, plus 5.5 t anodes and 153 t of concrete mattresses.</p> <p>Only 10% of the pipeline inventory will be recovered, meaning some 275 t of material will come to shore. The remaining pipeline material will remain <i>in situ</i>.</p> <p>The volume that will come to shore is insignificant. As a comparison, the removal of the topsides will result in 75,000 tonnes of steel being processed onshore.</p> <p>Given that dismantling facilities will operate within license conditions, the potential onshore impact of processing this volume of material is estimated to be 'insignificant'.</p> <p><b>Evaluation of scale of effect:</b> High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 2: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle</p> 
<p>The three pipelines in subgroup 2A are 6.4 km long in total and comprise 2,577 tonnes of steel, concrete and protective coating, plus 5.5 t anodes and 153 t of concrete mattresses.</p> <p>Only 10% of the pipeline inventory will be recovered, meaning some 275 t of material will come to shore. The remaining pipeline material will remain <i>in situ</i>.</p> <p>The volume that will come to shore is insignificant. As a comparison, the removal of the topsides will result in 75,000 tonnes of steel being processed onshore.</p> <p>Given that dismantling facilities will operate within license conditions, the potential onshore impact of processing this volume of material is estimated to be 'insignificant'.</p> <p><b>Evaluation of scale of effect:</b> High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 3: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle</p> 



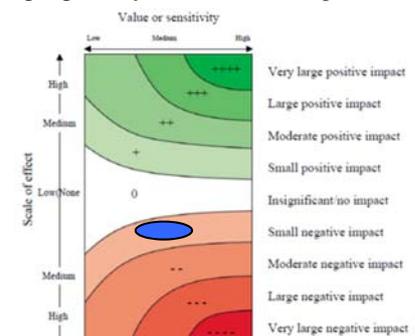
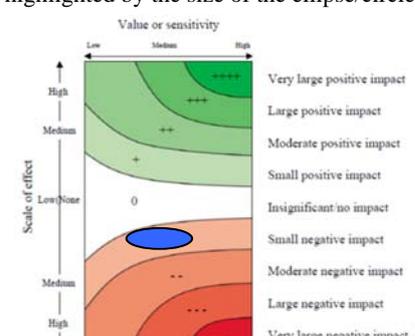




# PIPELINES - Onshore Impacts

<p><b>2. Description of the scale of effect - Subgroup 2B</b>  <b>Option 4: Trench and backfill whole length</b></p> <p>The 7 pipelines in subgroup 2B are ~25 km long in total and comprise 15,674 tonnes of steel, concrete and protective coating, plus 25.4 t anodes and 366 t of concrete mattresses.</p> <p>Only 5% of the pipeline inventory will be recovered, meaning some 882 t of material will come to shore. The remaining pipeline material will remain <i>in situ</i>.</p> <p>The volume that will come to shore is insignificant. As a comparison, the removal of the topsides will result in 75,000 tonnes of steel being processed onshore.</p> <p>Given that dismantling facilities will operate within license conditions, the potential onshore impact of processing this volume of material is estimated to be 'insignificant'.</p> <p><b>Evaluation of scale of effect:</b>  High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- -----   <span style="margin-left: 150px;">X</span></p>	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 4: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle</p> 
<p><b>2. Description of the scale of effect - Subgroup 2B</b>  <b>Option 5: Rock dump whole length</b></p> <p>The 7 pipelines in subgroup 2B are ~25 km long in total and comprise 15,674 tonnes of steel, concrete and protective coating, plus 25.4 t anodes and 366 t of concrete mattresses.</p> <p>Only 3% of the pipeline inventory will be recovered, meaning some 468 t of material will come to shore. The remaining pipeline material will remain <i>in situ</i>.</p> <p>The volume that will come to shore is insignificant. As a comparison, the removal of the topsides will result in 75,000 tonnes of steel being processed onshore.</p> <p>Given that dismantling facilities will operate within license conditions, the potential onshore impact of processing this volume of material is estimated to be 'insignificant'.</p> <p><b>Evaluation of scale of effect:</b>  High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- -----   <span style="margin-left: 150px;">X</span></p>	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 5: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle</p> 

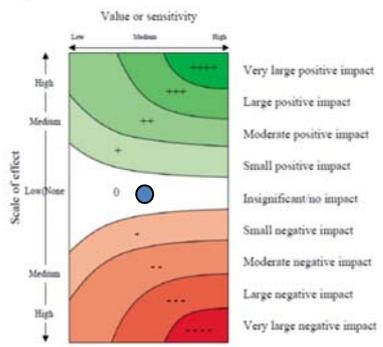
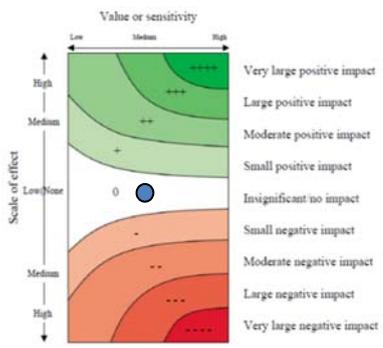
## PIPELINES - Onshore Impacts

2. Description of the scale of effect - Subgroup 2B <b>Option 6: Recover whole length by cut and lift</b>	3. Total (environmental) impact
<p>The 7 pipelines in subgroup 2B are ~25 km long in total and comprise 15,674 tonnes of steel, concrete and protective coating, plus 25.4 t anodes and 366 t of concrete mattresses.</p> <p>98% of the pipeline inventory will be recovered, meaning some 15,735 t of material will come to shore. The remaining pipeline material will remain <i>in situ</i>.</p> <p>The volume that will come to shore has potential to cause some onshore nuisance (e.g. noise, dust, traffic). Given that dismantling facilities will operate within license conditions, the potential onshore impact of processing this volume of material is estimated to be 'small negative'. As a comparison, the removal of the topsides will result in 75,000 tonnes of steel being processed onshore.</p> <p><b>Evaluation of scale of effect:</b>            High neg.    Medium neg.    Low/none    Medium pos.    High pos.             ----- ----- ----- -----   <div style="text-align: center; margin-top: 10px;">X</div> </p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 6: 'Small negative'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle</p>  <p>The matrix plots 'Scale of effect' (High, Medium, Low/None) against 'Value or sensitivity' (Low, Medium, High). Impact levels range from 'Very large positive impact' (top right) to 'Very large negative impact' (bottom right). A blue ellipse is centered in the 'Small negative impact' region.</p>
2. Description of the scale of effect - Subgroup 2B <b>Option 7: Recover whole length by reverse S lay (single joint)</b>	3. Total (environmental) impact
<p>The 7 pipelines in subgroup 2B are ~25 km long in total and comprise 15,674 tonnes of steel, concrete and protective coating, plus 25.4 t anodes and 366 t of concrete mattresses.</p> <p>98% of the pipeline inventory will be recovered, meaning some 15,677 t of material will come to shore. The remaining pipeline material will remain <i>in situ</i>.</p> <p>The volume that will come to shore has potential to cause some onshore nuisance (e.g. noise, dust, traffic). Given that dismantling facilities will operate within license conditions, the potential onshore impact of processing this volume of material is estimated to be 'small negative'. As a comparison, the removal of the topsides will result in 75,000 tonnes of steel being processed onshore.</p> <p><b>Evaluation of scale of effect:</b>            High neg.    Medium neg.    Low/none    Medium pos.    High pos.             ----- ----- ----- -----   <div style="text-align: center; margin-top: 10px;">X</div> </p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 7: 'Small negative'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle</p>  <p>The matrix plots 'Scale of effect' (High, Medium, Low/None) against 'Value or sensitivity' (Low, Medium, High). Impact levels range from 'Very large positive impact' (top right) to 'Very large negative impact' (bottom right). A blue ellipse is centered in the 'Small negative impact' region.</p>



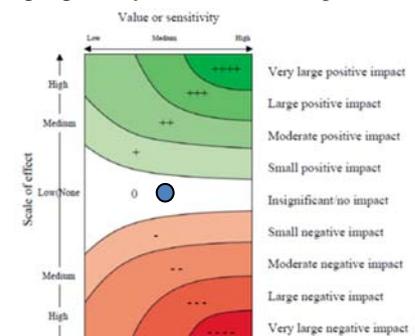
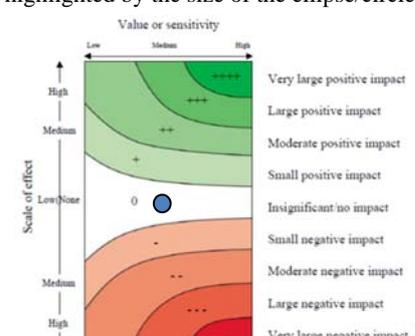


## PIPELINES - Onshore Impacts

2. Description of the scale of effect - Subgroup 2C	3. Total (environmental) impact
<p><b>Option 8: Trench and backfill shallow-trenched sections and isolated rock dump (N501)</b></p> <p>The pipeline in subgroup 2C is 36 km long and comprises 25,529 tonnes of steel, concrete and protective coating, plus 52 t anodes and 171 t concrete mattresses.</p> <p>Under this option, 99% of pipeline inventory will remain <i>in situ</i>, with less than 300 t returned to shore, hence there will be insignificant onshore impact.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 8: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle</p> 
<p><b>Option 9: Rock dump all shallow - trenched sections (N501)</b></p> <p>The pipeline in subgroup 2C is 36 km long and comprises 25,529 tonnes of steel, concrete and protective coating, plus 52 t anodes and 171 t concrete mattresses.</p> <p>Under this option, more than 99% of the pipeline inventory will remain <i>in situ</i>, with only approximately 100 t returned to shore, hence there will be insignificant onshore impact.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 9: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle</p> 

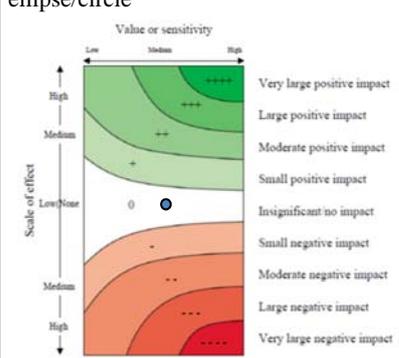
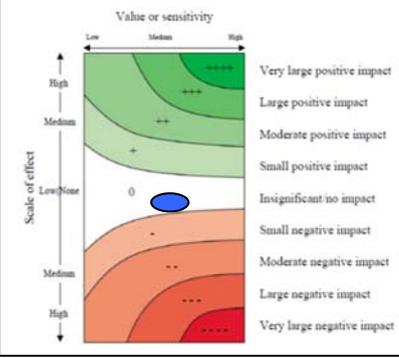


## PIPELINES - Onshore Impacts

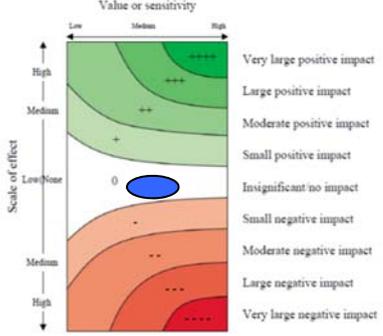
2. Description of the scale of effect - Subgroup 2D <b>Option 5: Rock dump whole length</b>	3. Total (environmental) impact
<p>The pipeline in subgroup 2D is approximately 400 metres long and comprise 121 t of steel, concrete and protective coating, plus 0.2 t anodes and 151 t of concrete mattresses. Only 20% of the pipeline inventory will be recovered, meaning some 30 t of material will come to shore. The remaining pipeline material will remain <i>in situ</i>.</p> <p>The volume that will come to shore is insignificant. As a comparison, the removal of the topsides will result in 75,000 tonnes of steel being processed onshore.</p> <p>Given that dismantling facilities will operate within license conditions, the potential onshore impact of processing this volume of material is estimated to be 'insignificant'.</p> <p><b>Evaluation of scale of effect:</b>            High neg.    Medium neg.    Low/none    Medium pos.    High pos.             ----- ----- ----- -----   <span style="margin-left: 200px;">X</span></p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 5: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle</p> 
2. Description of the scale of effect - Subgroup 2D <b>Option 6: Recover whole length by cut and lift</b>	3. Total (environmental) impact
<p>The pipeline in subgroup 2D is approximately 400 metres long and comprise 121 t of steel, concrete and protective coating, plus 0.2 t anodes and 151 t of concrete mattresses. 100% of the pipeline inventory will be recovered, meaning some 121 t of material will come to shore. The remaining pipeline material will remain <i>in situ</i>.</p> <p>The volume that will come to shore is insignificant. As a comparison, the removal of the topsides will result in 75,000 tonnes of steel being processed onshore.</p> <p>Given that dismantling facilities will operate within license conditions, the potential onshore impact of processing this volume of material is estimated to be 'insignificant'.</p> <p><b>Evaluation of scale of effect:</b>            High neg.    Medium neg.    Low/none    Medium pos.    High pos.             ----- ----- ----- -----   <span style="margin-left: 200px;">X</span></p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 6: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle</p> 



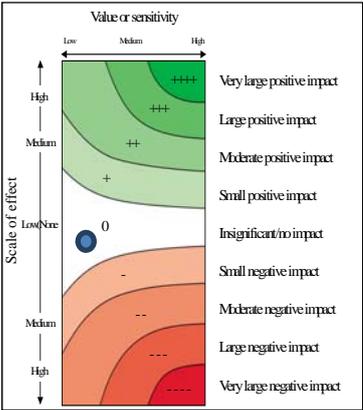
## PIPELINES - Onshore Impacts

<p><b>2. Description of the scale of effect - Subgroup 2E</b>  <b>Option 5: Rock dump whole length</b></p> <p>The pipelines in subgroup 2E are approximately 4.6 km long and comprise 2,218 t of steel, concrete and protective coating, plus 4 t anodes. There are no concrete mattresses. No material will be recovered under this option, hence there will be no onshore impact.</p> <p><b>Evaluation of scale of effect:</b>          High neg.    Medium neg.    Low/none    Medium pos.    High pos.           ----- ----- ----- -----   <span style="margin-left: 200px;">X</span></p>	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 5: 'No impact'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle</p> 
<p><b>2. Description of the scale of effect - Subgroup 2E</b>  <b>Option 6: Recover whole length by cut and lift</b></p> <p>The pipelines in subgroup 2E are approximately 4.6 km long and comprise 2,218 t of steel, concrete and protective coating, plus 4 t anodes. There are no concrete mattresses. 100% of the pipeline inventory will be recovered, meaning some 2,222 t of material will come to shore. The volume that will come to shore is small. As a comparison, the removal of the topsides will result in 75,000 tonnes of steel being processed onshore. Given that dismantling facilities will operate within license conditions, the potential onshore impact of processing this volume of material is estimated to be 'insignificant'.</p> <p><b>Evaluation of scale of effect:</b>          High neg.    Medium neg.    Low/none    Medium pos.    High pos.           ----- ----- ----- -----   <span style="margin-left: 200px;">X</span></p>	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 6: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle</p> 

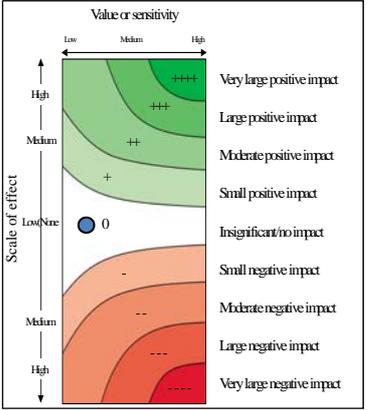
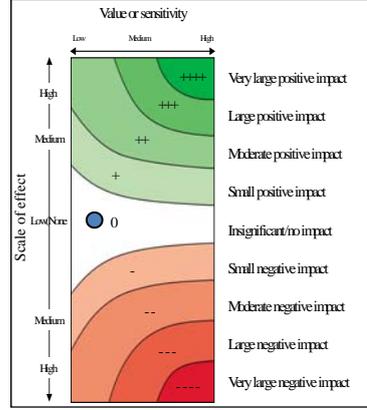
## PIPELINES - Onshore Impacts

2. Description of the scale of effect - Subgroup 2E Option 7: Recover whole length by reverse S-lay	3. Total (environmental) impact
<p>The pipelines in subgroup 2E are approximately 4.6 km long and comprise 2,218 t of steel, concrete and protective coating, plus 4 t anodes. There are no concrete mattresses.</p> <p>100% of the pipeline inventory will be recovered, meaning some 2,222 t of material will come to shore. The volume that will come to shore is small. As a comparison, the removal of the topsides will result in 75,000 tonnes of steel being processed onshore.</p> <p>Given that dismantling facilities will operate within license conditions, the potential onshore impact of processing this volume of material is estimated to be 'insignificant'.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 7: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle</p> 

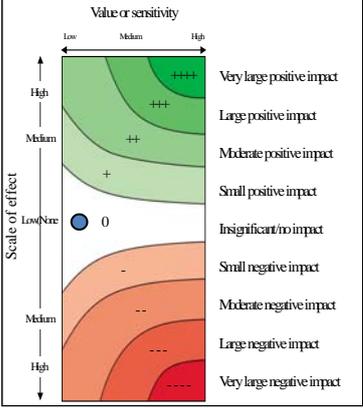
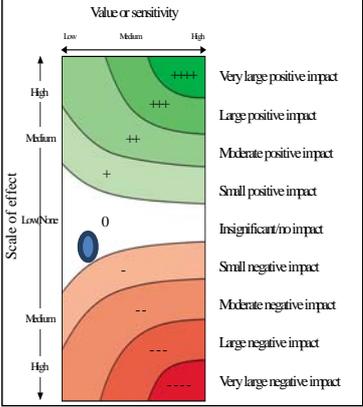
## 1.13 PIPELINES - RESOURCE USE

<p><b>Category: Pipelines – Groups 1 and 2</b></p> <p><b>Consequence evaluation for: Resource Use</b></p>	
<p><b>1. General description of the receiving environment (situation and characteristics)</b></p> <p>The baseline for resource use is the same for all pipeline options.</p> <p>A significant issue when considering resource use is fuel consumption from onshore and offshore decommissioning activities. Detailed information is presented in DNV GL's <i>Energy and Emissions Report for the Brent Field Decommissioning EIA</i> [1]. The corresponding energy consumption (and associated air emissions) from fuel use are captured in the 'Energy and Emissions' category. Hence the 'Resource Use' matrices do not include fuel use.</p> <p>The decommissioning of pipelines will involve the use of rock for rock dumping. No other resources will be used in decommissioning activities for pipelines. The value of this resource is assessed to be 'low'.</p> <p><b>Evaluation of the value:</b></p> <p>Low    Medium    High</p> <p> ----- ----- </p> <p>X</p>	
<p><b>2. Description of the scale of effect - Subgroup 1A</b></p> <p><b>Option 1: Leave in trench</b></p> <p>500 t of rock will be used for rock dumping subgroup 1A pipelines. The impact is estimated to be 'insignificant'.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p>X</p>	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix.</p> <p><b>Option 1: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

## PIPELINES – Resource Use

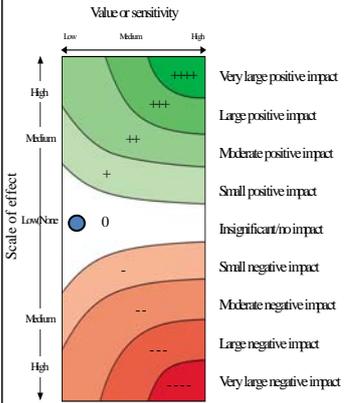
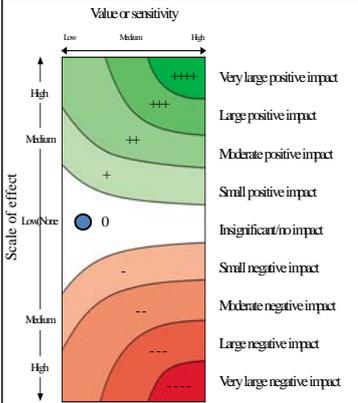
<p><b>2. Description of the scale of effect - Subgroup 1B</b>  <b>Option 2: Recover by cut and lift</b></p> <p>No additional resources will be used for decommissioning subgroup 1B pipelines. Therefore, there will be ‘no impact’.</p> <p><b>Evaluation of scale of effect:</b>          High neg.    Medium neg.    Low/none    Medium pos.    High pos.           ----- ----- ----- -----   <span style="margin-left: 200px;">X</span></p>	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 2: ‘No impact’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 
<p><b>2. Description of the scale of effect - Subgroup 1C</b>  <b>Option 3: Remove by reverse reeling</b></p> <p>No additional resources will be used for decommissioning subgroup 1C pipelines. Therefore, there will be ‘no impact’.</p> <p><b>Evaluation of scale of effect:</b>          High neg.    Medium neg.    Low/none    Medium pos.    High pos.           ----- ----- ----- -----   <span style="margin-left: 200px;">X</span></p>	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 3: ‘No impact’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

## PIPELINES – Resource Use

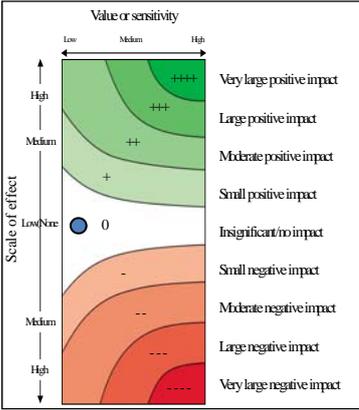
<p><b>2. Description of the scale of effect - Subgroup 2A</b>  <b>Option 2: Leave tied-in at platforms, trench and backfill non-platform ends</b></p> <p>No additional resources will be used for decommissioning pipelines in subgroup 2A. Therefore, there will be 'no impact'.</p> <p><b>Evaluation of scale of effect:</b>          High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 2: 'No impact'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 
<p><b>2. Description of the scale of effect - Subgroup 2A</b>  <b>Option 3: Leave tied-in at platforms and rock dump non-platform ends</b></p> <p>1,530 tonnes of rock will be used for rock dumping subgroup 2A pipelines. The impact is estimated to be insignificant.</p> <p><b>Evaluation of scale of effect:</b>          High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 3: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 



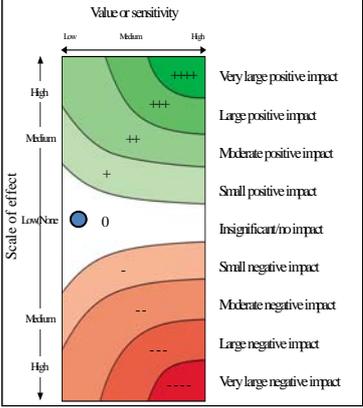
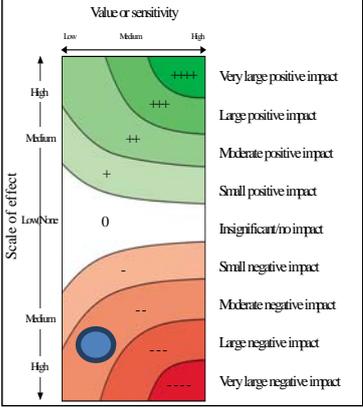
## PIPELINES – Resource Use

<p><b>2. Description of the scale of effect - Subgroup 2A</b>  <b>Option 6: Recover whole length by cut and lift</b></p> <p>Few resources will be used for decommissioning pipelines. Therefore, there will be 'insignificant' impact.</p> <p><b>Evaluation of scale of effect:</b>          High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 6: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 
<p><b>2. Description of the scale of effect - Subgroup 2A</b>  <b>Option 7: Recover whole length by reverse S lay (single joint)</b></p> <p>Few additional resources will be used for decommissioning pipelines. Therefore, there will be 'insignificant' impact.</p> <p><b>Evaluation of scale of effect:</b>          High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 7: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

## PIPELINES – Resource Use

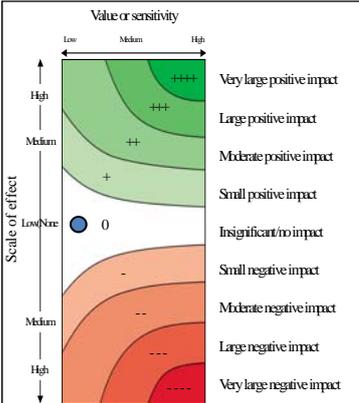
2. Description of the scale of effect - Subgroup 2B <b>Option 1: Leave <i>in situ</i> with no further remediation</b>	3. Total (environmental) impact
<p>Few additional resources will be used for decommissioning pipelines. Therefore, there will be 'insignificant' impact.</p> <p><b>Evaluation of scale of effect:</b>            High neg.    Medium neg.    Low/none    Medium pos.    High pos.             ----- ----- ----- -----   <span style="margin-left: 250px;">X</span></p>	<p>1) and 2) are combined in the impact matrix.</p> <p><b>Option 1: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

