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 *in situ* 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 *in situ* 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 *in situ* are assessed under 'Legacy'.
Energy and Emissions (E&E)	Energy and Emissions estimates the energy use and gaseous emissions (CO_2, NO_x, SO_x) 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 *in situ* or disposed of to landfill and thus not recycled) is taken into account. See Section **Error! Reference source not found.** 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.

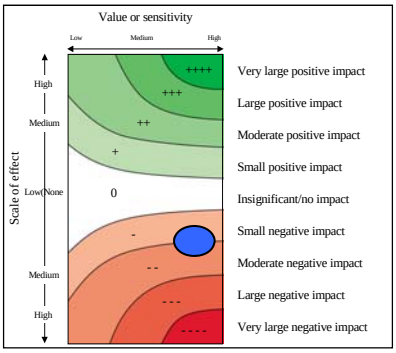
For the locations that are not yet known, the sensitivity is allocated some uncertainty because it is difficult to assess it without knowing the exact onshore dismantling location, the nature of the surrounding environment and the proximity to the local population. Shell UK's selection procedures will 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.

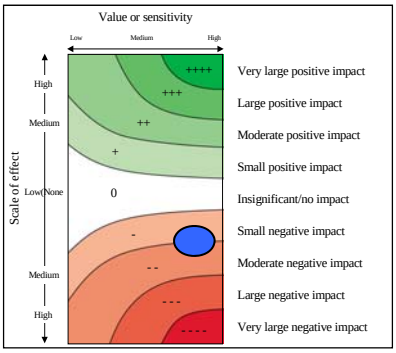
Evaluation of the value:

Low	Medium	High
	X	X

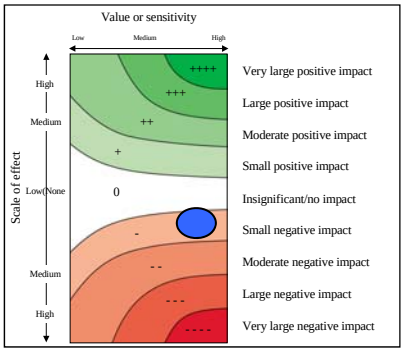
TOPSIDES – Onshore Impacts

2. Description of the scale of effect **Option 1: Complete Removal by SLV.**	3. Total (environmental) impact
For the topsides only one decommissioning option is considered – complete removal in one piece using SLV. DNV GL's Environmental Scoping Report [1] helps identify the main activities with potential for onshore impact when decommissioning the Brent Field topsides: • Dust emissions from deconstruction of topsides onshore • Dust and noise emissions from increased traffic onshore • Noise from onshore deconstruction activities (e.g. lifting and cutting) • Visual impacts 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. 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. 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. 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. 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. 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. Onshore operations will be independently audited to help ensure regulatory limits are satisfied. 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. (contd.)	1) and 2) are combined in the impact matrix. **Option 1: 'Small-moderate negative'** The uncertainty of the total impact is highlighted by the size of the ellipse/circle. 

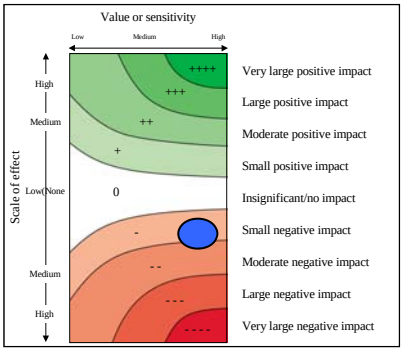
TOPSIDES – Onshore Impacts

2. Description of the scale of effect **Option 1: Complete Removal by SLV.**	3. Total (environmental) impact
(contd.) 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'. Further detail is provided in the Environmental Statement. **Evaluation of scale of effect:** High neg. Medium neg. Low/none Medium pos. High pos. |----------|----------|----------|----------| X	1) and 2) are combined in the impact matrix. **Option 1: 'Small-moderate negative'** The uncertainty of the total impact is highlighted by the size of the ellipse/circle. 

