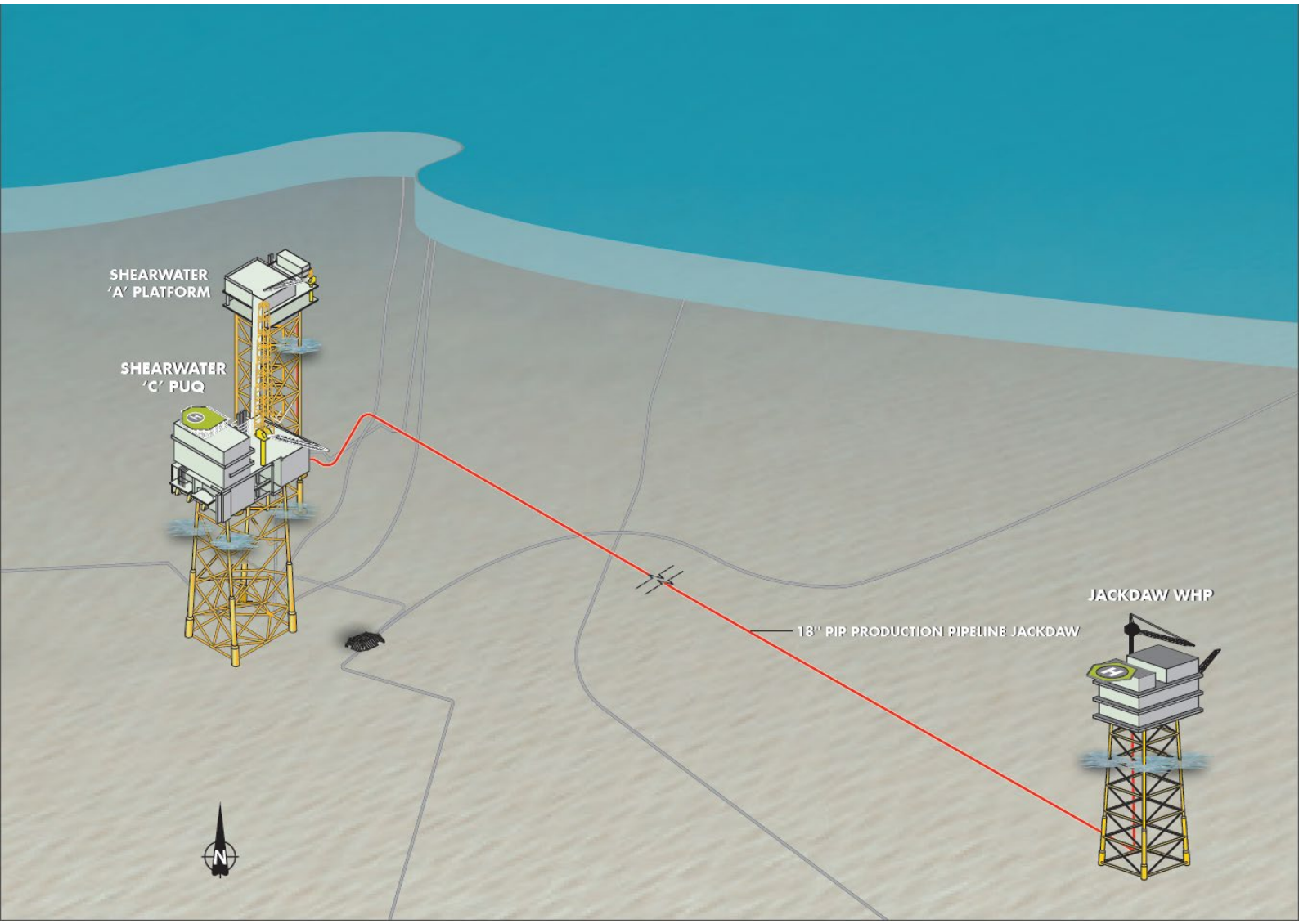
Jackdaw Field Development

Further Information required under DESNZ Regulation 12(1) Notices dated 21st July and 22nd September 2025

Part 2: Updated Assessment of the Project

November 2025

ES Ref: D/4260/2021 (February 2022)



Cautionary Note

The companies in which Shell plc directly and indirectly owns investments are separate legal entities. In this document "Shell", "Shell Group" and "Group" are sometimes used for convenience to reference Shell plc and its subsidiaries in general. Likewise, the words "we", "us" and "our" are also used to refer to Shell plc and its subsidiaries in general or to those who work for them. These terms are also used where no useful purpose is served by identifying the particular entity or entities. ''Subsidiaries'', "Shell subsidiaries" and "Shell companies" as used in this document refer to entities over which Shell plc either directly or indirectly has control. The terms "joint venture", "joint operations", "joint arrangements", and "associates" may also be used to refer to a commercial arrangement in which Shell has a direct or indirect ownership interest with one or more parties. The term "Shell interest" is used for convenience to indicate the direct and/or indirect ownership interest held by Shell in an entity or unincorporated joint arrangement, after exclusion of all third-party interest.

Shell's net-zero emissions target

Shell's operating plan and outlook are forecasted for a three-year period and 10-year period, respectively, and are updated every year. They reflect the current economic environment and what we can reasonably expect to see over the next three and ten years. Accordingly, the outlook reflects our Scope 1, Scope 2 and NCI targets over the next 10 years. However, Shell's operating plan and outlook cannot reflect our 2050 net zero emissions target, as this target is outside our planning period. Such future operating plans and outlooks could include changes to our portfolio, efficiency improvements and the use of carbon capture and storage and carbon credits. In the future, as society moves towards net-zero emissions, we expect Shell's operating plans and outlooks to reflect this movement. However, if society is not net zero in 2050, as of today, there would be significant risk that Shell may not meet this target.

STANDARD INFORMATION SHEET

Project Name		**Jackdaw Field Development**			
OPRED Reference No		D/4260/2021			
Shell Contact Details		*Contact Name*		*Contact Title*	
Developer		UK North Sea Limited Withheld		Jackdaw Opportunity Manager	
Further Information Contact		Withheld		Projects Environmental Specialist	
Further Information Preparation		*Job Title*		*Relevant Qualification/Experience*	
Shell U.K. Limited		Withheld		> 40 years' working in environment/oil and gas	
		Withheld		> 20 years' working in environment/oil and gas	
Genesis Energies Consultants		Withheld		9 years' working in environment/oil and gas	
Licence Nos		licences P.98, P.111 and P.672			
Licensees/ Owners		UK North Sea Limited 100% holding.			
Short Description		Jackdaw is a gas condensate field that will be developed with a not permanently attended Wellhead Platform (WHP) and drilling of four wells. Jackdaw produced fluids will be exported via a subsea pipeline to the Shearwater platform where these will be processed before onward export via the Fulmar Gas Line and the Forties Pipeline System. The proposed development may be summarised as follows: ■ Installation of a new WHP; ■ Drilling of four production wells; ■ Installation of a new approximately 31 km pipeline from the Jackdaw WHP to the Shearwater platform; ■ Processing and export of the Jackdaw hydrocarbons via the Shearwater host platform; and ■ First production expected between Q3 - Q4 2026.			
Quadrant/Block Nos.		Blocks 30/02a, 30/03a DEEP, and 30/02d			
Platform Location		Latitude	56° 54' 01.37" N (WGS84)	Longitude	02° 22' 45.45" E (WGS84)
Pipeline	**Start**	Latitude	56° 54' 01.37" N (WGS84)	Longitude	02° 22' 45.26" E (WGS84)
	End	Latitude	57° 01' 53.57" N (WGS84)	Longitude	01° 57' 13.71" E (WGS84)
Distance to UK		Approximately 250 km to Aberdeen, Scotland.			
Distance to Median Line		Approximately 5 km from UK/Norway median line.			
Previous Applications		Jackdaw Environmental Statement (D4260/2021) (Shell UK, 2022) submitted in February 2022 for which the Secretary of State agreed to the grant of a production consent for the Jackdaw project in May 2022.			

ABBREVIATIONS

%	Percent	m^3	Cubic Metre
"	Inches	MMO	Marine Mammal Observer
ADD	Acoustic Deterrent Device	MMO	Marine Management Organisation
BEIS	Department for Business, Energy & Industrial Strategy now DESNZ	MU	Management Unit
BOP	Blow Out Preventor	NGL	Natural Gas Liquids
CT	Coiled Tubing	nm	Nautical Mile
CtL	Consent to Locate	NSTA	North Sea transition Authority
CO_2	Carbon Dioxide	OGUK	Oil and Gas UK
CO_2e	Carbon Dioxide equivalent	OBM	Oil Based Mud
DESNZ	Department of Energy, Sustainability and Net Zero	OGA	Oil and Gas Authority now the NSTA
EAJ	Environmental Assessment Justification	OPEP	Oil Pollution Emergency Plan
EMODnet	European Marine Observation and Data Network	OPRED	Offshore Petroleum Regulator for Environment and Decommissioning
ES	Jackdaw Environmental Statement (D4260/2021) (Shell UK, 2022) submitted in February 2022 for which the Secretary of State agreed to the grant of a production consent for the Jackdaw project in May 2022	PAM	Passive Acoustic Monitoring
FEP	Fife Ethylene Plant	PMF	Priority Marine Feature
FGL	Fulmar Gas Line	ROV	Remotely Operated Vehicle
FNGL	Fife Natural Gas Liquids Plant	SEGAL	Shell Esso Gas and Associated Liquids
GHG	Greenhouse Gas	SGMD	Scottish Government Marine Directorate
HDJU	Heavy Duty Jack Up	SMRU	Sea Mammal Research Unit
ICES	International Council for the Exploration of the Sea	SSIV	Subsea Intervention Valve

ABBREVIATIONS

INTOG	Innovation and Targeted Oil and Gas Decarbonisation	**UK**	United Kingdom
JNCC	Joint Nature Conservation Council	**UKCS**	United Kingdom Continental Shelf
KJ	Kilojoule	**UKOPA**	United Kingdom Onshore Pipeline Association
km	Kilometre	**VTS**	Vessel Traffic Survey
LCM	Loss Control Material	**WBCU**	Wellbore Clean-up
LTOBM	Low Toxicity Oil Based Mud	**WBM**	Water Based Mud
m	Metre	**WHP**	Wellhead Platform
m^2	Square Metre		

CONTENTS

1. EXECUTIVE SUMMARY

This document provides a revised and updated assessment of the likely significant effects of the Jackdaw project on the environment that is not limited to downstream Scope 3 emissions and contains updated information for the Jackdaw Environmental Statement (ES).This document is provided as Part 2 of the response to OPRED's Regulation 12(1) Notice dated 21st July 2025 ("OPRED's Regulation 12(1) July Notice") and OPRED's subsequent Regulation 12(1) Notice dated 22nd September 2025 ("OPRED's Regulation 12(1) September Notice").

Project Aspects described in the ES have been compared to the most recent project descriptions and an assessment has been done to identify whether the Aspects have changed compared to the ES and whether the change has resulted in a change in the likely significant effect on the environment for the project. Most recent project descriptions have been taken from Environmental Assessment Justifications (EAJs) completed in support of permits and consents, current project details and internal tracking sheets for specific operations, for example, drilling operations.

Most Aspects of the current project execution and future expectations on the final stages of installation, commissioning and operations are considered to have either less or similar environmental effects compared to the assessment in the ES. A few Aspect differences were identified as requiring further assessment, after which it has been concluded that the Aspect differences have not resulted in a change of environmental effect, compared to the environmental effect that is assessed in the ES.

This means that the ES robustly assesses the environmental effects of the Jackdaw project and the following conclusions from the ES remain valid for the current Jackdaw project status:

- Within the ES, the planned activities were assessed to identify potential environmental effects and the majority were shown to have some minor/moderate effects on the environment. Where environmental effects were noted, suitable mitigation measures and controls were identified, and an additional assessment was undertaken for all associated effects to determine their residual impact.
- It was the overall conclusion of the ES that the Jackdaw Project can be completed without causing any significant long term environmental effects or cumulative and transboundary effects.
- Shell therefore concludes that the proposed operations do not present a likely significant effect on the environment.

2. INTRODUCTION

This document provides a revised and updated assessment of the likely significant effects of the Jackdaw project on the environment that is not limited to downstream Scope 3 emissions and contains updated information for the Jackdaw Environmental Statement (ES). This document is provided as Part 2 of the response to OPRED's Regulation 12(1) July Notice and OPRED's Regulation 12(1) September Notice.

A separate document, "Part 1: Scope 3 Emissions Assessment" has been presented which contains an assessment of the effects of downstream scope 3 emissions from the Jackdaw project on climate in response to item 1 of OPRED's Regulation 12(1) July Notice.

Item 3 of OPRED's Regulation 12(1) July Notice further stated that Shell may wish to provide 'relevant information for the Secretary of State to consider when reaching its decision on whether or not to agree to the grant of consent'. Shell has provided information relating to the role of Jackdaw gas in the context of the UK's energy security and the energy transition, as well as the role of Shell's UK businesses in these, in a separate document, "Part 3: Relevant Information to the Project".

Finally, in the context of the Shell U.K. Limited and Equinor Production UK Limited transaction to form Adura and, following NSTA consent on 1 October 2025 to the assignment of interests in the Jackdaw field and the Licences from BG International Limited to UK North Sea Limited (Company number 16203210), as of 1 November 2025, UK North Sea Limited is now the Jackdaw developer for the purposes of the Jackdaw Environmental Statement (ES Ref: D/4260/2021).

3. PROJECT DESCRIPTION AND PROGRESS TO DATE

Jackdaw is a gas condensate field development that is expected, at peak, to represent around 6.5% of UKCS gas production, which produces an amount of energy equivalent to heating over 1.4 million homes (Shell UK, 2022).