## PIPELINES – Resource Use

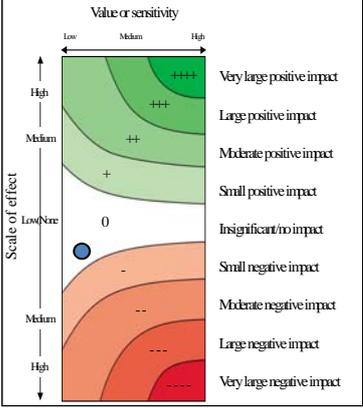
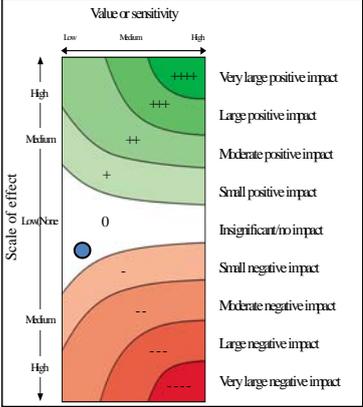
<p><b>2. Description of the scale of effect - Subgroup 2B</b>  <b>Option 4: Trench and backfill whole length</b></p> <p>Few additional resources will be used for decommissioning pipelines. Therefore, there will be ‘insignificant’ impact.</p> <p><b>Evaluation of scale of effect:</b>          High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 4: ‘Insignificant’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 
<p><b>2. Description of the scale of effect - Subgroup 2B</b>  <b>Option 5: Rock dump whole length</b></p> <p>430,300 tonnes of rock will be used for rock dumping subgroup 2B pipelines; this is estimated to have a ‘moderate negative’ impact.</p> <p><b>Evaluation of scale of effect:</b>          High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 5: ‘Moderate negative’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 



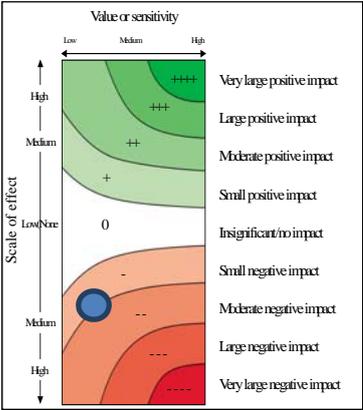
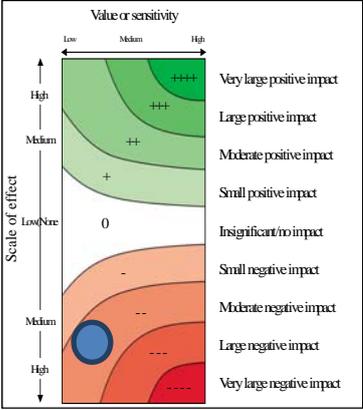
## PIPELINES – Resource Use

2. Description of the scale of effect - Subgroup 2C <b>Option 1: Leave disconnected on seabed and trench and backfill ends</b>	3. Total (environmental) impact
<p>No additional resources will be used for decommissioning pipelines. Therefore, there will be 'no impact'.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: 'No impact'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

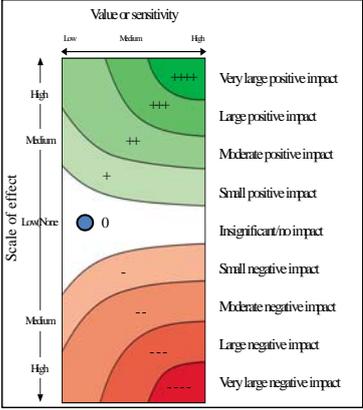
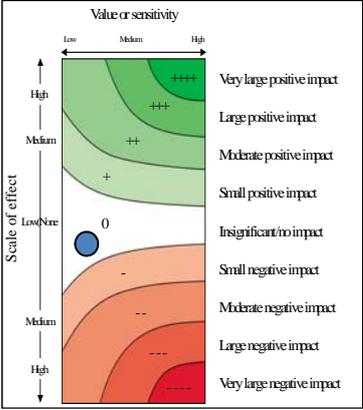
## PIPELINES – Resource Use

<p><b>2. Description of the scale of effect - Subgroup 2C</b>  <b>Option 6: Recover whole length by cut and lift</b></p> <p>Few additional resources (~3,000 t rock dump) will be used for decommissioning pipelines, with an 'insignificant' impact.</p> <p><b>Evaluation of scale of effect:</b>  High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 6: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 
<p><b>2. Description of the scale of effect - Subgroup 2C</b>  <b>Option 7: Recover whole length by reverse S lay (single joint)</b></p> <p>Few additional resources (~3,000 t rock dump) will be used for decommissioning pipelines, with an 'insignificant' impact.</p> <p><b>Evaluation of scale of effect:</b>  High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 7: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

## PIPELINES – Resource Use

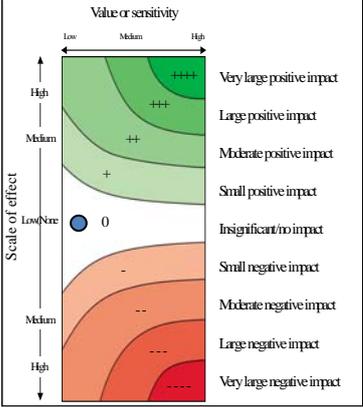
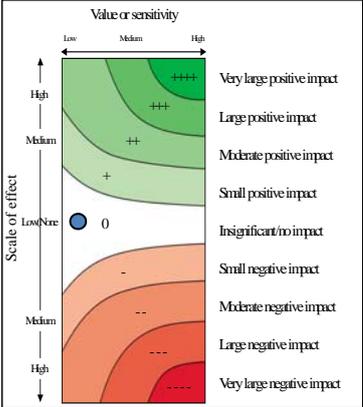
<p><b>2. Description of the scale of effect - Subgroup 2C</b>  <b>Option 8: Trench and backfill shallow-trenched sections and isolated rock dump (N501)</b></p> <p>146,800 tonnes of rock will be used for rock dumping the pipeline. The impact is estimated to be ‘small-moderate negative’.</p> <p><b>Evaluation of scale of effect:</b>          High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 8: ‘Small-moderate negative’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 
<p><b>2. Description of the scale of effect - Subgroup 2C</b>  <b>Option 9: Rock dump all shallow-trenched sections (N501)</b></p> <p>Almost 490,000 tonnes of rock will be used for this option, with a ‘moderate negative’ impact.</p> <p><b>Evaluation of scale of effect:</b>          High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 9: ‘Moderate negative’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

## PIPELINES – Resource Use

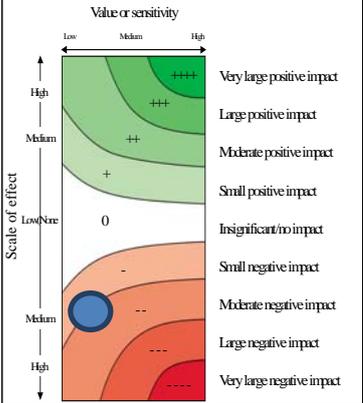
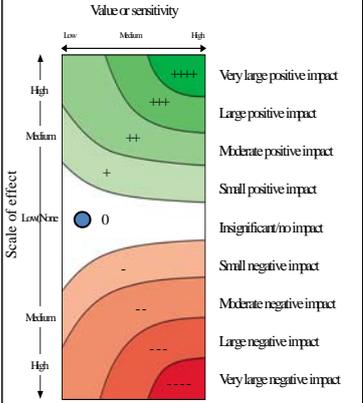
<p><b>2. Description of the scale of effect - Subgroup 2D</b>  <b>Option 2: Leave tied-in at platforms, no rock dump on closing spans, trench and backfill non-platform ends</b></p>	<p><b>3. Total (environmental) impact</b></p>
<p>No additional resources will be used for decommissioning pipelines. Therefore, there will be 'no impact'.</p> <p><b>Evaluation of scale of effect:</b>          High neg.    Medium neg.    Low/none    Medium pos.    High pos.           ----- ----- ----- -----   <span style="margin-left: 250px;">X</span></p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 2: 'No impact'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 
<p><b>2. Description of the scale of effect - Subgroup 2D</b>  <b>Option 3: Leave tied-in at platforms and rock dump non-platform ends</b></p>	<p><b>3. Total (environmental) impact</b></p>
<p>510 tonnes of rock will be used for rock dumping pipelines. The impact is estimated to be 'insignificant'.</p> <p><b>Evaluation of scale of effect:</b>          High neg.    Medium neg.    Low/none    Medium pos.    High pos.           ----- ----- ----- -----   <span style="margin-left: 250px;">X</span></p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 3: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 



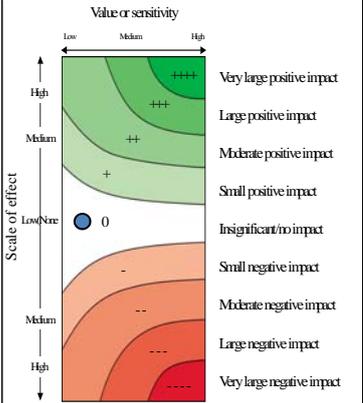
## PIPELINES – Resource Use

2. Description of the scale of effect - Subgroup 2E Option 1: Leave <i>in situ</i> with no further remediation	3. Total (environmental) impact
<p>No additional resources will be used for decommissioning pipelines. Therefore, there will be 'no impact'.</p> <p><b>Evaluation of scale of effect:</b>            High neg.    Medium neg.    Low/none    Medium pos.    High pos.             ----- ----- ----- -----   <span style="margin-left: 250px;">X</span></p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: 'No impact'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 
2. Description of the scale of effect - Subgroup 2E Option 4: Trench and backfill whole length	3. Total (environmental) impact
<p>No additional resources will be used for decommissioning pipelines. Therefore, there will be 'no impact'.</p> <p><b>Evaluation of scale of effect:</b>            High neg.    Medium neg.    Low/none    Medium pos.    High pos.             ----- ----- ----- -----   <span style="margin-left: 250px;">X</span></p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 4: 'No impact'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

## PIPELINES – Resource Use

<p><b>2. Description of the scale of effect - Subgroup 2E</b>  <b>Option 5: Rock dump whole length</b></p> <p>78,200 tonnes of rock will be used for rock dumping subgroup 2E pipelines under this option. The impact is estimated to be ‘small-moderate negative’.</p> <p><b>Evaluation of scale of effect:</b>  High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 5: ‘Small-moderate negative’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 
<p><b>2. Description of the scale of effect - Subgroup 2E</b>  <b>Option 6: Recover whole length by cut and lift</b></p> <p>No additional resources will be used for decommissioning pipelines. Therefore, there will be ‘no impact’.</p> <p><b>Evaluation of scale of effect:</b>  High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 6: ‘No impact’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

## PIPELINES – Resource Use

2. Description of the scale of effect - Subgroup 2E Option 7: Recover whole length by reverse lay	3. Total (environmental) impact
<p>No additional resources will be used for decommissioning pipelines. Therefore, there will be 'no impact'.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 7: 'No impact'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

<sup>1</sup> DNV GL, *Energy Use and Gaseous Emissions Report for the Brent Field Decommissioning EIA*, DNV GL Report No.: 187KVXJ-3, Rev 5, 2016.



## 1.14 PIPELINES - HAZARDOUS SUBSTANCES

**Category: Pipelines – Group 1 and 2**

**Consequence evaluation for: Hazardous Substances**

### 1. General description of the receiving environment (situation and characteristics)

This set of matrices focusses on the release of hazardous substances to the environment during decommissioning operations. The receiving environment in this instance depends on where the hazardous substance is released (if at all).

The receiving environment could be either:

- at Brent Field: low-medium sensitivity as described in, for example, 'Marine', or
- Onshore: medium sensitivity (with some uncertainty) is assumed for the onshore location for pipeline decommissioning (the location is currently unknown).

Note:

Prior to decommissioning, all pipelines will have been cleaned and flushed as part of the preparatory works. Where pipes are left *in situ*, the long-term impact of the release of residual contaminants (if any) is considered within 'Legacy'.

Non-hazardous waste is dealt with in the 'Waste'.

### Evaluation of the value:

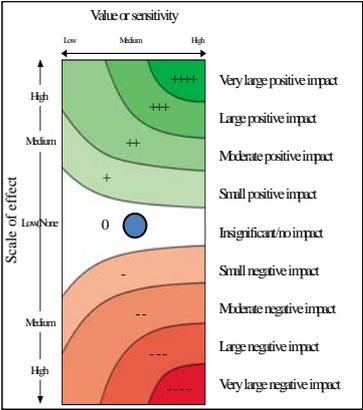
Low Medium High

|-----|-----|

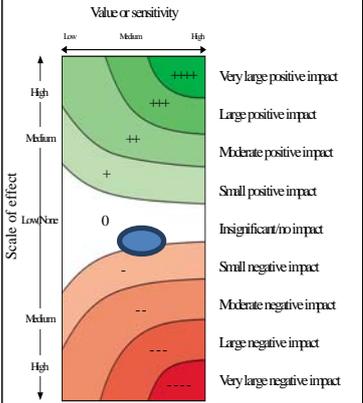
X X



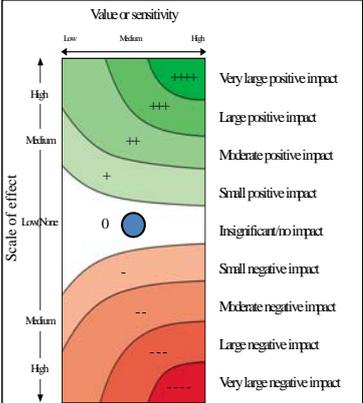
## PIPELINES – Hazardous Substances

<p><b>2. Description of the scale of effect - Subgroup 2A</b></p> <p><b>Option 2: Leave tied-in at platforms, trench and backfill remote ends</b></p> <p><b>Option 3: Leave tied-in at platforms and rock dump closing spans and remote ends</b></p> <p><b>Option 4: Trench and backfill whole length</b></p> <p><b>Option 5: Rock dump whole length</b></p>	<p><b>3. Total (environmental) impact</b></p>
<p>These decommissioning options will leave the pipelines in place. This will prevent release to the environment of any residual hazardous substances that may be present inside (if any) after draining/cleaning, until the pipes break down over time (see 'Legacy').</p> <p>There is therefore 'no impact' for all options.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Options 2-6: 'No impact'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

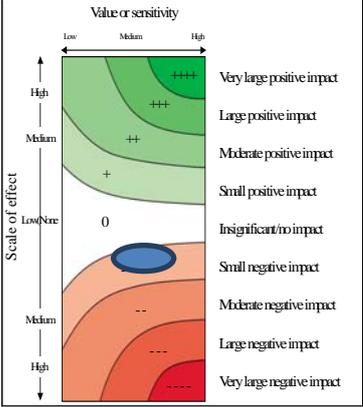
## PIPELINES – Hazardous Substances

<p><b>2. Description of the scale of effect - Subgroup 2A</b></p> <p><b>Option 6: Recover whole length by cut and lift</b></p> <p><b>Option 7: Recover whole length by reverse S lay (single joint)</b></p> <p>Under Options 6 and 7 the pipelines will be recovered to shore.</p> <p>Although the pipes will have been drained and flushed prior to decommissioning, the pipes may still contain some residual hazardous materials such as NORM, mercury and hazardous paint coatings (e.g. lead chromate paints, isocyanate paints and anti-fouling paints containing TBT). These can only be quantified once the pipes are brought to shore.</p> <p>All operations will be managed onshore at a licensed site and there are no wastes present that are not typical of offshore operations. The site will need to conduct detailed surveys onshore of hazardous materials present within the pipelines. Following the surveys, specific plans will need to be updated (if necessary) and implemented to manage all hazardous wastes in line with legislative requirements and good practice.</p> <p>Reflecting the length of pipeline that will be recovered (6.4 km), and the management measures that will be in place, the impact for all options is assessed to be 'insignificant-small negative'.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Options 6 &amp; 7: 'Insignificant-small negative'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 
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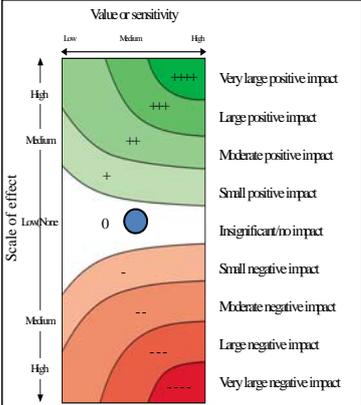
## PIPELINES – Hazardous substances

<p><b>2. Description of the scale of effect - Subgroup 2B</b></p> <p><b>Option 1: Leave <i>in situ</i> with no further remediation</b></p> <p><b>Option 4: Trench and backfill whole length</b></p> <p><b>Option 5: Rock dump whole length</b></p>	<p><b>3. Total (environmental) impact</b></p>
<p>These decommissioning options will leave the pipelines in place. This will prevent release to the environment of any residual hazardous substances that may be present inside (if any) after draining/cleaning, until the pipes break down over time (see 'Legacy').</p> <p>There is therefore 'no impact' for all options.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p><b>Options 1, 4 &amp; 5: 'No impact'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

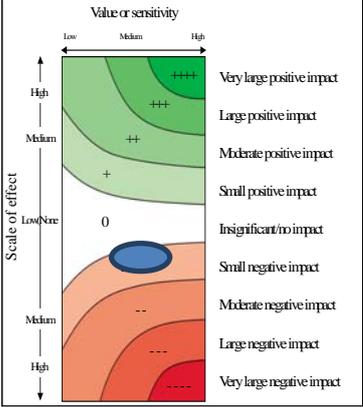
## PIPELINES – Hazardous Substances

<b>2. Description of the scale of effect - Subgroup 2B</b> <b>Option 6: Recover whole length by cut and lift</b> <b>Option 7: Recover whole length by reverse S lay (single joint)</b>	<b>3. Total (environmental) impact</b>
<p>Under Options 6 and 7 the pipelines will be recovered to shore.</p> <p>Although the pipes will have been drained and flushed prior to decommissioning, the pipes may still contain some residual hazardous materials such as NORM, mercury and hazardous paint coatings (e.g. lead chromate paints, isocyanate paints and anti-fouling paints containing TBT). These can only be quantified once the pipes are brought to shore.</p> <p>All operations will be managed onshore at a licensed site and there are no wastes present that are not typical of offshore operations. The site will need to conduct detailed surveys onshore of hazardous materials present within the pipelines. Following the surveys, specific plans will need to be updated (if necessary) and implemented to manage all hazardous wastes in line with legislative requirements and good practice.</p> <p>Reflecting the length of pipeline that will be recovered (~25 km), and the management measures that will be in place, the impact for all options is assessed to be 'small negative'.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p>----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p><b>Options 6 &amp; 7: 'Small negative'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

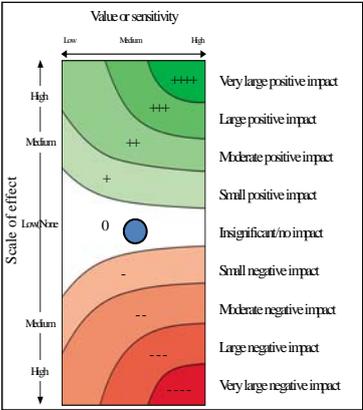
## PIPELINES – Hazardous Substances

<b>2. Description of the scale of effect - Subgroup 2C</b> <b>Option 1: Leave <i>in situ</i> with no further remediation</b> <b>Option 8: Trench and backfill shallow-trenched sections and isolated rock dump</b> <b>Option 9: Rock dump all shallow-trenched sections</b>	<b>3. Total (environmental) impact</b>
<p>These decommissioning options will leave the pipeline in place. This will prevent release to the environment of any residual hazardous substances that may be present inside (if any) after draining/cleaning, until the pipe breaks down over time (see 'Legacy').</p> <p>There is therefore 'no impact' for all options.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p><b>Options 1, 8 &amp; 9: 'No impact'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

## PIPELINES – Hazardous Substances

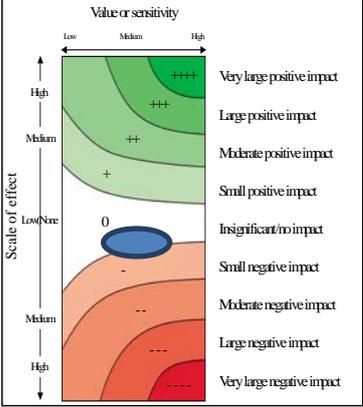
<b>2. Description of the scale of effect - Subgroup 2C</b> <b>Option 6: Recover whole length by cut and lift</b> <b>Option 7: Recover whole length by reverse S lay (single joint)</b>	<b>3. Total (environmental) impact</b>
<p>Under Options 6 and 7 the pipeline will be recovered to shore.</p> <p>Although the pipe will have been drained and flushed prior to decommissioning, the pipe may still contain some residual hazardous materials such as NORM, mercury and hazardous paint coatings (e.g. lead chromate paints, isocyanate paints and anti-fouling paints containing TBT). These can only be quantified once the pipe is brought to shore.</p> <p>All operations will be managed onshore at a licensed site and there are no wastes present that are not typical of offshore operations. The site will need to conduct detailed surveys onshore of hazardous materials present within the pipelines. Following the surveys, specific plans will need to be updated (if necessary) and implemented to manage all hazardous wastes in line with legislative requirements and good practice.</p> <p>Reflecting the length of pipeline that will be recovered (36 km), and the management measures that will be in place, the impact for all options is assessed to be 'small negative'.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p><b>Options 6 &amp; 7: 'Small negative'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

## PIPELINES – Hazardous Substances

<p><b>2. Description of the scale of effect - Subgroup 2D</b></p> <p><b>Option 2: Leave tied-in at platforms, trench and backfill non-platform ends</b></p> <p><b>Option 3: Leave tied-in at platforms and rock dump non-platform</b></p> <p><b>Option 5: Rock dump whole length</b></p> <p><b>Option 6: Recover whole length by cut and lift</b></p>	<p><b>3. Total (environmental) impact</b></p>
<p>Options 2, 3 and 5 will leave the pipeline in place. This will prevent release to the environment of any residual hazardous substances that may be present inside (if any) after draining/cleaning, until the pipes break down over time (see 'Legacy').</p> <p>Impact will only potentially result from Option 6, where the pipeline will be cut, recovered and treated onshore. Although the pipe will have been drained and flushed prior to decommissioning, the pipe may still contain some residual hazardous materials such as NORM, mercury and hazardous paint coatings (e.g. lead chromate paints, isocyanate paints and anti-fouling paints containing TBT). These can only be quantified once the pipe is brought to shore. All operations will be managed onshore at a licensed site and there are no wastes present that are not typical of offshore operations. The site will need to conduct detailed surveys onshore of hazardous materials present within the pipeline. Following the surveys, specific plans will need to be updated (if necessary) and implemented to manage all hazardous wastes in line with legislative requirements and good practice. The short length of the pipeline will also limit the scale of the effect.</p> <p>The impact of all options is assessed to be 'insignificant'.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Options 2, 3, 5 &amp; 6: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 



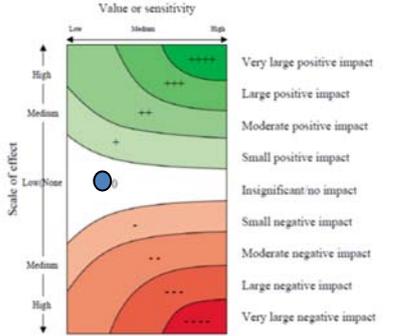
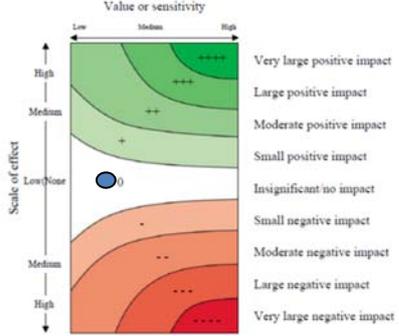
## PIPELINES – Hazardous Substances

<p><b>2. Description of the scale of effect - Subgroup 2E</b>  <b>Option 6: Recover whole length by cut and lift</b>  <b>Option 7: Recover whole length by reverse S lay (single joint)</b></p>	<p><b>3. Total (environmental) impact</b></p>
<p>Under Options 6 and 7 the pipelines will be recovered to shore.</p> <p>Although the pipes will have been drained and flushed prior to decommissioning, the pipes may still contain some residual hazardous materials such as NORM, mercury and hazardous paint coatings (e.g. lead chromate paints, isocyanate paints and anti-fouling paints containing TBT). These can only be quantified once the pipes are brought to shore.</p> <p>All operations will be managed onshore at a licensed site and there are no wastes present that are not typical of offshore operations. The site will need to conduct detailed surveys onshore of hazardous materials present within the pipelines. Following the surveys, specific plans will need to be updated (if necessary) and implemented to manage all hazardous wastes in line with legislative requirements and good practice.</p> <p>Reflecting the length of pipeline that will be recovered (4.6 km), and the management measures that will be in place, the impact for all options is assessed to be 'insignificant-small negative'.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p><b>Options 6 &amp; 7: 'Insignificant-small negative'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p>  <p>The diagram is a 2D matrix with 'Scale of effect' on the vertical axis (High, Medium, Low/None) and 'Value or sensitivity' on the horizontal axis (Low, Medium, High). The matrix is divided into positive (green) and negative (red) impact zones. The positive zones are labeled: Very large positive impact (++++), Large positive impact (+++), Moderate positive impact (++), and Small positive impact (+). The negative zones are labeled: Small negative impact (-), Moderate negative impact (--), Large negative impact (---), and Very large negative impact (----). A blue circle is placed in the 'Insignificant/to impact' zone (0), indicating the assessed impact level.</p>

