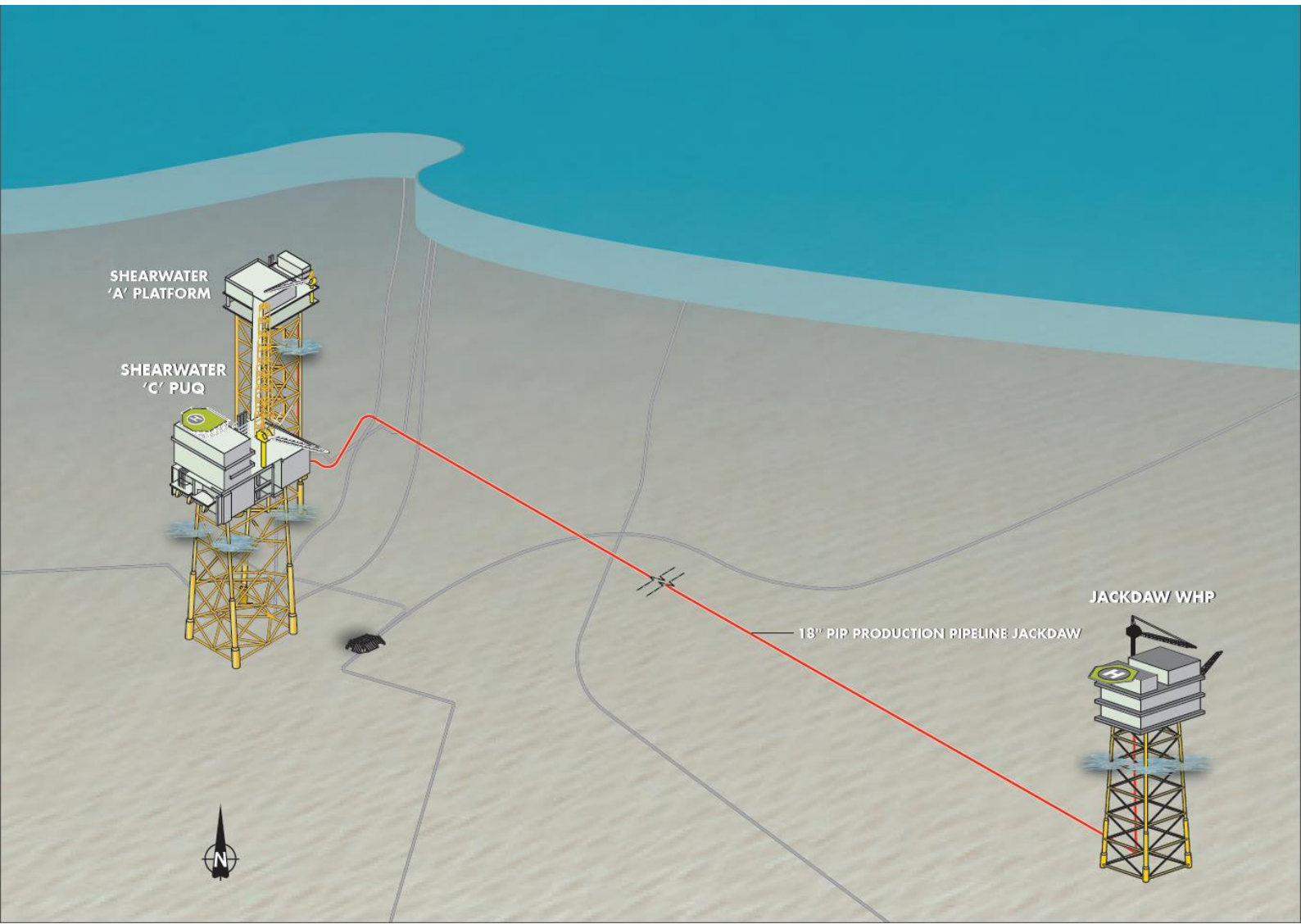
JACKDAW FIELD DEVELOPMENT PROJECT
ENVIRONMENTAL STATEMENT
D/4260/2021

FURTHER INFORMATION

JULY 2021



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1. BACKGROUND

BG International Limited submitted the Environmental Statement (ES) for Jackdaw Field Development Project (D/4260/2021) (BG International Limited, 2021) to the Offshore Petroleum Regulator for Environment and Decommissioning (OPRED) on 6th May 2021 and issued the ES for public consultation on May 10th 2021. Where the term "Shell UK" is used in this document, it means Shell U.K. Limited and/or its relevant UK registered affiliated compan(y)(ies) (including BG International Limited) holding exploration and/or production licences on the UKCS, as the context requires.

