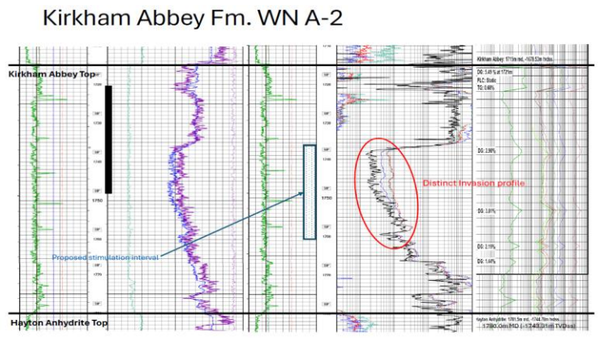
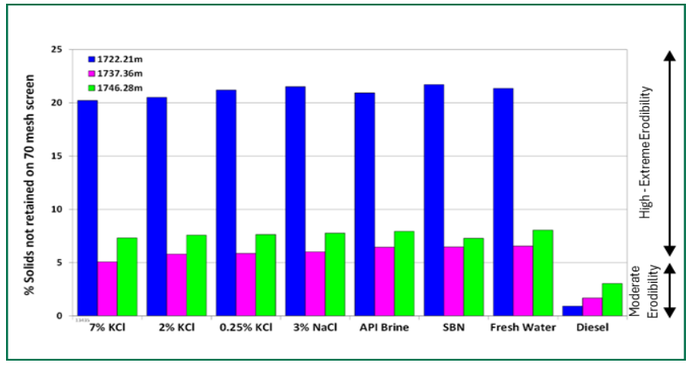
1	Explain how the changes in operation which are subject to this variation will have an impact on the designated habitats.	Reason –You previously submitted report entitled 'Ecological Impact Assessment, Project number: 60630268' dated December 2021 Revision 3 as part of the previous variation which remains applicable however, you have not assessed potential impacts on relevant ecological features as a consequence of the development and how the change in operation will affect the designated habitats, or set out the measures to be Hornsea Mere SPA, Lambwath Meadows SSSI, or the Local Wildlife Sites; The Moors, Burton Constable LWS and Wycliffe, North Plantation LWS. Explain in terms of source-pathway-receptor linkages how, if any, the revised operation will impact any of these designated habitats.	The Ecological Impact Assessment of Dec 2021 is still valid as the extents of the operation still fit within the 'operation' phase already assessed. The embedded mitigations have not changed as the well construction and surface water drainage will not change, the lighting assessment and air quality assessments have been conducted using the 'worst case scenario' of lighting furing the drilling phase and the air quality when flaring. The reservoir stimulation will not add any additional sources or pathways which will have impacts upon the ecological receptors set out in the Ecological Impact Assessment.
2	Explain how the changes in operation which are subject to this variation will contribute to noise emanating from the site.	Reason –You previously submitted report entitled 'Noise Impact Assessment for West Newton A Exploration, Appraisal and Production Development, JAT2106–REPT–04–R3-Rathlin-WNA, RPS, dated 14/12/2021' as part of the previous variation which remains applicable however, you have not assessed potential impacts of noise as a consequence of this variation and how the revised operation will have any additional impact	Temporary pumping equipment is already conditioned by the extant planning permission for minerals development. The RPS, Noise Impact Assessment for West Newton A Exploration, Appraisal and Production Development, December 2021 considers the worst-case scenario of two flares operating 24/7. Similar to the workover equipment and acid squeeze pumping equipment, the fluid pumping equipment is not considered a primary source of noise. Accounting for the reservoir stimulation pumping equipment, which has a similar noise profile to the acid squeeze pumping and gas lift equipment, the conclusion is the same as previously assessed due to the short duration (minutes) of activity at the wellsite. For clarity, this variation in activity is not proposing additional noise sources to run simultaneously alongside the already permitted pumping equipment. The pumping equipment will inject acid or fluid for the reservoir stimulation in isolation, never cumulatively. With the existing assessment accounting for pumping equipment, along with the short duration of daytime activity to be less than 1 hour (measurement time for LAeq) and the existing minerals authority noise condition, there is no change to the assessment conclusions.