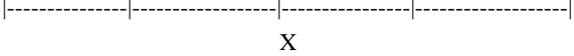
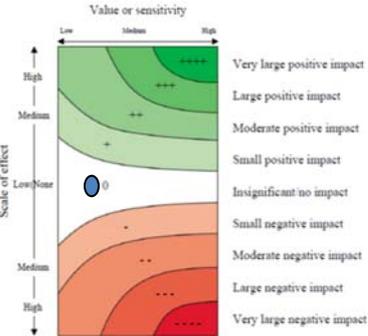
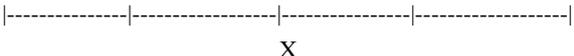
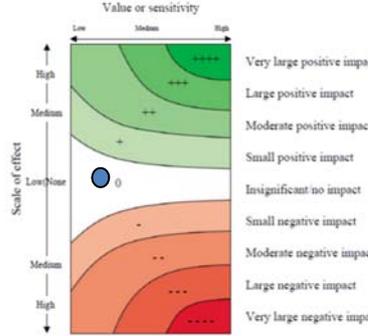
# 1.15 PIPELINES - WASTE

<p><b>Category: Pipelines - Groups 1 and 2</b></p> <p><b>Consequence evaluation for: Waste</b></p>	
<p><b>1. General description of the receiving environment (situation and characteristics)</b></p> <p>The onshore location of the dismantling site for pipelines has not yet been chosen, hence this evaluation of waste management concentrates on the types and amounts of waste generated. The major types of waste generated from the pipelines will be:</p> <ul style="list-style-type: none"> <li>• Steel</li> <li>• Concrete (including from concrete mattresses where relevant)</li> <li>• Marine growth</li> <li>• Smaller quantities of zinc and aluminium (anodes)</li> <li>• Plastics and other coating materials (including asphalt)</li> </ul> <p>The recyclable material from the pipelines is considered to be between ‘medium’ value (steel) to ‘low’ value (concrete) since the bulk of materials generated will be steel and concrete, which have different “values” if recycled. There is uncertainty regarding the total mass of concrete which can feasibly be recycled, but it is assumed that the majority recovered will be suitable for this purpose. Where possible, anodes and other materials (i.e. plastics) will be segregated and recycled.</p> <p><b>Evaluation of value:</b>          Low Medium High           ----- -----           X</p>	
<p><b>2. Description of the scale of effect - Subgroup 1A</b></p> <p><b>Option 1: Leave in trench</b></p> <p>For subgroup 1A, all pipes and concrete mattresses will remain in place, and no waste will be generated.</p> <p><b>Evaluation of scale of effect:</b>          High neg. Medium neg. Low/none Medium pos. High pos.           ----- ----- ----- -----           X</p>	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix.</p> <p><b>Option 1: ‘No impact’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle.</p> <p>The diagram is a 3x3 matrix. The vertical axis is 'Scale of effect' with levels High, Medium, and Low/None. The horizontal axis is 'Value or sensitivity' with levels Low, Medium, and High. The cells are color-coded: top row (High effect) is green, middle row (Medium effect) is light green, and bottom row (Low/None effect) is red. Impact levels are: Very large positive (top-right), Large positive (top-middle), Moderate positive (top-left), Small positive (middle-right), Insignificant no impact (middle-middle, containing a blue circle), Small negative (middle-left), Moderate negative (bottom-right), Large negative (bottom-middle), and Very large negative (bottom-left).</p>

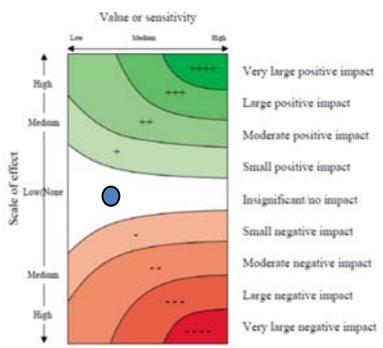
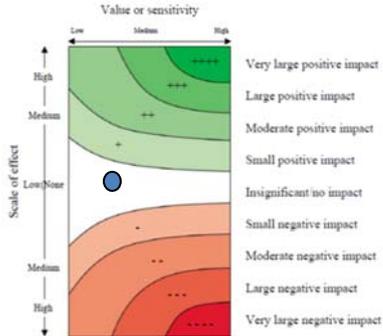
# PIPELINES – Waste

2. Description of the scale of effect – Subgroup 1B Option 2: Recover by cut and lift	3. Total (environmental) impact
<p>Pipelines in subgroup 1B comprise 71 tonnes of steel, 66 tonnes of concrete (including mattresses) and 190 tonnes of plastics and protective coatings. From the total weight of 327 tonnes, all material will be recovered with no material being left <i>in situ</i>. 6.75 km of pipeline will be recovered.</p> <p>As a comparison, the removal of the topsides will result in 75,000 tonnes of steel being processed onshore.</p> <p>The impact from a waste management perspective will be ‘insignificant’.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 2: ‘Insignificant’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle.</p> 
<p>Pipelines in subgroup 1C comprise 578 tonnes of steel, 363 tonnes of concrete mattresses and 251 tonnes of plastics and protective coatings. From the total weight of 1,192 tonnes, all material will be recovered with no material being left <i>in situ</i>. 6.76 km of pipeline will be recovered.</p> <p>As a comparison, the removal of the topsides will result in 75,000 tonnes of steel being processed onshore.</p> <p>The impact from a waste management perspective will be ‘insignificant’.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 3: ‘Insignificant’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle.</p> 

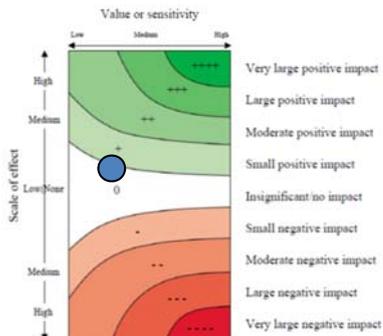
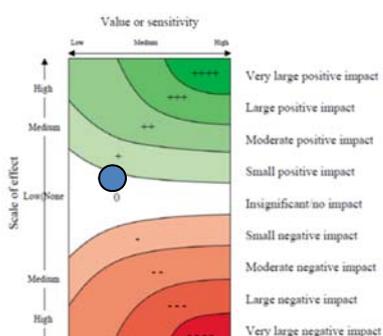
# PIPELINES – Waste

<p><b>2. Description of the scale of effect - Subgroup 2A</b>  <b>Option 2: Leave tied-in at platforms, trench and backfill non-platform ends</b></p> <p>The three pipelines in subgroup 2A are 6.4 km long in total and comprise 2,577 tonnes of steel, concrete and protective coating, plus 5.5 t anodes and 153 t of concrete mattresses.</p> <p>Only 10% of the pipeline inventory will be recovered, meaning some 275 t of material will come to shore. The remaining pipeline material will remain <i>in situ</i>.</p> <p>The volume of waste that will come to shore is 'insignificant'. As a comparison, the removal of the topsides will result in 75,000 tonnes of steel being processed onshore.</p> <p><b>Evaluation of scale of effect:</b>          High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> 	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix.</p> <p><b>Option 2: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle.</p> 
<p><b>2. Description of the scale of effect - Subgroup 2A</b>  <b>Option 3: Leave tied-in at platforms and rock dump the non-platform ends</b></p> <p>The three pipelines in subgroup 2A are 6.4 km long in total and comprise 2,577 tonnes of steel, concrete and protective coating, plus 5.5 t anodes and 153 t of concrete mattresses.</p> <p>Only 10% of the pipeline inventory will be recovered, meaning some 275 t of material will come to shore. The remaining pipeline material will remain <i>in situ</i>.</p> <p>The volume of waste that will come to shore is 'insignificant'. As a comparison, the removal of the topsides will result in 75,000 tonnes of steel being processed onshore.</p> <p><b>Evaluation of scale of effect:</b>          High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> 	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix.</p> <p><b>Option 3: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle.</p> 

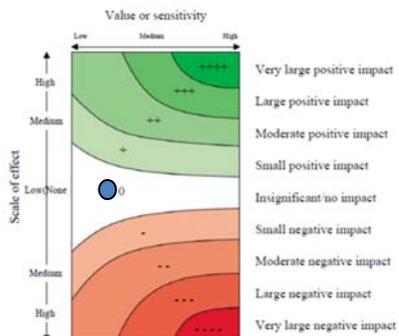
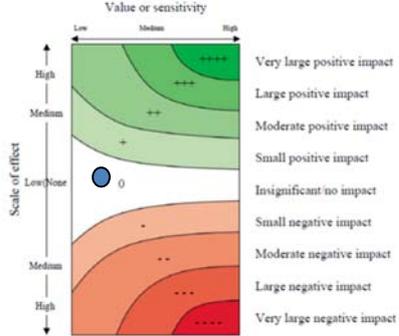
# PIPELINES – Waste

<p><b>2. Description of the scale of effect - Subgroup 2A</b>  <b>Option 4: Trench and backfill whole length</b></p> <p>The three pipelines in subgroup 2A are 6.4 km long in total and comprise 2,577 tonnes of steel, concrete and protective coating, plus 5.5 t anodes and 153 t of concrete mattresses.</p> <p>Only 14% of the pipeline inventory will be recovered, meaning some 384 t of material will come to shore. The remaining pipeline material will remain <i>in situ</i>.</p> <p>The waste volume generated is insignificant. As a comparison, the removal of the topsides will result in 75,000 tonnes of steel being processed onshore.</p> <p>The impact from a waste management perspective will be 'insignificant'.</p> <p><b>Evaluation of scale of effect:</b>          High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 4: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle.</p> 
<p><b>2. Description of the scale of effect - Subgroup 2A</b>  <b>Option 5: Rock dump whole length</b></p> <p>The three pipelines in subgroup 2A are 6.4 km long in total and comprise 2,577 tonnes of steel, concrete and protective coating, plus 5.5 t anodes and 153 t of concrete mattresses.</p> <p>Only 14% of the pipeline inventory will be recovered, meaning some 384 t of material will come to shore. The remaining pipeline material will remain <i>in situ</i>.</p> <p>The waste volume generated is insignificant. As a comparison, the removal of the topsides will result in 75,000 tonnes of steel being processed onshore.</p> <p>The impact from a waste management perspective will be 'insignificant'.</p> <p><b>Evaluation of scale of effect:</b>          High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 5: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle.</p> 

# PIPELINES – Waste

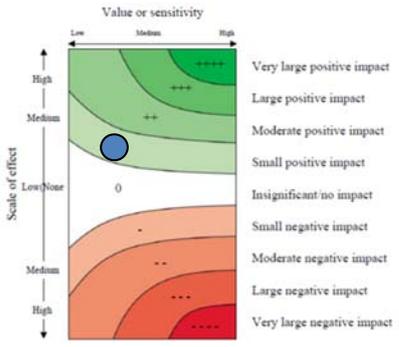
<p><b>2. Description of the scale of effect - Subgroup 2A</b>  <b>Option 6: Recover whole length by cut and lift</b></p> <p>The three pipelines in subgroup 2A are 6.4 km long in total and comprise 2,577 tonnes of steel, concrete and protective coating, plus 5.5 t anodes and 153 t of concrete mattresses. 96% of the pipeline inventory will be recovered, meaning some 2,638 t of material will come to shore. The remaining pipeline material will remain <i>in situ</i>.</p> <p>The waste volume generated is small. As a comparison, the removal of the topsides will result in 75,000 tonnes of steel being processed onshore.</p> <p>From a waste management perspective, decommissioning will result in a 'small positive' impact.</p> <p><b>Evaluation of scale of effect:</b>          High neg.    Medium neg.    Low/none    Medium pos.    High pos.           ----- ----- ----- -----   <span style="margin-left: 250px;">X</span></p>	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix.</p> <p><b>Option 6: 'Insignificant-small positive'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle.</p> 
<p><b>2. Description of the scale of effect - Subgroup 2A</b>  <b>Option 7: Recover whole length by reverse S lay (single joint)</b></p> <p>The three pipelines in subgroup 2A are 6.4 km long in total and comprise 2,577 tonnes of steel, concrete and protective coating, plus 5.5 t anodes and 153 t of concrete mattresses. 96% of the pipeline inventory will be recovered, meaning some 2,638 t of material will come to shore. The remaining pipeline material will remain <i>in situ</i>.</p> <p>The waste volume generated is small. As a comparison, the removal of the topsides will result in 75,000 tonnes of steel being processed onshore.</p> <p>From a waste management perspective, decommissioning will result in a 'small positive' impact.</p> <p><b>Evaluation of scale of effect:</b>          High neg.    Medium neg.    Low/none    Medium pos.    High pos.           ----- ----- ----- -----   <span style="margin-left: 250px;">X</span></p>	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix.</p> <p><b>Option 7: 'Insignificant-small positive'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle.</p> 

# PIPELINES – Waste

<p><b>2. Description of the scale of effect - Subgroup 2B</b>  <b>Option 1: Leave <i>in situ</i> with no further remediation</b></p>	<p><b>3. Total (environmental) impact</b></p>
<p>The 7 pipelines in subgroup 2B are ~25 km long in total and comprise 15,674 tonnes of steel, concrete and protective coating, plus 25.4 t anodes and 366 t of concrete mattresses.</p> <p>Under Option 1, all material will remain <i>in situ</i>, hence there will be no waste generated.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: ‘No impact’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle.</p> 
<p><b>2. Description of the scale of effect - Subgroup 2B</b>  <b>Option 4: Trench and backfill whole length</b></p>	<p><b>3. Total (environmental) impact</b></p>
<p>The 7 pipelines in subgroup 2B are ~25 km long in total and comprise 15,674 tonnes of steel, concrete and protective coating, plus 25.4 t anodes and 366 t of concrete mattresses.</p> <p>Only 5% of the pipeline inventory will be recovered, meaning some 882 t of material will come to shore. The remaining pipeline material will remain <i>in situ</i>.</p> <p>The volume of waste generated is insignificant. As a comparison, the removal of the topsides will result in 75,000 tonnes of steel being processed onshore.</p> <p>The impact from a waste management perspective will be ‘insignificant’, given the mass of materials recovered for recycling.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 4: ‘Insignificant’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle.</p> 



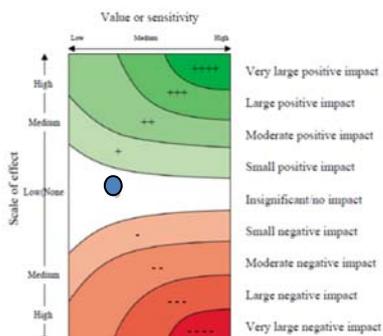
## PIPELINES – Waste

2. Description of the scale of effect - Subgroup 2B <b>Option 7: Recover whole length by reverse S lay (single joint)</b>	3. Total (environmental) impact
<p>The 7 pipelines in subgroup 2B are ~25 km long in total and comprise 15,674 tonnes of steel, concrete and protective coating, plus 25.4 t anodes and 366 t of concrete mattresses.</p> <p>98% of the pipeline inventory will be recovered, meaning some 15,677 t of material will come to shore. The remaining pipeline material will remain <i>in situ</i>.</p> <p>As a comparison, the removal of the topsides will result in 75,000 tonnes of steel being processed onshore.</p> <p>A small mass of marine growth may be attached to the recovered pipelines where lying exposed. This must be dealt with shortly after transporting to shore to avoid odour problems for the local community and will be disposed of to a suitable waste disposal site. In comparison with topsides and other structures being recovered, the mass of associated marine growth (if any) will be small and any impact therefore small.</p> <p>Decommissioning will have a 'small positive' impact from a waste management perspective.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 7: 'Small positive'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle.</p>  <p>The diagram is a 2D matrix with 'Scale of effect' on the vertical axis (High, Medium, Low/None) and 'Value or sensitivity' on the horizontal axis (Low, Medium, High). The matrix is divided into nine impact categories: Very large positive impact (top-right, dark green), Large positive impact (top-right, medium green), Moderate positive impact (top-right, light green), Small positive impact (top-right, very light green), Insignificant no impact (center, white), Small negative impact (bottom-left, light orange), Moderate negative impact (bottom-left, medium orange), Large negative impact (bottom-left, dark orange), and Very large negative impact (bottom-left, red). A blue circle is located in the 'Small positive impact' region, centered around the intersection of 'Medium' sensitivity and 'Medium' scale of effect.</p>

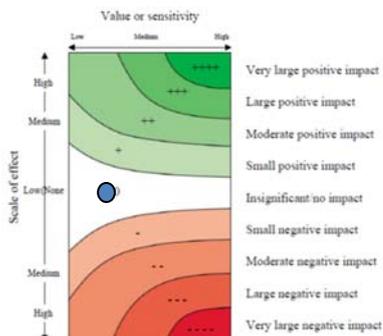
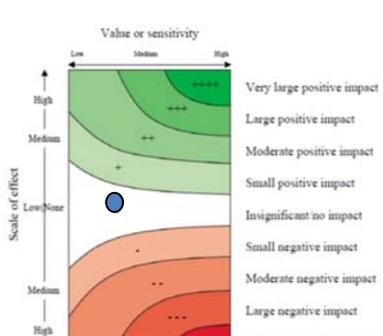




## PIPELINES – Waste

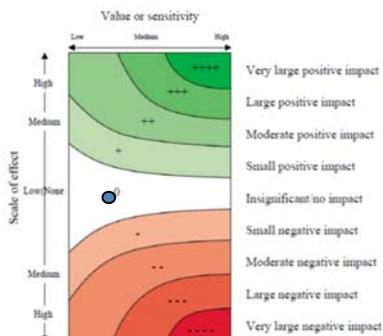
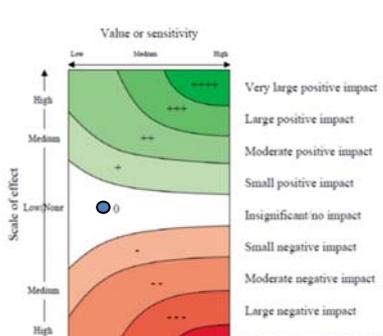
2. Description of the scale of effect - Subgroup 2C Option 9: Rock dump all shallow-trenched sections (N501)	3. Total (environmental) impact
<p>The pipeline in subgroup 2C is 36 km long and comprises 25,529 tonnes of steel, concrete and protective coating, plus 52 t anodes and 171 t concrete mattresses.</p> <p>Under this option, more than 99% of the pipeline inventory will remain <i>in situ</i>, with only approximately 100 t returned to shore, hence there will be insignificant waste generated.</p> <p><b>Evaluation of scale of effect:</b>            High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- -----   <span style="margin-left: 200px;">X</span></p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 9: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle.</p>  <p>The diagram is a 2D matrix with 'Scale of effect' on the vertical axis (High, Medium, Low/None) and 'Value or sensitivity' on the horizontal axis (Low, Medium, High). The matrix is divided into nine impact levels: Very large positive impact (top-right, dark green), Large positive impact (top-right, medium green), Moderate positive impact (top-right, light green), Small positive impact (top-right, very light green), Insignificant no impact (center, white), Small negative impact (bottom-right, light orange), Moderate negative impact (bottom-right, medium orange), Large negative impact (bottom-right, dark orange), and Very large negative impact (bottom-right, red). A blue circle is positioned in the 'Insignificant no impact' region, indicating the total impact for Option 9.</p>

# PIPELINES – Waste

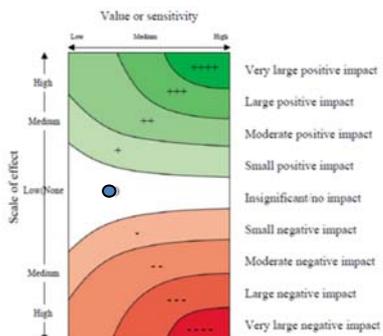
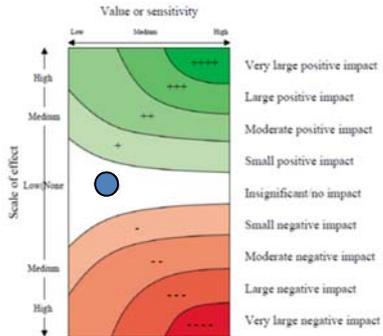
<p><b>2. Description of the scale of effect - Subgroup 2D</b>  <b>Option 2: Leave tied-in at platforms, trench and backfill non-platform ends</b></p> <p>The pipeline in subgroup 2D is approximately 400 metres long and comprise 121 t of steel, concrete and protective coating, plus 0.2 t anodes and 151 t of concrete mattresses.</p> <p>Only 5% of the pipeline inventory will be recovered, meaning some 8 t of material will come to shore. The remaining pipeline material will remain <i>in situ</i>.</p> <p>The volume of waste that that is generated is insignificant. As a comparison, the removal of the topsides will result in 75,000 tonnes of steel being processed onshore.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p>----- ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 2: ‘Insignificant’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle.</p> 
<p><b>2. Description of the scale of effect - Subgroup 2D</b>  <b>Option 3: Leave tied-in at platforms and rock dump non-platform ends</b></p> <p>The pipeline in subgroup 2D is approximately 400 metres long and comprise 121 t of steel, concrete and protective coating, plus 0.2 t anodes and 151 t of concrete mattresses.</p> <p>Only 5% of the pipeline inventory will be recovered, meaning some 8 t of material will come to shore. The remaining pipeline material will remain <i>in situ</i>.</p> <p>The volume of waste that is generated is insignificant. As a comparison, the removal of the topsides will result in 75,000 tonnes of steel being processed onshore.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p>----- ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 3: ‘Insignificant’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle.</p> 



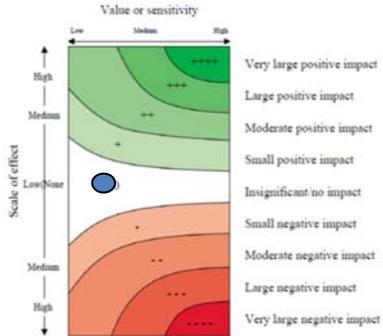
# PIPELINES – Waste

<p><b>2. Description of the scale of effect - Subgroup 2E</b>  <b>Option 1: Leave <i>in situ</i> with no further remediation</b></p> <p>The pipelines in subgroup 2E are approximately 4.6 km long and comprise 2,218 t of steel, concrete and protective coating, plus 4 t anodes. There are no concrete mattresses. No material will be recovered under this option, hence there will be no waste generated.</p> <p><b>Evaluation of scale of effect:</b>  High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- -----   <span style="margin-left: 150px;">X</span></p>	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: ‘No impact’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle.</p> 
<p><b>2. Description of the scale of effect - Subgroup 2E</b>  <b>Option 4: Trench and backfill whole length</b></p> <p>The pipelines in subgroup 2E are approximately 4.6 km long and comprise 2,218 t of steel, concrete and protective coating, plus 4 t anodes. There are no concrete mattresses. No material will be recovered under this option, hence there will be no waste generated.</p> <p><b>Evaluation of scale of effect:</b>  High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- -----   <span style="margin-left: 150px;">X</span></p>	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 4: ‘No impact’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle.</p> 

# PIPELINES – Waste

2. Description of the scale of effect - Subgroup 2E Option 5: Rock dump whole length	3. Total (environmental) impact
<p>The pipelines in subgroup 2E are approximately 4.6 km long and comprise 2,218 t of steel, concrete and protective coating, plus 4 t anodes. There are no concrete mattresses. No material will be recovered under this option, hence there will be no waste generated.</p> <p><b>Evaluation of scale of effect:</b> High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- -----  X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 5: ‘No impact’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle.</p> 
2. Description of the scale of effect - Subgroup 2E Option 6: Recover whole length by cut and lift	3. Total (environmental) impact
<p>The pipelines in subgroup 2E are approximately 4.6 km long and comprise 2,218 t of steel, concrete and protective coating, plus 4 t anodes. There are no concrete mattresses. 100% of the pipeline inventory will be recovered, meaning some 2,222 t of waste material will be generated and come to shore. As a comparison, the removal of the topsides will result in 75,000 tonnes of steel being processed onshore. From a waste management perspective, the volume of waste generated is very small and will have an ‘insignificant’ impact.</p> <p><b>Evaluation of scale of effect:</b> High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- -----  X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 6: ‘Insignificant’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle.</p> 

## PIPELINES – Waste

2. Description of the scale of effect - Subgroup 2E Option 7: Recover whole length by cut and lift	3. Total (environmental) impact
<p>The pipelines in subgroup 2E are approximately 4.6 km long and comprise 2,218 t of steel, concrete and protective coating, plus 4 t anodes. There are no concrete mattresses.</p> <p>100% of the pipeline inventory will be recovered, meaning some 2,222 t of waste material will be generated and come to shore. As a comparison, the removal of the topsides will result in 75,000 tonnes of steel being processed onshore.</p> <p>From a waste management perspective, the volume of waste generated is very small and will have an ‘insignificant’ impact.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 7: ‘Insignificant’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle.</p>  <p>The diagram is a 2D matrix with 'Scale of effect' on the vertical axis (High, Medium, Low/None) and 'Value or sensitivity' on the horizontal axis (Low, Medium, High). The matrix is divided into nine impact levels: Very large positive impact (top-right, dark green), Large positive impact (top-right, medium green), Moderate positive impact (top-right, light green), Small positive impact (top-right, very light green), Insignificant/no impact (center, white), Small negative impact (bottom-right, light orange), Moderate negative impact (bottom-right, medium orange), Large negative impact (bottom-right, dark orange), and Very large negative impact (bottom-right, red). A blue circle is positioned in the 'Insignificant/no impact' region, indicating the total impact for Option 7.</p>



## 1.16 PIPELINES - PHYSICAL

**Category: Pipelines – Groups 1 and 2**

**Consequence evaluation for: Physical**

### 1. General description of the receiving environment (situation and characteristics)

The baseline description for Physical is the same for all pipeline groups.