The Jackdaw development comprises a 'not permanently attended' Wellhead Platform (WHP) with four wells, connected via an approximately 31 km subsea pipeline to the existing Shell UK operated Shearwater hub, where the Jackdaw gas will be processed and sent onshore to the St Fergus Gas Plant via the Fulmar Gas Line (FGL), both also operated by Shell UK. Following onshore processing, the gas enters the National Gas Transmission network supplying homes and businesses across the UK. The remaining NGLs are routed via pipeline to the Mossmorran Natural Gas Liquids Plant, where components are separated at the Shell Fife Natural Gas Liquids Plant (FNGL). Ethane is fed to the Fife Ethylene Plant (FEP) operated by ExxonMobil and some ethylene products are routed to the United Kingdom Onshore Pipeline Association (UKOPA) ethylene pipeline network. The remaining liquids from FNGL are sent via pipeline to Braefoot Bay before being exported by ship.

Jackdaw is critical to sustaining strategic UK energy infrastructure. The Jackdaw field will sustain production through its host platform, Shearwater, which in turn helps sustain the UK infrastructure necessary for a balanced and orderly UK energy transition, i.e. the St Fergus Gas Plant and the SEGAL system, which processes around one-third of UK gas demand.

Jackdaw is a major project with distinct work streams and involves over 1,000 people across 30 companies to design, build and integrate the different components of the project to deliver gas to the UK. Shell has invested over £1 billion in Jackdaw to date and the project is now approximately 90% through the execution plan.

Key elements of project progress to date include:

- The steel jacket structure, which sits on the North Sea seabed, was installed in August 2023 and the topsides were installed in early October 2025.
- The four High Pressure/High Temperature wells are at an advanced stage, by the Valaris V122 drilling rig, which has specialist equipment and crew onboard to manage this complex drilling operation. These wells are amongst the highest-pressure highest temperature wells in the UK.
- The approximately 31 km pipeline from Jackdaw to Shearwater was laid in July 2024.
- Modifications to Shearwater to receive and process Jackdaw gas are currently in progress.

The ES assessed potential effects based on a start-up of production in mid-2025. Production forecasts remain unchanged compared to the ES, except that production is anticipated to start in mid-2026, a one-year delay.

4. BASELINE

Every Environmental Statement uses available sources of environmental data for the environmental baseline against which the environmental effects are assessed. Sources of information that were considered in the ES include: meteorological data, seabed sediment maps, bird, fish and cetacean populations and commercial fishing intensity.

An assessment of the differences between the ES environmental baseline and current, updated available sources of information has been completed.

All identified differences are deemed to be minor and have little to no impact on the environmental assessment of the project included within the ES.

The assessment of updates available to the data regarding commercial fishing, cetacean populations, pinniped populations, vessel density and the surrounding energy infrastructure is discussed in Appendix A.

5. ES SUBMISSION VERSUS PROJECT TO DATE

This section compares the current Jackdaw project status with those aspects that were assessed in the ES. An Aspect is 'an element of an organisation's activities, products or services that can interact with the environment' [ISO 14001; 2015]. An environmental statement assesses the potential environmental effect of all project Aspects. The Aspects assessed within the ES have been compared with the most recent project descriptions taken from:

- Environmental Assessment Justifications (EAJs) completed in support of permits and consents;
- The current project details; and
- Internal tracking sheets for specific operations, for example, drilling operations.

The following sections note Aspects of the Jackdaw field development from the ES and state if the details of the project underwent change following the ES assessment. The project changes are assessed for any significant change in environmental impact either directly within this Section or in greater detail within respective Appendices if considered required.

The table below indicates how each Aspect has been assessed within the assessment of environmental effect column of the table below.

Colour	Meaning
Effect is less than in the ES	Assessment indicates that the environmental effects are less than assessed in the ES.
No Change	Assessment indicates that the potential effects are the same or similar to the assessment within the ES.
Further assessment required	Assessment indicates changes compared to ES and further assessment is provided as discussed above, to understand significance.

There is no change to the ES description of the Legislative Overview, Shell UK Environmental Management System, Environmentally Critical Elements and Consultation sections within the Introduction (Chapter 1) nor to Chapter 2 which describes the Impact Assessment methodology. Therefore, these sections are not considered further in this updated information for the ES.

5.1. General Project Details & Drilling Comparison

Section 2 of the ES, Project Description, described various Aspects of the Jackdaw development and operations. These Aspects were then assessed later within the ES in the relevant section (Physical presence, Seabed disturbance etc.). The table below provides an assessment against the ES in-line with the subsections as originally presented within Section 2 of the ES document.

Aspect assessed in the ES	Aspect change from the ES?	Comparison between ES and Completed Operations / Permit EAJ	Assessment of environmental effect
Number of Wells.	No	4 Wells were planned in the ES and 4 wells have been drilled.	**No Change.**
Drilling operations will utilise a Heavy Duty Jack-Up (HDJU) drilling rig.	No	The Valaris-122 HDJU has been used during all drilling operations.	**No Change.**
Drilling rig 'soft-pinning'.	Yes	The ES provided for soft-pinning the drilling rig approximately 500 m from the WHP jacket. The drilling rig was actually soft pinned approximately 80 m from the WHP jacket.	**No Change.** Given the temporary nature of this disturbance and no seabed sensitivity differences between the planned soft-pin location in the ES and the actual soft-pin location it is deemed that there is no additional environmental impact that has not already been assessed.
All sections of the Jackdaw wells will be batch drilled.	Yes	The order of operations was different from the ES where the 36", 26" and 17 ½ " sections of the Jackdaw wells were batch drilled. Following completion of these sections the remaining sections were then drilled sequentially.	**No Change.** The order of operations is different from the ES assessment, however the cuttings from the lower sections were skipped and shipped to shore with zero discharge to sea, therefore there is no change in environmental effect compared to the ES.
Well depth and approximate section lengths.	No	The ES states ~6,000 m, this matches with the EAJs and the well tracking data obtained during the drilling operations.	**No Change.**

Aspect assessed in the ES	Aspect change from the ES?	Comparison between ES and Completed Operations / Permit EAJ	Assessment of environmental effect
The HDJU will be fitted with a Blow Out Preventer (BOP)	No	The ES stated that a HDJU would be fitted with a BOP stack and installed prior to drilling the lower sections of the well. The BOP was installed before drilling the 17.5" sections.	**No Change.**
Well Design	Yes	The ES provided a well design of 5 sections. Each well was expected to consist of 5 sections (36"; 26"; 16"; 12 ¼" and 8 ½"). The 16" section was replaced by a 17.5" section for drilling all of the Jackdaw wells, with this included within the EAJs. A 6.5" contingency reservoir section was also included and assessed in the EAJs.	**No Change.** The increase in cuttings generated from drilling a 17.5" section compared to the planned 16" section have been assessed as part of Appendix B. The additional drill cuttings produced for the lower sections were skipped and shipped to shore, which would have marginally increased the atmospheric emissions generated by vessel use. However, the total mass of the cuttings transported is relatively minor and this is balanced, from an environmental impact respect, against not discharging these cuttings into the marine environment, therefore there is minimal change in environmental effects compared to the ES. Refer also to the Atmospheric Emissions Section 4.5 below.
The 36" section drilled with Water Based Mud (WBM)	No	The ES stated that the 36" section was to be drilled with WBM and would be drilled riserless. Cuttings were to be discharged at the seabed and the riser to be installed following completion of the 36" section. The drilling of the 36" section was completed as stated in the ES.	**No Change.**
The 26" section (WBM)	No	For the 26" section, drilled with WBM, the cuttings were to be returned to the drilling rig and discharged ~15 m below the sea surface.	**No Change.**

Aspect assessed in the ES	Aspect change from the ES?	Comparison between ES and Completed Operations / Permit EAJ	Assessment of environmental effect
		The drilling of the 26" section was completed as stated in the ES.	
Cuttings from sections drilled with Low Toxicity Oil Based Mud (LTOBM)	No	The ES provided for the cuttings from sections drilled with LTOBM to be screened over shakers and then disposed of onshore through a 'Skip & Ship' operation or alternatively, thermally treated with the cuttings discharged in-line with the approved chemical permit. The cuttings from the 12 ½", 8 ¼" and contingency 6 ½" sections have been shipped to shore for disposal at the NOV facility. The majority of cuttings from the 17.5" section were thermally treated and discharged from the HDJU in-line with the approved chemical permits. A small proportion of the cutting from this Section were shipped onshore for processing and disposal.	**No Change.**
Production tree rating.	No	For completions, the ES provided for a conventional dry vertical tree system rated for Jackdaw HPHT conditions to be deployed. HPHT rated trees have been installed on the Jackdaw wells, therefore in-line with the ES..	**No Change.**
Pipeline Length and Diameter	No	Export will be via a pipeline with a length of approximately 31 km and maximum diameter of 18" as stated within the ES.	**No Change.**
Jackdaw Subsea Isolation Valve (SSIV) Umbilical	No	The ES addressed the effects of an SSIV umbilical with respect to seabed disturbance. Under Project Uncertainties within the ES it was not currently known if a control umbilical for the SSIV would be	**No Change.**

Aspect assessed in the ES	Aspect change from the ES?	Comparison between ES and Completed Operations / Permit EAJ	Assessment of environmental effect
		required. During the later design stages it was determined that an umbilical would be required.	
Cumulative General Project Details & Drilling			
No Change. The ES concluded that the Jackdaw development would not contribute to significant cumulative impacts due to the placement and location of the Jackdaw WHP. The above shows no material changes compared to the ES; therefore it has been concluded that there is no change to the assessment of cumulative effects for this section.			

5.2. WHP JACKET

Section 2 of the ES, Project Description, described various Aspects of the WHP Jacket at the Jackdaw development. These Aspects were then assessed later within the ES within the relevant section (Physical presence, Seabed disturbance etc.). The table below provides an assessment against the ES in-line with the subsections as originally presented within Section 2 of the ES document.

Aspect assessed in the ES	Aspect change from the ES?	Comparison between ES and Completed Operations / Permit EAJ	Assessment of environmental effect
WHP location	No	The WHP location is as per the ES.	**No Change.**
The dimensions of the WHP jacket.	No	The WHP jacket base dimensions are approximately 32 m x 32 m, as per the ES.	**No Change.**
Mass of WHP jacket.	No	Approximate mass of the WHP jacket is 3,000 tonnes, as per the ES.	**No Change.**
Jacket set down prior to installation	No	Installation occurred as described in the ES.	**No Change.**
Jackdaw WHP will have a 500 m zone.	No	The Jackdaw WHP (and the HDJU drilling rig) has a 500 m exclusion zone associated with it, as per the ES, such that fishing vessels should not access the area thus ensuring that the potential for collision risk is as low as reasonably practical.	**No Change.**
Topsides	No	WHP topside details are as per the ES.	**No Change.**
Cumulative WHP			
No Change. The ES concluded that the Jackdaw development would not contribute to significant cumulative impacts due to the placement and location of the Jackdaw WHP. The above shows no material changes compared to the ES; therefore it has been concluded that there is no change to the assessment of cumulative effects for this section.			

5.3. VESSELS

Section 2 of the ES, Project Description, described the requirement for vessel use during the Jackdaw development and operations. These Aspects were then assessed later within the ES within the relevant section (Physical presence, Atmospheric emissions etc.). The table below provides an assessment against the ES in-line with the subsections as originally presented within Section 2 of the ES document.

Aspect assessed in the ES	Aspect change from the ES?	Comparison between ES and Completed Operations / Permit EAJ	Assessment of environmental effect
A post installation survey.	No	The ES states that a post installation survey will be carried out following backfilling of the export pipeline to ensure the pipeline is over-trawlable and to ensure there are no clay berms remaining. A post installation survey will be undertaken on completion of installation activities, as per the ES.	**No Change.**
Vessel Traffic Survey (VTS)	No	VTS will inform a Consent to Locate (CtL) application for the drilling rig. The VTS was undertaken by Anatec, as per the ES.	**No Change.**
Statutory 500 m safety zone	No	The Jackdaw WHP (and the HDJU drilling rig) has a 500 m safety zone associated with it, as per the ES, such that fishing vessels should not access the area thus ensuring that the potential for collision risk is as low as reasonably practical.	**No Change.**
Subsea infrastructure	No	The ES stipulated that the Subsea infrastructure out-with the Jackdaw and Shearwater 500 m zones will be over-trawlable. The new pipeline will be trenched and buried and any rock that may be required to mitigate those areas, where targeted depth of burial could not be achieved, will be laid in industry standard profile that is known to be over-trawlable. In addition, the mid-water crossings and their approaches will be over trawlable.	**No Change.**

Aspect assessed in the ES	Aspect change from the ES?	Comparison between ES and Completed Operations / Permit EAJ	Assessment of environmental effect
Drilling operations total fuel use. Pipelines Fuel Use WHP Jacket Installation	Fuel use has been assessed in Section 4.5.		
Cumulative Vessels			
No Change. The ES concluded that the Jackdaw development would not contribute to significant cumulative impacts due to the increase in vessel movements associated with the Jackdaw development. The table above shows no material changes compared to the ES; therefore it has been concluded that there is no change to the assessment of cumulative effects for this section.			

5.4. SEABED DISTURBANCE

Section 6 of the ES, Seabed disturbance, described and quantified various impacts from seabed disturbance during the Jackdaw development and operations. The table below provides an assessment against the ES in-line with the subsections as originally presented within Section 6 of the ES document.