3	The application states there is a proposed change to permit boundary due to a change in activity A4 – oil storage location. For clarity confirm any physical boundary changes because of this variation. If the boundary is to increase provide a clear map showing the current permitted boundary (The permit boundary is as detailed in Schedule 7 Figure 1 of the current permit (V005) and the proposed extension. If the boundary is to increase explain why this is necessary and what activities are proposed in this new area.	Reason: There are various references to 'changes in boundary' within the application documents. For example, para 4.1.1.1 and 4.1.5 of the Waste Management Plan, para 4.1.1.1 and 4.1.5 of the NTS, and the footnote point 2 on page 11 of the NTS as examples. This was discussed by phone with the applicant, and it was confirmed that there were no changes to the boundary. The application remains confusing. Confirm which is correct. Is it that you are proposing to increase the permit boundary in a future variation? (Also note question 19 below on the SWMP).	The permit boundary is not changed to that which has already been approved and shown in Schedule 7, figure 2 of the Permit EPR/BB3001FT/V005
4	Provide a copy the probabilistic assessment of seismic hazards resulting from the proposed reservoir stimulation.	Reason: To allow for full review of the considerations made to assess any impact to surrounding geological structures as a product of the proppant injection. The independently produced report is referenced within supporting documents (Outer Limits, 2024) but not provided.	Outler Limits Seismic Hazard Assessment Provided
5	Provide a copy of the Central Regional GeoSeismic cross-section.	Reason: This is referenced as Figure 10 in the HRA Technical Addendum, but it is not provided in the supporting document, or as an appendix. This is needed to support analysis of faulting across the basin and any extent into adjacent stratigraphy.	Central Regional Geoseismic Cross-Section Provided. Since the initial mapping of the area in 2008 additional proprietary seismic, both 2D and 3D, have been acquired. Updated mapping, particularly around the West Newton wells where a three component three dimensional (3D3C) survey was acquired by Rathlin show no evidence for faulting in the immediate area that would extend either into the deeper Carboniferous or overlying Sherwood Sandstone sections from the Kirkham Abbey. Additional detail in this regard is provided in the Seismic Hazard Assessment by Outer Limits Geophysical provided for Item 4 above
6	Provide a copy of the report referenced as Rathlin Energy, 2008.	Reason: This is needed for review and assessment of discussed Carboniferous faulting extending into the Sherwood Sandstone in the area of West Newton A and any impact the stimulation activities might therefore have on deeper aquifers.	Relevant parts of the report have been provided. Since the initial mapping of the area in 2008 additional proprietary seismic, both 2D and 3D, have been acquired. Updated mapping, particularly around the West Newton wells where a three component three dimensional (3D3C) survey was acquired by Rathlin show no evidence for faulting in the immediate area that would extend either into the deeper Carboniferous or overlying Sherwood Sandstone sections from the Kirkham Abbey. Additional detail in this regard is provided in the Seismic Hazard Assessment by Outer Limits Geophysical provided for Item 4 above.