In the context of this assessment, physical impacts relate to physical changes as a result of project activities (such as trenching). Impacts that relate to both the 'physical changes' and 'local onshore impacts' are only covered under 'local onshore impacts'. Marine biological environment (e.g. habitat, biota, fish) impacts are covered under 'Marine'.

#### *Physical features in the Brent Field*

Water depths around the Brent Field platforms range from 137.8m Lowest Astronomical Tide (LAT) to 144.6m LAT. The average seabed gradients are less than 0.1° [1].

Seabed sediments over the majority of the North Sea are sand or mud, or a mixture of the two. Broad-scale sediment distribution indicates that the area in Quadrant 211, where the Brent Field is located, is dominated by sand. Recent seabed surveys around the Brent Field platforms indicate that the sediments predominantly comprise sand with occasional clay exposures and scattered cobbles/boulders up to 0.4 m high.

A debris survey conducted by Gardline Geosurvey in 2006 [2] covering the Brent Field and platforms found evidence of extensive trawling and anchoring activity in the form of trawl scars, anchor pull-out pits and scars throughout the survey area (15 km x 4 km).

No pockmarks were identified within the survey area, and all seabed depressions were attributed to anchoring or construction activity. The seabed sediments within the Brent area are not conducive to the formation of pockmarks or other fluid or gas escape features. No bedrock occurs at the seabed within the Brent area and the sedimentary sequence is expected to be in excess of 400 m thick. No reef structures were identified within the survey area.

#### *Other (wreck /cables/ military activities)*

Within the Brent area no wrecks have been identified that are of any significance or dangerous to navigation. No areas dedicated for military activities nor any known subsea cables have been identified in the vicinity of the Brent facilities.

The overall physical value of the area is assessed to be 'low'.

#### **Evaluation of the value:**

Low Medium High

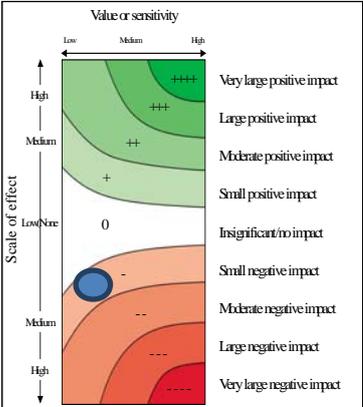
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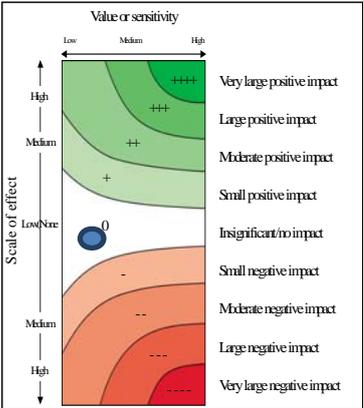




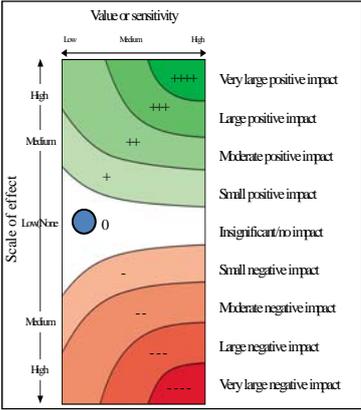
## PIPELINES – Physical

<p><b>2. Description of the scale of effect - Subgroup 2A</b>  <b>Option 4: Trench and backfill whole length</b>  <b>Option 6: Recover whole length by cut and lift</b>  <b>Option 7: Recover whole length by reverse S lay (single joint)</b></p>	<p><b>3. Total (environmental) impact</b></p>
<p>The use of vessels on anchors can cause disturbances to the seabed as a result of anchor pits, but most (if not all) pipeline decommissioning activities would be using vessels operating on DP, hence there would be few (if any) anchor pits resulting from pipeline decommissioning.</p> <p>Options 4, 6 and 7 involve volumes of rock dumping, which will permanently change the existing seabed in this area. This is covered within 'Legacy' matrices.</p> <p>There would be interventions along pipelines which will result in seabed disturbance (e.g. due to trenching, cut and lift operations or reverse reeling). Any impacts will be temporary and localized, and will not result in permanent physical changes. The largest disturbance will result under Option 4 (trench and backfill), but again no long-term physical change would be expected.</p> <p>The overall physical impact for each option is assessed to be 'small negative'.</p> <p><b>Evaluation of scale of effect:</b>  High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Options 4, 6 and 7: 'Small negative'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

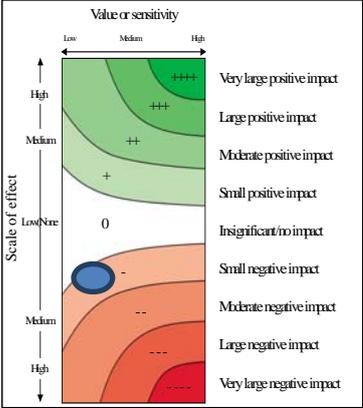
## PIPELINES – Physical

2. Description of the scale of effect - Subgroup 2A Option 5: Rock dump whole length	3. Total (environmental) impact
<p>The use of vessels on anchors can cause disturbances to the seabed as a result of anchor pits, but most (if not all) pipeline decommissioning activities would be using vessels operating on DP, hence there would be few (if any) anchor pits resulting from pipeline decommissioning.</p> <p>Option 5 involves a rock dump of 108,800 tonnes. This will permanently change the existing seabed in this area and it is a sizeable area. However, as it is a long term impact it is captured within 'Legacy'.</p> <p>Hence, the overall impact of physical changes is assessed to be 'insignificant'.</p> <p><b>Evaluation of scale of effect:</b>            High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 5: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

## PIPELINES – Physical

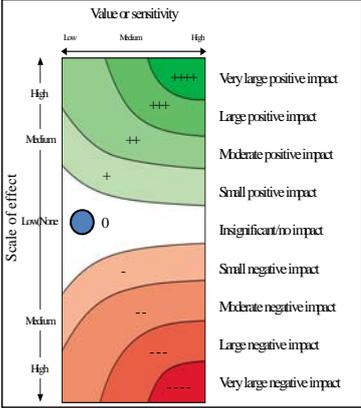
2. Description of the scale of effect - Subgroup 2B Option 1: Leave <i>in situ</i> with no further remediation	3. Total (environmental) impact
<p>There will be very few activities in Option 1, hence no physical impacts.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: ‘No Impact’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

## PIPELINES – Physical

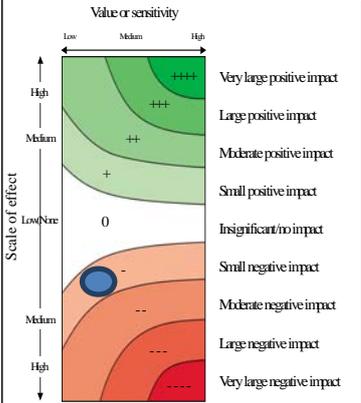
<p><b>2. Description of the scale of effect - Subgroup 2B</b></p> <p><b>Option 4: Trench and backfill whole length</b></p> <p><b>Option 6: Recover whole length by cut and lift</b></p> <p><b>Option 7: Recover whole length by reverse S lay (single joint)</b></p>	<p><b>3. Total (environmental) impact</b></p>
<p>The use of vessels on anchors can cause disturbances to the seabed as a result of anchor pits, but most (if not all) pipeline decommissioning activities would be using vessels operating on DP, hence there would be few (if any) anchor pits resulting from pipeline decommissioning.</p> <p>Options 4, 6 and 7 involve small volumes of rock dumping, which will permanently change the existing seabed in this area, but the areas involved are small. This is covered within 'Legacy' matrices.</p> <p>There would be interventions along pipelines which will result in seabed disturbance (e.g. due to trenching, cut and lift operations or reverse reeling). Any impacts will be temporary and localised, and will not result in permanent physical changes. The largest disturbance will result under Option 4 (trench and backfill), but again no long-term physical change would be expected.</p> <p>The overall physical impact for each option is assessed to be 'small negative'.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p>----- ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p><b>Options 4, 6, and 7: 'Small negative'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 



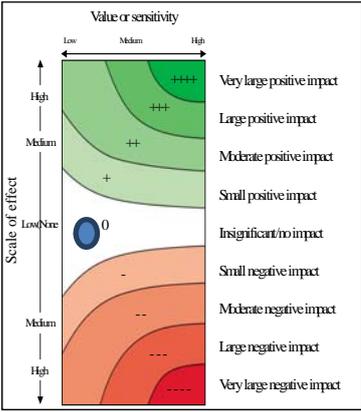
## PIPELINES – Physical

2. Description of the scale of effect - Subgroup 2C Option 1: Leave <i>in situ</i> with no further remediation	3. Total (environmental) impact
<p>There will be very few activities in Option 1, with no physical impacts.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: ‘No impact’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

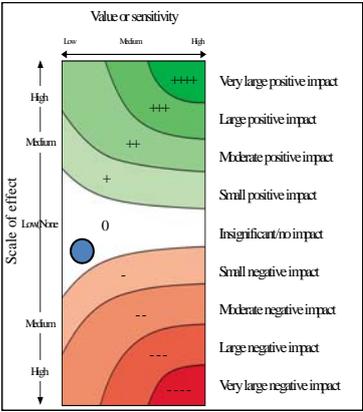
## PIPELINES – Physical

<p><b>2. Description of the scale of effect - Subgroup 2C</b></p> <p><b>Option 6: Recover whole length by cut and lift</b></p> <p><b>Option 7: Recover whole length by reverse S lay (single joint)</b></p> <p><b>Option 8: Trench and backfill shallow-trenched sections and isolated rock dump</b></p>	<p><b>3. Total (environmental) impact</b></p>
<p>The use of vessels on anchors can cause disturbances to the seabed as a result of anchor pits, but most (if not all) pipeline decommissioning activities would be using vessels operating on DP, hence there would be few (if any) anchor pits resulting from pipeline decommissioning.</p> <p>Options 6, 7 and 8 involves rock dumping, which will permanently change the existing seabed, but this is captured within the 'Legacy' matrices.</p> <p>There would be interventions along pipelines which will result in seabed disturbance (e.g. due to trenching, cut and lift operations or reverse reeling). Any impacts will be temporary and localised, and will not result in permanent physical changes but owing to the long length of the pipeline, a 'small negative' impact is allocated for each option.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p><b>Options 6-8: 'Small negative'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

## PIPELINES – Physical

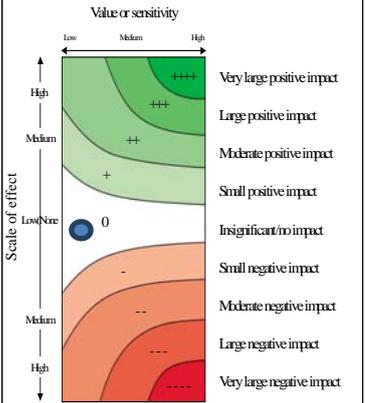
2. Description of the scale of effect - Subgroup 2C Option 9: Rock dump all shallow-trenched sections (N501)	3. Total (environmental) impact
<p>The use of vessels on anchors can cause disturbances to the seabed as a result of anchor pits, but most (if not all) pipeline decommissioning activities would be using vessels operating on DP, hence there would be few (if any) anchor pits resulting from pipeline decommissioning.</p> <p>Option 9 involves rock dumping approximately 490,000 tonnes. This will permanently change the existing seabed in this area. However, as it is a long term impact it is captured within 'Legacy'.</p> <p>The overall impact of physical changes is assessed to be 'insignificant'.</p> <p><b>Evaluation of scale of effect:</b>            High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 9: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

# PIPELINES – Physical

<p><b>2. Description of the scale of effect - Subgroup 2D</b></p> <p><b>Option 2: Leave tied-in at platforms, trench and backfill the non-platform ends</b></p> <p><b>Option 3: Leave tied-in at platforms and rock dump the non-platform ends</b></p> <p><b>Option 5: Rock dump whole length</b></p> <p><b>Option 6: Recover whole length by cut and lift</b></p>	<p><b>3. Total (environmental) impact</b></p>
<p>The use of vessels on anchors can cause disturbances to the seabed as a result of anchor pits, but most (if not all) pipeline decommissioning activities would be using vessels operating on DP, hence there would be few (if any) anchor pits resulting from pipeline decommissioning.</p> <p>Options 3 and 5 involve small volumes of rock dumping, which will permanently change the existing seabed in this area, but this is captured in 'Legacy'. The other two options do not include any rock dump.</p> <p>There would be interventions along the pipeline which will result in seabed disturbance, but the short pipeline length (0.4 km) would limit the area of disturbance. Any impacts will be temporary and localized, and will not result in permanent physical changes.</p> <p>The overall impact of physical changes for the subgroup 2D pipeline is assessed to be 'insignificant' for each decommissioning option.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p><b>Options 2,3,5,6: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 



## PIPELINES – Physical

2. Description of the scale of effect - Subgroup 2E <b>Option 5: Rock dump whole length</b>	3. Total (environmental) impact
<p>The use of vessels on anchors can cause disturbances to the seabed as a result of anchor pits, but most (if not all) pipeline decommissioning activities would be using vessels operating on DP, hence there would be few (if any) anchor pits resulting from pipeline decommissioning.</p> <p>Option 5 involves a rock dump of 78,200 tonnes, which will permanently change the existing seabed in this area. However, as it is a long term impact it is captured within 'Legacy'.</p> <p>The overall impact of physical changes is assessed to be 'insignificant'.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 5: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

<sup>1</sup> BMT Cordah, *Brent Decommissioning Project Environmental Setting Including Brent Field, Transportation Route, Transfer Area and Onshore Destination*, Shell Doc. No.: BDE-F-GEN-HE-7753-00010, Rev 05, 4 November 2014.

<sup>2</sup> Gardline Geosurvey, *Brent Debris and Habitat Survey UKCS Block 211/29*, Volume I, Shell EPE Report: ED-2006-034, Rev 02, January 2007.

## 1.17 PIPELINES MARINE

Category: Pipelines - Group 1 and 2

Consequence evaluation for Marine environment

### 1. General description of the receiving environment (situation and characteristics)

The assessments below depict short-term impacts to the marine environment as a result of the Brent Field decommissioning programme; long-term impacts are captured under 'Legacy'.

The information below is summarised from the 2015 BMT Cordah Environmental Baseline study [1].

#### Marine Environment at the Brent Field

**The benthic communities** (seabed communities) in this region of the Northern North Sea comprise species typical of the deep water and soft, fine sediments at this latitude in the North Sea; the seabed communities are diverse and abundant. Data from benthic surveys around the Brent Field indicate that characteristic infaunal species associated with this region of the North Sea include the polychaete *Owenia fusiformis* (tube worm), *Thyasira spp* (bivalve mollusc) and *Myriochele spp.* (polychaete worm). The benthic communities around the Brent Field were analysed as part of environmental surveys in 1990 and 1994. Analysis of these historic survey data indicated that the benthic fauna was affected up to a few hundred metres from the Brent platforms with a zone of slight benthic disturbance extending 500 m to 800 m from the platform. Stations more than 800 m from the Brent A platform showed diverse benthic communities indicative of undisturbed conditions, typical of the East Shetland Basin. More recent surveys conducted by Gardline in 2007 [2,3] found some ecological impacts due to contamination, and that the fauna community appeared to be relatively uniform between stations. None of the species identified were of statutory conservation significance. There are also **corals** present as fouling growth on the installation legs, not native on soft bottom seabed.

**Fish:** Two types of fish species are commonly found in the vicinity of the Brent Field: pelagic species (which occur in shoals swimming in mid-water, typically making extensive seasonal movements or migrations between sea areas) and demersal species (which live on or near the seabed). The Brent Field is located within spawning and nursery grounds used by 13 fish species, during different parts of the year. The Brent Field is located within spawning grounds used by cod (January to April), haddock (February to May), Norway pout (January to April), saithe (January to April), sandeel (November to February) and whiting (February to June). Pelagic species typically have pelagic eggs that are released into the water column to be fertilised. Spawning grounds are dynamic features of fish life history and are rarely fixed in one location from year to year. Therefore, the information on the fish spawning areas represents the widest known distribution given current knowledge. Nursery grounds are used throughout the year by all 13 fish species, potentially making it impossible to avoid an operational period coincident with the presence of juvenile fish.

**Plankton:** The planktonic communities are composed of a both phytoplankton and zooplankton, with a variety of species within both categories. The most common phytoplankton groups are the diatoms, dinoflagellates (e.g. *Ceratium spp*) and the smaller flagellates. Together they are responsible for the majority of the primary production of the North Sea. The zooplankton community are dominated by neritic (coastal) and intermediate (mixed water) species.

**Seabirds:** Twenty-five species of seabird in six families breed in the UK and mainland North Sea coastlines, including fulmar, cormorant, northern gannet, skua, gull, tern and auk. The overall vulnerability of seabirds to oil pollution in the Brent area is 'low', however for the months of January, March, July and between September to November, some blocks show seabird vulnerability is 'high'.

**Marine mammals:** Harbour porpoises and white-sided dolphins have been recorded in the area, while minke whales and killer whales have been recorded in surrounding quadrants. Cetacean species present in the area are generally distributed throughout the North Sea. There are 2 species of pinnipeds (seals) which reside in UK waters, the common or harbour seal, and the grey seal. Both of these species breed in the UK, however their distribution at sea is constrained by their need to return periodically to land.

#### **Marine protected areas:**

With regards to offshore marine protected areas, the nearest SCI to the Brent Field is the Pobie Bank Reef, 85 km away. The closest MPA is the NE Faroe Shetland Channel NCMPA, located approximately 110 km to the north-west.

#### Summary

Because the offshore environment at the Brent Field is considered to be typical of other North Sea installations and does not contain any particularly sensitive habitats or species, it is allocated a 'low-medium' value.

#### **Evaluation of the value:**

Low Medium High

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X





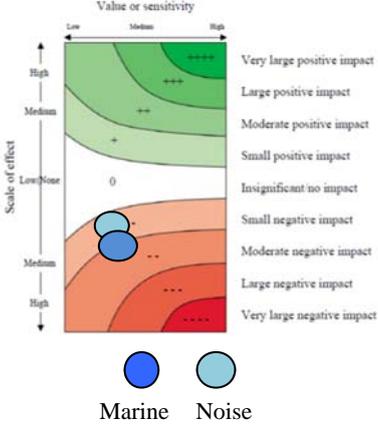








## PIPELINES - Marine

2. Description of the scale of effect - Subgroup 2A <b>Option 5: Rock dump whole length</b>	3. Total (environmental) impact
<p>Under Option 5 pipelines will be decommissioned by rock dump along the entire length to a minimum depth of 0.5 m.</p> <p>In this option there is an estimated 108,800 t rock dumping. Rock dumping will damage/smother the existing benthic fauna along the footprint of the rock dump which is the whole length of the pipeline. Although the benthic community in the area is diverse and abundant and does not appear to contain any species of particular conservation concern, the rock dump area involved is not insignificant, and there will be a 'small-moderate negative' impact.</p> <p>Putting this into context, there is currently a rock dump footprint of approximately 8,300 m<sup>2</sup> (10,000 t) at the Brent Field for the 28 Group 1 and 2 pipelines. DNV GL has been unable to obtain the annual amount of rock dumping on the UKCS, but in Norway there was 6.2 million m<sup>3</sup> rock dumping in 2012.</p> <p>For cumulative impacts of rock dumping, please see the Pipelines chapter of the ES. Long-term impacts from rock dumping upon habitat and fisheries are captured within 'Legacy'.</p> <p>The decommissioning of pipelines will involve marine operations for a period of time in the area. Noise modelling indicates that marine mammals and fish will be affected in localised areas, based on a worst-case scenario. The noise impact will be 'small negative'.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p>----- ----- ----- ----- </p> <p>                  X    X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 5:</b> <b>Marine: 'Small-moderate negative'</b> <b>Noise: 'Small negative'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle</p>  <p style="text-align: center;">●    ● Marine    Noise</p>

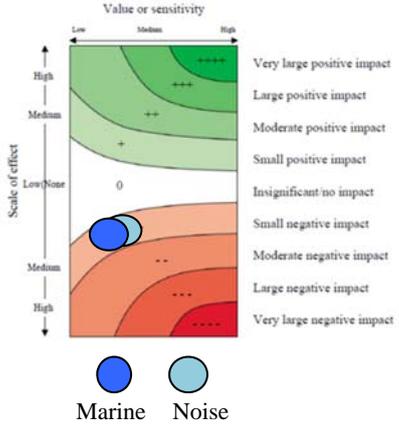


# PIPELINES - Marine

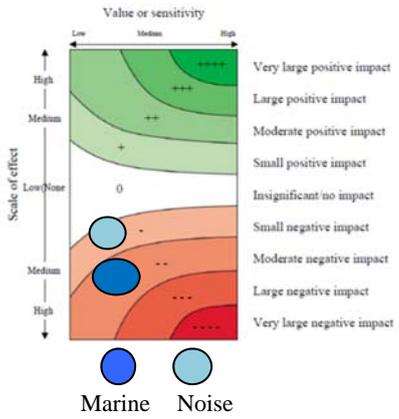
2. Description of the scale of effect - Subgroup 2A <b>Option 7: Recover whole length by reverse S lay (single joint)</b>	3. Total (environmental) impact
<p>Under Option 7 the entire pipelines will be recovered. The disturbance will temporarily affect the surface layers and associated benthic communities, through sediment disturbance, suspension and re-deposition. Communities would be expected to recover without any permanent adverse effects, and no habitats of conservation interest would be affected. The potential effect upon the seabed will be 'small negative'; given the extent of disturbance and since any impacts will be temporary and reversible.</p> <p>The decommissioning of pipelines will involve marine operations for a period of time in the area. Noise modelling indicates that marine mammals and fish will be affected in localised areas, based on a worst-case scenario. The noise impact will be 'small negative'.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">XX</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 7:</b> <b>Marine: 'Small negative'</b> <b>Noise: 'Small negative'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle</p> <p>The diagram is a 2D matrix with 'Scale of effect' on the vertical axis (High, Medium, Low/None) and 'Value or sensitivity' on the horizontal axis (Low, Medium, High). The matrix is divided into colored zones representing different impact levels: Very large positive (dark green), Large positive (medium green), Moderate positive (light green), Small positive (pale green), Insignificant/no impact (white), Small negative (pale orange), Moderate negative (orange), Large negative (dark orange), and Very large negative (red). Two circles are plotted: a blue circle (Marine) and a light blue circle (Noise), both positioned in the 'Small negative' zone at a 'Medium' scale of effect and 'Medium' value of sensitivity.</p>