The latest 2021 ES was an update to the original statement for the Jackdaw Project (BG International Limited, 2020) submitted in January 2020 and disclosed for public consultation. Due to deferral in project sanctioning in 2020, the updated ES was re-submitted under the new Offshore Oil and Gas Exploration, Production, Unloading and Storage (Environmental Impact Assessment) Regulations 2020 (hereafter referred to as the 2020 Offshore EIA Regulations) that came into force 31 December 2020. The updated ES incorporated comments received, addressed and accepted during the 2020 consultations.

Following the latest consultation, additional information was sought under Regulation 12(1) of the 2020 Offshore EIA Regulations. The OPRED Notice under Regulation 12(3) stated that "Further Information" ought to be made public because the information is directly relevant to reaching a conclusion on whether the project is likely to have a significant effect on the environment."

The requested information is provided below with the context of the Jackdaw project outlined in Part 2 and response to the specified comments included in Part 3.

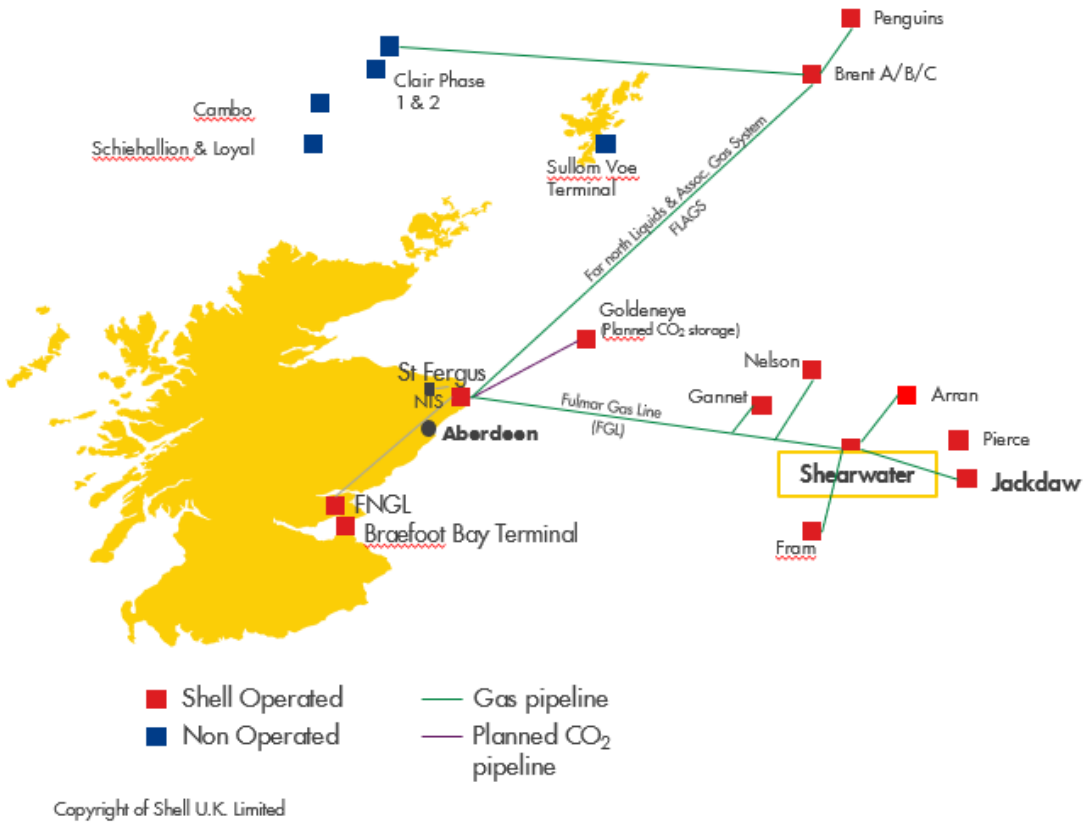
2. JACKDAW PROJECT CONTEXT

Jackdaw is a gas/condensate development comprising a "not permanently attended" wellhead platform with four wells, tied back to the Shell UK operated Shearwater hub via a 30 km pipeline.