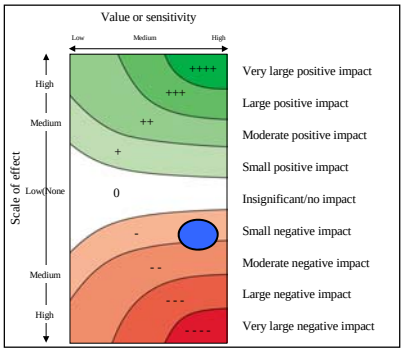
BRENT A UPPER JACKET – Onshore Impacts

2. Description of the scale of effect **Option 1: Removal in one piece to approx. -84.5m LAT using SLV**	3. Total (environmental) impact
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:** High neg. Medium neg. Low/none Medium pos. High pos. |----------|----------|----------|----------| X	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. 

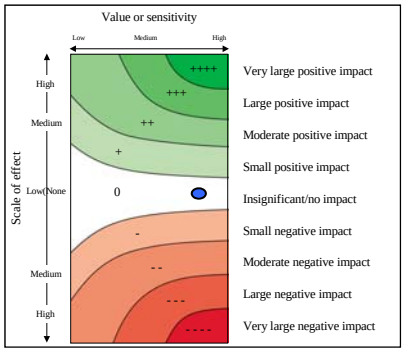
BRENT A JACKET FOOTINGS – Onshore Impacts

2. Description of the scale of effect **Option 1: Complete removal by SSCV in several pieces, after cuttings the piles externally**	3. Total (environmental) impact
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. The main difference for this option is the volumes of material involved. 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. 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. **Evaluation of scale of effect:** High neg. Medium neg. Low/none Medium pos. High pos. |----------|----------|----------|----------| X	1) and 2) are combined in the impact matrix. **Option 1: 'Small-moderate negative'** The uncertainty of the total impact is highlighted by the size of the circles/ellipses. 

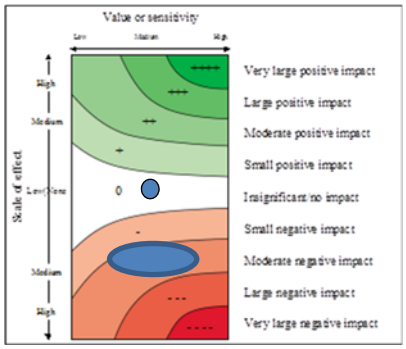
BRENT A JACKET FOOTINGS – Onshore Impacts

2. Description of the scale of effect **Option 2: Complete removal by SSCV in several pieces, after cutting the piles internally**	3. Total (environmental) impact
The decommissioned Brent A jacket footings will be brought onshore to the ASP facility under Option 2. The potential onshore impacts will be very similar to those described in the matrix for the Brent A jacket footings Option 1, including: odour from marine growth, noise, dust and vibration, and increased traffic nuisance. The impact is estimated to be 'small-moderate' negative. **Evaluation of scale of effect:** High neg. Medium neg. Low/none Medium pos. High pos. |----------|----------|----------|----------| X	1) and 2) are combined in the impact matrix. **Option 2: 'Small-moderate negative'** The uncertainty of the total impact is highlighted by the size of the circles/ellipses. 

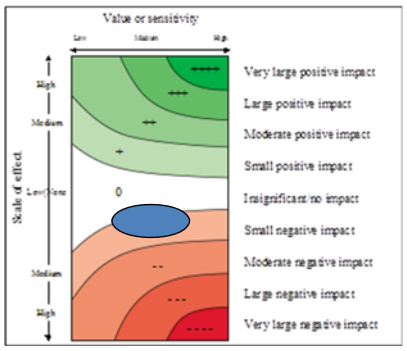
BRENT A JACKET FOOTINGS – Onshore Impacts

2. Description of the scale of effect **Option 3: Leave *in situ***	**3. Total (environmental) impact**
As the Brent A jacket footings will be left *in situ* in Option 3, there are no onshore impacts. **Evaluation of scale of effect:** High neg. Medium neg. Low/none Medium pos. High pos. |----------|----------|----------|----------| X	1) and 2) are combined in the impact matrix. **Option 3: 'No impact'** The uncertainty of the total impact is highlighted by the size of the circles/ellipses. 