7	Provide models or references explaining the stimulation pressures chosen.	Reason: Justification for the pressure used to complete the stimulation activities is needed. This is to show sensitivity analysis has been completed and gives due regard in respect to any surrounding geological structures that exists and whether any re-activation of nearby faulting may be likely.	As stated in response to Q8, the pressures stated in the documents are surface pressures rather than sub-surface fracture pressures. The surface pressure required to achieve a certain sub-surface pressure will depend upon a number of factors including fluid rheology, depth at which fluid is being pumped to, size of tubing being flowed through and the flow rates. The final pressures and models have not yet been completed and may depend upon information gained through a DFIT. More information will be included in the HFP. With regards to pressure and the liklihood of fault re-activation, The Seismic Hazard Assessment (submitted with this Schedule 5 response) undertakes a geomechanical evaluation of the *in situ* stress conditions and the orintations of mapped faults in order to assess whether the planned stimulation activities are likely to intersect critically-stressed faults. The nearest mapped fault is approximately 1km from the WNA-2 well. Given the distances to any mapped faults and the small injection volumes proposed (~60m3), any perturbations are unlikely to extend any significant distance beyond the planned stimulation disctance (<20m). The Seismic Hazard Assessment concludes that there are no identified critically-stressed faults within a distance of the WNA-2 well that could be influenced by fluid injection of the scale and volume under consideration in this case.
8	Confirm what re-conditioning activities have taken place at site to date.	Reason: If the DFit has been completed, confirm the propagation pressure is still appropriate at 9,000psi. If greater pressure is needed, then re-submission of assessments made in mind of faulting and structural stability will need to be completed.	A DFIT has not been undertaken in this reservoir using the proposed fluid. As above, the surface pressure of 9000psi has been assessed.
9	Confirm the type of casing to be used in the borehole from the start of the Sherwood Sandstone to total depth, specifically outlining details from 1700m TVD.	Reason: Figure 3 in the HRA Technical Addendum shows production casing stopping at c. 1700m TVD and the configuration of the borehole appears to move towards an open hole set up. The Waste Management Plan indicates steel production casing with be set from c.1520m TVD, which does not seem to follow the same as the schematic in Figure 3.	The HRA technical addendum shows the well schematically in figure 3. The WMP describes a typical well design that would be used for a newly drilled well. All new wells would require a WR11 submission an consent to drill. The WR11 submission for the WNA-2 well is attached, along with the consent. CAR forms PP3833VA/0332764r2 dated 13/05/2019 and PP3833VA/0335353 dated 06/06/2019 note the inspection audits on construction of the borehole.
10	Confirm the depth when the side track commenced. Confirm the angle of the hole through the Kirkham Abbey Formation, including the angle at entry and exit of the formation. Confirm the total depth of the hole. Confirm the remaining thickness (both upper and lower to the stimulation zone) of the Kirkham Abbey Formation which will not be subject to any stimulation affects; be clear on the unaffected thickness of the Formation at the point closest to the entry and exit of the unit. Include details of any mitigation methods proposed.	Reason: To re-affirm the distance between the stimulation zone and adjacent stratigraphic units across the 27/30m interval which the stimulation is proposed to take place; and to ensure the upper and lower lithologies are not at risk from any stimulation effects. Reassurance is needed to show the stimulation fractures will be isolated to only the Kirkham Abbey Formation.	There is no sidetrack in the WNA-2 well. The WNA-2 well is drilled slightly deviated. It enters the KA at -1679.5m TVDSS (1715m MD KB) at an angle of 11.26deg. The top of the Hayton Anhydrity (immediately below the Kirkham Abbey) is 1743.5m TVDSS (1780.2m MD KB) and the well is at an angle of 10.92deg, giving a total of 65.2m exposure to the formation. The proposed area to undertake the reservoir stimulation is 1736-1761m MD BRT leaving 20.6m TVD above the top perforations to the Fordon Evaporite and 18.85m TVD below the bottom of the perforations to the Hayton Anhyrite.
11	Confirm if the HFP (Hydraulic Fracture Plan) has been submitted and approved by the NSTA. Provide a copy of the HFP. Provide any comments given by the NSTA.	Reason: Supporting documents confirm the HFP has been submitted to both the NSTA and EA for approval with sign off. No copy is stored on internal EA systems nor has a copy been submitted with this application.	The HFP has not yet been submitted to the NSTA but will be in advance of the operation. The EA will receive a copy of the HFP when submitted to the NSTA.