The Shearwater hub is Shell UK's major operated UK footprint and at the heart of its UK gas value chain. As the below schematic indicates:

- Wet gas is evacuated from Shearwater (Shell UK equity 28%1) via the Shell UK operated SEGAL (Shell Esso Gas and Associated Liquids) system (Shell UK equity 50%) to the St Fergus Gas Processing Terminal (Shell UK equity 50%).
- At St Fergus, a deep cryogenic extraction process is used to recover Natural Gas Liquids (NGLs) from the wet gas streams and deliver sales gas to the National Transmission System (NTS).
- NGLs are exported by onshore pipeline to the Fife NGL Plant (Shell UK equity 50%) which processes NGLs to separate ethane, propane, butane and natural gasoline for onward sale, including via the Braefoot Bay Marine Terminal (Shell UK equity 50%), and further on to the Fife Ethylene Plant (operated by Exxon Mobil and outside the SEGAL system).

[1] Shell U.K. Limited has now signed a Sale and Purchase Agreement with BP for its equity in the Shearwater asset, which on completion will bring its total equity to 55.5%.



Shearwater hub production is however subject to decline and Jackdaw is a critical "longevity bridge": Shell UK has a finite window in which to economically develop and tie-back Jackdaw as a critical component of the Shearwater hub. As such, near term development of Jackdaw acts as a "longevity bridge". This will allow optionality to sustain strategic infrastructure as an enabler for future tiebacks to maximise economic recovery, as well as time to mature the feasibility of two critical and strategic energy transition opportunities. Firstly, structural abatement in support of the basin wide ambition to reduce Scope 1 emissions by 50% by 2030 (e.g. through offshore electrification). Secondly through the development of a future energy transition hub focusing on carbon capture and storage (CCUS) and hydrogen. Specifically:

- Enabler for the overall reduction in Scope 1 emissions ambition (50% by 2030): In supporting Shearwater longevity, Jackdaw is also an enabler of efforts to reduce Scope 1 emissions by 50% by 2030. Shell UK is actively pursuing a portfolio of abatement projects and evaluating the feasibility of offshore electrification is a key element, and notably at Shearwater. Sufficient longevity of operation will be an essential pre-requisite for electrification. The Shearwater hub is an essential component of the multi-hub CNS electrification opportunity currently being framed within the context of the North Sea Transition Deal.
- Enabler for a future CCUS/Hydrogen low carbon energy hub: The Acorn project which will be based at the St Fergus Gas Terminal is the focus for the ambition to create a CCUS and Hydrogen low carbon energy hub, to support Shell UK's wider de-carbonisation ambitions in the UK. As described above, methane from the integrated value stream, including the Shearwater hub and Jackdaw, is a key component which could be re-purposed to blue

hydrogen, St Fergus and the associated pipeline infrastructure provides CO_2 access to the geological store at the depleted Goldeneye field.

Jackdaw's own emissions profile is a fraction of the UK 4th and 5th Carbon Budgets (0.03% and 0.01% respectively). Furthermore, Shell UK did nevertheless consider the potential for offshore CCS at Shearwater. However, this would require significant additional infrastructure (including a new bridge linked platform) and an estimated cost per tonne of carbon significantly higher than the government forecasted UK carbon price.

Shell UK's commitment to Jackdaw is strong, but there is a finite and narrowing window to invest. Since discovery in 2006, no operator has been able to make Jackdaw economically viable. Over the last four years, during which period Shell UK has been the operator, the Jackdaw JV has worked strenuously to create an investable proposition.

Regrettably, the project has already been delayed due to the implications of the pandemic. However, Shell UK remains committed to Jackdaw, particularly given its strategic context outlined above.

3. FURTHER INFORMATION TO THE COMMENTS

Comment 2: The magnitude criteria (Table 4-2 of the ES) include example descriptors for each level. Please provide example descriptors for magnitude levels relating to emissions and climate? Given the nature of the impact and its effects on climate factors (and targets) when considered cumulatively with other existing or approved projects of the same nature, please explain why a magnitude level of 'slight' is appropriate for the impacts in relation to climate?

Shell UK carefully considers the potential impacts on the environment of all its activities through the application of global environmental standards. The Shell group of companies has a target to become a net zero emissions energy business by 2050. In the UK, Shell UK has set up a dedicated energy transition team to seek new opportunities and investments in energy transition in support of the net zero target.