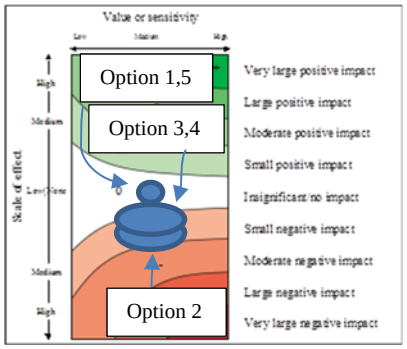
GBS - Onshore Impacts

2. Description of the scale of effect **Options 1 and 2: Partial removal, and Leave *in situ***	3. Total (environmental) impact
For the GBS two decommissioning options are considered: • Option 1: partial removal of the GBS legs in a single piece to give -55 m clear water depth below LAT. Approximately 37,917 tonnes of concrete and 9,382 tonnes steel will be taken onshore, plus 4,502 tonnes of steel from the upper conductors. • Option 2: leave *in situ* DNV GL's Environmental Scoping Report [1] helps identify the main activities with potential for impact if not controlled when decommissioning the GBS: • Dust emissions from deconstruction of GBS legs onshore • Odour from marine growth on removed GBS concrete legs • Noise from lifting and crushing of concrete legs inshore and onshore • Visual impacts • Potentially increased onshore traffic nuisance Option 2 will not involve any onshore operations, so there would be no impact. The extent of the onshore impact for Option 1 is discussed below. There are 3 GBS and dismantling GBS legs will generate large volumes of concrete. The concrete GBS have more potential for the generation of significant dust, noise and traffic than the dismantling of the Brent A steel jacket. Marine growth removal from the GBS legs will result in odour emissions onshore, the extent depending on the amount of marine growth, temperature, air exposure time, drying and the efficiency of disposal methods. If the licensed facility for the onshore dismantling has a small local population in the immediate vicinity, some small negative impacts might be anticipated though of limited duration. Noise impacts are possible given that crushing of concrete legs will be required and will take a considerable amount of time owing to the large volumes (37,917 tonnes for all 3 GBS). Strict noise abatement measures (e.g. working hours' restrictions, good physical site planning, and noise control) may need to be put in place to minimise the extent of noise impacts, however the prolonged duration of these operations could still result in some noise impacts. Dust emissions could also potentially impact local populations. Mitigation measures will be put in place (e.g. water sprays, onsite speed restrictions, strict controls and independent auditing) where necessary to minimise impacts. Impacts could also result from increased onshore traffic nuisance, and good planning will be required. The GBS legs will either be dismantled in a horizontal or vertical position on the quayside. If the legs are dismantled vertically, they would be grouted and fixed to the platform on the quay, and dismantled in a 'piece-small' operation using conventional dismantling equipment to cut the legs into sections, using a mobile crane to lift the sections away for recycling. If dismantled vertically, there will be a period of visual impact owing to the size of legs. However, assuming that the onshore location is an established industrial facility, and because the visual impact will reduce as the legs are dismantled, the anticipated visual impacts will be reduced. The overall scale of effect of onshore impacts from Option 1 is estimated to be 'medium negative' as the operations would involve significant and prolonged onshore activities. 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. Some uncertainty is allocated as the onshore location has not yet been selected. The scale of effect of onshore impacts from Option 2 is 'no impact', as there will be no onshore operations. **Evaluation of scale of effect:** High neg. Medium neg. Low/none Medium pos. High pos. |----------|----------|----------|----------| X_1 X_2	1) and 2) are combined in the impact matrix. **Option 1: 'Moderate negative'** **Option 2: 'No impact'** The uncertainty of the total impact is highlighted by the size of the circles/ellipses. 