Aspect assessed in the ES	Aspect change from the ES?	Comparison between ES and Completed Operations / Permit EAJ	Assessment of environmental effect
Drilling and WHP Installation			
Diameter of spud cans	Yes	Diameter of spud cans matches the information provided within the ES. The EAJ provided an assessment for a smaller area for permanent impact than in the ES, 1,520 m^2 vs. 4,072 m^2 as there was no requirement to relocate the rig as assessed in the ES.	**Impact is less than in the ES.**
Spud can penetration	No	Penetration into the seabed was ~3 m deep and ~18 m in diameter. Depth of spud can penetration matches ES.	**No Change.**
Anchors	Yes	ES assesses 4,000 m^2 area of temporary impact compared to the EAJs 900 m^2 area due to no requirement to re-locate the drill rig as originally assessed.	**Impact is less than in the ES.**
Anchor lines	Yes	ES assessed 600,000 m^2 area of temporary impact compared to the EAJs 120,000 m^2 due to no requirement to re-locate the drill rig as originally assessed.	**Impact is less than in the ES.**

Aspect assessed in the ES	Aspect change from the ES?	Comparison between ES and Completed Operations / Permit EAJ	Assessment of environmental effect
WHP Jacket	Yes	The ES assessed more permanent and less temporary impact from the jacket legs. The ES assessed 360 m^2 (permanent) and 168 m^2 (temporary) impact compared to the EAJ, which assessed 335 m^2 (permanent) and 193 m^2 (temporary) impact.	**Further assessment required.** The area of permanent impact assessed in the EAJ is smaller due to a reduction in the dimensions of the jacket legs. While it is presumed that increased temporary impact will affect benthic species, given the temporary nature of this disturbance, the seabed is expected to recover relatively quickly. Lambert (2014) found that heavily fished seabed began to recover within a year and that recovery was aided by undisturbed seabed within a 6 km radius. Dernie *et al* found that soft sediments begin to recover from 64 to 208 days depending on degree of physical disturbance, (Dernie, 2003). The additional area impacted is also relatively small (25 m^2) therefore the additional cumulative impact compared to the ES is considered minimal.
Wave rider buoy	Yes	A temporary wave-rider buoy was deployed, within the WHP 500 m zone, to provide real-time wave data prior to the WHP jacket piling operation. This was not considered as part of the project development and therefore not assessed in the ES. The temporary impact was assessed as 5 m^2 in the EAJ.	**Further assessment required.** While it is presumed that 5 m^2 temporary impact will affect benthic species, given the temporary nature of this disturbance, the seabed is expected to recover relatively quickly. Lambert (2014) found that heavily fished seabed began to recover within a year and that recovery was aided by undisturbed seabed within a 6 km radius, (Lambert, 2014). Dernie *et al* found that soft sediments begin to recover from 64 to 208 days depending on degree of physical disturbance, (Dernie, 2003).

Aspect assessed in the ES	Aspect change from the ES?	Comparison between ES and Completed Operations / Permit EAJ	Assessment of environmental effect
			The additional area impacted is also relatively small (5 m^2) therefore the additional cumulative impact compared to the ES is considered minimal. The wave-rider buoy was deployed from a vessel prior to the piling operation and within the Jackdaw 500 m zone. Vessels remained on-station during the piling operation and retrieved the wave-rider buoy following cessation of piling activities. It is therefore considered that the deployment of the wave-rider buoy posed no additional risk to other users of the sea.
Cement Patio	Yes	The ES assessed a maximum of 10 m^2 per well, so 40 m^2 in total. This was revised upwards in the respective EAJ. This states that a 7.5 m radius may be impacted (176.71 m^2 per well). Remotely Operated Vehicle (ROV) footage taken after all cementing operations were undertaken showed that the approximate area of impact of the cement patio, associated with the four wells, is 120 m^2. It is worthy of note that this area of impact is beneath the area impacted by the cuttings piles and within the footprint of the WHP jacket.	**Further assessment required.** The permit EAJs assessed a larger area of cement patio than the ES. The EAJ area was calculated and assessed as a worst-case prior to the commencement of drilling. In reality the size was less than in the EAJ. The patio will change the seabed habitat in a small area within the footprint of the WHP jacket and will result in the presence of a small area of hard substrate within the generally sandy area. However, given the relatively small area affected, it is not considered to have a significant environmental effect.
Drill cuttings	Yes	The ES uses the 2019 drill cutting modelling. Since then the drill cuttings discharge has been remodelled at least twice due to regulatory requirements to assess additional side-track contingencies and modelling issues (see Appendix B).	**Further assessment required.** The impacts associated with the differences between the ES and EAJs with respect to the mass of drill cuttings discharged is assessed further in Appendix B.

Aspect assessed in the ES	Aspect change from the ES?	Comparison between ES and Completed Operations / Permit EAJ	Assessment of environmental effect
		The result is that the overall temporary and permanent seabed disturbance from drill cuttings has changed.	
Pipeline Installation			
Seabed disturbance associated with the pipeline construction.	Yes	The ES assessed as larger area of temporary and permanent total seabed disturbance associated with subsea/pipelines construction compared to the EAJ. Total permanent seabed disturbance associated with pipeline installation assessed 108,936 m^2 compared to a smaller area of 100,738 m^2 in the EAJ, a difference of 8,198 m^2. The ES assessed a total area of 1,636,096 m^2 temporary impact compared to the EAJs 1,605,256 m^3, a difference of 30,840 m^2. There are differences between the number of items such as concrete mattresses and grout bags between the assessments and the ES does not assess the use of sand during operations. Up to 800 tonnes of sand was assessed to back fill a 80 x 16 m trench used to bury a spool within the Shearwater 500 m zone.	**No Change.** The ES assessed a larger area of permanent and temporary impact even though the exact number of items and make up was different. These differences are shown in Appendix B. As the area of impact is below that of the ES there is no additional environmental impact that has not already been assessed and no further assessment is proposed.
Pipeline as laid condition	No	The ES states that the pipeline will be trenched and backfilled with natural sediment which will be available for recolonisation and habitat recovery. The mitigation measure remains valid, as per the ES.	**No Change.**

Aspect assessed in the ES	Aspect change from the ES?	Comparison between ES and Completed Operations / Permit EAJ	Assessment of environmental effect
Cumulative Seabed Disturbance			

No Change.

The ES assessed the cumulative impacts from seabed disturbance as being not expected to have any significant cumulative effects, given the relatively small footprint of permanent disturbance.

An updated seabed disturbance assessment is provided in Appendix B and whilst the overall total of permanent and temporary impact has reduced between the assessments in the ES and EAJs the exact number of items and make-up are different, as shown in Table B-7.

The area of permanent impact has reduced between the ES and EAJs/actual from142,738 m^2 to 132,048 m^2, whilst the area of temporary impact has reduced from 2,539,432 m^2 to 2,025,552 m^2.

The assessment therefore shows no material changes compared to the ES and thus it has been concluded that there is no change to the assessment of cumulative effects for this section.

5.5. Atmospheric Emissions

Section 7 of the ES, Emissions to Air, described and quantified the various sources of gaseous emissions to air during each phase of the proposed Jackdaw project and the nature and significance of the impact associated with these. The ES also provided a comprehensive estimate of the fuel use expected during the project execution and production phase of the Jackdaw project. Section 2.10 of the ES and in particular Table 2-12 provided an estimate of the vessel types and associated fuel consumptions during the project execution. Production emissions for both Jackdaw and Shearwater were discussed and estimated in Sections 7.3.4 and 7.3.5. The table below provides an assessment against the ES, in-line with the subsections as originally presented within Section 7 of the ES. The ES assumed that all emissions associated with this phase should be considered as 'Scope 1' as all operations are under the control of the company. At the time this document was produced the wells had not yet been perforated and completed.

Aspect assessed in the ES	Aspect change from the ES?	Comparison between ES and Completed Operations / Permit EAJ	Assessment of environmental effect
Drilling and Installation Phase			
WHP Jacket Installation	Yes	The jacket installation was undertaken and completed, predominantly during August 2023. The estimated fuel use provided in the ES was 4,600 tonnes; the quantity of actual fuel used during the jacket installation operations was just under 1,400 tonnes.	**Impact is less than in the ES.** Fuel use for this phase is less than assessed within the ES and therefore no further assessment is proposed.
Drilling Operations	Yes	The length of time the drilling rig has been on location is significantly longer than originally envisaged within the ES. The estimated drilling period was given as 513 days. Drilling commenced following the jacket installation on the 1st September 2023, the drilling of the wells has just been completed (July 2025). At the time of writing the wells have not yet been perforated and the drilling rig will be staying on location until these final operations have been completed. From an emissions point of view the drilling rig uses less fuel per day than was originally used for quantification in the ES. The fuel consumption for	**No Change.** Overall fuel use associated with the drilling operations is not expected to exceed the quantities assessed within the ES and therefore no change in environmental effect compared to ES and no further assessment is proposed.

Aspect assessed in the ES	Aspect change from the ES?	Comparison between ES and Completed Operations / Permit EAJ	Assessment of environmental effect
		the ES was based on 25 tonnes per day, the current HDJU uses approximately 14 to 16 tonnes per day while drilling and considerably less (approximately 5 to 12 tonnes/day) when not drilling for example during maintenance or when the rig is acting in hotel mode. The ES estimated fuel use for the drilling of the wells, at 12,825 tonnes, fuel use to the end of the present drilling operations (not including completion and perforating operations) is just under 9,400 tonnes. The drilling rig will be remaining on location for a further period of time, possibly until year end, 2025. However during this time the rig will mainly be operating in maintenance / hotel mode. It is currently estimated that fuel use prior to departure will be in line with the original figure provided in the ES at just under 12,500 tonnes.	
Potential Flaring During Perforation Operations	Yes	As part of the drilling operations associated with the perforation of the wells, the potential exists for a limited amount of flaring to be required. With this being a safety mitigation measure, any gas unexpectedly detected at the surface would be safely flared enabling the safe deployment and / or retrieval of the perforating assembly. Whilst the flaring, if needed, will be kept to a minimum. The maximum quantity of gas that may require to be flared is just under 1,200 tonnes in total.	**Further assessment required.** At the time the ES was submitted the potential requirement to undertake the flaring was not envisaged and therefore an assessment has been undertaken and the results are presented below in Appendix C.

Aspect assessed in the ES	Aspect change from the ES?	Comparison between ES and Completed Operations / Permit EAJ	Assessment of environmental effect
Topside Installation	Yes	The topsides installation fuel estimate assessed within the ES was given as 2,648 tonnes. The current estimate is less at just under 2,000 tonnes.	**Impact is less than in the ES.** The estimated future fuel use for the topsides lift is less than provided within the ES and therefore no further assessment is proposed.
Pipeline Installation	No	The installation of the subsea infrastructure including the pipeline is still ongoing and will not be completed until the final hook-up of the topsides to the subsea infrastructure has been undertaken. At present the fuel use associated with the pipeline installation and associated activities is below the quantity assessed within the ES.	**No Change.** The estimated future use to finish the pipeline activities is not expected to exceed the quantities assessed within the ES and therefore no further assessment is proposed.
Commissioning and Production Phase			
Commissioning & Start-up	No	The majority of commissioning and start-up activities covered in the ES will be undertaken after the topsides has been installed. A review of the section within the ES has been undertaken and the ES continues to reflect the commissioning and start-up plans. Therefore the atmospheric emissions quantified within the ES remain valid.	**No Change.**
Production Operations at Jackdaw WHP	No	The emissions associated with the production operations covered in the ES continues to reflect the Jackdaw WHP production plans. Therefore, the atmospheric emissions quantified within the ES remain valid. Production operations are anticipated to commence mid 2026 with this being dependent on the provision of the production consent by the NSTA.	**No Change.**

Aspect assessed in the ES	Aspect change from the ES?	Comparison between ES and Completed Operations / Permit EAJ	Assessment of environmental effect
		The only difference in emissions from the ES to the present is that production is due to commence a year later. To put the impact of that in context Appendix D provides a revised comparison against the UK Carbon Budgets allocation alongside the currently projected UK emissions for these periods.	
Production Operations at Shearwater Host Installation	No	As discussed above the wells have not yet been perforated and therefore there is no flow. The reservoir quality & fluid property results from the four Jackdaw development wells have come in at the pre-drill expected case. These static reservoir properties, while not conclusive of final well performance, provide confidence that the pre-drill production profiles previously provided remain the most likely case for Jackdaw well production. In consequence the emissions associated with the production operations discussed and assessed within the ES remain valid. With this including the CO_2 emissions from the amine vent. Further an assessment of the emissions associated with the Shearwater Native emission has also been undertaken which has demonstrated that the Shearwater Native Emissions are below those reported in the ES.	**No Change.**
Cumulative Atmospheric Emissions			

Aspect assessed in the ES	Aspect change from the ES?	Comparison between ES and Completed Operations / Permit EAJ	Assessment of environmental effect

No Change.

An assessment has been undertaken of fuel use to date associated with the drilling and installation phase and has included an estimate for the work still to be completed. This has demonstrated that total fuel use and therefore the estimated emissions as presented within the ES will not be exceeded even though the length of time the drilling operations were originally expected to last has been exceeded.

The ES looked closely at the cumulative impacts of Jackdaw Emissions and Shearwater Emissions. Given that CO_2 has a global rather than a local impact, the cumulative assessment was undertaken in the context of the much wider UK and UKCS emissions rather than framing the assessment with considerations of local proximity. The ES concluded that the Jackdaw development would not significantly impact on the UK's ability to meet its emissions targets and that overall the development is not anticipated to cumulatively represent a considerable contribution to global emissions. The overall significance of the impact of atmospheric emission arising from the development is considered to be minor.

The table above shows no material changes compared to the ES; therefore it has been concluded that there is no change to the assessment of cumulative effects relevant for this section.

5.6. Discharges to Sea

Section 8 of the ES, Discharges to Sea, described and quantified the various discharges during the Jackdaw development and operations. The table below provides an assessment against the ES in-line with the subsections as originally presented within Section 8 of the ES document.

Aspect assessed in the ES	Aspect change from the ES?	Comparison between ES and Completed Operations / Permit EAJ	Assessment of environmental effect
Drill cuttings - Mass of cuttings	Yes	The mass of cuttings for the 36"/26"/17.5"/12 ¼"/8 ½" sections was increased in the EAJs.	**Further assessment required.** The total mass of drill cutting discharge assessed in the ES was 7,056 tonnes vs. actual discharge of 8,501 tonnes. The effects associated with the differences between the ES, EAJs and actual with respect to the mass of drill cuttings discharged is assessed further in the seabed disturbance assessment in Appendix B.
Drill cuttings - 36"	Yes	The actual mass discharged was higher than the ES. (656 tonnes actual vs. 584 tonnes ES)	
Drill cuttings - 26"	Yes	The actual mass discharged was lower than the ES. (2,960 tonnes actual vs. 2,988 tonnes ES)	
Drill cuttings - 16" (17.5")	Yes	The actual mass discharged was higher than the ES. (4,885 tonnes actual vs. 3,484 tonnes ES) See previous entry (Section 4.1) for discussion of 16" vs. 17.5" section.	
Drill cuttings - 12 ¼"	Yes	EAJ assessed a larger mass of cuttings, the actual mass discharged was zero.	**No Change.** It is confirmed that the cuttings were skipped and shipped to NOV for treatment. Base oil will be recovered for re-use, and any solids (with oil removed) sent to landfill. Any unused loss control material (LCM) will also be returned to shore and sent to an approved waste disposal plant. The ES assessed the disposal of special waste including a range of disposal methods (re-use / recycle / incineration / landfill) along with waste management and duty of care. Skip and ship was used for the lower sections (plus a portion of the 17.5" section) due to the lower volumes
Drill cuttings - 8 ½"	Yes	EAJ assessed a larger mass of cuttings, the actual mass discharged was zero.	