For Jackdaw, environmental considerations including GHG emissions were factored into project decision making from a very early stage. The selected Jackdaw concept has been designed to minimize emissions as far as reasonable, from day one of operations. While all GHG emissions can be considered to be significant, our evaluation in the Environmental Statement (and below) indicates that Jackdaw incremental emissions are 'slight' relative to national and sectoral carbon budgets.

Shell UK does recognise that the combined anticipated emissions of Jackdaw together with its host Shearwater form a marginally larger proportion of sectoral emissions than those of Jackdaw alone. The Shearwater host involves the discharge, offshore, of some of the CO_2 from the Jackdaw field gas (the remainder is blended with the gas from other fields processed at Shearwater), in order to meet the export specification. This results in a relatively higher offshore emissions profile from Shearwater (with average Jackdaw incremental emissions of ~48 ktpa via the amine discharge) than other comparable platforms without amine treatment, as indicated by the OGA's 2020 flaring and venting report (OGA, 2021). The Jackdaw JV's host select decision did consider this alongside a range of other factors (see response to question 3), but also recognised that the export route via Judy would ultimately result in the same volume of emissions (offshore and onshore). At present, there is no facility (across either export route) to capture and store the CO_2 from the Jackdaw field gas. This means that any emissions avoided offshore would still occur onshore (either at the gas processing terminal or at the end user).

While Shell UK is actively pursuing a wide range of near-term abatement projects, the most significant abatement potential would be delivered via offshore electrification, notably at Shearwater. Shell UK is actively pursuing a joint industry multi-hub CNS electrification project, to frame and evaluate the feasibility for electrification of a number of facilities including Shearwater. As described in the cover note, Jackdaw volumes support the longevity of Shearwater, and therefore the potential for investment in electrification.

Shell UK has also considered an offshore carbon capture and storage option at Shearwater. However, this would require significant additional infrastructure with an overall cost estimated in excess of £200m, which could not be economically justified.

Shell UK's immediate focus for large-scale emissions reduction at Shearwater is therefore on pursuing the viability of the CNS electrification project as mentioned above.

For clarification, the evaluation of project GHG emissions in the Jackdaw Environmental Statement aligns with the Institute of Environmental Management and Assessment (IEMA) Guide to Assessing Greenhouse Gas Emissions and Evaluating their Significance. The IEMA guidance does not assign specific significance criteria/descriptors or defined thresholds. Under the principle that all GHG emissions might be considered significant (climate change being the largest inter-related cumulative environmental effect), it recommends generating a project's carbon contribution to enable the impact of the project on climate to be contextualised against sectoral, local or national carbon budgets.

The Jackdaw Environmental Statement evaluated the Jackdaw project's carbon contribution, contextualised against UK national carbon budgets and sectoral emissions levels. As such in Section 7.4.2, Table 7.14 compares Jackdaw profiled peak annual emissions (2025) to UK (2018) emissions, and UKCS (2018) emissions. Jackdaw in this case represents 0.029% of UK emissions and 0.94% of UKCS emissions. Table 7.15 compares Jackdaw profiled emissions to the UK's Carbon Budgets. Jackdaw emissions for the relevant periods (2023-27 and 2028-32) represent 0.03% and 0.01% of the UKs 4th & 5th Carbon Budgets respectively.

Building on this, Tables 7.14 (included as part of the answer to question 4) and 7.15 (included below) have now been expanded to reflect the contribution of cumulative emissions from Jackdaw and Shearwater to the relevant national and sectoral envelopes. Jackdaw and Shearwater combined profiled emissions in 2025 (peak annual emissions from Jackdaw) represent 0.1% of UK emissions and 3.21% of UKCS emissions (Shearwater alone without Jackdaw represents 2.3% of UKCS emissions). Jackdaw and Shearwater combined profiled emissions represent 0.09% and 0.1% of the UK's 4th and 5th Carbon Budgets respectively.