12	Confirm metrics for the stimulation activity, include supporting models, assumptions and documentation. Provide justification for the stimulation pressure.	Reason: Different values are given for the height/zone of the stimulation activity and differing values are given for the radius/diameter of penetration. This lends to differing sizes calculated for the mining waste facility. Greater confidence is needed to support the stimulation pressure outlined.	Stimulation pressures referenced as surface pressures 9000 psi in the NTS section 6.8, the WMP section 6.8 and the HRA section 3.2.2 are incorrect and were referenced in error. Initial modelling considers; Reservoir parameters Net Pay interval: 30 m Pumping parameters Proppant Range: - 10 – 15 Tonne Fluid Volume Range: - 50-63 m3 Resulting in: Frac Height: 30 m Effective ½ length range: - 14.5-16.3 m
13 14	Confirm the expected depth of skin damage around the borehole into the Kirkham Abbey Formation. If vastly different to the reservoir stimulation penetration distance, explain and justify why such penetration depths are needed.	Reason: To support the need to penetrate the environment as much as requested.	Rathlin focusses on two operations that are the primary sources of skin damage in the Kirkham Abbey formation: drilling activities and completion activities. During the 2019 drilling of the WNA-2 well, the Permian section of the well, which includes the Kirkham Abbey (KA), was drilled with a water-based salt-saturated NaCl/KCl polymer fluid. The density of the drilling fluid was 11.10 ppg (pounds per gallon), which means that the column of drilling fluid exerted a hydrostatic pressure slightly in excess of the KA reservoir pressure. This overbalanced situation is a standard practice in drilling and required for well control purposes, however, it leads to invasion of the drilling fluids into the target formation. The open hole logs that were run after the conclusion of drilling and prior to the casing of the well provide evidence that damaging drilling fluids invaded into the Kirkham Abbey formation. The WNA-2 open hole log display over the KA (below) shows a very distinct invasion profile on the resistivity curves across the interval of the proposed reservoir stimulation. The drilling fluids utilised during drilling are very saline and consequently have very low resistivity values, which are lower than the gas saturated KA matrix. The black curve within the highlighted area (red oval) is the micro resistivity curve which measures 4" to 6" into formation and identifies the fully invaded zone. The blue curve is the shallow laterolog (measures approximately 24") and the red curve is the deep laterolog which measures approximately 48" into the KA. It's clear that the damaging drilling fluid invasion extends as far as the shallow laterolog and quite possibly to the deep laterolog and beyond. The other primary source of skin damage from water-based fluids is related to the 2019 and 2021 completion activities on the Kirkham Abbey formation. During the completion activities acid was pumped into the formation in an attempt to obtain better communication between the reservoir and the wellbore. 12m3 of diluted 15% HCl acid and a subsequent 12m3 of HCl/Acetic acid blend were squeezed into the formation through perforations between 1715m BRT and 1739m BRT at a volume of 1m3 per 1m of perforations. This operation was undertaken prior to Rathlin understanding that water-based fluids were damaging to the KA. If dilute acid uniformly penetrated the KA matrix with a uniform porosity of 10% over the perforated interval, the radius around the wellbore affected by the damaging fluid would penetrate approximately 2m into the formation. However, the formation is not homogeneous throughout the perforated interval with variations of both porosity and permeability, so the calculation estimates an average the depth of invasion. Streaks of higher permeability will result in fluids invaded further into the formation. Damage is recognised from drilling fluid invasion as well as from pumping of the completion fluids, as noted above. Rathlin's proposed injection of approximately 60m3 of stimulation fluid is 2.5X the volume of the completion fluid previously introduced into the KA and provides reasonable certainty that the proposed reservoir stimulation will extend beyond the formation damage, without being excessive. 