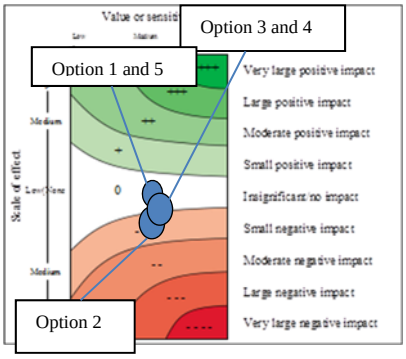
GBS ATTIC OIL - Onshore Impacts

2. Description of the scale of effect **Option 1: Recover to Shore**	3. Total (environmental) impact
For all cell contents options, the attic oil (approximately 12-14,000 m^3 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. **Evaluation of scale of effect:** High neg. Medium neg. Low/none Medium pos. High pos. |----------|----------|----------|----------| X	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. 

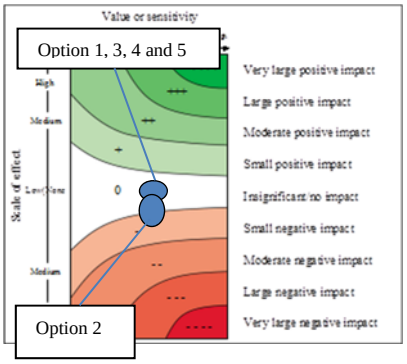
GBS CELL CONTENTS – Onshore Impacts

2. Description of the scale of effect **Options 1, 2, 3, 4, 5**	**3. Total (environmental) impact**
For the GBS cell contents, 5 decommissioning options are considered: • Option 1: mobilise to vessel and re-inject to new wells in the Brent Field • Option 2: mobilise and retrieve to vessel and transport to shore for treatment • Option 3: cap or cover *in situ* in the cells using e.g. a mixture of sand / gravel • Option 4: leave *in situ* in the cells and treat with MNA • Option 5: leave *in situ* in the cells for natural degradation For all cell contents options, the attic oil /interphase material (total approximately 12-14,000 m^3) 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'. Options 3 and 4 will involve the return of displaced cell water to shore for treatment (between approximately 15,000-35,000 m^3) 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. 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^3 slurry for all three GBS, plus an additional 640,000 m^3 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. **Evaluation of scale of effect:** High neg. Medium neg. Low/none Medium pos. High pos. |----------|----------|----------|----------| X_2 $X_{3,4}$ $X_{1,5}$	1) and 2) are combined in the impact matrix. **Options 1, 5: 'No impact'** **Options 3/4: 'Small negative'** **Option 2: 'Small-moderate negative'** The uncertainty of the total impact is highlighted by the size of the circles/ellipses. 

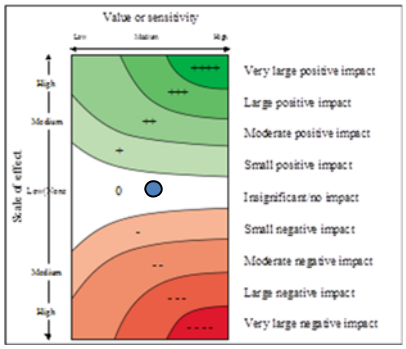
GBS DRILLING LEG MATERIAL – Onshore Impacts