Aspect assessed in the ES	Aspect change from the ES?	Comparison between ES and Completed Operations / Permit EAJ	Assessment of environmental effect
			required to be shipped combined with an increase in the quantity of attached chemicals.
Offshore treatment of LTOBM cuttings	No	The ES provided for the potential thermal treatment of LTOBM cuttings offshore. Further, if treated offshore the resultant cuttings powder would be discharged into the water column (rather than at the seabed) resulting in greater dispersion and a relatively small contribution to the overall cuttings pile (which is primarily made up of WBM cuttings). Thermally treated cuttings were discharged into the water column as stated.	**No Change.**
Well bore clean-up fluids.	Yes	The ES assessed approximately 500 m^3 per well (2,000 m^3 in total) of "visible oil free displaced fluid" that would be discharged. This was reduced in the EAJs to 400 m^3 (1,800 m^3 in total) of "visible oil free" displaced fluid to be discharged per well.	**Impact is less than in the ES.**
Production Phase	No	The topsides have not yet been installed. The drainage system has been constructed as described in the ES. The reservoir quality & fluid property results from the four Jackdaw development wells have come in at the pre-drill expected case, which provides confidence that the production profiles previously provided in the ES remain the most likely case for the Jackdaw development. In consequence the produced water discharges at Shearwater, as discussed in the ES remain valid.	**No Change.**
Cumulative Discharges to Sea			
No Change.			

Aspect assessed in the ES	Aspect change from the ES?	Comparison between ES and Completed Operations / Permit EAJ	Assessment of environmental effect
The ES concluded that significant cumulative impacts due to the discharges associated with the drilling and construction operations would not occur as a result of the Jackdaw development. The cumulative impacts associated with the differences between the ES and EAJs with respect to the mass of drill cuttings discharged is assessed further in the assessment of seabed disturbance in Appendix B. As discussed in the table above; although production operations have not yet commenced, the production profiles previously provided in the ES remain the most likely case for the Jackdaw development. Therefore the cumulative assessment within the ES for production discharges remains unchanged.			

5.7. UNDERWATER NOISE

Section 9 of the ES, Underwater Noise, described and assessed the impact of various sources of underwater noise during the Jackdaw development and operations. The ES provided a description of the sensitivity of receptors and an impact assessment for the activities planned. The table below provides an assessment against the ES in-line with the subsections as originally presented within Section 2 of the ES document.

Aspect assessed in the ES	Aspect change from the ES?	Comparison between ES and Completed Operations / Permit EAJ	Assessment of environmental effect
Noise associated with piling the WHP jacket.	No	The hammer capacity of 3,500 kJ with maximum anticipated energy requirement of 2,835 kJ is unchanged from the ES in the EAJ.	**No Change.**
Noise associated with piling the WHP jacket.	Yes	Pile dimensions stated in the EAJ are slightly larger than stated in the ES. 108" (2.74 m) in diameter and approximately 91.5 m in length compared to 100" (2.54 m) in diameter and approximately 90 m in length.	**No Change.** The difference in pile dimensions might have resulted in a slight increase in the time required to complete the piling. In the actual event piling did not take longer than envisaged in the ES even though the piles were slightly larger.
	Yes	The deployment of an Acoustic Deterrent Device (ADD) prior to piling activities in order to deter marine mammals from entering the vicinity of the piling activity was not considered in the ES. However this was included in the EAJ (15 minutes of ADD coinciding with last 15 minute of pre-piling survey).	**No Change.** The ES modelling omitted the use of an ADD as this was a later optimisation to the piling process. This optimisation does not mean that the modelling is now inaccurate as the use of the ADD will replace an energy equivalent section of the soft-start mitigation method. No further assessment is required.
Marine mammal observers (MMOs).	No	The provision of MMOs was included within the ES as a mitigation measure. The mitigation zone would be at least 500 m. MMOs would carry out a 30-minute pre-piling survey and, if a marine mammal is detected, then work would be	**No Change.**

Aspect assessed in the ES	Aspect change from the ES?	Comparison between ES and Completed Operations / Permit EAJ	Assessment of environmental effect
		delayed until it has left the area. Mitigations measures were observed, as per the ES.	
Noise associated with piling the WHP jacket.	Yes	ES mitigation provided for the inclusion of a soft-start period of 50 minutes with the hammer operating at less than 320 kJ energy and a blow rate of one strike every ten seconds. This duration was reduced in the EAJ to 30 minutes as ADD designed to deter marine mammals from approaching the area of operations was deployed as additional mitigation.	**No Change.** The addition of the ADD was a later optimisation to the piling process and consequently the period of soft-start was reduced. The JNCC piling protocol does not define a period of time required for "soft start" as long as it lasts more than 20 mins (JNCC, 2010). Therefore, as the "soft start" is of sufficient length to satisfy the guidance and an ADD was deployed during operations it is deemed that the change in procedure helps reduce the risk to the environment resulting from these operations.
Breaks during Piling operations.	No	ES management measures discuss repeating the pre-piling survey and soft-start for a break of over 10 minutes. The EAJ described breaks as being less than 60 minutes following agreement with JNCC due to the short hammer positioning times. Breaks of greater than 60 minutes require a full restart of the soft-start. The enhanced mitigation measures were followed during the piling operations, in-line with the ES.	**No Change.**
Further Noise mitigation measures.	No	The ES described avoiding commencing piling at night or in poor visibility when marine mammals cannot reliably be detected.	**No Change.**

Aspect assessed in the ES	Aspect change from the ES?	Comparison between ES and Completed Operations / Permit EAJ	Assessment of environmental effect
		If this cannot be avoided, then Passive Acoustic Monitoring (PAM) will be used. These standards were observed.	
Noise associated with piling SSIV.	Yes	The ES did not specifically include an assessment of the piling required for the installation of the SSIV. The noise assessment and modelling was included within EAJ. The ES stated that the piling of the WHP jacket would constitute the worst-case noise source associated with the development; this is confirmed by the assessment of noise produced during the SSIV piling.	**No Change.** The assessment of the impact of underwater noise within the ES is specifically described for the piling of the WHP jacket. It is noted that the impact from the underwater noise associated with SSIV installation is less than that assessed within the ES, for the WHP, due to lower hammer energy requirement and the duration of operations being shorter. The modelling in the EAJ concluded that SSIV piling activities would not have a significant impact on marine mammals, fish, and fish eggs and larvae if the relevant mitigation measure (i.e. MMOs, soft-start to piling, PAM, etc.) were followed. The mitigation measures were followed during operations. Therefore the additional underwater noise associated with the installation of the SSIV will not significantly impact the environmental assessment made of the Jackdaw field development during the ES.
Cumulative Underwater Noise			
No Change.			

5.8. Waste Generation and Management and Accidental Events

Section 10 of the ES, Waste Generation and Management and Section 11 Accidental Events, described and quantified the various associated Aspects during the Jackdaw development and operations. The table below provides an assessment against the ES in-line with the subsections as originally presented within Section 8 of the ES document.

Aspect assessed in the ES	Aspect change from the ES?	Comparison between ES and Completed Operations / Permit EAJ	Assessment of environmental effect
Waste Management	No	The assessment undertaken within the ES on waste management has been noted to contain no changes or updates. Waste management was included in the ES as a potential ongoing source of environmental impact throughout the life of the project. Waste generation will occur during all phases of the project and will include special (hazardous), non-hazardous and recyclable wastes. Drilling waste and operational waste associated with processing, maintenance and utilities will account for the majority of waste generated during the Project. A project-specific waste management plan has been developed and implemented.	**No Change.**
Accidental Event	No	The assessment on accidental events undertaken within the ES has been reviewed and there are no changes or updates. An approved Temporary Operation Oil Pollution Emergency Plan (OPEP) (Shell UK, n.d.) has been in place through-out the drilling stages of the project and will remain in place until the drilling rig moves off location. At this time the approved Shearwater OPEP will be in place for the start of production from the Jackdaw Field.	**No Change.**

Aspect assessed in the ES	Aspect change from the ES?	Comparison between ES and Completed Operations / Permit EAJ	Assessment of environmental effect
Cumulative Waste Management and Accidental Events			
No Change.			

6. SUMMARY OF FURTHER ENVIRONMENTAL ASSESSMENT

This section details any Aspects of the Jackdaw field development from Section 4 that are deemed to require further assessment due to changes or updates that have occurred following the submission of the ES.

Aspect Requiring Further Assessment	Summary of Assessment	Assessment of Environmental Effect
Seabed Disturbance: ■ WHP Jacket ■ Wave-rider Buoy ■ Cement Patio ■ Drill Cuttings ■ Pipeline Construction	An updated seabed disturbance assessment noted that whilst the overall total of permanent and temporary impact has reduced between the assessments in the ES and EAJs, the exact number of items and make-up are different, as shown in Table B-7. The area of permanent impact has reduced between the ES and EAJs/actual from 142,738 m^3 to 132,048 m^2, whilst the area of temporary impact has reduced from 2,539,432 m^2 to 2,025,552 m^2. It is presumed that within these areas there has been some impact on benthic species, megafauna burrows, and a level of degradation of the PMF habitat offshore subtidal sands and gravels habitat. However, in the context of the wider distribution of the benthic community present, offshore subtidal sands and gravels (one of the most common marine habitats on the UKCS (Tyler-Walters, 2016), and megafauna burrows, this area is very small. Lambert (2014) found that heavily fished seabed began to recover within a year and that recovery was aided by undisturbed seabed within a 6 km radius, (Lambert, 2014). Dernie *et al* found that soft sediments begin to recover from 64 to 208 days depending on degree of physical disturbance, (Dernie, 2003). Given that the temporary disturbance will occur in a relatively undisturbed seabed and within an area with low fishing effort, which will be subsequently excluded with the establishment of a 500 m exclusion zone, it is likely that the benthic community will recover quickly from the temporary disturbance. It should also be noted that although the 2023 drill cuttings assessment used does indicate a substantial increase in the impacted area the modelling result is now considered an overestimation of the area impacted. The actual disturbance due to drill cuttings discharge will likely be lower than this.	**No Change.**

	The assessment therefore shows no significant changes compared to the ES; therefore there is no change to the ES assessment that disturbance to the seabed is not predicted to have a significant impact on the benthic environment and other seabed receptors.	
Perforation Flaring	As part of the drilling operations associated with the perforation of the wells, the potential exists for a limited amount of flaring to be required. With this being a safety mitigation measure, any gas unexpectedly detected at the surface would be safely flared enabling the safe deployment and / or retrieval of the perforating assembly. Whilst the flaring, if needed, will be kept to a minimum the maximum quantity of gas that may require to be flared is just under 1,200 tonnes in total. Emissions from potential flaring during perforation operations should be considered within the broader context of the overall Jackdaw project emissions assessed in the ES, rather than in isolation. These potential emissions, for example, represent approximately 4% of the total estimated GHG emissions for Jackdaw during the drilling phase and less than 1% of the project's overall emissions. Even if these potential emissions were considered as an increase in absolute terms relative to the baseline estimate in the ES, they are unlikely to alter the conclusions in Section 7.4.2.1 regarding Jackdaw and the cumulative Shearwater hub emissions' contribution to broader UK and UKCS emissions. Similarly, they would not impact the context provided in Section 7.4.2.3 concerning national carbon budgets. Therefore, the conclusions related to local air quality, Jackdaw's contribution to global emissions, and the project's alignment with UK government net zero targets remain valid.	**No Change.**

7. CONCLUSIONS

Based on a thorough comparison between the current project status and the ES, the report concludes that the environmental effects associated with the current project status remain consistent with the environmental effects assessed in the ES:

- Most Aspects that have been assessed in this document are considered to have either less or similar environmental effects compared to the assessment in the ES.
- A few Aspect differences were identified as requiring further assessment, after which it has been concluded that the Aspect differences have not resulted in a change of environmental effect, compared to the environmental effect that was assessed in the ES.
- This assessment has looked at the current project status as well as the future operations as far as possible and there are no major future differences expected from the information provided within the ES.

This means that the ES robustly assesses the environmental effects of the Jackdaw project and therefore the following conclusions from the ES remain valid for the current Jackdaw project status:

- Within the ES, the planned activities were assessed to identify any potential environmental effects and the majority were shown to have some minor/moderate effects on the environment. Where environmental effects were noted, suitable mitigation measures and controls were identified, and an additional assessment was undertaken for all associated effects to determine their residual impact.
- It was the overall conclusion of the ES that the Jackdaw Project can be completed without causing any significant long term environmental effects or cumulative and transboundary effects.
- Shell therefore concludes that the proposed operations do not present likely significant effects on the environment.

APPENDICES

A. BASELINE ASSESSMENT

Every ES uses available sources of environmental data for the environmental baseline against which the environmental effects are assessed. Sources of information that were considered in the ES include: meteorological data, seabed sediment maps, bird, fish and cetacean populations and commercial fishing intensity.

An assessment of the differences between the ES environmental baseline and current, updated available sources of information has been completed.

The assessment of updates available to the data regarding commercial fishing, cetacean populations, pinniped populations, vessel density and the surrounding energy infrastructure is discussed below.

Fishing

To assess any impact the Jackdaw development may have on commercial fishing the ES used the most recent data available at the time of submission, in this case this was up to 2020.

Table A-1 shows that from 2020 to 2023 (the most recent data available) the combined fishing effort across the ICES Rectangles relevant to the Jackdaw development remained largely unchanged. The Jackdaw project area remains of relatively low importance to the UK fishing industry.