## PIPELINES - Marine

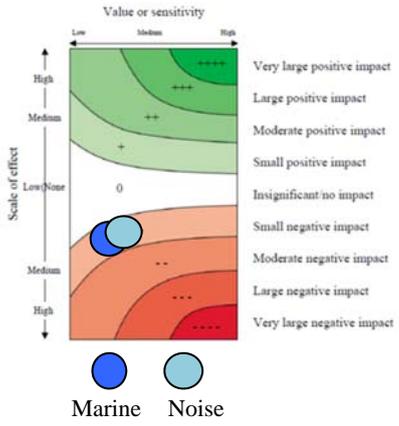
2. Description of the scale of effect - Subgroup 2B Option 4: Trench and backfill whole length	3. Total (environmental) impact
<p>Trenching under Option 4 represents one of the most extensive decommissioning options, and involves pipelines being trenched to a suitable depth (nominally 0.6m minimum to top of pipe) and covered in natural sediment or backfill.</p> <p>The disturbance to the seabed and to benthic communities and fauna will be limited in duration and be localised along the length of the pipelines. Any disturbance will temporarily affect the surface layers and associated benthic communities, through sediment disturbance, suspension and re-deposition. Communities would be expected to recover without any permanent adverse effects, and no habitats of conservation interest would be affected. The potential effect on the seabed will be 'small negative'; given the limited extent of disturbance and since any impacts will be temporary and reversible.</p> <p>The decommissioning of pipelines will involve marine operations for a period of time in the area. Noise modelling indicates that marine mammals and fish will be affected in localised areas, based on a worst-case scenario. The noise impact will be 'small negative'.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">XX</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 4:</b> <b>Marine: 'Small negative'</b> <b>Noise: 'Small negative'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle</p>  <p style="text-align: center;">● Marine    ● Noise</p>

## PIPELINES - Marine

2. Description of the scale of effect - Subgroup 2B Option 5: Rock dump whole length	3. Total (environmental) impact
<p>Under Option 5 pipelines will be decommissioned by rock dump along the entire length. In this option there is an estimated 430,300 t rock dumping. Rock dumping will damage/smother the existing benthic fauna along the footprint of the rock dump which is the whole length of the pipeline. Although the benthic community in the area is diverse and abundant and does not appear to contain any species of particular conservation concern, the rock dump area has a relatively large footprint, and will have a 'moderate negative' impact.</p> <p>Putting this into context, there is currently a rock dump footprint of approximately 8,300 m<sup>2</sup> (10,000 t) at the Brent Field for the 28 Group 1 and 2 pipelines. DNV GL has been unable to obtain the annual amount of rock dumping on the UKCS, but in Norway there was 6.2 million m<sup>3</sup> rock dumping in 2012.</p> <p>For cumulative impacts of rock dumping, please see the Pipelines chapter of the ES. Long-term impacts from rock dumping upon habitat and fisheries are captured within 'Legacy'.</p> <p>The decommissioning of pipelines will involve marine operations for a period of time in the area. Noise modelling indicates that marine mammals and fish will be affected in localised areas, based on a worst-case scenario. The noise impact will be 'small negative'.</p> <p><b>Evaluation of scale of effect:</b>            High neg.    Medium neg.    Low/none    Medium pos.    High pos.             ----- ----- ----- -----                               X           X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 5:</b>  <b>Marine: 'Moderate negative'</b>  <b>Noise: 'Small negative'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle</p> 



## PIPELINES - Marine

2. Description of the scale of effect - Subgroup 2B Option 7: Recover whole length by reverse S lay (single joint)	3. Total (environmental) impact
<p>The disturbance will temporarily affect the surface layers and associated benthic communities, through sediment disturbance, suspension and re-deposition. Communities would be expected to recover without any permanent adverse effects, and no habitats of conservation interest would be affected. The potential effect on the seabed will be 'small negative'; given the extent of disturbance and since any impacts will be temporary and reversible.</p> <p>The decommissioning of pipelines will involve marine operations for a period of time in the area. Noise modelling indicates that marine mammals and fish will be affected in localised areas, based on a worst-case scenario. The noise impact will be 'small negative'.</p> <p><b>Evaluation of scale of effect:</b>            High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- -----             XX</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 7:</b>  <b>Marine: 'Small negative'</b>  <b>Noise: 'Small negative'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle</p>  <p>The diagram is an impact matrix with 'Scale of effect' on the vertical axis (High, Medium, Low/None) and 'Value or sensitivity' on the horizontal axis (Low, Medium, High). The matrix is divided into impact levels: Very large positive (dark green), Large positive (medium green), Moderate positive (light green), Small positive (pale green), Insignificant/no impact (white), Small negative (pale red), Moderate negative (medium red), Large negative (dark red), and Very large negative (darkest red). Two circles are shown: a blue circle for 'Marine' and a light blue circle for 'Noise', both positioned in the 'Small negative' impact level at a 'Medium' scale of effect and 'Medium' value or sensitivity.</p>

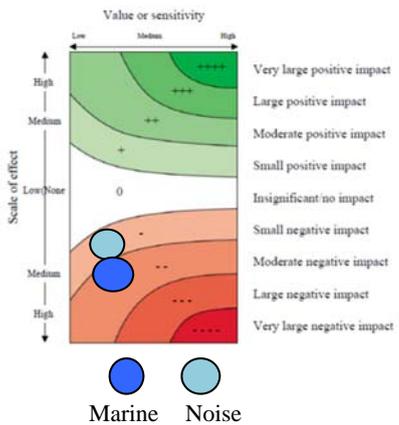
## PIPELINES - Marine

2. Description of the scale of effect - Subgroup 2C Option 1: Leave <i>in situ</i> with no further remediation	3. Total (environmental) impact
<p>Under Option 1 the pipeline will remain on the seabed without any further remediation, which will prevent disturbance to the marine environment.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1:</b> <b>Marine: 'No impact'</b> <b>Noise: 'No impact'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle</p> <p>The diagram is a 2D matrix with 'Scale of effect' on the vertical axis (High, Medium, Low/None) and 'Value or sensitivity' on the horizontal axis (Low, Medium, High). The matrix is divided into nine impact levels, each with a corresponding color and symbol: Very large positive impact (green, +++), Large positive impact (green, ++), Moderate positive impact (green, +), Small positive impact (green, .), Insignificant/no impact (white, .), Small negative impact (orange, -), Moderate negative impact (orange, --), Large negative impact (orange, ---), and Very large negative impact (red, ----). A legend at the bottom shows a blue circle for 'Marine' and a light blue circle for 'Noise'. Two blue circles are plotted in the 'Insignificant/no impact' region, and two light blue circles are plotted in the 'Small negative impact' region.</p>





## PIPELINES - Marine

<b>2. Description of the scale of effect - Subgroup 2C</b> <b>Option 8: Trench and backfill shallow-trenched sections and isolated rock dump</b>	<b>3. Total (environmental) impact</b>
<p>Under Option 8 all shallow trenched sections will be trenched and backfilled and the impact of trenching will therefore be localised to relevant sections. This will result in localised and temporary sediment disturbance along the length. Any disturbance will temporarily affect the surface layers and associated benthic communities, through sediment disturbance, suspension and re-deposition. Communities would be expected to recover without any permanent adverse effects, and no habitats of conservation interest would be affected. The potential effect on the seabed will be small given that effects will be temporary and reversible.</p> <p>In this option there is also an estimated 146,800 t rock dumping. Rock dumping will damage/smother the existing benthic fauna along the footprint of the rock dump, although it should be noted that the benthic community in the area is diverse and abundant and does not appear to contain any species of particular conservation concern. Putting this into context, there is currently a rock dump footprint of approximately 8,300 m<sup>2</sup> (10,000 t) at the Brent Field for the 28 Group 1 and 2 pipelines. DNV GL has been unable to obtain the annual amount of rock dumping on the UKCS, but in Norway there was 6.2 million m<sup>3</sup> rock dumping in 2012.</p> <p>There will be a 'moderate negative' impact because of the combination of rock dumping and trenching over a significant pipeline length.</p> <p>For cumulative impacts of rock dumping, please see the Pipelines chapter of the ES. Long-term impacts from rock dumping upon habitat and fisheries are captured within 'Legacy'.</p> <p>The decommissioning of pipelines will involve marine operations for a period of time in the area. Noise modelling indicates that marine mammals and fish will be affected in localised areas, based on a worst-case scenario. The noise impact will be 'small negative'.</p> <p><b>Evaluation of scale of effect:</b>            High neg.    Medium neg.    Low/none    Medium pos.    High pos.             ----- ----- ----- -----                               X           X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 8:</b>  <b>Marine: 'Moderate negative'</b>  <b>Noise: 'Small negative'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle</p>  <p>The diagram is an impact matrix with 'Scale of effect' on the vertical axis (High, Medium, Low/None) and 'Value or sensitivity' on the horizontal axis (Low, Medium, High). The matrix is divided into colored zones representing different impact levels: Very large positive (dark green), Large positive (medium green), Moderate positive (light green), Small positive (pale green), Insignificant/no impact (white), Small negative (pale orange), Moderate negative (orange), Large negative (dark orange), and Very large negative (red). Two circles are plotted: a blue circle for 'Marine' and a light blue circle for 'Noise'. The Marine circle is located in the 'Moderate negative' zone at a 'Medium' scale of effect and 'Medium' value of sensitivity. The Noise circle is located in the 'Small negative' zone at a 'Low/None' scale of effect and 'Medium' value of sensitivity. The size of the circles indicates uncertainty.</p>

## PIPELINES - Marine

<b>2. Description of the scale of effect - Subgroup 2C</b> <b>Option 9: Rock dump all shallow-trenched sections</b>	<b>3. Total (environmental) impact</b>
<p>Under Option 9 all shallow trenched sections will be rock dumped, creating localised disturbance to the marine environment. There is an estimated 490,000 t of rock dumping, which will damage/smother the existing benthic fauna along the footprint of the rock dump. Although the benthic community in the area is diverse and abundant and does not appear to contain any species of particular conservation concern, the rock dump area involved is sizeable; there will be a 'moderate negative' impact.</p> <p>Putting this into context, there is currently a rock dump footprint of approximately 8,300 m<sup>2</sup> (10,000 t) at the Brent Field for the 28 Group 1 and 2 pipelines. DNV GL has been unable to obtain the annual amount of rock dumping on the UKCS, but in Norway there was 6.2 million m<sup>3</sup> rock dumping in 2012.</p> <p>For cumulative impacts of rock dumping, please see the Pipelines chapter of the ES. Long-term impacts from rock dumping upon habitat and fisheries are captured within 'Legacy'.</p> <p>The decommissioning of pipelines will involve marine operations for a period of time in the area. Noise modelling indicates that marine mammals and fish will be affected in localised areas, based on a worst-case scenario. The noise impact will be 'small negative'.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p>----- ----- ----- ----- ----- </p> <p>                  X            X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 9:</b>  <b>Marine: 'Moderate negative'</b>  <b>Noise: 'Small negative'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle</p>



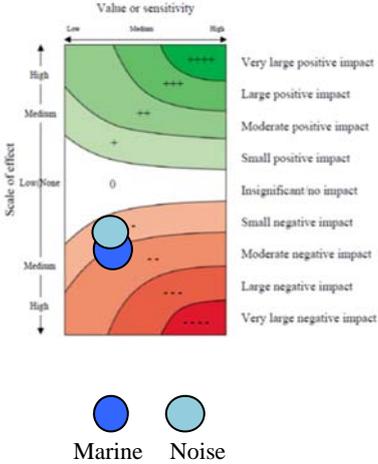




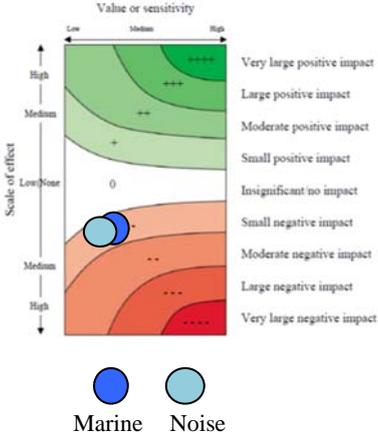




## PIPELINES - Marine

2. Description of the scale of effect - Subgroup 2E Option 5: Rock dump whole length	3. Total (environmental) impact
<p>There is an estimated 78,200 t rock dumping, which will damage/smother the existing benthic fauna along the footprint of the rock dump. Although the benthic community in the area is diverse and abundant and does not appear to contain any species of particular conservation concern, the rock dump area involved is not insignificant, hence there will be a 'small/moderate' negative impact.</p> <p>Putting this into context, there is currently a rock dump footprint of approximately 8,300 m<sup>2</sup> (10,000 t) at the Brent Field for the 28 Group 1 and 2 pipelines. DNV GL has been unable to obtain the annual amount of rock dumping on the UKCS, but in Norway there was 6.2 million m<sup>3</sup> rock dumping in 2012.</p> <p>For cumulative impacts of rock dumping, please see the Pipelines chapter of the ES. Long-term impacts from rock dumping upon habitat and fisheries are captured within 'Legacy'.</p> <p>The decommissioning of pipelines will involve marine operations for a period of time in the area. Noise modelling indicates that marine mammals and fish will be affected in localised areas, based on a worst-case scenario. The noise impact will be 'small negative'.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">                  X    X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 5:</b> <b>Marine: 'Small-moderate negative'</b> <b>Noise: 'Small negative'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle</p>  <p style="text-align: center;">●    ● Marine    Noise</p>

## PIPELINES - Marine

2. Description of the scale of effect - Subgroup 2E Option 6: Recover whole length by cut and lift	3. Total (environmental) impact
<p>Under Option 6 pipelines will be decommissioned by cut and lift, which will involve the use of divers or remotely operated vehicles (ROVs) operating on the seabed and the cutting of pipelines into manageable lengths using abrasive water jetting or wire / rotating cutters, for example. Locally, this will result in sediment disturbance and turbidity within the water column.</p> <p>Any disturbance will temporarily affect the surface layers and associated benthic communities, through sediment disturbance, suspension and re-deposition. Communities would be expected to recover without any permanent adverse effects, and no habitats of conservation interest would be affected. The potential effect on the seabed will be 'small negative' given the extent of disturbance and since any impacts will be temporary and reversible.</p> <p>The decommissioning of pipelines will involve marine operations for a period of time in the area. Noise modelling indicates that marine mammals and fish will be affected in localised areas, based on a worst-case scenario. The noise impact will 'small negative'.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p>----- ----- ----- ----- </p> <p style="text-align: center;">XX</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 6:</b> <b>Marine: 'Small negative'</b> <b>Noise: 'Small negative'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle</p>  <p style="text-align: center;">● Marine    ● Noise</p>





## 1.18 PIPELINES - ENVIRONMENTAL RISK FROM ACCIDENTS

**Category: Pipelines – Groups 1 and 2**

**Consequence evaluation for: Environmental Risks from Accidents**

### 1. General description of the receiving environment (situation and characteristics)

In this EIA, environmental risk from accidents refers to potential accidents during the decommissioning activities that could impact the environment. This EIA considers environmental risk from accidents in a high level and qualitative manner, and this is not a quantitative environmental risk assessment. Risk is a combination of the likelihood of an environmental event (e.g. spill) and its associated consequence.

The consequences from such failures are expected to be reversible, usually delaying the schedule of the decommissioning activities. Some failures will have the potential to impact the environment through operations going wrong (such as lifting) resulting in spillages of oil or chemicals (from vessels or broken pipelines) or misplaced disposal (dropped objects/module). Impacts such as spillages from vessels and broken pipelines can also result in economic impacts (e.g. unplanned shut-downs).

There are currently a number of live hydrocarbon pipelines and other critical equipment on the seabed of the Brent Field area that can potentially be affected, and these are the items that have potential to cause environmental impact should they be cracked by a heavy dropped object during the BDP and routes to shore. However, these pipelines will not be operational by the time decommissioning commences but other lines might still be live. The FLAGS pipeline will be re-routed for the purposes of the BDP. In addition, a 500 m exclusion zone will apply around each platform during decommissioning activities, as required by law (i.e. no live pipelines within this zone).

No especially environmentally sensitive habitats have been identified in the Brent Field area. There may potentially be environmentally sensitive habitats near the coast or inshore depending on the location of the onshore receiving yard, but the location is currently unknown.

As such, the overall value is assessed as similar to the marine category i.e. 'low to medium'.

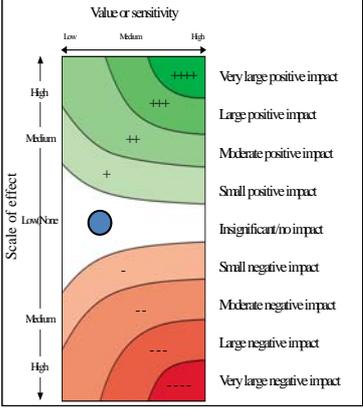
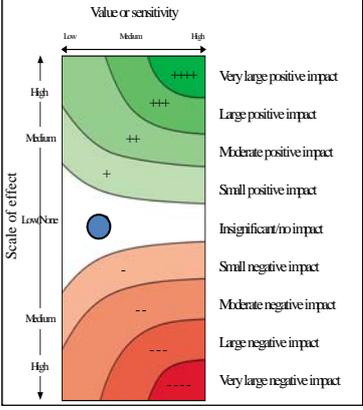
#### Evaluation of the value:

Low Medium High

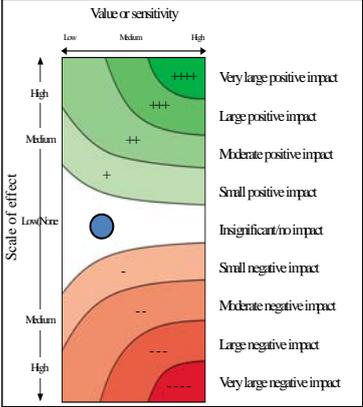
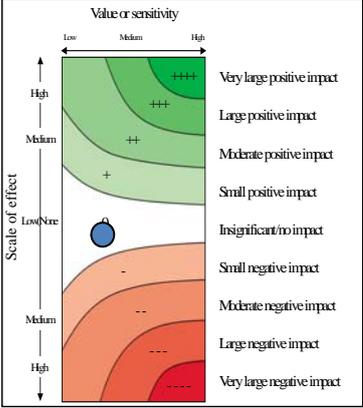
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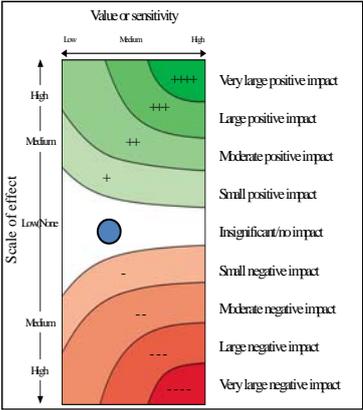
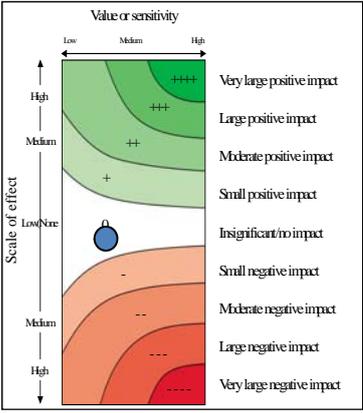
# PIPELINES – Environmental risk from accidents

<p><b>2. Description of the scale of effect: Subgroup 1A</b>  <b>Option 1: Leave in trench</b></p> <p>As subgroup 1A does not involve any operations as the pipelines will be left <i>in situ</i>, there is no risk and therefore 'no impact'.</p> <p><b>Evaluation of scale of effect:</b>          High neg.    Medium neg.    Low/none    Medium pos.    High pos.           ----- ----- ----- -----   <span style="margin-left: 200px;">X</span></p>	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: 'No impact'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 
<p><b>2. Description of the scale of effect: Subgroup 1B and 1C</b>  <b>Option 2: Recover by cut and lift</b>  <b>Option 3: Remove by reverse reeling</b></p> <p>Prior to decommissioning, all pipelines will be flushed and cleaned. There will be no live pipes in the Brent area at the time of decommissioning, the environmental risk will therefore be negligible, and will be minimised further by mitigation measures (e.g. safety measures such as isolation (SSIVs) of pipelines will minimize any potential spillages).</p> <p>The environmental risk from unplanned events will be primarily due to incidents involving dropped objects (e.g. pipeline sections).</p> <p>Options involving the removal of pipelines presents the risk of accidents, but the extent of any environmental effect would be limited since all pipelines will have been cleaned and flushed. The potential environmental risk from all options is estimated to be 'insignificant', as the likelihood of an accident that could cause environmental impact (e.g. a dropped object breaking a live pipeline on the seabed during transit of decommissioned pipeline to shore) is very small.</p> <p><b>Evaluation of scale of effect:</b>          High neg.    Medium neg.    Low/none    Medium pos.    High pos.           ----- ----- ----- -----   <span style="margin-left: 200px;">X</span></p>	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Options 2 &amp; 3: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

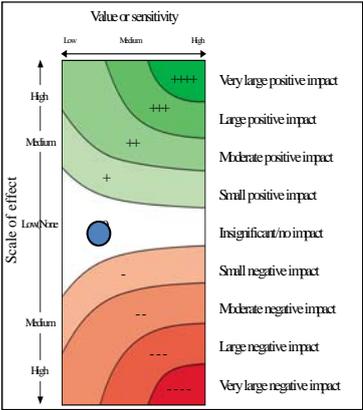
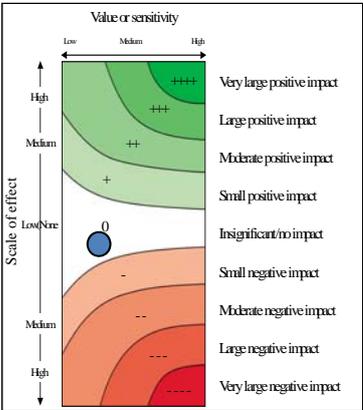
## PIPELINES – Environmental risk from accidents

<p><b>2. Description of the scale of effect - Subgroup 2A</b></p> <p><b>Option 2: Leave tied-in at platforms, trench and backfill non-platform end</b>  <b>Option 3: Leave tied-in at platforms and rock dump non-platform end</b>  <b>Option 4: Trench and backfill whole length</b>  <b>Option 5: Rock dump whole length</b></p> <p>Prior to decommissioning, all pipelines will be flushed and cleaned. There will be no live pipes in the Brent area at the time of decommissioning, the environmental risk will therefore be negligible, and will be minimised further by mitigation measures (e.g. safety measures such as isolation (SSIVs) of pipelines will minimize any potential spillages).</p> <p>The environmental risk from unplanned events will be primarily due to incidents involving dropped objects (e.g. pipeline sections).</p> <p>As the options above do not involve the removal of pipelines the potential risk for all options is estimated to be ‘insignificant’.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Options 2-5: ‘Insignificant’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 
<p><b>2. Description of the scale of effect - Subgroup 2A</b></p> <p><b>Option 6: Recover whole length by cut and lift</b>  <b>Option 7: Recover whole length by reverse S lay (single joint)</b></p> <p>Prior to decommissioning, all pipelines will be flushed and cleaned. There will be no live pipes in the Brent area at the time of decommissioning, the environmental risk will therefore be negligible, and will be minimised further by mitigation measures (e.g. safety measures such as isolation (SSIVs) of pipelines will minimize any potential spillages).</p> <p>The environmental risk from unplanned events will be primarily due to incidents involving dropped objects (e.g. pipeline sections).</p> <p>Options involving the removal of pipelines presents the risk of accidents, but the extent of any environmental effect would be limited since all pipelines will have been cleaned and flushed. The potential environmental risk from all options is estimated to be ‘insignificant’, as the likelihood of an accident that could cause environmental impact (e.g. a dropped object breaking a live pipeline on the seabed during transit of decommissioned pipeline to shore) is very small.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Options 6 &amp; 7: ‘Insignificant’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

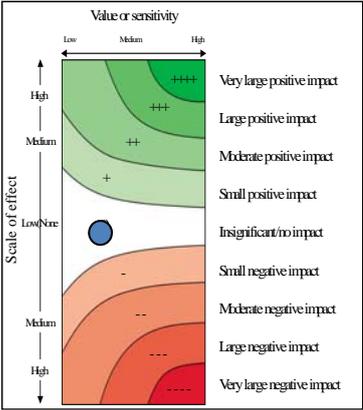
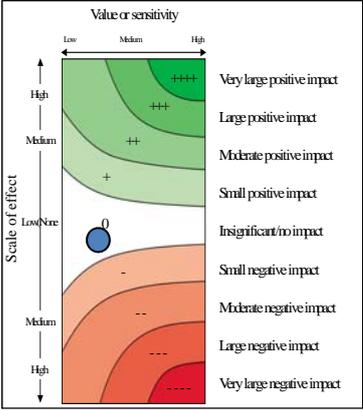
## PIPELINES – Environmental risk from accidents