Table 7-15. Comparison with the UK allocated carbon budget and the projected total UK GHG emissions. [EXPANDED]

CARBON BUDGET PERIOD [1]		MTONNES OF CO_2E					
		UK CARBON BUDGET ALLOCATION [2]	UK EMISSION PROJECTIONS [3]	JACKDAW EMISSIONS AS A % OF ALLOCATION	JACKDAW EMISSIONS AS A % OF PROJECTION	CUM SW+JD EMISSIONS AS A % OF ALLOCATION	CUM SW+JD EMISSIONS AS A % OF PROJECTION
1	2008-2012	3,018	2,982 (actual)	-	-	-	-
2	2013-2017	2,782	2,398 (actual)	-	-	-	-
3	2018-2022	2,544	2,518	-	-	-	-
4	2023-2027	1,950	2,138	0.028	0.025	0.092	0.084
5	2028-2032	1,725	1,978	0.013	0.012	0.105	0.091

6	2033-2037	965	Not yet assessed	-	-	-	-

1. Note that the 6th carbon budget has been proposed by the Committee on Climate Change and is undergoing the process of being legislated for in the UK Parliament.

2. Set under the Climate Change Act 2008.

3. BEIS Updated Energy and Emissions Projections 2018 (BEIS, October 2020). 2019 projected performance against the carbon budget based on existing policies.

Cumulative emissions from Jackdaw and Shearwater have been compared against the 'North Sea Transition Deal' target for the oil and gas industry to reduce emissions from oil and gas production by 50% in 2030 (subject to making progress on other aspects of the deal). Jackdaw profiled emissions and combined Jackdaw and Shearwater profiled emissions make up 0.4% and 4% respectively of this targeted level of UKCS emissions (9.5Mt CO_2e) in 2030.

This evaluation is intended to provide a sense of scale and does not in any way diminish Shell UK's commitment to reduce the emissions from its activities or its efforts to design the Jackdaw concept to minimise emissions as far as reasonable.

A separate question was asked why Shell UK has not assessed the cumulative impact of Jackdaw and Shearwater emissions, when combined with emissions from the Elgin facility. This is covered in the response to question 4 below.

Comment 3: Please provide further explanation as to why Judy was not selected as the tie-back host facility, given that cost and technical viability don't render the alternative unfeasible? The ES states that Shearwater offered (1) a slightly lower risk option in terms of brownfield modifications, and (2) that there were no significant environmental differentiators between the two options. The latter justification seems odd given the clear benefits of avoiding significant offshore vent emissions from the amine unit and a shorter pipeline length (and seabed disturbance) requirement to that of Shearwater.

The Jackdaw JV carried out a robust and detailed assessment of Shearwater and Judy host bids throughout 2018. This involved lengthy engagement with both the Shearwater and Judy operators, with Exxon Mobil acting as substitute commercial operator for Shearwater to ensure impartiality. It also involved multiple discussions with the OGA, including to evaluate each option against the Government's 'principal objective' to maximise the value of economically recoverable petroleum from the UKCS. This process resulted in a clear JV decision to select Shearwater as the tie-back host facility, based on technical, economic, commercial and environmental grounds. In May 2019 the OGA issued a letter of 'non-objection' and gave its approval, based on the selected concept, for the project to progress towards field development consent.

While the Jackdaw JV considered the environmental impacts of the two host options to be similar (as expanded on below); from a technical, economic, and commercial perspective, there were strong drivers to select Shearwater as the preferred concept to process and further export the Jackdaw fluids.

With respect to the comparative environmental impacts the environmental differentiators between the two export routes were not assessed by the Jackdaw JV to be significant.

As outlined in the cover note, and previous question, Shell UK is actively pursuing abatement opportunities, including the feasibility for electrification via a joint industry project.

The Shearwater host does involve the discharge, offshore, of some of the CO_2 from the Jackdaw field gas (the remainder is blended with the gas from other fields processed at Shearwater), in order

to meet the export specification. This results in a relatively higher offshore emissions profile from Shearwater (with average incremental emissions of ~48ktpa via the amine discharge). The host select decision recognised that the export route via Judy would ultimately result in the same volume of emissions (offshore and onshore). There is no facility, at present, across either export route to capture and store the CO_2 from the Jackdaw field gas. This means that any emissions avoided offshore would still occur onshore (either at the gas processing terminal or at the end user).

As set out in Section 2.5.3 of the ES, Shell UK has also considered the potential for capturing, injecting and storing cumulative Shearwater CO_2 emissions from the amine discharge, as set out in Section 2.5.3 of the ES. In order to be able to implement CCS, the following would be required:

- an injection well offshore for reinjection
- additional equipment offshore (including an additional bridge linked platform)
- proven subsurface feasibility.