Table A-1 - Fishing Effort Across ICES Rectangles 42F2, 43F1 & 43F2 from 2020 – 2023 (SGMD, 2024).

Year	UK Total Effort (Days)	Effort 42F2 (Days)	Effort 43F1 (Days)	Effort 43F2 (Days)	Combined % of UK Total
2020	103,918	10	103	D*	0.11%
2020[1]	104,027	10	105	D*	0.11%
2021	105,763	D*	63	D*	0.06%
2022	95,211	D*	51	D*	0.05%
2023	95,358	D*	56	D*	0.06%

* If less than five vessels over 10 metres undertook fishing activity in the ICES rectangle the data is considered to be disclosive (D) and therefore not shown.

Notes:

[1] – This row of 2020 is taken from the ES.

[2] – This row of 2020 data is taken from the most recent SGMD data (SGMD, 2024). The minor variation in the data was likely a correction due to an error in the original Scottish government data set.

Cetaceans

Since the Jackdaw development ES was submitted a new report on the distribution and abundance of cetaceans in European Atlantic waters has been released, SCANS-IV (Gilles, 2023).

The most recent available data on marine mammal populations from SCANS IV now results in the ES and the EAJ underestimating the number of Harbour Porpoise and Minke whales potentially disturbed during operations.

Table A-2 shows the comparison between the SCANS-III (Hammond et al., 2021) and SCANS-IV data. The SCANS-IV data shows an increase in abundance of both harbour porpoise and minke whale as well as the addition of white-sided dolphin within the locality of the Jackdaw development.

It should be noted that between SCANS-III and SCANS-IV the survey area designations were changed, however the actual area represented has not significantly changed.

The increase in the abundance of marine mammals shown in Table A-2 is potentially important to the conclusions of the underwater noise modelling assessment in the ES with respect to the total number of animals potentially disturbed.

Using the disturbance area calculated in the original report for Harbour Porpoise, Minke Whale and White-beaked dolphin, Table A-2 also shows the differences in the percentage of Management Unit (MU) population disturbed between SCANS-III and SCANS-IV.

The increase in percentage of MU population disturbed is only deemed to be significant for harbour porpoise (where the percentage has increased above 1%). However, this increase is not deemed to contradict the conclusion of the supporting modelling report and noise assessment from the ES. The conclusion that the number of animals potentially effected is small compared to the total MU population and that operations will only impact a localised area is unaffected by these changes. Therefore, the change is not deemed to be significant.

Table A-2 – Comparison of the impact on marine mammals due to underwater noise associated with the Jackdaw Development.

Survey Block	Species	Animal Abundance per Survey Block	Animal Density (per km^2)	Percentage of MU Population Disturbed (%)
Q (SCANS-III)	Harbour Porpoise	16,569	0.333	0.334
	Minke Whale	384	0.007	0.06
NS-G (SCANS-IV)	Harbour Porpoise	51,646	1.04	1.04
	Minke Whale	510	0.01	0.08
	White-beaked dolphin	5,218	0.11	0.4

Pinnipeds

Two species of seal are resident in British waters: the grey seal (*Halichoerus grypus*) and the harbour seal (*Phoca vitulina*). Both grey seals and harbour (also called common) seals tend to frequent inshore waters but have been seen offshore from a number of platforms in the North Sea.

The ES and EAJs assessed the impact of the Jackdaw development on seals using data from Russell *et al.* and Sea Mammal Research Unit (SMRU) data respectively (Russell, 2017) (SMRU, 2017). This indicated that both grey seals and harbour seals may occur in very low numbers / densities (0-1) in the vicinity of the proposed Jackdaw Project.

The most recent data available, Carter *et al*., 2022, does not contradict this, (Carter, 2020). The resulting distribution maps indicate that harbour seals are not likely to be present in the Jackdaw area and that grey seals are likely to occur in low numbers, with 0 to 0.001% of the UK and Ireland at-sea grey seal population potentially present in the area. Therefore, the change in source material is not deemed to be significant.

Vessel Density

Shipping density was assessed in the ES using data from the Oil and Gas Authority (OGA) (now the NSTA), the Marine Management Organisation (MMO) and from Anatec (in the form of a Vessel Traffic Study (VTS)).

Within the ES shipping density was considered to be moderate in Block 22/30, low in Blocks 23/26 and 30/1 and very low in Blocks 30/02 and 30/03 (OGA, 2019). Data collated by the Marine Management Organisation (MMO) also showed relatively low shipping density (MMO (Marine Management Organisation), 2016) as shown in Figure A-1.

The EAJs presented the OGA shipping density data as shown in Figure A-2. Although the reference is different (OGA, 2016 compared with OGA, 2019) the data is from the same source. The blocks identified for the Jackdaw development range in classification from very low to moderate shipping density. As there is no change from the density assessed in the ES, the change in information source is deemed to have no impact on the assessment.

Since submission of the ES and the EAJs, vessel traffic data from the European Marine Observation and Data Network (EMODnet) has become available. Vessel density maps are produced using a grid of 1 km x 1 km squares and express density in hours per kilometre per month. Figure A-3 below shows that vessel traffic in the area is still concentrated around oil and gas infrastructure with relatively low shipping density within the Jackdaw development area. Therefore, the change in information source is deemed to have no impact on the assessment.

Figure A-1 - Vessel density in the vicinity of the Jackdaw development (MMO (Marine Management Organisation), 2016)

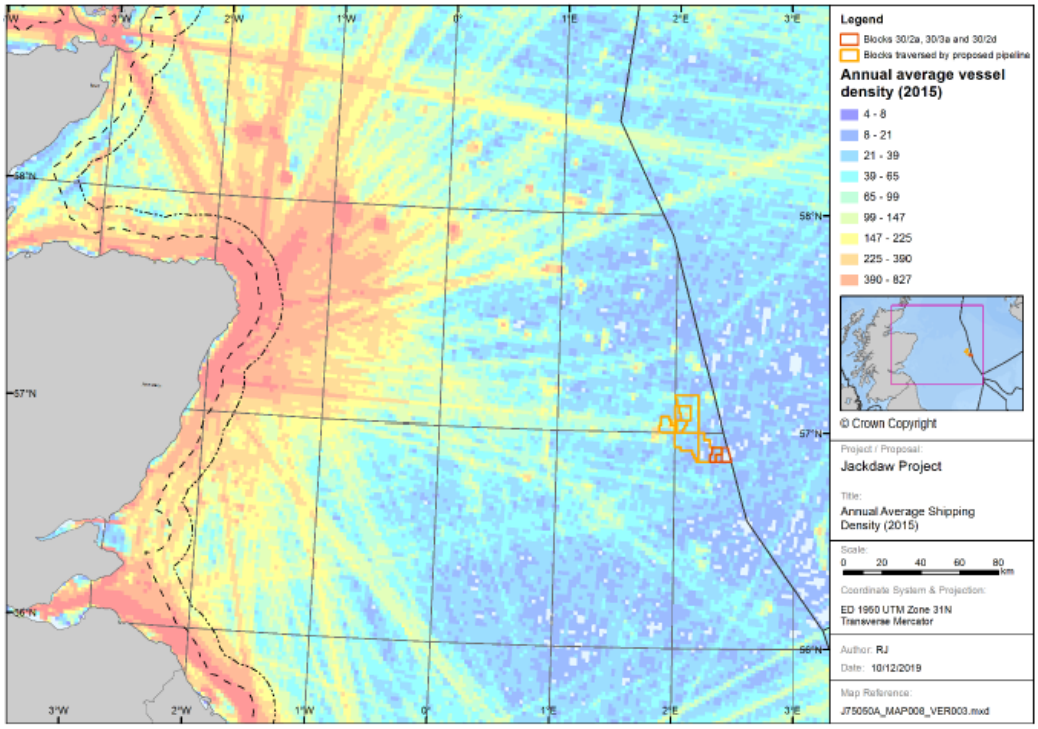
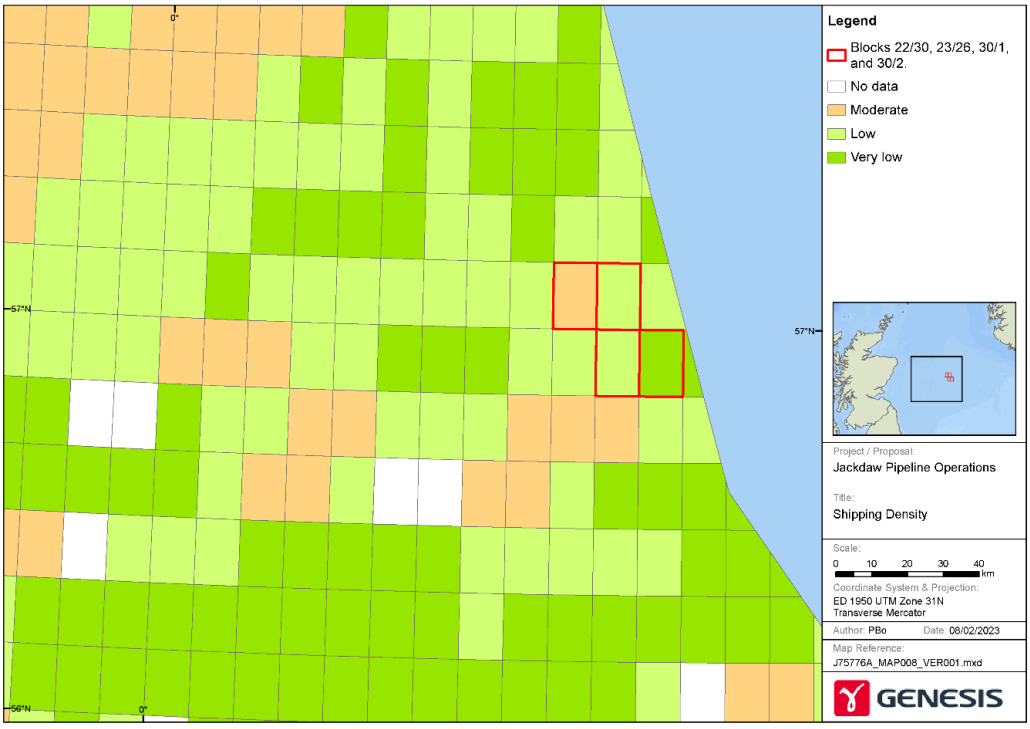
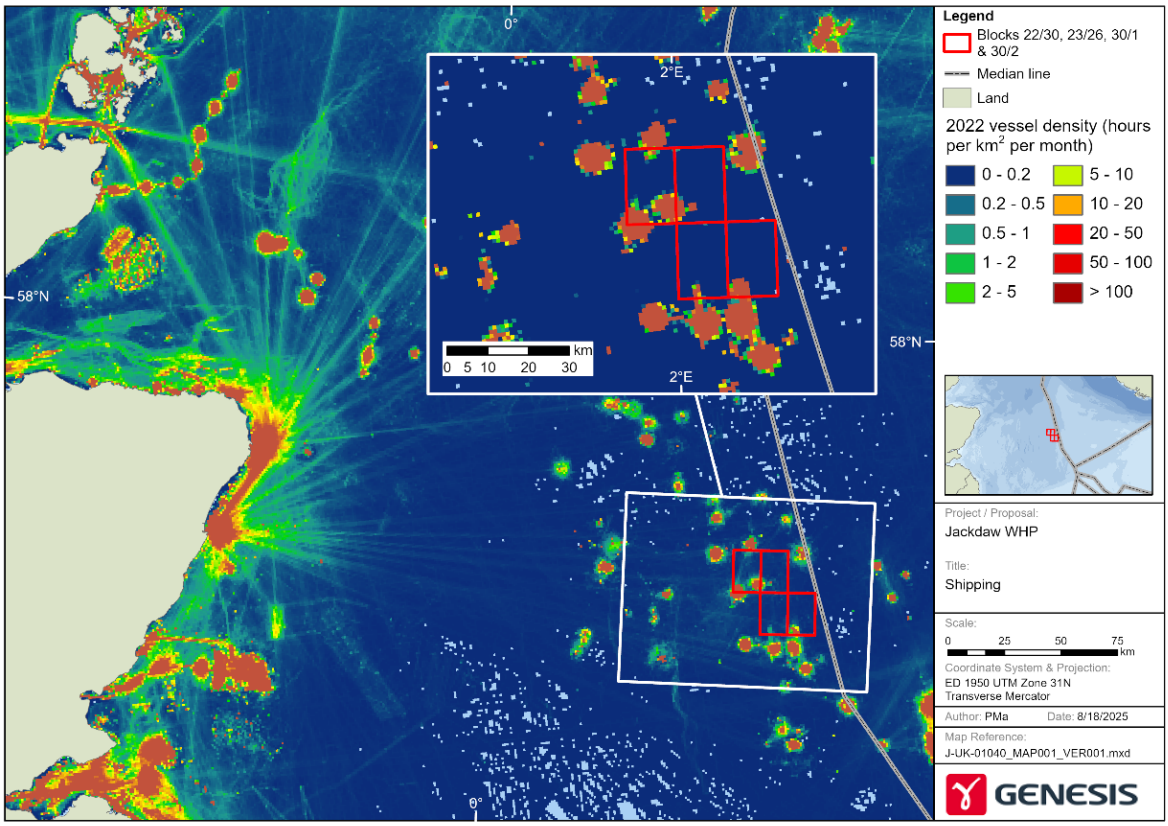


Figure A-2 - Vessel density in the vicinity of the Jackdaw development (OGUK (Oil & Gas UK), 2019)



As part of both the ES and EAJ assessment a VTS was undertaken by Anatec. A comparison between the shipping routes identified within the survey's is shown in Figure A-4 and Figure A-5. The original survey completed in 2019 identified 17 shipping routes within the vicinity of the Jackdaw WHP location. Two routes (labelled 1 and 2 on the figure) pass within 3 nm of the WHP location. Route No. 1 passes approximately 1.4 nm from the WHP location and is used by an estimated eight vessels per year while route No. 2 passes approximately 2.5 nm from the WHP location.

Figure A-3 - EMODnet Vessel Density



The 2023 survey identified an additional shipping route that passes approximately 0.3 nm from the WHP location (Culzean-Le Havre with a total of 12 vessel per year) as well as some minor changes to vessel routes within 10 nm of the WHP. In total 19 shipping routes pass within 10 nm of the proposed WHP location.