2. Description of the scale of effect **Options 1, 2, 3, 4, 5**	**3. Total (environmental) impact**
For the GBS Brent B and D drilling legs material, 5 decommissioning options are considered: 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 *in situ* using sand and coarse gravel. Option 4: Leave *in situ* and improve natural biodegradation by adding chemicals (Monitored Natural Attenuation, MNA) Option 5: Leave *in situ* for natural biodegradation Note for Options 1,2,3 and 4 there are further sub–options considered: • 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. • 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. But whichever combination of sub-options are selected, they would result in the similar impact, so the assessment below just details Options 1-5. For Options 1 and 5 there are no onshore activities, therefore there are no onshore impacts. Option 2: In Option 2, for Brent B and D, it is estimated that 8,000 m3 of sediment would be dredged and mobilised as a slurry to a SSCV. The volume involved is approximately 20% of the total cell sediment volume from the 3 GBS. The dilute slurry will be dewatered onshore and the treated water discharged in accordance with permit conditions. The dewatered slurry will be treated via low temperature thermal desorption, and the dry inert solids will be sent to landfill and recovered oil will be re-used. Only relatively small volumes of recovered oil (56m^3) and dried residue would be transported on the road network and this could cause some minor nuisance, but the volumes involved are small (and only a fraction of those for the GBS cell sediments), hence the onshore impact is allocated 'small negative'. Options 3 and 4: Options 3 and 4 will involve the return of some displaced water to shore for treatment as a result of the addition of materials to the drilling legs. But the volumes of displaced cell water involved are only a fraction of those for GBS cell sediments Options 3 and 4, hence the onshore impact is considered' insignificant-small negative'. **Evaluation of scale of effect:** High neg. Medium neg. Low/none Medium pos. High pos. |----------|----------|----------|----------| X_2 $X_{3,4}$ $X_{1,5}$	1) and 2) are combined in the impact matrix. **Options 1, 5: 'No impact'** **Option 2: 'Small negative'** **Options 3,4: 'Insignificant -small negative'** The uncertainty of the total impact is highlighted by the size of the circles/ellipses. 

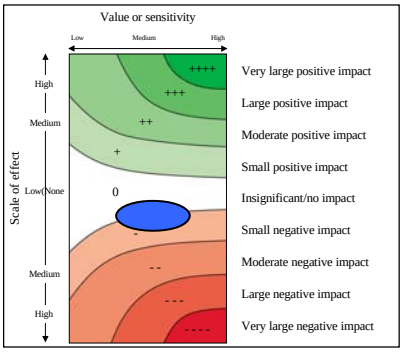
GBS MINICELL ANNULUS MATERIAL – Onshore Impacts

2. Description of the scale of effect **Options 1, 2, 3, 4, 5**	**3. Total (environmental) impact**
For the GBS Brent B and D minicell annulus material, 5 decommissioning options are considered: 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 *in situ* using sand and coarse gravel. Option 4: Leave *in situ* and improve natural biodegradation by adding chemicals (Monitored Natural Attenuation, MNA) Option 5: Leave *in situ* for natural biodegradation For Options 1 and 5 there are no onshore activities, therefore no onshore impact. Option2: For Brent B and D, it is estimated that 500 m3 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. 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. 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. **Evaluation of scale of effect:** High neg. Medium neg. Low/none Medium pos. High pos. |----------|----------|----------|----------| X_2 $X_{1,3,4,5}$	1) and 2) are combined in the impact matrix. **Options 1, 3,4, 5: 'No impact/insignificant'** **Option 2: 'Insignificant – small negative'** The uncertainty of the total impact is highlighted by the size of the circles/ellipses. 

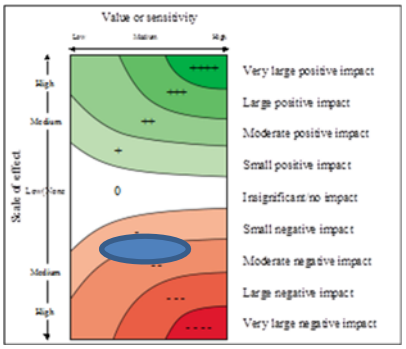
SEABED DRILL CUTTINGS – Onshore Impacts

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

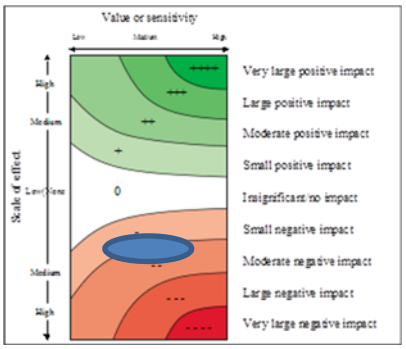
BRENT A SEABED DRILL CUTTINGS - Onshore Impacts