<p><b>2. Description of the scale of effect - Subgroup 2B</b>  <b>Option 1: Leave <i>in situ</i> with no further remediation</b>  <b>Option 4: Trench and backfill whole length</b>  <b>Option 5: Rock dump whole length</b></p> <p>Prior to decommissioning, all pipelines will be flushed and cleaned. There will be no live pipes in the Brent area at the time of decommissioning, the environmental risk will therefore be negligible, and will be minimised further by mitigation measures (e.g. safety measures such as isolation (SSIVs) of pipelines will minimize any potential spillages).</p> <p>The environmental risk from unplanned events will be primarily due to incidents involving dropped objects (e.g. pipeline sections).</p> <p>As the options above do not involve the removal of pipelines the potential risk from all options is estimated to be ‘insignificant’.</p> <p><b>Evaluation of scale of effect:</b>  High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- -----   <span style="margin-left: 200px;">X</span></p>	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix.</p> <p><b>Options 1, 4 &amp; 5: ‘Insignificant’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 
<p><b>2. Description of the scale of effect - Subgroup 2B</b>  <b>Option 6: Recover whole length by cut and lift</b>  <b>Option 7: Recover whole length by reverse S lay (single joint)</b></p> <p>Prior to decommissioning, all pipelines will be flushed and cleaned. There will be no live pipes in the Brent area at the time of decommissioning, the environmental risk will therefore be negligible, and will be minimised further by mitigation measures (e.g. safety measures such as isolation (SSIVs) of pipelines will minimize any potential spillages).</p> <p>The environmental risk from unplanned events will be primarily due to incidents involving dropped objects (e.g. pipeline sections).</p> <p>Options involving the removal of pipelines presents the risk of accidents, but the extent of any environmental effect would be limited since all pipelines will have been cleaned and flushed. The potential environmental risk from all options is estimated to be ‘insignificant’, as the likelihood of an accident that could cause environmental impact (e.g. a dropped object breaking a live pipeline on the seabed during transit of decommissioned pipeline to shore) is very small.</p> <p><b>Evaluation of scale of effect:</b>  High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- -----   <span style="margin-left: 200px;">X</span></p>	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix.</p> <p><b>Options 6 &amp; 7: ‘Insignificant’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

## PIPELINES – Environmental risk from accidents

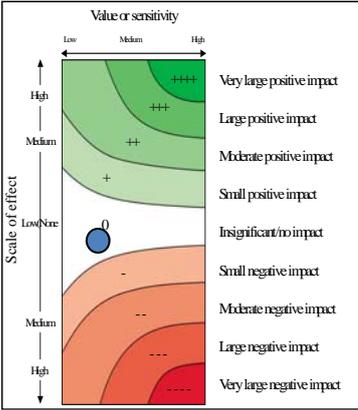
<p><b>2. Description of the scale of effect - Subgroup 2C</b>  <b>Option 1: Leave <i>in situ</i> with no further remediation</b>  <b>Option 8: Trench and backfill shallow-trenched sections and isolated rock dump</b>  <b>Option 9: Rock dump all shallow-trenched sections</b></p> <p>Prior to decommissioning, all pipelines will be flushed and cleaned. There will be no live pipes in the Brent area at the time of decommissioning, the environmental risk will therefore be negligible, and will be minimised further by mitigation measures (e.g. safety measures such as isolation (SSIVs) of pipelines will minimize any potential spillages).</p> <p>The environmental risk from unplanned events will be primarily due to incidents involving dropped objects (e.g. pipeline sections).</p> <p>As the options above do not involve the removal of pipelines the potential risk from all options is estimated to be ‘insignificant’.</p> <p><b>Evaluation of scale of effect:</b>  High neg.    Medium neg.    Low/none    Medium pos.    High pos.   ----- ----- ----- -----   <span style="margin-left: 200px;">X</span></p>	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1, 8 &amp; 9: ‘Insignificant’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 
<p><b>2. Description of the scale of effect - Subgroup 2C</b>  <b>Option 6: Recover whole length by cut and lift</b>  <b>Option 7: Recover whole length by reverse S lay (single joint)</b></p> <p>Prior to decommissioning, all pipelines will be flushed and cleaned. There will be no live pipes in the Brent area at the time of decommissioning, the environmental risk will therefore be negligible, and will be minimised further by mitigation measures (e.g. safety measures such as isolation (SSIVs) of pipelines will minimize any potential spillages).</p> <p>The environmental risk from unplanned events will be primarily due to incidents involving dropped objects (e.g. pipeline sections).</p> <p>Options involving the removal of the pipeline presents the risk of accidents, but the extent of any environmental effect would be limited since the pipeline will have been cleaned and flushed. The potential environmental risk from all options is estimated to be ‘insignificant’, as the likelihood of an accident that could cause environmental impact (e.g. a dropped object breaking a live pipeline on the seabed during transit of decommissioned pipeline to shore) is very small.</p> <p><b>Evaluation of scale of effect:</b>  High neg.    Medium neg.    Low/none    Medium pos.    High pos.   ----- ----- ----- -----   <span style="margin-left: 200px;">X</span></p>	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Options 6 &amp; 7: ‘Insignificant’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

## PIPELINES – Environmental risk from accidents

<p><b>2. Description of the scale of effect - Subgroup 2D</b>  <b>Option 2: Leave tied-in at platform, trench and backfill the non-platform end</b>  <b>Option 3: Leave tied-in at platform and rock dump the non-platform end</b>  <b>Option 5: Rock dump whole length</b></p> <p>Prior to decommissioning, all pipelines will be flushed and cleaned. There will be no live pipes in the Brent area at the time of decommissioning, the environmental risk will therefore be negligible, and will be minimised further by mitigation measures (e.g. safety measures such as isolation (SSIVs) of pipelines will minimize any potential spillages).</p> <p>The environmental risk from unplanned events will be primarily due to incidents involving dropped objects (e.g. pipeline sections).</p> <p>As the options above do not involve the removal of pipelines the potential risk from all options is estimated to be ‘insignificant’.</p> <p><b>Evaluation of scale of effect:</b>  High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix.</p> <p><b>Options 2, 3 &amp; 5: ‘Insignificant’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 
<p><b>2. Description of the scale of effect - Subgroup 2D</b>  <b>Option 6: Recover whole length by cut and lift</b></p> <p>Prior to decommissioning, all pipelines will be flushed and cleaned. There will be no live pipes in the Brent area at the time of decommissioning, the environmental risk will therefore be negligible, and will be minimised further by mitigation measures (e.g. safety measures such as isolation (SSIVs) of pipelines will minimize any potential spillages).</p> <p>The environmental risk from unplanned events will be primarily due to incidents involving dropped objects (e.g. pipeline sections). The cut and lift option for subgroup 2D will only involve a short section of cleaned and flushed pipeline (0.4km). The potential environmental risk from this option is estimated to will be ‘insignificant’, as the likelihood of an accident that could cause environmental impact (e.g. a dropped object breaking a live pipeline on the seabed during transit of decommissioned pipeline to shore) is very small.</p> <p><b>Evaluation of scale of effect:</b>  High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix.</p> <p><b>Option 6: ‘Insignificant’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 



## PIPELINES – Environmental risk from accidents

<b>2. Description of the scale of effect - Subgroup 2E</b> <b>Option 6: Recover whole length by cut and lift</b> <b>Option 7: Remove whole length by reverse lay</b>	<b>3. Total (environmental) impact</b>
<p>Prior to decommissioning, all pipelines will be flushed and cleaned. There will be no live pipes in the Brent area at the time of decommissioning, the environmental risk will therefore be negligible, and will be minimised further by mitigation measures (e.g. safety measures such as isolation (SSIVs) of pipelines will minimize any potential spillages).</p> <p>The environmental risk from unplanned events will be primarily due to incidents involving dropped objects (e.g. pipeline sections).</p> <p>Options involving the removal of pipelines presents the risk of accidents, but the extent of any environmental effect would be limited since all pipelines will have been cleaned and flushed. The potential environmental risk from all options is estimated to be 'insignificant', as the likelihood of an accident that could cause environmental impact (e.g. a dropped object breaking a live pipeline on the seabed during transit of decommissioned pipeline to shore) is very small.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p><b>Options 6 &amp; 7: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 



## 1.19 PIPELINES - EMPLOYMENT

**Category: Pipelines – Groups 1 and 2**

**Consequence evaluation for: Employment**

### 1. General description of the receiving environment (situation and characteristics)

This assessment considers the employment generated from decommissioning the Brent Field pipelines.

The Oil and Gas UK 2016 economic report states that the UK's oil and gas sector currently supports employment for approximately 330,000 people [1]. Analysis demonstrates that each £billion spent by the industry in the UKCS currently delivers between 20 - 25,000 jobs, depending on the balance of spending between capital investment and operational costs. This equates to be about £22 billion.

The report states that in 2015, over £1billion was spent on decommissioning and this is expected to increase to around £2billion in 2017. Beyond this, decommissioning spend will depend on the industry's ability to manage its ageing assets so that they remain economically viable even if low oil prices prevail. [1]

The key activities that would create employment as part of the BDP are onshore preparation works, offshore operations, vessel operations and onshore disposal works.

The location and contracts for the onshore dismantling and disposal of the pipelines have not yet been decided.

UKCS oil and gas production are both currently declining and this has implications on levels of activity and employment. Currently levels of employment in UK oil and gas are 27% less than in 2014. The employment created by the BDP should help to slow down the rate of decline and also have indirect employment benefits in the surrounding area. As such, employment is allocated a 'medium' value for all pipelines.

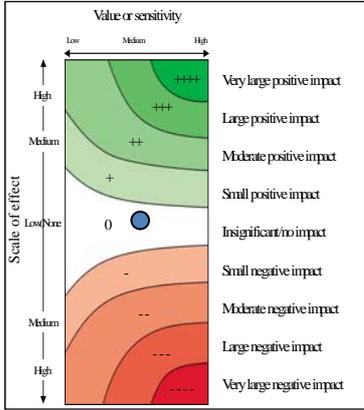
#### Evaluation of the value:

Low Medium High

|-----|-----|

X

## PIPELINES – Employment

<b>2. Description of the scale of effect: Subgroup 1A, 1B 1C</b> <b>Subgroup 1A Option 1: Leave in trench</b> <b>Subgroup 1B Option 2: Recover by cut and lift</b> <b>Subgroup 1C Option 3: Remove by reverse reeling</b>	<b>3. Total (environmental) impact</b>																		
<p>Shell commissioned an independent report to estimate the employment generated by the BDP. As part of this study, a factor was derived for the Brent project of £250,000 per new job per year. This factor was then applied by Shell to estimate the employment generated for each of the decommissioning options.</p> <p>Subgroup 1A Shell estimates that pipelines in subgroup 1A will generate 13 man-years of work.</p> <p>Subgroup 1B Shell estimates that pipelines in subgroup 1B will generate 30 man-years of work.</p> <p>Subgroup 1C Shell estimates that pipelines in subgroup 1C will generate 29 man-years of work.</p> <table border="1"> <thead> <tr> <th colspan="6">Employment Impact Categories (DNV GL)</th> </tr> <tr> <th>Effect</th> <th>None /Insignificant</th> <th>Small positive</th> <th>Small – moderate positive</th> <th>Moderate positive</th> <th>Large</th> </tr> </thead> <tbody> <tr> <td>Man-Years</td> <td>0-400</td> <td>400-1,000</td> <td>1,000-3,000</td> <td>3,000-9,000</td> <td>&gt;9,000</td> </tr> </tbody> </table> <p>This equates to an ‘insignificant’ impact for Group 1 pipelines overall as per the arbitrary employment impact table above.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	Employment Impact Categories (DNV GL)						Effect	None /Insignificant	Small positive	Small – moderate positive	Moderate positive	Large	Man-Years	0-400	400-1,000	1,000-3,000	3,000-9,000	>9,000	<p>1) and 2) are combined in the impact matrix.</p> <p><b>Options 1-3: ‘Insignificant’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 
Employment Impact Categories (DNV GL)																			
Effect	None /Insignificant	Small positive	Small – moderate positive	Moderate positive	Large														
Man-Years	0-400	400-1,000	1,000-3,000	3,000-9,000	>9,000														

## PIPELINES – Employment

### 2. Description of the scale of effect - Subgroup 2A

**Option 2: Leave tied-in at platforms, trench and backfill the non-platform end**

**Option 3: Leave tied-in at platforms and rock dump the non-platform end**

**Option 4: Trench and backfill whole length**

**Option 5: Rock dump whole length**

**Option 6: Recover whole length by cut and lift**

**Option 7: Recover whole length by reverse S lay (single joint)**

Shell commissioned an independent report to estimate the employment generated by the BDP. As part of this study, a factor was derived for the Brent project of £250,000 per new job per year. This factor was then applied by Shell to estimate the employment generated for each of the decommissioning options.

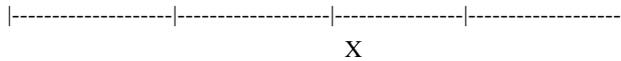
Shell estimates that pipelines in subgroup 2A will generate a total of 212 man-years of work for all options combined.

Employment Impact Categories (DNV GL)					
Effect	None /Insignificant	Small positive	Small – moderate positive	Moderate positive	Large
Man-Years	0-400	400-1,000	1,000-3,000	3,000-9,000	>9,000

This equates to an ‘insignificant’ impact overall as per the arbitrary employment impact table above.

#### Evaluation of scale of effect:

High neg.    Medium neg.    Low/none    Medium pos.    High pos.

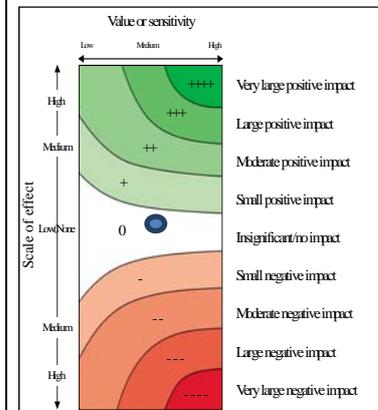


### 3. Total (environmental) impact

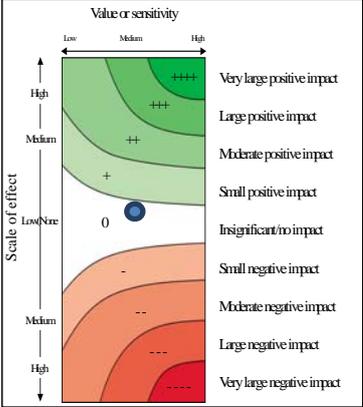
1) and 2) are combined in the impact matrix.

#### Options 2-7: ‘Insignificant’

The uncertainty of the total impact is highlighted by the size of the circle/ellipse.



## PIPELINES – Employment

<p><b>2. Description of the scale of effect - Subgroup 2B</b>  <b>Option 1: Leave <i>in situ</i> with no further remediation</b>  <b>Option 4: Trench and backfill whole length</b>  <b>Option 5: Rock dump whole length</b>  <b>Option 6: Recover whole length by cut and lift</b>  <b>Option 7: Recover whole length by reverse S lay (single joint)</b></p>	<p><b>3. Total (environmental) impact</b></p>																		
<p>Shell commissioned an independent report to estimate the employment generated by the BDP. As part of this study, a factor was derived for the Brent project of £250,000 per new job per year. This factor was then applied by Shell to estimate the employment generated for each of the decommissioning options.</p> <p>Shell estimates that pipelines in subgroup 2B will generate 796 man-years of work for all options combined. The contribution of subgroup 2B pipelines will depend on the option selected, and will result in employment opportunities, but each option is estimated to have an 'insignificant' impact when considered in isolation.</p>	<p>1) and 2) are combined in the impact matrix.</p> <p><b>Options 1, 4-7: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p>																		
<table border="1" style="width: 100%; text-align: center;"> <thead> <tr> <th colspan="6">Employment Impact Categories (DNV GL)</th> </tr> <tr> <th>Effect</th> <th>None /Insignificant</th> <th>Small positive</th> <th>Small – moderate positive</th> <th>Moderate positive</th> <th>Large</th> </tr> </thead> <tbody> <tr> <td>Man-Years</td> <td>0-400</td> <td>400-1,000</td> <td>1,000-3,000</td> <td>3,000-9,000</td> <td>&gt;9,000</td> </tr> </tbody> </table>		Employment Impact Categories (DNV GL)						Effect	None /Insignificant	Small positive	Small – moderate positive	Moderate positive	Large	Man-Years	0-400	400-1,000	1,000-3,000	3,000-9,000	>9,000
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Effect	None /Insignificant	Small positive	Small – moderate positive	Moderate positive	Large														
Man-Years	0-400	400-1,000	1,000-3,000	3,000-9,000	>9,000														
<p><b>Evaluation of scale of effect:</b>            High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X<sub>1,4-7</sub></p>																			
																			

## PIPELINES – Employment

<p><b>2. Description of the scale of effect - Subgroup 2C</b>  <b>Option 1: Leave <i>in situ</i> with no further remediation</b>  <b>Option 6: Recover whole length by cut and lift</b>  <b>Option 7: Recover whole length by reverse S lay (single joint)</b>  <b>Option 8: Trench and backfill shallow-trenched sections and isolated rock dump</b>  <b>Option 9: Rock dump all shallow-trenched sections</b></p>	<p><b>3. Total (environmental) impact</b></p>																		
<p>Shell commissioned an independent report to estimate the employment generated by the BDP. As part of this study, a factor was derived for the Brent project of £250,000 per new job per year. This factor was then applied by Shell to estimate the man-years generated for each of the pipelines' decommissioning options.</p> <p>Shell estimates that subgroup 2C will generate 750 man-years of work for all options combined. The employment contribution of subgroup 2C will depend on the option selected, and will result in employment opportunities, but each option is estimated to have an 'insignificant' impact when considered in isolation.</p>	<p>1) and 2) are combined in the impact matrix.</p> <p><b>Options 1, 6-9: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p>																		
<table border="1" style="width: 100%; text-align: center;"> <thead> <tr> <th colspan="6">Employment Impact Categories (DNV GL)</th> </tr> <tr> <th>Effect</th> <th>None /Insignificant</th> <th>Small positive</th> <th>Small – moderate positive</th> <th>Moderate positive</th> <th>Large</th> </tr> </thead> <tbody> <tr> <td>Man-Years</td> <td>0-400</td> <td>400-1,000</td> <td>1,000-3,000</td> <td>3,000-9,000</td> <td>&gt;9,000</td> </tr> </tbody> </table>		Employment Impact Categories (DNV GL)						Effect	None /Insignificant	Small positive	Small – moderate positive	Moderate positive	Large	Man-Years	0-400	400-1,000	1,000-3,000	3,000-9,000	>9,000
Employment Impact Categories (DNV GL)																			
Effect	None /Insignificant	Small positive	Small – moderate positive	Moderate positive	Large														
Man-Years	0-400	400-1,000	1,000-3,000	3,000-9,000	>9,000														
<p><b>Evaluation of scale of effect:</b>            High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X<sub>1,6-9</sub></p>																			

## PIPELINES – Employment

### 2. Description of the scale of effect - Subgroup 2D

**Option 2: Leave tied-in at platforms, trench and backfill the non-platform end**

**Option 3: Leave tied-in at platform and rock dump the non-platform end**

**Option 5: Rock dump whole length**

**Option 6: Recover whole length by cut and lift**

Shell commissioned an independent report to estimate the employment generated by the BDP. As part of this study, a factor was derived for the Brent project of £250,000 per new job per year. This factor was then applied by Shell to estimate the man-years generated for each of the pipelines' decommissioning options.

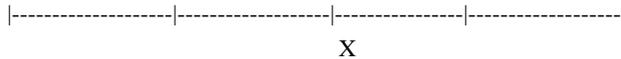
Shell estimates that subgroup 2D will generate 16 man-years of work.

Employment Impact Categories (DNV GL)					
Effect	None /Insignificant	Small positive	Small – moderate positive	Moderate positive	Large
Man-Years	0-400	400-1,000	1,000-3,000	3,000-9,000	>9,000

This equates to an 'insignificant' impact overall as per the arbitrary employment impact table above.

#### Evaluation of scale of effect:

High neg.    Medium neg.    Low/none    Medium pos.    High pos.

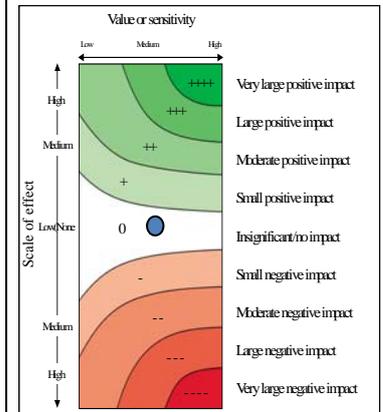


### 3. Total (environmental) impact

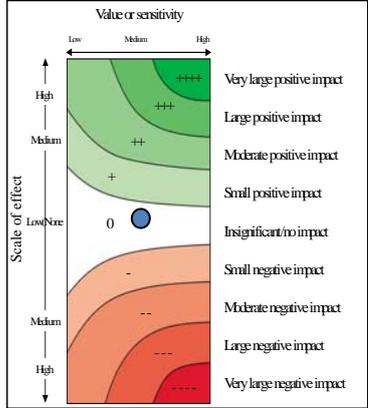
1) and 2) are combined in the impact matrix.

#### Options 2,3,5,6: 'Insignificant'

The uncertainty of the total impact is highlighted by the size of the circle/ellipse.



## PIPELINES – Employment

<p><b>2. Description of the scale of effect - Subgroup 2E</b>  <b>Option 1: Leave <i>in situ</i> with no further remediation</b>  <b>Option 4: Trench and backfill whole length</b>  <b>Option 5: Rock dump whole length</b>  <b>Option 6: Recover whole length by cut and lift</b>  <b>Option 7: Remove the whole length by reverse lay</b></p>	<p><b>3. Total (environmental) impact</b></p>																		
<p>Shell commissioned an independent report to estimate the employment generated by the BDP. As part of this study, a factor was derived for the Brent project of £250,000 per new job per year. This factor was then applied by Shell as part of a cost assessment to estimate the man-years generated for each of the pipelines' decommissioning options.</p> <p>Shell estimates that pipelines in subgroup 2E will generate 61 man-years of work.</p> <table border="1"> <thead> <tr> <th colspan="6">Employment Impact Categories (DNV GL)</th> </tr> <tr> <th>Effect</th> <th>None /Insignificant</th> <th>Small positive</th> <th>Small – moderate positive</th> <th>Moderate positive</th> <th>Large</th> </tr> </thead> <tbody> <tr> <td>Man-Years</td> <td>0-400</td> <td>400-1,000</td> <td>1,000-3,000</td> <td>3,000-9,000</td> <td>&gt;9,000</td> </tr> </tbody> </table> <p>This equates to an 'insignificant' impact overall as per the arbitrary employment impact table above.</p> <p><b>Evaluation of scale of effect:</b>  High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- -----   <span style="margin-left: 250px;">X<sub>1,4-7</sub></span></p>	Employment Impact Categories (DNV GL)						Effect	None /Insignificant	Small positive	Small – moderate positive	Moderate positive	Large	Man-Years	0-400	400-1,000	1,000-3,000	3,000-9,000	>9,000	<p>1) and 2) are combined in the impact matrix.</p> <p><b>Options 1, 4-7: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 
Employment Impact Categories (DNV GL)																			
Effect	None /Insignificant	Small positive	Small – moderate positive	Moderate positive	Large														
Man-Years	0-400	400-1,000	1,000-3,000	3,000-9,000	>9,000														

<sup>1</sup> Oil and Gas UK, *Economic Report 2016*, Website: <http://oilandgasuk.co.uk/product/economic-report-2016/> <Accessed October 2016>.

## 1.20 PIPELINES –Legacy

**Category: Pipelines – Groups 1 and 2**

**Consequence evaluation for: Legacy**

### 1. General description of the receiving environment (situation and characteristics)

For ‘Legacy’ the key items of interest are marine, fisheries and shipping. The sensitivity of the area is considered to be ‘low-medium’ for these items for the following reasons:

- The marine environment in the Brent Field is typical of the Northern North Sea and contains no unique species of particular conservation concern. See ‘Marine’ matrices for more information.
- Compared to other North Sea areas, the Brent Field area does not have a high commercial fishing value. See ‘Fisheries’ matrices for more information.
- There are relatively low numbers of vessels using shipping routes in close proximity to the Brent platform. See ‘Shipping’ matrices for more information.

The legacy assessments have been conducted on the basis that this situation remains similar in the future.