Although there is an additional route that passes extremely close to the WHP location, the VTS report concluded that vessels on this route would increase their passing distance to the north east of the Jackdaw WHP as there is available sea room to do so.

The changes identified within the most recent VTS report have been deemed to have no impact on the assessment within the ES.

Figure A-4 - Shipping routes identified during the ES assessment (Anatec, 2019)

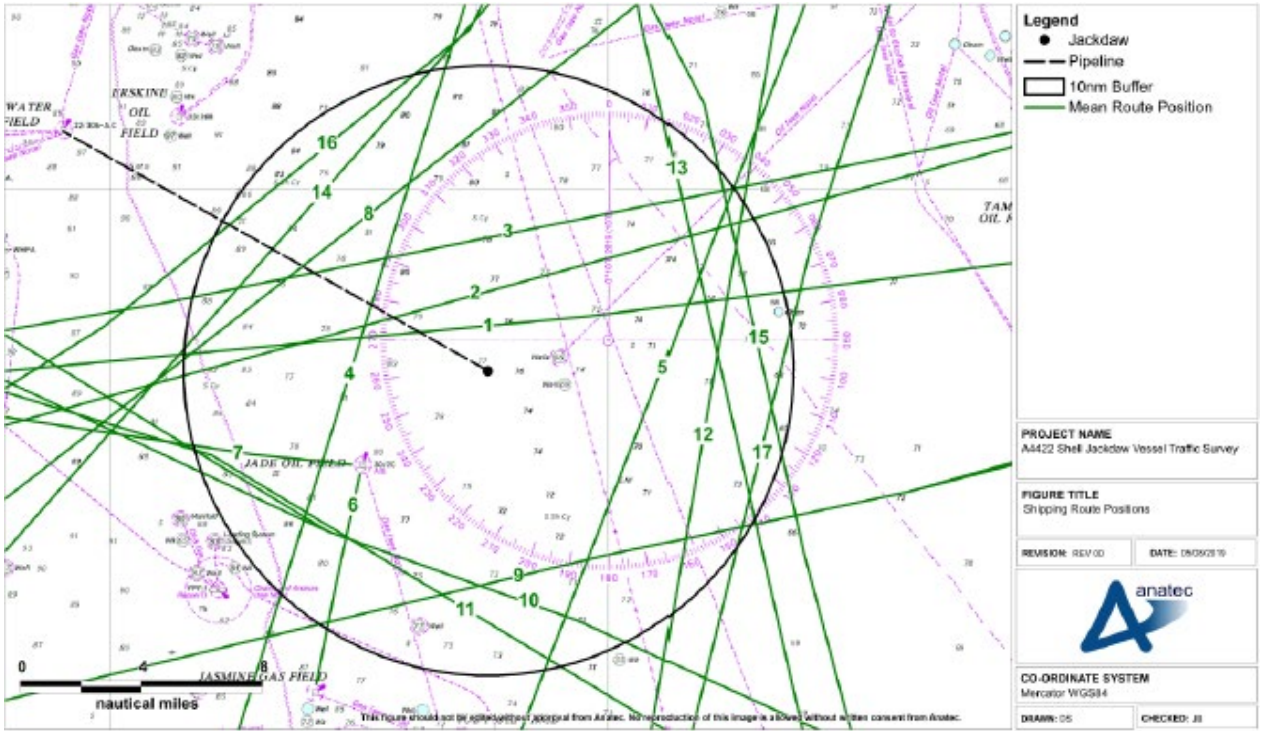
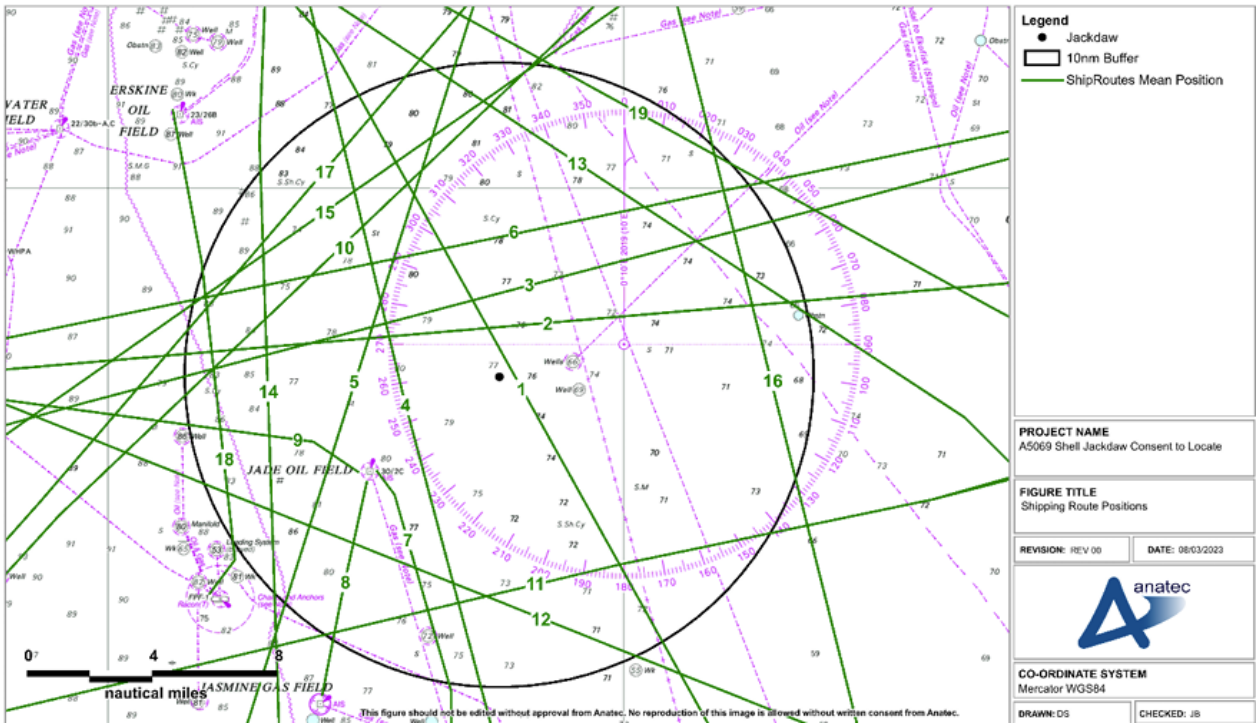


Figure A-5 – Most recent shipping routes identified (Anatec, 2023)



Surrounding Energy Infrastructure

The ES assessed the Jackdaw Project as within a well-established area for oil and gas infrastructure. Figure A-6 shows the surround infrastructure to the Jackdaw development at the time of the ES submission. At the time of submission the closest surface infrastructure to the WHP location was the Jade platform approximately 10 km to the southwest. The closest surface infrastructure to the pipeline route was the Erskine platform approximately 4 km to the northeast. The Elgin and Franklin platforms are located approximately 8 km west-southwest and 10 km southwest of the Shearwater installation, respectively. The export pipeline crosses the trenched Judy to Culzean telecommunications cable. The ES noted no renewable energy developments in close proximity to the Jackdaw field (Scottish Government, 2019).

Figure A-6 - Jackdaw Development - Surrounding Infrastructure (ES Submission)

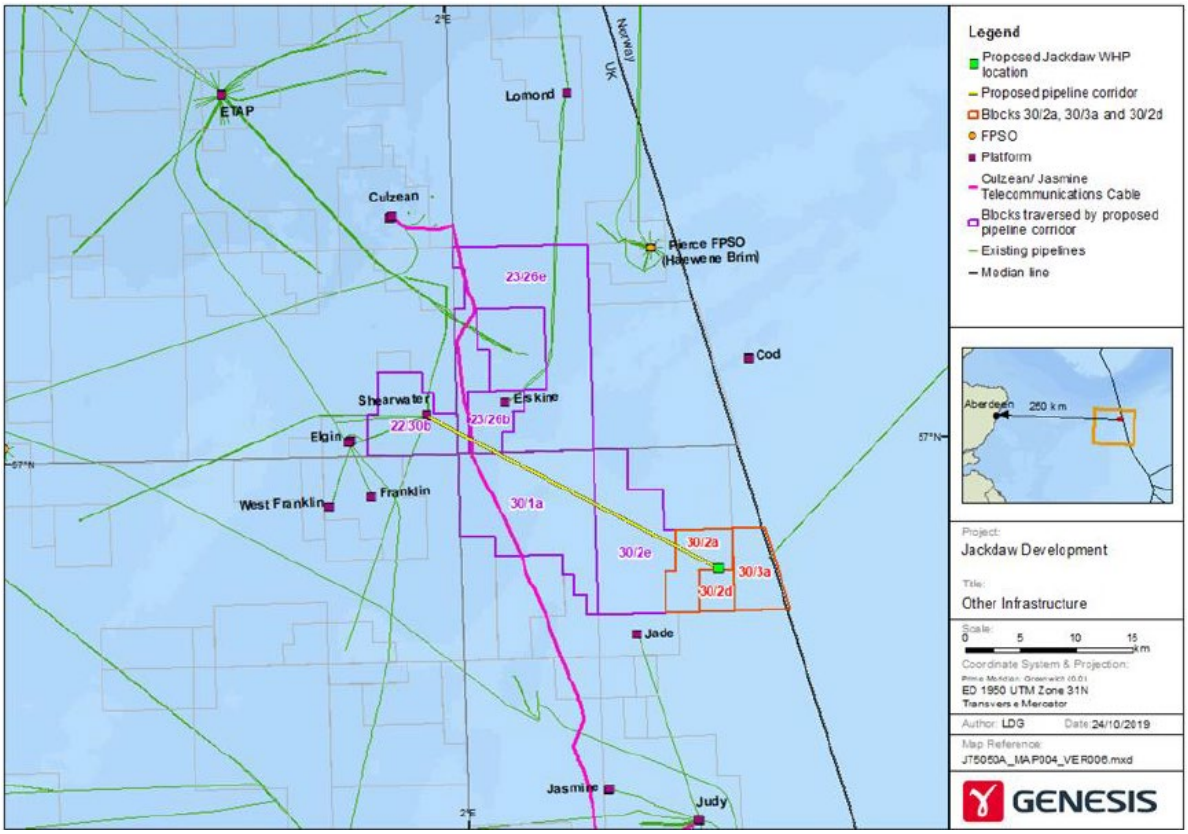
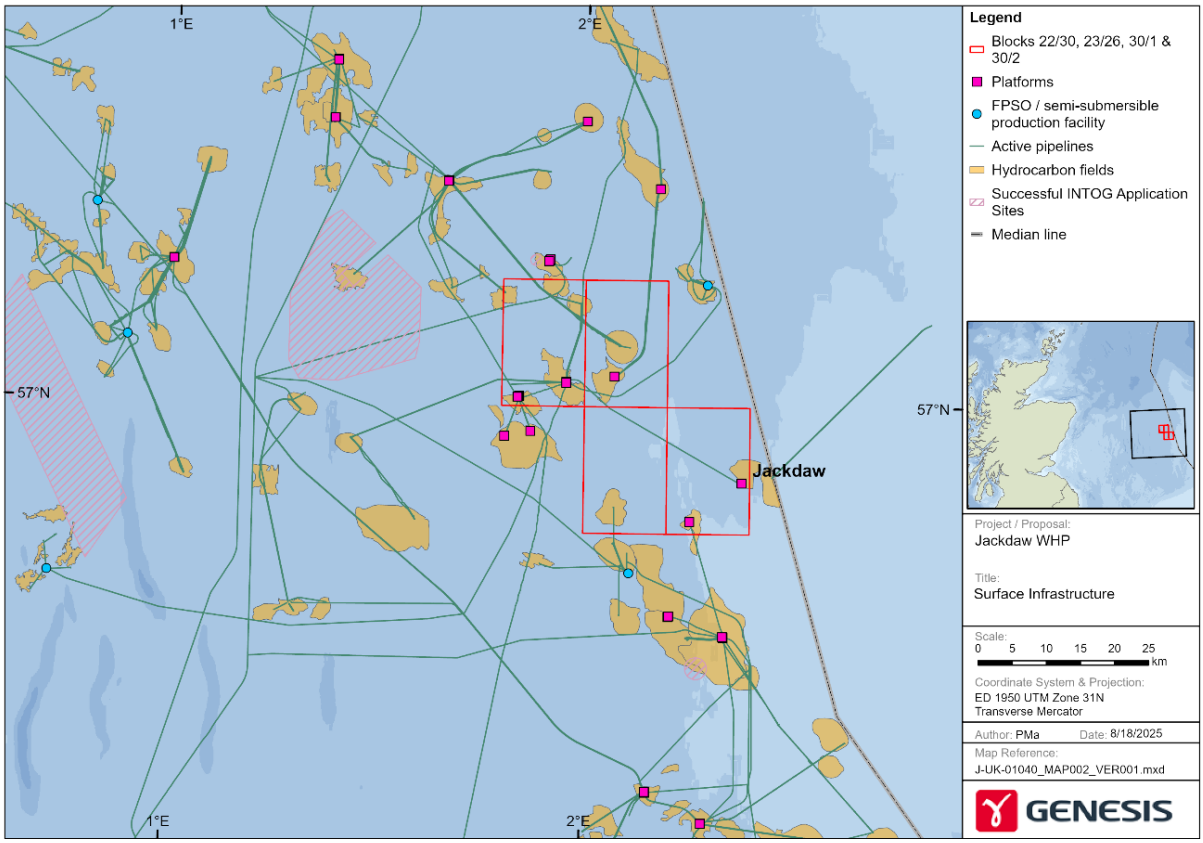


Figure A-7Figure shows the surrounding infrastructure to the Jackdaw development. As noted above this is a well-established area for oil and gas infrastructure, as such there has been continued development since submission of the ES. The Jackdaw – Shearwater pipeline route is now crossed by the 12" Pierce gas export pipeline to Shearwater approximately 3.9 km south east of the Shearwater platform. The Vorlich (bp/Ithaca) subsea wells have also been completed in 2020. The wells are approximately 12.5 km south west of the Jackdaw – Shearwater pipeline route. Since the ES was re-submitted in 2022 a variety of permits and consents have been approved within blocks 22/30, 23/26, 30/1 & 30/2. These permits are either directly associated with the developments noted in the ES, those listed above or directly associated with continuous operation and development of the Shearwater platform.