2A. Description of the scale of effect **Brent A Seabed Drill Cuttings: Option 1: Dredge, transfer to Brent C topsides and treat and discharge water and solids to sea**	3A. Total (environmental) impact
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. Option 1 involves dredging approximately 8,000 m^3 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'. **Evaluation of scale of effect:** High neg. Medium neg. Low/none Medium pos. High pos. |----------|----------|----------|----------| X	1) and 2) are combined in the impact matrix. **Option 1: 'Insignificant-small negative'** The uncertainty of the total impact is highlighted by the size of the circles/ellipses. 

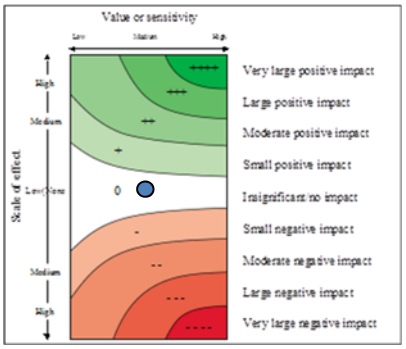
BRENT A SEABED DRILL CUTTINGS - Onshore Impacts

2B. Description of the scale of effect **Brent A Seabed Drill Cuttings: Option 2: Dredge, transfer to vessel and transport slurry to shore for treatment and disposal**	3B. Total (environmental) impact
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. Option 2 involves dredging approximately 8,000 m^3 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^3. 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^3 of slurry (containing less than 1% oil) onshore, a significant volume. Assuming that: • the slurry will settle in holding tanks and hence be de-watered onsite to some degree (reduced to approx. 15,000 m^3 sludge); the water will be treated and returned to sea or sewer in accordance with permit conditions. • the 15,000 m^3 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. • the recovered oil will be recycled (~500 tonnes). • all activities will be undertaken under responsible management and control and in line with permit conditions; 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. **Evaluation of scale of effect:** High neg. Medium neg. Low/none Medium pos. High pos. |----------|----------|----------|----------| X	1) and 2) are combined in the impact matrix. **Option 2: 'Small-moderate negative'** The uncertainty of the total impact is highlighted by the size of the circles/ellipses. 

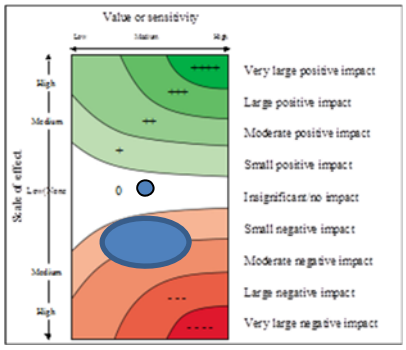
BRENT A SEABED DRILL CUTTINGS - Onshore Impacts

2C. Description of the scale of effect **Brent A Seabed Drill Cuttings: Option 3: Dredge to vessel, transfer to Brent C topsides; water treated and discharged to sea, solids to shore**	3C. Total (environmental) impact
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. Option 3 involves dredging approximately 8,000 m^3 of seabed drill cuttings and contaminated seabed from around the Brent A jacket, dewatering the slurry (approximately 80,000 m^3) on the Brent C topsides, and transporting the resultant thickened sludge (approximately 10,000 m^3) by shuttle tanker to shore for treatment. 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^3 of thickened sludge onshore. Assuming that: • the 10,000 m^3 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. • the recovered oil will be recycled (~500 tonnes). • all activities will be undertaken under responsible management and control and in line with permit conditions. 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. 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. **Evaluation of scale of effect:** High neg. Medium neg. Low/none Medium pos. High pos. |----------|----------|----------|----------| X	1) and 2) are combined in the impact matrix. **Option 3: 'Small-moderate negative'** The uncertainty of the total impact is highlighted by the size of the circles/ellipses. 