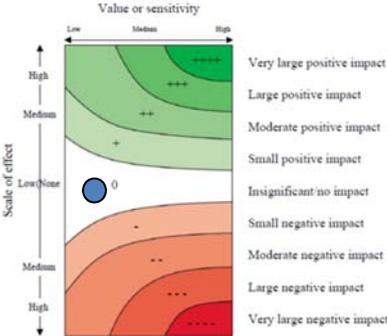
#### **Evaluation of value:**

Low Medium High

|-----|-----|

X

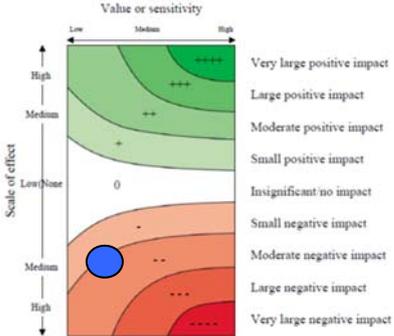
# PIPELINES –Legacy

2. Description of the scale of effect - Subgroup 1A Option 1: Leave in trench	3. Total (environmental) impact
<p>All pipelines in subgroup 1A (total length 17.1 km) and concrete mattresses (combined pipe and mattress weight of 2,377 t) will be left <i>in situ</i>.</p> <p>Pipelines within subgroup 1A are already trenched along the majority of the length (with the exception of N0952 which is under an existing rock dump). Given the relative stability within the North Sea, once pipelines are trenched they will remain <i>in situ</i> and will not present legacy issues. Since the pipes will be cleaned and flushed no contaminants would be released into the marine sediment or the water column after pipe breakdown, apart from residual contaminants (if any) which could have local impact.</p> <p>At Brent South, the subsea end will be left within its existing rock dump covering approximately 3,000m<sup>2</sup> total area footprint for the 5 pipelines in this subgroup. This has already been certified as over-trawlable at time of Interim Pipeline Regime. However, a small amount of additional rock dump of 500 tonnes will be installed over the pipeline end flanges. The impact on fisheries long term from industrial trawlers will be small/ insignificant as the new rock dumped area is small and also final over-trawling of this area will be conducted as part of the main overtrawling program following completion of decommissioning operations.</p> <p>The new rock dump will also create a long term habitat change of a very small area of seabed, modifying from soft sandy substrate to a hard substrate. The rock dumped area will provide a habitat that may be colonised by organisms which occur in the North Sea but typically live on, around or within crevices in rocky, rather than sedimentary substrata. These include such as anemones, soft corals, tubeworms, hydroids, sponges, bryozoan, tunicates, molluscs and a variety of fish, and shellfish. This impact would be limited to a very small area, so is not considered significant.</p> <p>Since the pipeline will be decommissioned <i>in situ</i>, it will be subject to a suitable monitoring programme as agreed with BEIS, to account for changes in pipeline stability and any increased risk to sea users.</p> <p>The residual impact following decommissioning is 'insignificant' given the small rock dump footprint, and considering that none of the pipeline will be exposed on the seabed.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle.</p> 





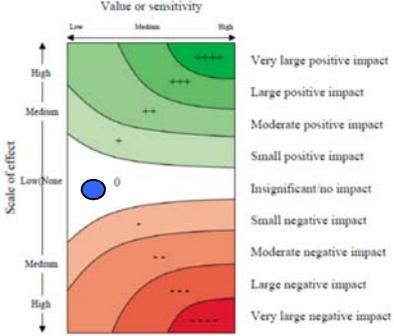
# PIPELINES –Legacy

2. Description of the scale of effect - Subgroup 2A <b>Option 3: Leave tied-in at platforms and rock dump non-platform ends</b>	3. Total (environmental) impact
<p>The three pipelines in subgroup 2A are exposed on the sea bed and comprise approximately 2,575 tonnes of steel and concrete and a small quantity of plastic. There are no 'FishSAFE' spans, but there are numerous stable and persistent spans at each of the pipelines (these spans are not protected by FishSAFE scheme) upon which fishing vessels could potentially snag. Concrete mattresses are positioned at crossings and subsea structures.</p> <p>In Option 3, the pipeline tie-in spools would be cut and removed at the non-platform ends and rock dumped (1,530 t) for a length of ~30 m. Less than 5% of the pipeline inventory will be recovered, the remaining 95% of pipelines (approximately 6.1 km) will remain <i>in situ</i> exposed on the sea bed following decommissioning. There would be no rectification on the spans.</p> <p>The main legacy issue is cumulative risks to sea users from the 3 pipelines left <i>in situ</i>, particularly from the numerous spans that will remain at each pipeline. As a result of the perceived safety risk, fishing vessels operations and behaviour could be affected and a 'small-moderate negative' socioeconomic impact is allocated. Since the pipeline will be decommissioned <i>in situ</i>, it will be subject to a suitable monitoring programme as agreed with BEIS, to account for changes in pipeline stability and any increased risk to sea users, but risks remain.</p> <p>Since the pipes will be cleaned and flushed prior to decommissioning, no contaminants would be released into sediments or the water column after pipe breakdown (apart from any potential residual contaminants, which could have negligible local effect).</p> <p>And as the benthic community in the area is diverse and abundant and does not appear to contain any species of particular conservation concern, and as the rock dump area involved is limited, rock dump has only a minor impact.</p> <p>The legacy impact following decommissioning is allocated 'small-moderate negative', mainly as a result of risks to sea users from pipelines left <i>in situ</i> with no further remediation.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 3: 'Small-moderate negative'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle.</p>  <p>The diagram is a 2D matrix with 'Scale of effect' on the vertical axis (High, Medium, Low/None) and 'Value or sensitivity' on the horizontal axis (Low, Medium, High). The matrix is divided into seven impact levels: Very large positive impact (top right, dark green), Large positive impact (top middle, medium green), Moderate positive impact (top left, light green), Insignificant/no impact (center, white), Small negative impact (bottom left, light orange), Moderate negative impact (bottom middle, medium orange), and Very large negative impact (bottom right, dark red). A blue circle is positioned in the 'Small negative impact' region, centered around the 'Low/None' effect level and 'Low' sensitivity level.</p>

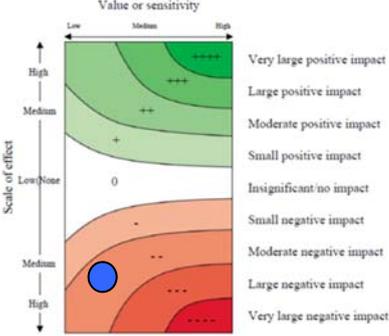




# PIPELINES – Legacy

<b>2. Description of the scale of effect - Subgroup 2A</b> <b>Option 6: Recover whole length by cut and lift</b> <b>Option 7: Recover whole length by reverse S lay (single joint)</b>	<b>3. Total (environmental) impact</b>
<p>Pipelines will be completely removed. Through removal, any legacy risks to the marine environment or risks to fishing vessels from snagging will be removed. There is a small amount of rock dumping, with 'insignificant' legacy impact.</p> <p><b>Evaluation of scale of effect:</b>            High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 6-7: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle.</p> 

# PIPELINES – Legacy

2. Description of the scale of effect - Subgroup 2B Option 1: Leave <i>in situ</i> with no further remediation	3. Total (environmental) impact
<p>Pipelines in subgroup 2B are approximately 25 km long in total and comprise more than 15,500 t of (primarily) steel and concrete. The pipelines are exposed on the seabed as there has been little natural burial over time. Small sections of the pipelines are covered either by mattresses or rock dump (e.g. at crossings and platform ends). There are no 'FishSAFE' spans, but there are numerous stable and persistent spans (these spans are not protected by FishSAFE scheme) at each of the seven pipelines upon which fishing vessels could potentially snag.</p> <p>Under this option, the pipelines would remain <i>in situ</i> with no further remediation. There would be no span correction. There would be a small amount of rock dump (2,210 t) at one pipeline.</p> <p>The main legacy issue is cumulative risks to sea users from the 7 pipelines left <i>in situ</i>, particularly from the numerous spans that will remain at each pipeline. As a result of the perceived safety risk, fishing vessels operations and behaviour could be affected and a 'moderate negative' socioeconomic impact is allocated. Since the pipeline will be decommissioned <i>in situ</i>, it will be subject to a suitable monitoring programme as agreed with BEIS, to account for changes in pipeline stability and any increased risk to sea users, but risks remain.</p> <p>Since the pipes will be cleaned and flushed prior to decommissioning, no contaminants would be released into sediments or the water column after pipe breakdown (apart from any potential residual contaminants, which could have negligible local effect).</p> <p>The legacy impact following decommissioning is 'moderate negative', mainly as a result of risks to sea users from pipelines left <i>in situ</i> with no further remediation.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: 'Moderate negative'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle.</p> 

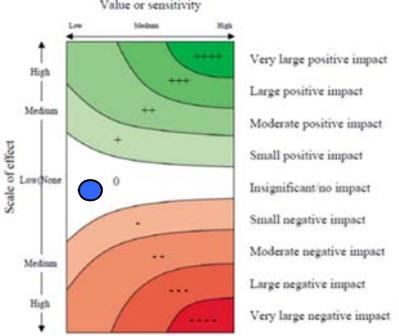






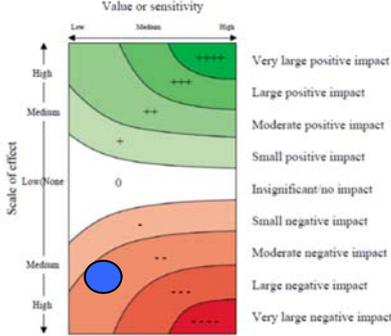


# PIPELINES – Legacy

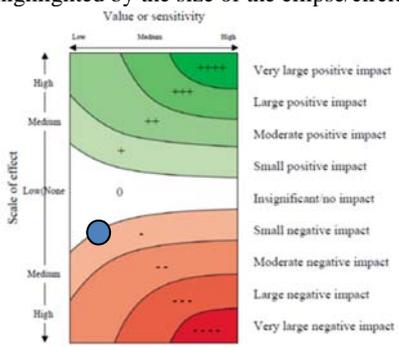
<p><b>2. Description of the scale of effect - Subgroup 2C</b>  <b>Option 6: Recover whole length by cut and lift</b>  <b>Option 7: Recover whole length by reverse S lay (single joint)</b></p>	<p><b>3. Total (environmental) impact</b></p>
<p>Pipelines will be completely removed. Through removal, any legacy risks to the marine environment or risks to fishing vessels from snagging will be removed. There is a small amount of rock dumping (~3,000 t for each option), with 'insignificant' legacy impact.</p> <p><b>Evaluation of scale of effect:</b>          High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 6-7: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle</p>  <p>The diagram is a 2D matrix with 'Scale of effect' on the vertical axis (High, Medium, Low/None, Medium, High) and 'Value or sensitivity' on the horizontal axis (Low, Medium, High). The matrix is divided into colored zones representing different impact levels: Very large positive impact (dark green), Large positive impact (medium green), Moderate positive impact (light green), Small positive impact (pale green), Insignificant/no impact (white), Small negative impact (pale orange), Moderate negative impact (medium orange), Large negative impact (dark orange), and Very large negative impact (dark red). A blue circle labeled '0' is located in the 'Insignificant/no impact' zone at the 'Low/None' effect level and 'Low' sensitivity level.</p>



# PIPELINES – Legacy

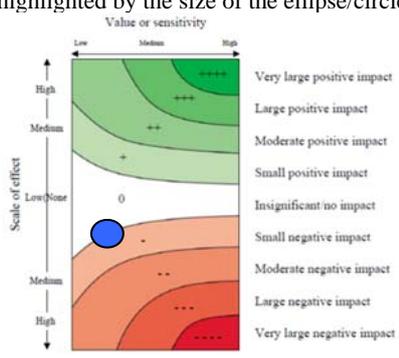
2. Description of the scale of effect - Subgroup 2C Option 9: Rock dump all shallow-trenched sections	3. Total (environmental) impact
<p>Pipeline N0501 is 36 km long and less than half of it is trenched to varying degrees along its route, with remaining sections of the pipeline protruding partially or completely. Under Option 9 all shallow-trenched sections will be rock dumped to 0.6 m depth, with almost 490,000 t rock dump.</p> <p>Rock dumping has potential to impact both fisheries and habitat in the long term as follows.</p> <p><b>Fisheries:</b> Rock dumping can present long term problems to industrial trawlers because they drag a small meshed trawl net along the seabed (other types of trawl nets stay above the seabed so are not impacted). Sharp rocks can potentially damage the industrial trawl net. Furthermore, if rocks are collected by the trawl net they can damage the catch and ultimately damage pumping equipment when the catch is pumped into the processing line. However, industrial trawling is only relevant for shrimp, sand eel and Norway pout, and thus not very relevant in the Brent area where more than 90% of the fish caught are mackerel, cod and haddock. Thus rock dumping at the Brent Field is considered to have small impact to fisheries.</p> <p><b>Habitat:</b> As well as damaging/smothering benthic fauna in the immediate vicinity of the rock dump (as captured in 'Marine'), rock dumping the seabed area changes the marine habitat type in that specific area. This is generally considered a negative impact from a conservation point of view (but there are some positive outputs in that new species will populate the rock dump, thus increasing diversity of species). Although the benthic community in the area is diverse and abundant and does not appear to contain any species of particular conservation concern, the rock dump area involved is significant, hence a 'moderate negative' impact is allocated for this pipeline.</p> <p>For cumulative impacts of rock dumping, please see the Pipelines chapter of the ES.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 9: 'Moderate negative'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle</p>  <p>The diagram is a 2D matrix with 'Scale of effect' on the vertical axis (High, Medium, Low/None) and 'Value or sensitivity' on the horizontal axis (Low, Medium, High). The matrix is color-coded: green for positive impacts and red for negative impacts. Impact levels are indicated by the number of '+' or '-' signs. A blue circle is placed in the cell corresponding to 'Moderate negative impact' (Medium scale of effect, High sensitivity).</p>

# PIPELINES – Legacy

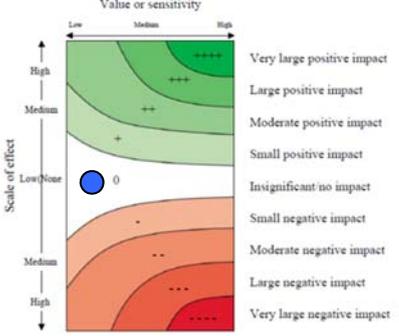
2. Description of the scale of effect - Subgroup 2D Option 2: Leave tied-in at platform, trench and backfill the non-platform ends	3. Total (environmental) impact
<p>The one pipeline in subgroup 2D is 400 m long, weighs approximately 151 t and is exposed on the seabed. There are no 'FishSAFE' spans, but there 5 spans (these spans are not protected by FishSAFE scheme) upon which fishing vessels could potentially snag. Concrete mattresses are positioned at crossings.</p> <p>In Option 2, the pipeline tie-in spool would be cut and removed and the non-platform end trenched and backfilled. Less than 7% of the pipeline will be recovered, the remaining 93% (~375 m) will remain <i>in situ</i> exposed on the sea bed following decommissioning. There would be no rectification on the spans. There is no rock dump in this option.</p> <p>The main legacy issue is the risk to sea users from the pipeline left <i>in situ</i>, particularly from the spans. As a result of the perceived safety risk, fishing vessels operations and behaviour could be affected and a 'insignificant-small negative' socioeconomic impact is allocated. Since the pipeline will be decommissioned <i>in situ</i>, it will be subject to a suitable monitoring programme as agreed with BEIS, to account for changes in pipeline stability and any increased risk to sea users, but risks remain.</p> <p>Since the pipe will be cleaned and flushed prior to decommissioning, no contaminants would be released into sediments or the water column after pipe breakdown (apart from any potential residual contaminants, which could have negligible local effect).</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p><b>Option 2: 'Insignificant-small negative'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle</p>  <p>The diagram is a 2D matrix with 'Scale of effect' on the vertical axis (High, Medium, Low/None, Medium, High) and 'Value or sensitivity' on the horizontal axis (Low, Medium, High). The matrix is divided into colored regions representing different impact levels: Very large positive impact (dark green), Large positive impact (medium green), Moderate positive impact (light green), Small positive impact (pale green), Insignificant/no impact (white), Small negative impact (pale orange), Moderate negative impact (orange), Large negative impact (dark orange), and Very large negative impact (red). A blue circle is positioned in the 'Low/None' row and 'Low' column, indicating the impact level for Option 2.</p>



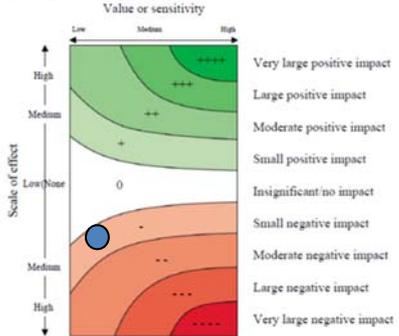
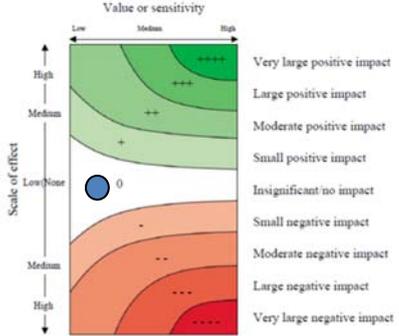
# PIPELINES – Legacy

2. Description of the scale of effect - Subgroup 2D Option 5: Rock dump whole length	3. Total (environmental) impact
<p>Under Option 5, there is approximately 6,800 t of rock dumping, which will impact both fisheries and habitat in the long term as follows.</p> <p><b>Fisheries:</b> Rock dumping can present long term problems to industrial trawlers which drag a small meshed trawl net along the seabed (other types of trawl nets stay above the seabed so are not impacted). Sharp rocks can potentially damage the industrial trawl net. Furthermore, if rocks are collected by the trawl net they can damage the catch and ultimately damage pumping equipment when the catch is pumped into the processing line. However, industrial trawling is only relevant for shrimp, sand eel and Norway pout, and thus not very relevant in the Brent area where more than 90% of the fish caught are mackerel, cod and haddock. Thus rock dumping of this volume at the Brent Field is considered to have only an insignificant-small impact to fisheries.</p> <p><b>Habitat:</b> As well as damaging/smothering benthic fauna in the immediate vicinity of the rock dump (as captured in 'Marine'), rock dumping the seabed area changes the marine habitat type in that specific area. This is generally considered a negative impact from a conservation point of view (but there are some positive outputs in that new species will populate the rock dump, thus increasing diversity of species). Because the benthic community in the area is diverse and abundant and does not appear to contain any species of particular conservation concern, and because the rock dump volume is small, an 'insignificant-small negative' impact is allocated.</p> <p>For cumulative impacts of rock dumping, please see the Pipelines chapter of the ES. Since the pipeline will be decommissioned <i>in situ</i>, it will be subject to a suitable monitoring programme as agreed with BEIS.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p><b>Option 5: 'Insignificant–small negative'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle</p>  <p>The diagram is a 2D matrix with 'Scale of effect' on the vertical axis (High, Medium, Low/None) and 'Value or sensitivity' on the horizontal axis (Low, Medium, High). The matrix is divided into colored regions representing different impact levels: Very large positive impact (dark green), Large positive impact (medium green), Moderate positive impact (light green), Small positive impact (pale green), Insignificant/no impact (white), Small negative impact (pale orange), Moderate negative impact (light orange), Large negative impact (medium orange), and Very large negative impact (dark orange/red). A blue circle is positioned in the 'Insignificant/no impact' region, centered around the '0' mark on the horizontal axis and the 'Low/None' mark on the vertical axis.</p>

# PIPELINES – Legacy

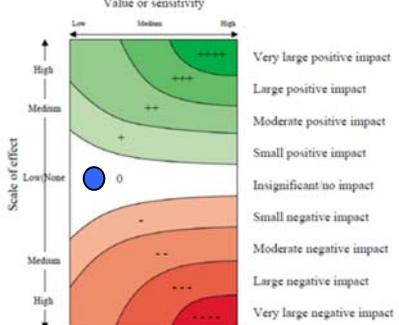
2. Description of the scale of effect - Subgroup 2D Option 6: Recover whole length by cut and lift	3. Total (environmental) impact
<p>The pipeline will be completely removed. Through removal, any legacy risks to the marine environment or risks to fishing vessels from snagging will be removed and there is 'no impact'. There is no rock dump in this option.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 6: 'No impact'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle</p>  <p>The diagram is a 2D matrix with 'Scale of effect' on the vertical axis (Low/None, Medium, High) and 'Value or sensitivity' on the horizontal axis (Low, Medium, High). It features concentric contour lines representing impact levels: Very large positive (++++), Large positive (+++), Moderate positive (++) and Small positive (+) in the upper green quadrant; Insignificant/no impact (0) in the center; and Small negative (-), Moderate negative (--), Large negative (---) and Very large negative (----) in the lower red quadrant.</p>

# PIPELINES – Legacy

<p><b>2. Description of the scale of effect - Subgroup 2E</b>  <b>Option 1: Leave <i>in situ</i> with no further remediation</b></p> <p>Pipelines in subgroup 2E are approximately 4.6 km long in total and comprise 2,218 t of steel, concrete and protective coating, plus 4 t anodes. There are no concrete mattresses. The pipelines are exposed on the seabed and have intermittent spans upon which fishing vessels could potentially snag. No FishSAFE spans are present.</p> <p>Under this option, the pipelines would remain <i>in situ</i> with no further remediation and there would be no span correction.</p> <p>The main legacy issue is risks to sea users from the 2 pipelines left <i>in situ</i>, particularly from the spans that will remain at each pipeline. As a result of the perceived safety risk, fishing vessels operations and behaviour could be affected and avoid some fishing grounds. Since the pipeline will be decommissioned <i>in situ</i>, it will be subject to a suitable monitoring programme as agreed with BEIS, to account for changes in pipeline stability and any increased risk to sea users, but risks remain.</p> <p>Since the pipes will be cleaned and flushed prior to decommissioning, no contaminants would be released into sediments or the water column after pipe breakdown (apart from any potential residual contaminants, which could have negligible local effect).</p> <p>Due to the short length of pipeline left <i>in situ</i> and the lack of FishSAFE spans, the legacy impact following decommissioning is estimated to be ‘small negative’, mainly as a result of risks to sea users from pipelines left <i>in situ</i> with no further remediation.</p> <p><b>Evaluation of scale of effect:</b>  High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- -----   <span style="margin-left: 150px;">X</span></p>	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: ‘Small negative’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle</p>  <p>The diagram is a 2D matrix with 'Scale of effect' on the y-axis (High, Medium, Low/None) and 'Value or sensitivity' on the x-axis (Low, Medium, High). Impact levels are: Very large positive (green, +++++), Large positive (green, ++++), Moderate positive (green, +++), Small positive (green, ++), Insignificant/no impact (white, 0), Small negative (orange, -), Moderate negative (orange, --), Large negative (red, ---), Very large negative (red, ----).</p>
<p><b>2. Description of the scale of effect - Subgroup 2E</b>  <b>Option 4: Trench and backfill whole length</b></p> <p>Given the relative stability within the North Sea, once the pipelines are trenched to 0.6 m deep, they will remain <i>in situ</i> and should not present any legacy issues to fisheries. As the pipelines will be decommissioned <i>in situ</i>, they will also be subject to a suitable monitoring programme as agreed with BEIS.</p> <p>Also, since the pipes will be cleaned and flushed prior to decommissioning, no contaminants would be released into sediments or the water column after pipe breakdown (apart from any potential residual contaminants, which could have negligible local effect). There is no rock dump in this option.</p> <p>The residual impact following decommissioning is ‘insignificant’ given the burial status.</p> <p><b>Evaluation of scale of effect:</b>  High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- -----   <span style="margin-left: 150px;">X</span></p>	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 4: ‘Insignificant’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle</p>  <p>The diagram is a 2D matrix with 'Scale of effect' on the y-axis (High, Medium, Low/None) and 'Value or sensitivity' on the x-axis (Low, Medium, High). Impact levels are: Very large positive (green, +++++), Large positive (green, ++++), Moderate positive (green, +++), Small positive (green, ++), Insignificant/no impact (white, 0), Small negative (orange, -), Moderate negative (orange, --), Large negative (red, ---), Very large negative (red, ----).</p>



# PIPELINES – Legacy

<b>2. Description of the scale of effect - Subgroup 2E</b> <b>Option 6: Recover whole length by cut and lift</b> <b>Option 7: Recover whole length by reverse S-lay</b>	<b>3. Total (environmental) impact</b>
<p>Pipelines will be completely removed. Through removal, any legacy risks to the marine environment or risks to fishing vessels from snagging will be removed and there is 'no impact'. There is no rock dumping in these options.</p> <p><b>Evaluation of scale of effect:</b>            High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 6-7: 'No impact'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle</p> 

## 1.21 PIPELINES - FISHERIES

**Category: Pipelines - Group 1 and 2**

**Consequence evaluation for: Fisheries**

### 1. General description of the receiving environment (situation and characteristics)

The assessments below cover only short-term impacts to fisheries as a result of the Brent Field decommissioning programme; long-term impacts are captured under 'Legacy'.

Marine Scotland is responsible for the management of Scotland's seas and reports statistical data from the International Council for the Exploration of the Seas (ICES) [1]. Two reports by Mackay Consultants summarise and assess the ICES statistical data [2,3]. The total value of the catch over the period 2000-2015 in rectangle 51F1 was approximately £75 million, with an annual average of less than £5 million. The total catch (in terms of weight and value) over the last 5 years is much lower than the preceding decade. It should be noted that these data reflect historic fluctuations in fisheries ecosystems and may not be representative of future statistics.