In addition there are 3 successful Offshore Wind for Innovation and Targeted Oil and Gas Decarbonisation (INTOG) application sites in the vicinity of the Jackdaw development. The largest planned project is Cenos, approximately 50 km northwest of Jackdaw or 23 km northwest of the pipeline. The project is planned to deliver power by 2031.

Figure A-7 - Jackdaw Development - Surrounding Infrastructure (Current Situation)



Summary

An assessment of the differences between the ES and the Environmental Assessment Justifications (EAJs), completed in support of installation permits and consents, in terms of the available sources of data used for the environmental baseline has been completed.

Factors that were considered include the sources of meteorological data, seabed sediment maps, bird, fish and cetacean populations and commercial fishing intensity.

All identified differences are deemed to be minor and have little to no impact on the environmental assessment of the project included within the ES.

B. SEABED DISTURBANCE

This Section assesses the potential impact of those seabed disturbance Aspects that required further assessment as identified in Section 4.4.

Drill Cuttings Quantities and Modelling

The cuttings associated with the 36" section were discharged at the seafloor and will have settled out in close proximity to the well, whilst the cuttings from the 26" sections were discharged from the rig and are expected to settle over a wider area. Cuttings from the 17½" section were thermally treated (Rotomilled) and discharged (a portion were also skipped and shipped) whilst cuttings from the 12 ½", 8 ¼ " and contingency 6 ½" sections were skipped and shipped.

The original modelling completed for drill cuttings discharge as part of the ES underestimated the mass of cutting produced during operations. However, this was reevaluated prior to the start of drilling operations and additional drill cuttings modelling was included as part of the EAJs to assess a larger discharge.

A comparison between the masses of cuttings modelled for the ES and the actual quantity of cuttings discharged is shown in Table B-1 and Table B-2. The quantities of cuttings modelled within the EAJs in 2023 and 2024 are shown in Table B-3 and Table B-4.

It should be noted that the modelling within the EAJs was completed after confirmation that the 16" section would instead be a 17.5" section and that the 12.25" and 8.5" sections would be skipped and shipped to shore for disposal and treatment rather than treated offshore and discharged.

Table B-1 - Summary details of the scenario modelled to support the ES.

Well Section	Mass of Cuttings (tonnes)	Mud Components (tonnes)			
		Barite	Bentonite	Oil	Chemicals
36"	584	264	95	-	6
26"	2,988	528	172	-	8
16"	3,484	904	-	4.5	-
12 ¼"	972	644	-	1.7	-
8 ½"	156	292	0	0.5	-
Total	**7,056**				

Note: The 12 ¼" and 8 ½" we're assessed as a precaution before confirming they would be skipped and shipped.

Table B-2 - Summary of Actual Cuttings Discharged.

Well Section	Mass of Cuttings (tonnes)	Mud Components (tonnes)			
		Barite	Bentonite	Oil	Chemicals
36"	656				
26"	2,960				
17.5"	4,885				
12 ¼" 8 ½"	Skipped and shipped and therefore not included.				
Total	**8,501**				

Table B-3 - Summary details of the 2023 modelling.

Well Section	Mass of Cuttings (tonnes)	Mud Components (tonnes)		Base Oil on solids discharged from rotomill (tonnes)
		Barite	Bentonite	
36"	1,240	1,500	700	
26"	5,772	288	-	
17½"	6,930	325	-	1.39
12 ¼"	Skipped and shipped and therefore not included in the modelling scenario.			
8 ½"				
6 ½"				
Total	**143,942**			

Table B-4 - Summary details of the 2024 modelling.

Well Section	Mass of Cuttings (tonnes)	Mud Components (tonnes)		Base Oil on solids discharged from rotomill (tonnes)
		Barite	Bentonite	
36"	1,240	1,500	700	
26"	5,772	288	-	
17½"	15,648	520	-	1.96
12 ¼"	Skipped and shipped and therefore not included in the modelling scenario.			
8 ½"				
6 ½"				
Total	**22,660**			

As can be seen from the tables, an increased mass of cuttings, was modelled in 2023/2024 compared to the ES.

Evaluation of the results of this modelling showed that the 2023 modelling gave an overestimation of the areas of risk and temporary impact. Modelling was therefore rerun in 2024 which showed a reduced area of initial impact compared with the 2023 modelling even though the 17.5" section cuttings mass had increased (16,168 tonnes for 2024 compared to the mass used in 2023 of 7,255 tonnes (all other factors were kept the same, see Table B-5 and Table B-6 below).

Table B-5 - Predicted combined risk over time from the 2023 modelled scenario.

Time period	Description	Area where combined risk is >5% (km²)	Percentage reduction in area (%)
32 days	End of 26" section	2.224	-
84 days	End of simulation	0.637	71.3
2 years	2 years post drilling	0.428	80.0
5 years	5 years post drilling	0.390	82.4
10 years	10 years post drilling	0.358	83.9

Table B-6 - Predicted combined risk over time from the 2024 modelled scenario. Assumes 8 x 17.5" sections (4 + 4 contingency's).

Time period	Description	Area where combined risk is >5% (km²)	Percentage reduction in area (%)
32.5 days	End of 26" section	0.698	-
134 days	End of simulation	0.519	25.6
2 years	2 years post drilling	0.434	37.8
5 years	5 years post drilling	0.412	41.0
10 years	10 years post drilling	0.382	45.3
Note: The model was run 3 times to check results.			

The ES assessed a permanent impact of 0.029 km² after 10 years using the modelling completed at the time. This is significantly less than the 2023 permanent impact of 0.358 km² and that modelled in 2024 of 0.382 km².

Table B-7 shows that the actual mass of cuttings discharged is much closer to the values detailed in the ES than in either of the 2023 and 2024 modelling scenarios. The mass of actual discharged cuttings is 1,445 tonnes larger than modelled in the ES compared to 5,441 tonnes and 14,159 tonnes for the respective 2023 and 2024 modelling,

The area of permanent impact from the actual mass of discharged cuttings cannot be calculated, it is therefore considered that the area assessed in the ES is a more representative area of impact in relation to the actual mass of cuttings discharged and will be taken forward to the cumulative seabed assessment.

Cumulative Seabed Disturbance Assessment

Table B-7 shows a comparison between the assessed cumulative area of potential seabed disturbance from the ES against that assessed in the EAJs or actual impact.

As discussed previously a number of seabed disturbance Aspects have changed from the Jackdaw ES when compared to either the assessment provided in the relevant EAJ or when compared to the actual recorded disturbance during or following operations. An assessment of the impact of any increase in disturbance to the seabed is provided below.

Within the Jackdaw field the sediments generally comprise poorly to moderately sorted fine sand with small amounts (up to 2%) of gravel (Fugro, 2019).

Habitat types are summarised as follows:

- In the Jackdaw field, habitats were classified as biotope complex 'Circalittoral muddy sand' (A5.26) and categorised as 'Endangered' on the European Red List;
- Along the Jackdaw to Shearwater pipeline route habitats transitioned from the biotope complex 'Circalittoral muddy sand' (A5.26) (Jackdaw end) to 'Circalittoral fine mud' (A5.36) (Shearwater end), categorised as 'Endangered' on the European Red List with patches of 'Deep circalittoral coarse sediment' (A5.15) and 'Deep circalittoral mixed sediment' (A5.45), categorised as 'Vulnerable' on the European Red List;

A number of other potentially sensitive habitats were also noted during the surveys:

- OSPAR habitat 'sea pens and burrowing megafauna communities' is likely to be present along the route. Burrowed mud communities are sensitive to change in substrate, high level of siltation, physical removal and surface abrasion;
- Individuals and small clumps of horse mussels (*Modiolus modiolus*) occur along the pipeline route corridor but due to the low density are not considered to represent Annex I *M. modiolus* reef;
- PMF 'mud habitats in deep water' along a section of the pipeline route';
- The broad habitat PMF 'offshore subtidal sands and gravels' along a section of the pipeline route; and
- The macrofauna recorded across the Jackdaw field are typical of sandy Central North Sea sediments. Community composition is dominated by annelids, molluscs, arthropods and echinoderms and is considered representative of background communities.

Each species has its own response and degree of adaptability to changes in the physical and chemical environment. Infaunal and sessile species are fixed to a single location and are unable to avoid unfavourable conditions. Epifaunal species living on the seabed are able to move and relocate. The physical disturbance resulting from the activities at Jackdaw may cause mortality or displacement of motile benthic species in the impacted area, direct mortality of sessile seabed organisms that cannot move away from the contact area and direct loss of habitat. In addition, disturbance from sediment re-suspension will occur in the immediate area when the infrastructure is initially positioned.

Table B-7 - Comparison of cumulative seabed disturbance between ES and EAJ/Actual.

Infrastructure	Area Impacted – ES (m^2)		Area Impacted – EAJ/Actual (m^2)	
	Permanent	Temporary	Permanent	Temporary
Drilling and WHP Installation				
Diameter of spud cans	4,072	-	1,520	-
Anchors	-	4,000	-	900
Anchor lines		600,000		120,000
WHP Jacket	360	168	335	193
Wave rider buoy	-	-	-	5
Cement Patio	10	0	120	0
Drill Cuttings	29,000	299,000	29,000[1]	299,000[1]
Total	**33,442**	**903,168**	**30,975**	**420,098**
WHP Jacket				
WHP Jacket	360	168	335	193
Wave rider buoy	0	0	0	5
Total	**360**	**168**	**335**	**198**
Pipeline Installation				
SSIVs and Manifold	296	136	258	101
Pipeline	0	1,530,000	0	1,500,000
Concrete troughs	2,800	1,200	-	-
Mattresses (pipeline)	3,600	4,400	7,270[3]	9,380[3]
GRP covers (spools outwith concrete troughs)	840	360	220	1,200
Mattresses (umbilicals)	4,900	3,500	-[3]	-[3]
Crossings in open water	5,000	5,000	8,520	10,425
Crossings within Shearwater 500 m zone	1,500	1,500	-[3]	-[3]
Concrete plinths	-	-	220	1,200
Grout Bags	-	-	450	450
Sand	-	-	1,300	0
Spot rock placement	90,000	90,000	82,500	82,500
Total	**108,936**	**1,636,096**	**100,738**	**1,605,256**
Cumulative Total	**142,738**	**2,539,432**	**132,048**	**2,025,552**

Notes :
[1] - Cannot be directly calculated but assumed to be the same as the ES.
[2] – The EAJ doesn't discriminate between mattresses used for pipeline or umbilical protection.
[3] - Grout bags described in the ES were to be laid in conjunction with the mattresses and other stabilisation features identified and therefore are not entered separately in the assessment.

Arctica. islandica

During the 2018 survey a number of *A. islandic* juveniles were found at several of the survey stations in the Jackdaw field. Although *A. islandica* have a thick, solid and heavy shell, they are considered to be highly sensitive to sub-surface abrasion/penetration. Damage is related to body size with larger specimens being more affected than smaller ones (Klein, 1993). As they burrow into the sediment, they are thought to be less sensitive to surface abrasion; however, they use a short inhalant siphon which sits above the sediment surface for feeding and respiration. If this is damaged then there may be an adverse effect on the organism, but the potential for this to happen is uncertain (Marine Scotland, 2020). It remains possible that individuals of this species may be directly impacted by seabed disturbance as a result of the removal and relocation of debris and boulders and the settling of drill cuttings, potentially resulting in individual mortality. It is not considered that the potential loss of a small number of juvenile individuals of this species will result in a significant effect on the population viability of this species.

Offshore Subtidal Sands and Gravel

The vicinity of the Jackdaw field is dominated by offshore circalittoral sand. This habitat fits under the umbrella of the PMF Offshore subtidal sands and gravels. Offshore subtidal sands and gravels is one of the most common habitats on the UKCS (Tyler-Walters *et al*., 2016). The samples identified the sediment type muddy sand. This sediment type is known to support a biologically diverse community dominated by annelids, which is typical of offshore subtidal sands and gravels (Tyler-Walters *et al*., 2016). The activities assessed at Jackdaw (drilling, subsea construction etc.) are likely to result in a minor impact on the species present via smothering. However, given the small area of permeant seabed disturbance the impacts are not likely to be significant and are considered to only affect the very local population. Thus, the impact of this operation on offshore subtidal sands and gravels is considered to be low.

Sea Pens and Burrowing Megafauna

In the vicinity of the Jackdaw WHP jacket location, no specimens of sea pens or Norway lobster were identified. However, megafauna burrows were identified at a number of the nearby stations. The closest stations to the WHP location are JDS01, JD02, and JD03, and at all three of these stations, burrows were recorded as frequent. Given these station's proximities to the jacket location a realistic worst-case scenario is that megafauna burrows exist at an equivalent density at the WHP location to these stations. Megafauna burrows are low lying structures formed out of the surrounding sediment; this feature is common to fine sediment habitats as these are low energy. Megafauna burrows are sensitive to physical disturbance of the seabed. While no sea pens were identified within the vicinity of the Jackdaw WHP location, there is the potential for them to be present given the presence of the megafauna burrows. Experimental studies have shown that all three species of sea pen can re-anchor themselves in the sediment if dislodged (by fishing gear) (Eno, 2003). In long-term experimental trawling, Tuck *et al* found no effect on *Virgulariua. mirabilis* populations and Kinnear *et al* found that sea pens were quite resilient to being dragged or uprooted (by creels), (Tuck, 1998); (Kinnear, 1996). Any disturbance of the seabed has the potential to affect any sea pens present, however once again none were found in the vicinity and studies have shown them resilient to disturbance. Given the relatively small area of additional disturbance and the widespread nature of the burrows across the wider area, it is unlikely that even in the worst-case scenario that the activities at Jackdaw will result in a significant impact on megafauna burrows.