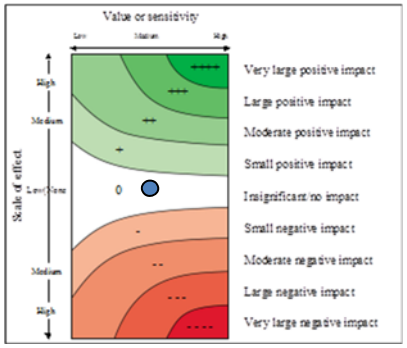
BRENT A SEABED DRILL CUTTINGS - Onshore Impacts

2D. Description of the scale of effect **Brent A Seabed Drill Cuttings: Option 4: Dredge to vessel and re-inject into a new well**	3D. Total (environmental) impact
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. Option 4 involves dredging approximately 8,000 m^3 of seabed drill cuttings and contaminated seabed from around the Brent A jacket, transporting the slurry in a containment vessel to a newly drilled well in the Brent Field, where the water content is reduced to 50% before the slurry is injected into the well. There are no onshore impacts for Option 4. **Evaluation of scale of effect:** High neg. Medium neg. Low/none Medium pos. High pos. |----------|----------|----------|----------| X	1) and 2) are combined in the impact matrix. **Option 4: No impact** The uncertainty of the total impact is highlighted by the size of the circles/ellipses. 

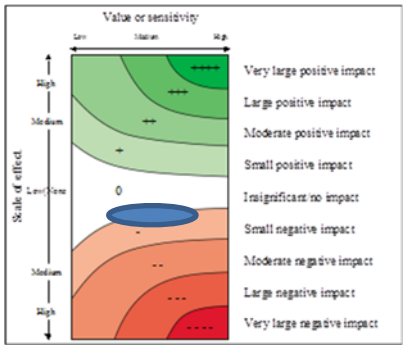
CELL TOP DRILL CUTTINGS – Onshore Impacts