The estimated capital cost of offshore CCS at Shearwater is estimated to be well in excess of £200 million and cannot be economically justified in the circumstances.

In respect to the pipeline, it is recognised that the difference in pipeline length between the options (minimum direct distance to Judy estimated at 23 km, as opposed to 30km to Shearwater), does give rise to a difference in seabed disturbance footprint between the two options. Assuming disturbance over a 100 m corridor, the difference of 0.7km^2 (2.3 km^2 for Judy as opposed to 3 km^2 for Shearwater) is small in relation to the disturbance area of the whole pipeline, and the available habitat in the area. The expected natural recovery rate of the sediments was further considered, which in the case of both pipelines ranges from a few months to a few years. Based on these factors the Jackdaw JV concluded that variance in pipeline length and seabed disturbance did not constitute a significant environmental differentiator between the options.

Comment 4: Given the importance of Jackdaw to the longevity of Shearwater as a functioning host facility (Section 1.1 in the ES), please explain why total emissions from Jackdaw, Shearwater, the current and forthcoming tiebacks have not been assessed in terms of cumulative impact (table 7-14 in the ES)? Further, the Elgin platform (8 km from Shearwater) represents an existing project which demonstrates a similar philosophy in terms of venting from corrosive gas treatment. Why has the cumulative effect of this project not been considered too?

Managing the cumulative impact of our activities is extremely important to Shell UK. The Shell group of companies' climate target is to be a net zero emissions energy business by 2050. Shell companies also have medium term carbon intensity targets in 2030 (20%) and 2035 (45%). The Shell group of companies' target includes the emissions not only from the energy Shell companies produce and process themselves but also from all the energy products that others produce and Shell companies sell to their customers.

For the Jackdaw project, the ES has taken account of the cumulative emissions not just from Jackdaw but also the Shearwater host. This is reflected in Table 7-8 of the ES which estimates cumulative emissions at Shearwater (including Jackdaw). Section 7.3.5.2 (Table 7-8, Figure 7-4) of the Environmental Statement, also notes that while Jackdaw production increases the absolute emissions from Shearwater, it improves energy intensity and reduces GHG intensity of the produced hydrocarbons on Shearwater.

The table below provides a comparison of cumulative Shearwater hub emissions (in the year of maximum projected Jackdaw emissions) with broader UK and UKCS emissions. Jackdaw and Shearwater combined profiled emissions in 2025, the highest predicted emission level for Jackdaw, constitute 3.2% of the 2018 UKCS emissions.

Table 7-14 Comparison with 2018 UK and UKCS emissions figures. [UPDATED]

SOURCE	MTONNES EMITTED							
	CO_2e	CO_2	NOx	N_2O	SO_2	CO	CH_4	VOC
2018 UK emissions [1]	465.9	380.8	0.834	0.0644	0.163	1.56	2.08	0.806
2018 UKCS emissions [2]	14.54	13.2	0.059	0.001	0.003	0.03	0.044	0.05
Jackdaw estimated emissions for 2025 as a % of:								
2018 UK Emissions	0.03	0.04	0.04	0.01	0.00	0.00	0.01	0.00
2018 UKCS emissions	0.94	1.01	0.50	0.39	0.06	0.20	0.30	0.05
Cumulative Jackdaw and Shearwater emissions for 2025 as % of:								
2018 UK Emissions	0.10	0.12	0.21	0.03	0.00	0.03	0.04	0.02
2018 UKCS emissions	3.21	3.49	2.90	2.20	0.10	1.61	1.68	0.26
Cumulative Jackdaw, Shearwater and Elgin (3) emissions for 2025 as % of:								
2018 UK Emissions	0.24							
2018 UKCS emissions	7.62							

1. UK Greenhouse Gas Inventory, 1990 to 2018 from the Annual Report for submission under the Framework Convention on Climate Change (UK NIR, 2020).
2. UKCS EEMS emissions data (EEMS, 2019).
3. Elgin emissions estimates are based on Elgin 2019 CO_2e emissions from combustion and flaring as reported in the annual Environmental Statement (TEPUK, n.d.)