Fishing in ICES rectangle 51F1 was historically dominated by the mackerel fishery (a pelagic species), which accounted for 76% of the value of the catch over the period 2000-2015 and 84% of the catch weight. Demersal species including haddock, cod, saithe, monkfish and whiting accounted for the remaining value/weight. Although the mackerel fishery represents 84% of the catch weight, the UK mackerel quota can usually be caught in only a few weeks. Therefore, the majority of the fishing effort (e.g. the number of days fished) has been by the whitefish fleet. [3]

In the period 2010-2013, no mackerel were reported to be caught in rectangle 51F1. This reflects the changing nature of the mackerel fishery resulting from a northwards migration of the stock. Since the early 2000's, catches of mackerel in this area have declined as the focus of this fishery has shifted elsewhere [2]. A small mackerel catch was reported in 2014 and 2015, but this represented only 3% of the overall mackerel catch from 2000-2015 [1].

According to the Marine Scotland website [1], the value of demersal species caught in rectangle 51F1 in 2014 was approximately £0.95 million, representing a 'moderate' value. The value of pelagic species caught in rectangle 51F1 in 2014 was approximately £0.79 million, and the value of shellfish species was approximately £281, or a 'low' value. These categories are somewhat arbitrary and should only be used as an indication of the sensitivity of an area.

Projections of future fishing activity in the Brent area by Mackay [3] indicate the value of the mackerel fishery to be similar to the annual average from 2006-2009 in rectangle 51F1, of approximately £5 million. The future projection for the demersal fishery is an annual average value of approximately £2 million. Combining both the mackerel and demersal values gives an overall annual average of £7 million. This is similar to the 2000-2009 average of approximately £6.8 million.

During the decommissioning of pipelines, access to locations used for fishing may be temporarily restricted as preparatory, decommissioning and debris survey works are conducted. However, according to a 2014 study by Anatec of fishing vessel activity in ICES rectangle 51F1 [4], fishing vessel activity in the area is not significant and equates to a rough average of one vessel every other day in the vicinity of the platforms travelling at relatively slow speeds of under 5 knots. This was estimated as an average of 180 days per year from 2005 to 2011, with seasonal variations and April to May being the busiest months.

In accordance with data from Marine Scotland, the marine fisheries at the Brent Field are allocated a 'low-medium' value.

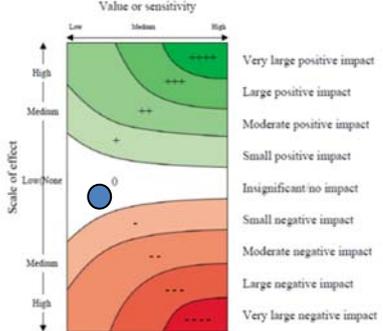
Low Medium High

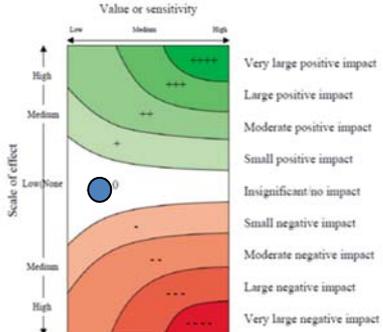
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## PIPELINES – Fisheries

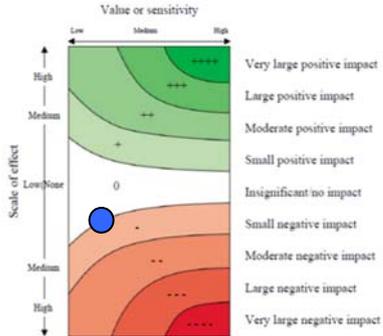
2. Description of the scale of effect - Subgroup 1C Option 3: Remove by reverse reeling	3. Total (environmental) impact
<p>Decommissioning pipelines in subgroup 1C will require vessels but given the short duration of vessel activities, the impact on fisheries during decommissioning is estimated to be 'insignificant'.</p> <p><b>Evaluation of scale of effect:</b> High neg. Medium neg. Low/none Medium pos. High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 3: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle.</p> 

2. Description of the scale of effect - Subgroup 2A Option 2: Leave tied-in at platforms, trench and backfill non-platform end.	3. Total (environmental) impact
<p>Decommissioning operations under Option 2 will require marine works by approximately 34 vessel days, which includes trafficking to and from the Brent Field and pipelines.</p> <p>Given the short duration of vessel activities, the impact on fisheries during decommissioning is estimated to be 'insignificant'.</p> <p><b>Evaluation of scale of effect:</b> High neg. Medium neg. Lw/none Medium pos. High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 2: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle.</p> 

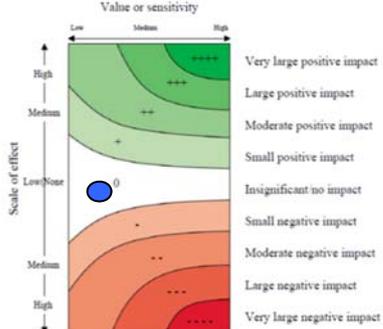


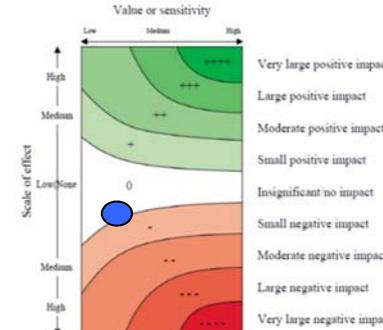


## PIPELINES – Fisheries

2. Description of the scale of effect - Subgroup 2A: Option 7: Recover whole length by reverse S lay (single joint)	3. Total (environmental) impact
<p>Decommissioning operations under Option 7 will require marine works of approximately 130 vessel days, which includes trafficking to and from the Brent Field and pipelines. Works will occur at various locations along pipeline routes, either in isolation or simultaneously depending on the pipeline decommissioning programme.</p> <p>Given the relatively short timescales involved, any impact upon fisheries during decommissioning is considered to be 'insignificant-small negative'.</p> <p><b>Evaluation of scale of effect:</b> High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p><b>Option 7: 'Insignificant-small negative'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle.</p> 

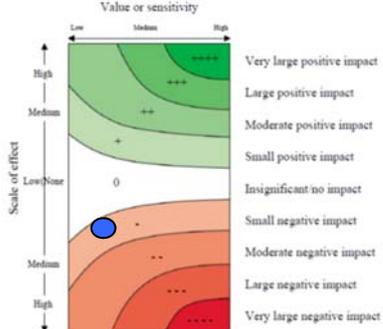
## PIPELINES –Fisheries

2. Description of the scale of effect - Subgroup 2B <b>Option 1: Leave <i>in situ</i> with no further remediation</b>	3. Total (environmental) impact
<p>Decommissioning operations under Option 1 will require works by marine vessels for only 28 vessel days. Given the short timescales involved, any impact upon fisheries during decommissioning is considered to be ‘insignificant’.</p> <p><b>Evaluation of scale of effect:</b> High neg.   Medium neg.   Low/none   Medium pos.   High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: ‘Insignificant’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle.</p>  <p>The diagram is a 2D matrix with 'Scale of effect' on the vertical axis (High, Medium, Low/None) and 'Value or sensitivity' on the horizontal axis (Low, Medium, High). It is divided into seven impact levels: Very large positive impact (dark green), Large positive impact (medium green), Moderate positive impact (light green), Small positive impact (pale green), Insignificant/no impact (white), Small negative impact (pale orange), Moderate negative impact (light orange), Large negative impact (medium orange), and Very large negative impact (dark orange/red). A small blue circle is positioned at the 'Insignificant/no impact' level, indicating the total impact for Option 1.</p>

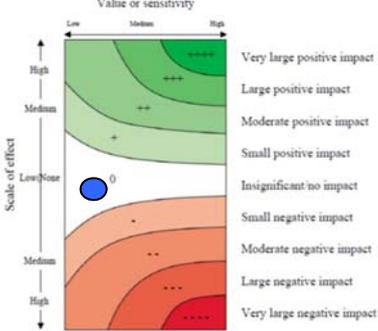
2. Description of the scale of effect - Subgroup 2B <b>Option 4: Trench and backfill whole length</b>	3. Total (environmental) impact
<p>Decommissioning operations under Option 4 will require works by marine vessels for approximately 140 vessel days. Works will occur at various locations along pipeline routes, either in isolation or simultaneously depending on the pipeline decommissioning programme.</p> <p>Given the relatively short timescales involved, any impact upon fisheries during decommissioning is considered to be ‘insignificant-small negative’.</p> <p><b>Evaluation of scale of effect:</b> High neg.   Medium neg.   Low/none   Medium pos.   High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 4: ‘Insignificant-small negative’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle.</p>  <p>The diagram is a 2D matrix with 'Scale of effect' on the vertical axis (High, Medium, Low/None) and 'Value or sensitivity' on the horizontal axis (Low, Medium, High). It is divided into seven impact levels: Very large positive impact (dark green), Large positive impact (medium green), Moderate positive impact (light green), Small positive impact (pale green), Insignificant/no impact (white), Small negative impact (pale orange), Moderate negative impact (light orange), Large negative impact (medium orange), and Very large negative impact (dark orange/red). A small blue circle is positioned at the 'Small negative impact' level, indicating the total impact for Option 4.</p>



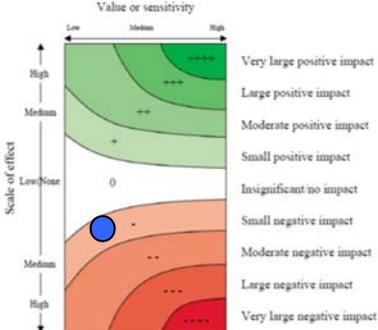
## PIPELINES – Fisheries

2. Description of the scale of effect - Subgroup 2B <b>Option 7: Recover whole length by reverse S lay (single joint)</b>	3. Total (environmental) impact
<p>Decommissioning operations under Option 7 will require works by marine vessels for approximately 420 vessel days for all pipelines in this subgroup. Works will occur at various locations along pipeline routes, either in isolation or simultaneously depending on the pipeline decommissioning programme.</p> <p>Given the relatively short timescales involved, any impact upon fisheries during decommissioning is considered to be 'small negative'.</p> <p><b>Evaluation of scale of effect:</b> High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 7: 'Small negative'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle.</p>  <p>The diagram is a 2D matrix with 'Scale of effect' on the vertical axis (High, Medium, Low/None) and 'Value or sensitivity' on the horizontal axis (Low, Medium, High). The matrix is divided into seven impact levels, each represented by a different color and a number of dots: Very large positive impact (dark green, 5 dots), Large positive impact (medium green, 3 dots), Moderate positive impact (light green, 2 dots), Small positive impact (pale green, 1 dot), Insignificant no impact (white, 0 dots), Small negative impact (light orange, 1 dot), Moderate negative impact (orange, 2 dots), Large negative impact (red-orange, 3 dots), and Very large negative impact (dark red, 5 dots). A blue circle is placed in the 'Small negative impact' region, centered around the 'Medium' sensitivity and 'Medium' scale of effect area.</p>

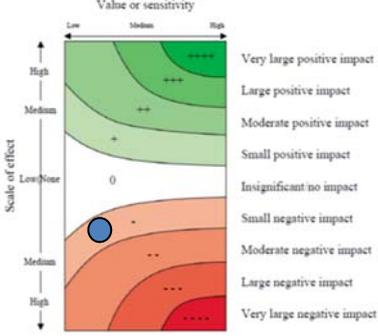
## PIPELINES –Fisheries

2. Description of the scale of effect - Subgroup 2C Option 1: Leave <i>in situ</i> with no further remediation	3. Total (environmental) impact
<p>Decommissioning operations under Option 1 will require works by marine vessels for only 15 vessel days. Given the relatively short timescales involved, any impact upon fisheries during decommissioning is considered to be 'insignificant'.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle.</p> 

## PIPELINES - Fisheries

2. Description of the scale of effect - Subgroup 2C Option 6: Recover whole length by cut and lift	3. Total (environmental) impact
<p>Decommissioning operations under Option 6 will require works by marine vessels for approximately 680 vessel days. This could potentially have a 'small negative' impact on fisheries.</p> <p><b>Evaluation of scale of effect:</b> High neg.   Medium neg.   Low/none   Medium pos.   High pos.</p> <p style="text-align: center;"> ----- ----- ----- -----  X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 6: 'Small negative'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle.</p> 

## PIPELINES –Fisheries

2. Description of the scale of effect - Subgroup 2C <b>Option 7: Recover whole length by reverse S lay (single joint)</b>	3. Total (environmental) impact
<p>Decommissioning operations under Option 7 will require works by marine vessels for approximately 500 days. This could potentially have a ‘small negative’ impact on fisheries.</p> <p><b>Evaluation of scale of effect:</b> High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 7: ‘Small negative’</b></p> <p>The uncertainty of the total impact is highlighted by the size of the ellipse/circle.</p> 















## 1.22 PIPELINES - SHIPPING

**Category: Pipelines – Groups 1 and 2**

**Consequence evaluation for: Shipping**

### 1. General description of the receiving environment (situation and characteristics)

The baseline for 'Shipping' is the same for all pipeline groups. The assessments below depict short-term impacts to shipping as a result of the Brent Decommissioning Programme (BDP); long-term impacts to shipping are captured under 'Legacy'.

Shipping traffic to European ports entering the Northern North Sea from the west generally traverse through the Pentland Firth or Fair Isle Channel between the Orkney and Shetland Islands. Therefore, the main shipping routes in the North Sea are predominantly well to the south of the Brent Field.

A study by Anatec in 2014 [1] found that a total of 24 shipping routes are trafficked by an estimated 686 ships per year passing within 10 nm of the Brent platforms. This corresponds to 1-2 ships per day. Offshore vessels (by type) account for the largest constituent of vessels (44%) passing within 10 nm of the platforms. Tankers (28%), cargo vessels (25%) and ferries (3%) make up the remainder.

In the evaluation of the impact on shipping of the various decommissioning options, the following criteria were considered:

- Proximity of shipping routes (closest point of approach) to the Brent platforms and frequency (total number) of ships traversing along these routes, their type and size
- Projected vessel utilisation for decommissioning activities based on vessel data provided by Shell, included in DNV GL's Energy and Emissions Report [2].

Due to the relatively low numbers of vessels using shipping routes in close proximity to the Brent platforms, and navigational courses being clear of the offshore oil & gas development zones, shipping is considered to be of 'low' value in the assessment.

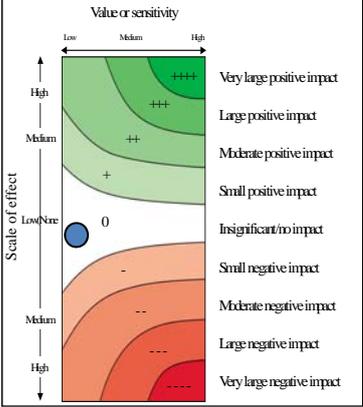
#### Evaluation of the value:

Low Medium High

|-----|-----|

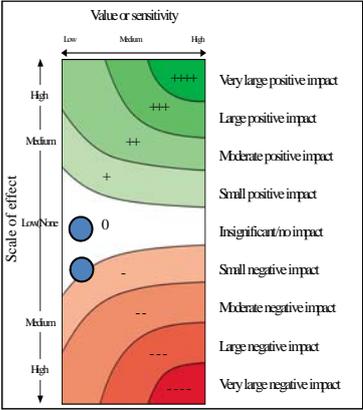
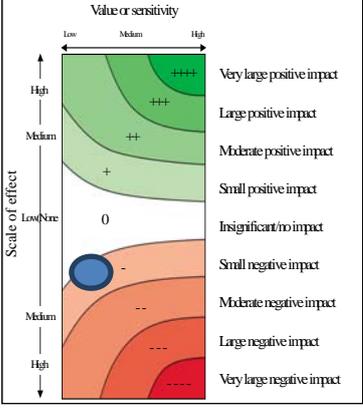
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## PIPELINES – Shipping

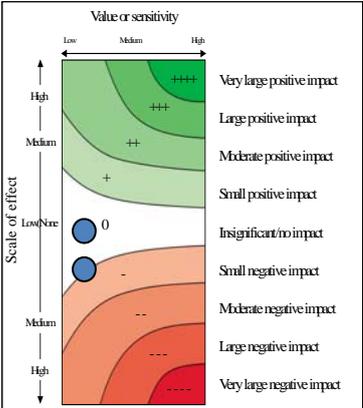
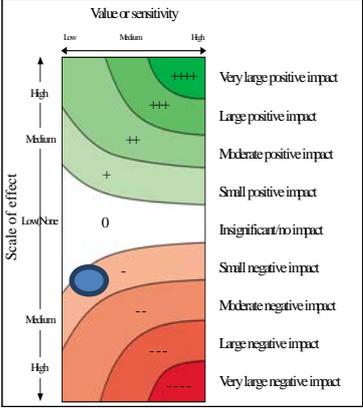
<p><b>2. Description of the scale of effect - Subgroup 1A, 1B, 1C</b>  <b>Group 1A Option 1: Leave in trench</b>  <b>Group 1B Option 2: Recover by cut and lift</b>  <b>Group 1C Option 3: Remove by reverse reeling</b></p>	<p><b>3. Total (environmental) impact</b></p>
<p>Shipping activity will be limited to marine operations in the vicinity of the pipelines, and on routes to and from shore for limited periods. Subgroups 1A, 1B and 1C only involve a small number of marine operations, hence it is not anticipated that operations from any option would have any practical impact on shipping and the impact is estimated to be 'insignificant'.</p> <p><b>Evaluation of scale of effect:</b>  High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Options 1-3: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 



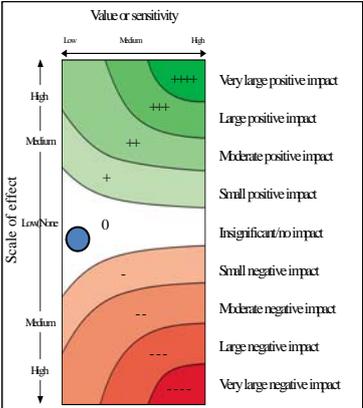
# PIPELINES – Shipping

<p><b>2. Description of the scale of effect - Subgroup 2B</b>  <b>Option 1: Leave <i>in situ</i> with no further remediation</b>  <b>Option 4: Trench and backfill whole length</b>  <b>Option 5: Rock dump whole length</b></p> <p>Shipping activity will be limited to marine operations in the vicinity of the pipelines, and on routes to and from shore for limited periods. The options involve marine operations ranging from approximately 30 to 160 days, and it is not anticipated that such operations would have any practical impact on shipping and the impact is estimated to be 'insignificant' for Option 1 and 'insignificant-small negative' for Options 4 and 5.</p> <p><b>Evaluation of scale of effect:</b>          High neg.    Medium neg.    Low/none    Medium pos.    High pos.           ----- ----- ----- -----   <span style="margin-left: 200px;">X<sub>4,5,X</sub></span></p>	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: Insignificant</b>  <b>Options 4 &amp; 5: 'Insignificant-small negative'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 
<p><b>2. Description of the scale of effect - Subgroup 2B</b>  <b>Option 6: Recover whole length by cut and lift</b>  <b>Option 7: Recover whole length by reverse S lay (single joint)</b></p> <p>Shipping activity will be limited to marine operations in the vicinity of the pipelines, and on routes to and from shore for limited periods. Options 6 and 7 involve marine operations for about 430 days each, and may have a 'small negative' impact on shipping.</p> <p><b>Evaluation of scale of effect:</b>          High neg.    Medium neg.    Low/none    Medium pos.    High pos.           ----- ----- ----- -----   <span style="margin-left: 200px;">X</span></p>	<p><b>3. Total (environmental) impact</b></p> <p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Options 6 &amp; 7: 'Small negative'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

# PIPELINES – Shipping

<p><b>2. Description of the scale of effect - Subgroup 2C</b>  <b>Option 1: Leave <i>in situ</i> with no further remediation</b>  <b>Option 8: Trench and backfill shallow-trenched sections and isolated rock dump</b>  <b>Option 9: Rock dump all shallow-trenched sections</b></p>	<p><b>3. Total (environmental) impact</b></p>
<p>Shipping activity will be limited to marine operations in the vicinity of the pipelines, and on routes to and from shore for limited periods. The options above involve marine operations ranging from 15 to 155 days. It is not anticipated that operations from any option would have any practical impact on shipping and the impact is estimated to be 'insignificant' for Option 1 and 'insignificant-small negative' for Options 8 and 9.</p> <p><b>Evaluation of scale of effect:</b>  High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- -----   <span style="margin-left: 150px;">X<sub>8,9</sub> X</span></p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Option 1: Insignificant'</b>  <b>Options 8 &amp; 9: 'Insignificant-small negative'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 
<p><b>2. Description of the scale of effect - Subgroup 2C</b>  <b>Option 6: Recover whole length by cut and lift</b>  <b>Option 7: Recover whole length by reverse S lay (single joint)</b></p>	<p><b>3. Total (environmental) impact</b></p>
<p>Shipping activity will be limited to marine operations in the vicinity of the pipelines, and on routes to and from shore for limited periods. Options 6 and 7 involve marine operations for approximately 680 and 490 days respectively. It is not anticipated that operations from any option would have any practical impact on shipping, but due to the duration of operations the impact is estimated to be 'small negative', as some of the operations will take place outside of the 500 m safety zone.</p> <p><b>Evaluation of scale of effect:</b>  High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p style="text-align: center;"> ----- ----- ----- -----   <span style="margin-left: 150px;">X</span></p>	<p>1) and 2) are combined in the impact matrix.</p> <p style="text-align: center;"><b>Options 6 &amp; 7: 'Small negative'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

## PIPELINES – Shipping

<p><b>2. Description of the scale of effect - Subgroup 2D</b></p> <p><b>Option 2: Leave tied-in at platform, trench and backfill the non-platform end</b></p> <p><b>Option 3: Leave tied-in at platforms and rock dump the non-platform end</b></p> <p><b>Option 5: Rock dump whole length</b></p> <p><b>Option 6: Recover whole length by cut and lift</b></p>	<p><b>3. Total (environmental) impact</b></p>
<p>Shipping activity will be limited to a small number of marine operations in the vicinity of the pipeline, and on routes to and from shore for limited periods. Marine operations range between 10 to 13 days for these options and thus it is not anticipated that operations from any option would have any practical impact on shipping. The impact is estimated to be 'insignificant'.</p> <p><b>Evaluation of scale of effect:</b></p> <p>High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p> ----- ----- ----- ----- </p> <p style="text-align: center;">X</p>	<p>1) and 2) are combined in the impact matrix.</p> <p><b>Options 2,3,5,6: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> 

## PIPELINES – Shipping

<p><b>2. Description of the scale of effect - Subgroup 2E</b>  <b>Option 1: Leave <i>in situ</i> with no further remediation</b>  <b>Option 4: Trench and backfill whole length</b>  <b>Option 5: Rock dump whole length</b>  <b>Option 6: Recover whole length by cut and lift</b>  <b>Option 7: Remove whole length of pipeline by reverse lay</b></p>	<p><b>3. Total (environmental) impact</b></p>
<p>Shipping activity will be limited to marine operations in the vicinity of the two pipelines, and on routes to and from shore for limited periods. Option 7 involves the longest duration of marine operations at 98 days for the two pipelines. It is not anticipated that operations from any option would have any practical impact on shipping and the impact is estimated to be 'insignificant'.</p> <p><b>Evaluation of scale of effect:</b>  High neg.    Medium neg.    Low/none    Medium pos.    High pos.</p> <p>----- ----- ----- ----- -----   <span style="margin-left: 200px;">X</span></p>	<p>1) and 2) are combined in the impact matrix.</p> <p><b>Options 1, 4-7: 'Insignificant'</b></p> <p>The uncertainty of the total impact is highlighted by the size of the circle/ellipse.</p> <p>The diagram is a 2D matrix with 'Scale of effect' on the vertical axis (High, Medium, Low/None) and 'Value or sensitivity' on the horizontal axis (Low, Medium, High). The matrix is divided into positive (green) and negative (red) impact zones. The positive zones are labeled: Very large positive impact (++++), Large positive impact (+++), Moderate positive impact (++), and Small positive impact (+). The negative zones are labeled: Small negative impact (-), Moderate negative impact (--), Large negative impact (---), and Very large negative impact (----). The central zone is labeled '0' for 'Insignificant to impact'. A small blue circle is located in the 'Insignificant to impact' zone, centered around the 'Low' sensitivity and 'Low/None' effect levels.</p>

<sup>1</sup> Anatec Ltd., *Assessment of Safety Risk to Mariners from Derogated GBSs in the Brent Field*, BDE-F-GBS-HX-0709-00003, Rev 03, 19 February 2014.

<sup>2</sup> DNV GL, *Energy Use and Gaseous Emissions Report for the Brent Field Decommissioning EIA*, DNV GL Report No.: 187KVXJ-3, Rev 5, 2016.