2. Description of the scale of the effect GBS Cell Top Drill Cuttings: Options 1, 2, 3, 4, 5, 6	3. Total (environmental) impact
For the drill cuttings on the GBS cell tops, six decommissioning options are considered: • Option 1: Re-locate small amounts locally by water jetting into water column • Option 2: Dredge, transfer to Brent C topsides and treat and discharge water and solids to sea • Option 3: Dredge, transfer to vessel and transport slurry to shore for treatment and disposal • Option 4: Dredge to vessel, transfer to Brent C topsides; water treated and discharged to sea, solids to shore • Option 5: Dredge to vessel and re-inject into a new well • Option 6: Leave *in situ* Potential onshore impacts are as follows: • None identified for Options 1, 2, 5 & 6 (because no activities onshore). • Traffic, noise, waste, wastewater, odour and nuisance impacts will be associated with the handling of the sizeable volumes of slurry/sludge in options: o Option 3: approximately 134,000 m^3 dilute slurry to shore. o Option 4: approximately 15,000 m^3 thickened sludge to shore. Further detail for Options 3 and 4 is given below: <u>Option 3:</u> the 134,000 m^3 of slurry will be taken onshore and will settle in holding tanks and then be de-watered onsite (reduced to an estimated 25,000 m^3 of thickened sludge). The separated water will be treated and returned to sea or sewer in accordance with permit conditions. The 25,000 m^3 of thickened sludge will be transported offsite (estimated 1,350 trips) and further de-watered before treatment by thermal desorption. The cleaned processed powder will be deposited at a licensed landfill site in accordance with permit conditions (this will involve further transport to landfill but of a smaller volume of material). <u>Option 4:</u> once the 134,000 m^3 of slurry has been dewatered on the Brent C topsides, the resultant thickened sludge (estimated 15,000 m^3) will be taken to shore and transported offsite (approximately 970 trips) and further de-watered and then treated by thermal desorption. The cleaned processed powder will be deposited at a licensed landfill site in accordance with permit conditions (this will involve further transport, but of a smaller volume). The recovered oil (~500 tonnes) will be recycled for both Options 3 and 4. All activities will be undertaken under responsible management and control and in line with permit conditions, and therefore it is expected that the impact would be managed to acceptable levels. The most significant onshore impact is considered to be the transport of sludge/slurry out of the onshore site and along local roads; as stated previously an estimated 1,350 trips will be required for Option 3. 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 process will be located at the onshore location. If so, this would reduce the volumes of materials requiring transport offsite. Both Options 3 and 4 are allocated a 'small-moderate negative' impact (Option 3 will have a slightly higher impact than Option 4 owing to the increased volumes involved). The evaluation is based on the assumption that all these activities will be undertaken under responsible management and strict controls. **Evaluation of scale of effect:** High neg. Medium neg. Low/none Medium pos. High pos. |----------|----------|----------|----------| $X_{Options3,4}$ $X_{Options1,2,5,6}$	1) and 2) are combined in the impact matrix. **Options 1, 2, 5 & 6: 'No impact'** **Options 3 & 4: 'Small-moderate negative'** The uncertainty of the total impact is highlighted by the size of the circles/ellipses. 

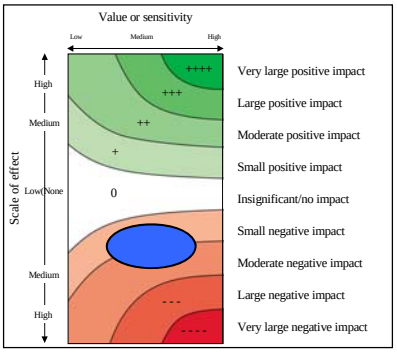
TRI-CELL DRILL CUTTINGS – Onshore Impacts

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

SUBSEA STRUCTURES AND DEBRIS – Onshore Impacts

2. Description of the scale of effect **Option 1: Complete removal**	3. Total (environmental) impact
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. The waste generated from collection of the seabed structures and debris are: • Steel (from SSIV, SPAR protection cover and PLEM, umbilical splitter, VASP and scaffolding) • Grout 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. **Evaluation of scale of effect:** High neg. Medium neg. Low/none Medium pos. High pos. |----------|----------|----------|----------| X	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. 

WELLS – Onshore Impacts

2. Description of the scale of effect Option 1: Plugging and Abandonment	3. Total (environmental) impact
There is only one option to decommission the wells – P&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^3 of OMB/WBM fluids. All this material will come onshore and will require handling, recycling and disposal. Wastes generated from the P&A of Brent's 146 wells are estimated to be: • Steel (tubings, conductors, casings, and subsea wellheads): 40,000 tonnes • OBM/ WBM recirculated fluids: 3,600 - 11,520 m^3 • Marine growth on the Brent C conductors. No cement or concrete will be recovered. 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. The overall evaluation of onshore impacts as a result of decommissioning the wells is estimated to be 'small–moderate negative' for Option 1. **Evaluation of scale of effect:** High neg. Medium neg. Low/none Medium pos. High pos. |----------|----------|----------|----------| X	1) and 2) are combined in the impact matrix. **Option 1: 'Small- moderate negative'** The uncertainty of the total impact is highlighted by the size of the ellipse/circle. 

[1] DNV GL, *Environmental Scoping Report for Brent Field Decommissioning EIA*, Rev 5, 24 May 2011.