Given that the Shell UK approach has always been to make a cumulative assessment where the impacts of separate sources had an additive or synergistic effect on a receptor, the cumulative impact of Jackdaw and Shearwater combined with the Elgin platform in the Environmental Statement was not assessed. As CO_2 has a global rather than a local impact, the cumulative assessment was made in the context of the much wider UK and UKCS emissions rather than framing the assessment with considerations of local proximity, particularly where the operations are entirely independent of the project under environmental assessment. The Elgin platform in this case has a cumulative global rather than local impact and is not in any way connected with the Shearwater hub including Jackdaw.

However, as requested, the cumulative effect of Jackdaw and Shearwater emissions have been considered, when combined with the existing Elgin platform. According to publicly available information, the Elgin facility (including all producing fields e.g. Franklin) emitted approximately 640,000 tonnes of CO_2e (TEPUK, n.d.) annual environmental statement) in 2019 with daily production of 338mmscfd (WoodMackenzie, 2021). As an approximation, assuming the Elgin emissions were to remain at the 2019 level in 2025, when viewed cumulatively with Shearwater and Jackdaw estimated emissions, the combined emissions would comprise 0.24% of the 2018 UK emission or 7.6% of 2018 UKCS emissions levels, with the estimated Elgin emissions comprising 4.4%.

While cumulatively combined 2025 Elgin, Jackdaw and Shearwater emissions would form a higher proportion of the UKCS emissions as per the table above and would have a greater impact, the Jackdaw contribution to this (approximately a tenth of combined Elgin, Shearwater and Jackdaw

emissions) is less than 1 % of the UKCS emissions and has no direct bearing on the Elgin emissions levels.

Based on the analysis of the wider oil and gas industry, according to OGUK data, ~75% of basin wide sector emissions result from power generation (OGUK, 2020). This is also reflective of the Shearwater host total annual GHG emissions. It is largely for this reason that industry's main focus in terms of reducing offshore production emissions, is on electrification. As stated in the ES, a potential benefit of the tie-back to Shearwater is the prospect of electrification at the Shearwater hub (as part of a regional multi hub electrification project) well within the lifetime of Jackdaw production. When considering the potential cumulative impact of Jackdaw and Shearwater with the Elgin platform, it is important to recognise that Elgin is one of the CNS hubs involved in the CNS Electrification Project, and Total, the Elgin operator, is part of a joint industry project team (with Shell, Harbour Energy and BP) that is currently maturing the project towards concept select. If executed, the project can reasonably be expected to materially reduce the cumulative emissions impact estimated above.

Comment 7: Section 8.3.2 of the ES does not assess the potential impacts from effectively doubling the produced water (PW) volume and oil in water when Jackdaw comes on-line, please qualify why this has been omitted or provide an assessment of the environmental effects on the environment from such an activity?

The answer to question 7 is combined with the answer to question 8.

Comment 8: Can the developer provide further justification as to why they believe the magnitude criteria for the effect of PW (particularly entrained oil in PW) on the receptors should be 'slight'.

The ES acknowledges a near doubling of produced water volumes at Shearwater resulting from the addition of Jackdaw (Section 8.3.1.2) and the environmental impacts of this are considered in Sections 8.3.2 and 8.3.4. The following summarises the key points from this assessment.

The introduction of Jackdaw fluids could increase the total amount of produced water volumes and associated oil in water discharges with the maximum Jackdaw and Shearwater combined oil in water discharges expected in 2027 (5.6 and 10.4 tonnes of dispersed hydrocarbons per year respectively, Table 8-2).

Section 8.3.2 discusses potential components of produced water with a focus on polycyclic aromatic hydrocarbons (PAHs), alkylphenols, and a few metals which are of greater environmental concern due to potential toxicity, and their effect on the receiving environment. Jackdaw maximum annual discharge should be very small and should contribute less than 0.25% of the total dispersed hydrocarbons discharged with produced water on the UKCS (Table 8-5, Section 8.3.4). After discharge, produced water is expected to dilute rapidly, considering the local hydrographic conditions of the North Sea. Dilution rates of 30 to 100-fold occur within the first few tens of metres of the discharge point, and at distances from 500-1,000 metres from the release point, dilution rates of 1,000 to 100,000-times are typical (OGP, 2005). Most organic constituents should degrade rapidly in sea water.