Demersal Fish

The direct and indirect impacts to the seabed also have the potential to impact on fish species that require particular sediments on which to feed and spawn (Rogers, 2001). The most

vulnerable stages of the fish life cycle to activities, such as seabed disturbance and marine discharges, are the egg and larval stages.

Evidence suggests that the sensitivity of fish to suspended sediments varies greatly between species and their life history stages and depends on sediment composition (particle size and angularity), concentration and the duration of exposure (Newcombe, 1996). Being the major organ for respiration and osmoregulation, gills are directly exposed to, and affected by, suspended solids in the water. If sediment particles are caught in or on the gills, gas exchange with the water may be reduced leading to oxygen deprivation (Essink, 1999); (Clarke, 2000). This effect is greatest for juvenile fish as they have small easily clogged gills and higher oxygen demand (FeBEC, 2010). There is potential for resuspended sediment in the water column, however this is expected to be temporary with minimal impacts.

Disturbance to sandeel (*Ammodytes spp.*) habitat is considered further as this species is known to have a particularly important ecological function as a prey item for other fish, seabirds and marine mammals. There is evidence that the presence of fines in the sediment reduces its suitability to sandeels. Lancaster *et al* indicated that sandeels avoid areas with greater than 10% of silt/clay or very fine sand, (Lancaster, 2014). Moreover, Holland *et al* recorded extremely low densities of sandeels in sediments with a silt content > 4% and found that increased fractions of silt from 0 to 10% correlated with a reduction in sandeel density, (Holland, 2005). Fugro observed that fines content at Jackdaw ranged from 6.5% to 10.2%, which is broadly comparable to the mean from a Gardline survey at the Jackdaw field (7.0%; Gardline), (Fugro, 2019); (Gardline, 2014). Sandeels are not expected to occur in the Jackdaw area as the sediment in the vicinity of Shearwater is unsuitable for this species due to the high levels of fines across the area therefore the potential impact of sediment size change from drill cuttings discharge to sandeels is low, (Holland, 2005); (Wright, 2000).

Summary

The assessment of the area of disturbance from the drilling and WHP jacket and pipeline installation as noted above is discussed below.

An updated seabed disturbance assessment noted that whilst the overall total of permanent and temporary impact has reduced between the assessments in the ES and EAJs, the exact number of items and make-up are different, as shown in Table B-7. The area of permanent impact has reduced between the ES and EAJs/actual from 142,738 m^3 to 132,048 m^3, whilst the area of temporary impact has reduced from 2,539,432 m^3 to 2,025,552 m^3.

It is presumed that within these areas there has been some impact on benthic species, megafauna burrows, and a level of degradation of the PMF habitat offshore subtidal sands and gravels habitat. However, in the context of the wider distribution of the benthic community present, offshore subtidal sands and gravels (one of the most common marine habitats on the UKCS (Tyler-Walters *et al*., 2016), and megafauna burrows, this area is very small.

Lambert *et al* (2014) found that heavily fished seabed began to recover within a year and that recovery was aided by undisturbed seabed within a 6 km radius. Dernie *et al* (2003) found that soft sediments begin to recover from 64 to 208 days depending on degree of physical disturbance. Given that the temporary disturbance will occur in a relatively undisturbed seabed and within an area with low fishing effort, which will be subsequently excluded with the establishment of a 500 m exclusion zone, it is likely that the benthic community will recover quickly from the temporary disturbance.

It should also be noted that although the 2023 drill cuttings assessment used does indicate a substantial increase in the impacted area the modelling result is now considered an overestimation of the area impacted. The actual disturbance due to drill cuttings discharge will likely be lower than this.

The assessment therefore shows no significant changes compared to the ES; therefore there is no change to the ES assessment that disturbance to the seabed associated with the Jackdaw development is not predicted to have a significant impact on the benthic environment and other seabed receptors.

C. POTENTIAL PERFORATION FLARING

The base case for the perforation is no flaring however, if required as a safety mitigation, the perforation operation on the wells will be conducted in a single perforation run conveyed on Coiled Tubing (CT) to the planned perforation interval. A temporary bleed-off package will be connected to the well to support bleed-off operations. There is no planned intent to bleed off hydrocarbons or flare; however, as an unplanned safety mitigation measure, any gas unexpectedly detected at the surface, would be safely flared enabling the safe deployment and / or retrieval of the perforating assembly. The maximum anticipated quantity of gas that could be flared per well is 298 tonnes, therefore the maximum quantity of gas that could be flared is 1,192 tonnes.

The emissions associated with this potential flaring are provided in Table C-1.

Table C-1 - Potential emissions from perforation flaring.

Source	Tonnes emitted							
	CO_2e	CO_2	NOx	N_2O	SO_2	CO	CH_4	VOC
Potential flaring during perforation operations	4,707	3,338	1.43	0.10	0.02	8	54	6

Emissions from potential flaring during perforation operations should be considered within the broader context of the overall Jackdaw project emissions assessed in the ES, rather than in isolation. These potential emissions, for example, represent approximately 4% of the total estimated GHG emissions for Jackdaw during the drilling phase and less than 1% of the project's overall emissions in the ES. Although flaring during perforation was not envisaged at the time of preparing the ES, other emissions associated with project activities have been conservatively accounted for and as shown in Section 4.5 come under what was assessed in the ES such that the overall project emissions estimate remains a conservative estimation.

Even if these potential emissions were considered as an increase in absolute terms relative to the baseline estimate in the ES, they are unlikely to alter the conclusions in Section 7.4.2.1, of the ES, regarding Jackdaw and the cumulative Shearwater hub emissions' contribution to broader UK and UKCS emissions. Similarly, they would not impact the context provided in Section 7.4.2.3, of the ES concerning national carbon budgets. Therefore, the conclusions related to local air quality, Jackdaw's contribution to global emissions, and the project's alignment with UK government net zero targets remain valid.

D. REVISED CARBON BUDGET ASSESSMENT

Table D-1 below shows the comparison between the ES and the current emission forecasts for Jackdaw against the UK Carbon Budgets based on the commencement of production in 2026 as opposed to the start of production in 2025 as provided in the ES.

Table D-1 - Comparison with the UK allocated Caron Budgets.

Carbon Budget Period		Million tonnes of CO_2e		
		UK Carbon Budget Allocation	ES Jackdaw Emissions as % of Allocation	Revised Jackdaw Emissions as % of Allocation
CB4	2023-2027	1,950	0.0154	0.0088
CB5	2028-2032	1,725	0.0134	0.0194
CB6	2033-2037	965	0.0012	0.0012

The changes from the ES submission are as follows:

- Carbon Budget 4, shows a decrease in percentage from 0.0154 to 0.0088 with this primarily due to the later start-up of the field and therefore less emissions produced within the Carbon Budget period.
- Carbon Budget 5, shows an increase from 0.0134 to 0.0194 due to there being higher production during the period than originally envisaged, again due to the later start-up of the field.
- Cabon Budget 6, shows that, the percentage remains the same.

Overall the original conclusions drawn in the ES remain valid in that the project will represent a relatively minor percentage increase to the wider UK GHG emissions.

REFERENCES

Anatec, 2019. *Vessel Traffic Survey Jackdaw WHP (Technical Note). A4422-SHE-VTS-1. Revision 00. 05,* s.l.: s.n.

Anatec, 2023. *Vessel Traffic Survey Jackdaw WHP (Block 30/02) (Technical Note). A5069-SHE-CR-1. Revision 00. 14 March 2023.,* s.l.: s.n.

BEIS, 2020. *Updated Energy and Emissions Projections 2019. October 2020. Updated energy and emissions projections 2019 (publishing.service.gov.uk),* s.l.: s.n.

Carter, M., 2020. *Habitat-based predictions of at-sea distribution for grey and harbour seals in the british isles. Report to DESNZ, OESEA-16-76/OESEA-16-78. Sea Mammal Research Unit, University of St Andrews.,* s.l.: s.n.

Clarke, D. G., 2000. *Assessment of potential impacts of dredging operations due to sediment resuspension. DOER Technical Notes Collection (ERDC TN-DOERE9), US Army Engineer Research and Development Centre, Vicksburg, MS. 2000. Available at: http://www.dtic.mil/get-tr-doc/pdf?,* s.l.: s.n.

Dernie, K. M., 2003. *Recovery of soft sediment communities and habitats following physical disturbance, Journal of Experimental Marine Biology and Ecology. Elsevier. Available at: https://www.sciencedirect.com/science/article/abs/pii/S0022098102005415 (Accessed: 27th August 2,* s.l.: s.n.

Eno, N., 2003. *Effects of crustacean traps on benthic fauna ICES Journal of Marine Science, 58, 11-20,* s.l.: s.n.

Essink, K., 1999. *Ecological effects of dumping of dredged sediments; options for management. Journal of Coastal Conservation. 1999. 5: 69-80.,* s.l.: s.n.

FeBEC, 2010. *Sediment Dose Response Study. Technical Report. Prepared for Femern A/S. Doc. No. E4-TR-036. 147 pp.,* s.l.: s.n.

Fugro, 2019. *Jackdaw Field and Jackdaw to Shearwater Pipeline Route UKCS Blocks 30/2a, 30/2d, 30/3a and 22/30b Volume 3 of 4 Environmental Baseline Survey Report. Fugro Report No.: 181685.4V3 Shell Report No: ED-2018-28. Revised Draft.,* s.l.: s.n.

Gardline, 2014. *Survey Report for BG International Limited. UKCS Blocks 30/2 and 30/3 Jackdaw Platform Site Survey – Environmental Baseline Report. September to December 2013. Gardline Geosurvey Limited Ref. 9766.3 Final. 15 May 2014. Client reference: 116910 CNT.,* s.l.: s.n.

Gilles, A., 2023. *Estimates of cetacean abundance in European Atlantic waters in summer 2022 from the SCANS-IV aerial and shipboard surveys. University of Veterinary Medicine Hannover.,* s.l.: s.n.

Hammond et al., 2021. *Estimates of cetacean abundance in European Atlantic waters in summer 2016 from the SCAN-III aerial and shipboard surveys. https://synergy.st-andrews.ac.uk/scans3/files/2021/06/SCANS-III_design-based_estimates_final_report_revised_June_2021.pdf,* s.l.: s.n.

Holland, G., 2005. *Identifying sandeel Ammodytes marinus sediment habitat preferences in the marine environment. Marine Ecology Progress Series. 303:269-282.,* s.l.: s.n.

JNCC, 2010. *Statutory Nature Conservation Agency Protocol for Minimising the Risk of Injury to Marine Mammals from Piling Noise.,* s.l.: s.n.

Kinnear, J., 1996. *Effects of Nephrops creels on the environment. Fisheries Research Services Report No. 2/96,* s.l.: s.n.

Klein, R., 1993. *The appearance of scars on the shell of Arctica islandica L. (Mollusca, Bivalvia) and their relation to bottom trawl fishery. NIOZ - Rapport, 12., Unpublished, Nederlands Instituut voor Onderzoek der Zee.,* s.l.: s.n.

Lambert, G., 2014. *Quantifying recovery rates and resilience of seabed habitats impacted by bottom fishing, British Ecological Society. BES. Available at: https://besjournals.onlinelibrary.wiley.com/doi/full/10.1111/1365-2664.12277,* s.l.: s.n.

Lancaster, J., 2014. *Development of detailed ecological guidance to support the application of the Scottish MPA selection guidelines in Scotland's seas. Scottish Natural Heritage Commissioned Report No.491. Sandeels – supplementary document. Available at: http://www.snh.gov.u,* s.l.: s.n.

Marine Scotland, 2020. *FEAST – Feature Activity Sensitivity Tool. Available at: https://www.marine.scotland.gov.uk/feast/,* s.l.: s.n.

MMO (Marine Management Organisation), 2016. *Vessel Density Grid 2014. [online] Available at: https://data.gov.uk/dataset/vessel-density-grid-2014,* s.l.: s.n.

Newcombe, C., 1996. *Channel suspended sediment and fisheries: a synthesis for quantitative assessment of risk and impact. North American Journal of Fisheries Management. Volume 16,4: 693-727.,* s.l.: s.n.

OGUK (Oil & Gas UK), 2019. *Environment Report 2019. Available from: https://oilandgasuk.co.uk/product/environment-report/,* s.l.: s.n.

Rogers, S., 2001. *North Sea Fish and Fisheries, Technical Report produced for Strategic Environmental Assessment - SEA2: CEFAS.,* s.l.: s.n.

Russell, D., 2017. *Updated Seal Usage Maps: The Estimated at-sea Distribution of Grey and Harbour Seals. Scottish Marine and Freshwater Science Vol 8 No 25. Marine Scotland Science.,* s.l.: s.n.

Scottish Government, 2019. *Scotland's Marine Atlas: Information for The National Marine Plan Part 34 Sharks and Rays. Available online at: https://www2.gov.scot/Publications/2011/03/16182005/53,* s.l.: s.n.

SGMD, 2024. *Scottish Government (2024). 2023 Scottish Sea Fisheries Statistics - Fishing Effort and Quantity and Value of Landings by ICES Rectangles.,* s.l.: s.n.

Shell UK, 2022. *Jackdaw Environmental Statement (D4260/2021),* s.l.: s.n.

Shell UK, n.d. *Temporary Operation Oil Pollution Emergency Plan (CAP Ref: 230022/2),* s.l.: s.n.

SMRU, 2017. *Sea Mammal Research Unit (SMRU) and Marine Scotland (2017). Estimated at-sea Distribution of Grey and Harbour Seals - updated maps 2017.,* s.l.: s.n.

Tuck, I., 1998. *Effects of physical trawling disturbance in a previously unfished sheltered Scottish sea loch. Marine Ecology Progress Series, 162, 227-242.,* s.l.: s.n.

Tyler-Walters, H., 2016. *Descriptions of Scottish Priority Marine Features (PMFs). Scottish Natural Heritage Commissioned Report No. 406.,* s.l.: s.n.

UK Government, 2020. *The Offshore Oil and Gas Exploration, Production, Unloading and Storage (Environmental Impact Assessment) Regulations 2020,* s.l.: s.n.

Wright, P., 2000. *The influence of sediment type on the distribution of the lesser sandeel, Ammodytes marinus. Journal of Sea Research, 44: 243-256.,* s.l.: s.n.