Shell UK does not, however, assess the potential environmental impacts of this increase in produced water discharge to be significant/material. The magnitude criteria for the effect of produced water on the receptors is categorised as 'slight' for several reasons:

- Jackdaw does not inject corrosion inhibitor, and as such produced water from Shearwater (after Jackdaw comes online) should not contain any increase in corrosion inhibitor which has been assessed as the single largest contributor (over 90%) to the overall toxicity of the effluent.
- The addition of the Jackdaw water volumes should reduce the corrosion inhibitor discharge concentrations and risk quotient (toxicity) of the overboard discharge stream (this is further elaborated in Section 8.1.3 and Section 8.3.2, which outlines the relative reduction in toxicity of the discharge stream). It is anticipated that any impacts (in particular, due to entrained oil in PW) detectable above background variability should be limited to a small area in the immediate vicinity of the discharge point.
- The exposure times of organisms to key contaminants should be too short to induce a significant threat to marine ecosystems from these discharges – any impacts should be rapidly and fully reversible beyond the mixing zone of the discharges.
- Jackdaw, in its year of greatest discharge (at the Shearwater platform) is expected to contribute just 0.25% of total UKCS dispersed hydrocarbons in produced water (based on 2018 levels).
- The cumulative discharges of combined produced water streams from Shearwater should contribute <0.5% of the UKCS PW. Dispersed hydrocarbon discharges should be confined to the near field mixing zone and should not have any cumulative relationships with other discharges, as outlined in Section 8.3.4.

Comment 12: Please expand on how a magnitude level of 'moderate' for coastal protected areas was arrived at?

Shell companies always seek to avoid adverse environmental impacts when carrying out their activities and, where avoidance is not possible, they implement controls designed to minimise any residual impacts. Minimising any risk of impact to coastal protected areas is extremely important to Shell UK. As set out in Section 11.2.6.3 of the Environmental Statement, Shell UK has commissioned spill modelling for the Jackdaw project which suggests that less than 0.1 % of any released condensate (in the event of a major incident) could reach the coastline or remain at the sea surface.

The modelling indicates that, where oil onshore concentrations thresholds (100 g/m^2) are exceeded, the modelling indicates that this would occur across 13 separate locations, as opposed to one continuous stretch of coastline, 12 along the Norwegian coast and 1 on the Danish coast. The average length of impacted coastline at each location is 2.83km, hence a total of 36.77km. The Norwegian coastline in the potential area of impact is largely formed of cliffs and rocky shore. These types of coastline are likely to be subjected to high energy events and therefore persistence of condensate residues on such shorelines is expected to be brief. The single area of Danish coastline that could be affected is sandy beach. Given the absence of asphaltene in the Jackdaw condensate, it is not expected that viscous and persistent emulsions will form, therefore impacts to the shoreline, if any, are expected to be localized and short-term, and it is expected that the residual condensate reaching the shore will break up naturally in the wind and waves.

The magnitude of the impact is assessed as 'minor' due to the short length of the coastline that could be impacted (0.033% and 0.032% of the Norwegian and Danish coastlines respectively) and the nature of the hydrocarbons, (i.e. condensate rather than heavy oil) with little or no intervention

expected to be required to restore the affected area. Potential consequences of a major spill are expected to result in relatively minor short-term, localised environmental damage with no lasting effects.

The impact significance was assessed as 'moderate'. This is because some of the residual hydrocarbon concentrations may reach protected areas within Norway and Denmark and the sensitivity of the coastline was assessed as 'High'. The 'High' receptor sensitivity combined with the magnitude of 'minor' resulted in the 'moderate' significance assessment.

4. REFERENCES

BG International Limited, 2020. *Environmental Statement. Jackdaw Field Development Project . D/4246/2019,* s.l.: s.n.

BG International Limited, 2021. *Environmental Statement. Jackdaw Field Develoment Project, D/4260/2021,* s.l.: s.n.

OGA, 2021. *OGA. UKCS Flaring and Venting 2020 Report..* [Online] Available at: https://ogauthorityreports.wixsite.com/ukcs-f-v-report-2020 [Accessed 21 July 2021].

OGP, 2005. *Fate and effects of naturally occurring substances in produced water on the marine environment. Report No. 364. February 2005,* s.l.: s.n.

OGUK, 2020. *UK UPSTREAM OIL AND GAS SECTOR Pathway to a Net-Zero Basin: Production Emissions Targets. 2020..,* s.l.: s.n.

TEPUK, n.d. *TEPUK Operational Environmental Statement 2019,* s.l.: s.n.

WoodMackenzie, 2021. *Asset Report. Elgin Franklin Area ,* s.l.: s.n.