14	Confirm the volume of proppant fluid need for the stimulation. Explain any variations to the confirmed amount.	Reason: Supporting documents confirm 60 m3 to 70 m3, but not more than 85 m3 will be needed for the activity. This is a variation of up to 42% of proppant required.	85m3 is to include the volume used for the DFIT. This is currently unknown, so maximum volume has been specified to allow for assessment of worst case scenario.
15	Explain why both an acidic or alkali-based wash and squeeze are discussed as interchangeable.	Reason: Given the composition of adjacent lithologies being primarily compounds sensitive to acid, justification is needed for why an acidic wash might be chosen. An alkyl ester gelling agent is also confirmed as the chosen additive during the reservoir stimulation so explanation into the potential interchangeable use of an acid-based wash is needed.	To clarify, the acid / alkali wash and squeeze have already been approved in past permits. The methods are not meant to be interchangable but ot os required to have the ability to use each operation if deemed appropriate. The acid / alkali wash is a common operation to conduct to wash out any residue left from drilling. The alkali fluid is often used to remove barite (which is a weighting agent used in oil based mud). The product approved to use as an alkali-based wash is actually an acid with a high pH (alkaline) and so behaves in the same way as the acid but with a lot slower reaction time than some of the low pH acids proposed.
16	For the wash/squeeze activity, confirm explicitly the volumes intended to be used, the exact depths and frequency of the acid wash activity. Explain and justify any variation to figures provided.	Reason: To be registered as a deminimis activity we need to know such specifics to include in the permits operating techniques.	This operation has already been approved. The quantities stipulated are 1m3 per 1m of perforations.
17	Define which chemicals listed in the chemical inventory are to be used for which activity.	Reason: It is unclear which chemical is being used for which activity. Justification for the use of hazardous chemicals over non-hazardous alternatives is needed for both activities.	All chemicals apart from the reservoir stimulation checmicals have already been approved. The reservoir stimulation chemicals are denoted under a separate heading and have been resubmitted separately for clarity.

18	Justify the use of an oil-based gelling fluids over water-based alternatives for use in the proppant squeeze.	Reason: Robust evidence is needed to support the use of oil-based fluids over water-based fluids for this activity.	Based on an internal review of the drilling and completion results of the West Newton wells, suspicions of formation damage to the Kirkham Abbey were heightened. The formation appeared to be acting like a "check valve" during the completion and testing operations, meaning that the reservoir readily accepted the input of the water-based completion fluids, including the acid stimulations, but returned those same fluids slowly, which appeared to be restricting the flow of gas from the reservoir. The PEDL 183 partnership group decided to seek independent evaluations from leading third-party evaluators to help resolve the reservoir flow issues. Three preserved Kirkham Abbey core sections from each of WNA-2 and WNB-1z were sent to a specialist laboratory for core analysis and potential mechanisms of formation damage due to drilling and completion methodologies utilised in well operations. All of the WNB-1z preserved sections were taken from the upper lagoonal cycle (Cycle II) while for WNA-2 there was one Cycle II preserved section and the other two were from the lower grainstone shoal cycle (Cycle I). As WNA-2 preserved sections represented both major Kirkham Abbey cycles, the results of those tests were more informative than those from WNB-1z. The figure below shows the results of the Roller Oven Erosional Stability Testing on WNA-2 preserved Kirkham Abbey core samples. The Roller Oven (RO) stability test simulates the circulation of fluids around ground rock particles over a 16–24-hour period and studies the reduction in particle size due to mechanical erosion. RO results of 0.5% or less indicate no sensitivity while RO values of 10% or greater indicate extreme sensitivity and erodibility. As can be seen from Figure __, the Kirkham Abbey samples from WNA-2 show high to extreme sensitivity to any form of aqueous-based fluid tested. The sample from 1722.21m represents the upper lagoonal cycle (Cycle II) and shows extreme sensitivity to water-based fluids while the other two samples (1737.36m and 1746.28m) represent the lower grainstone shoal cycle (Cycle I) show high erodibility associated with water-based fluids. This high to extreme erodibility is a source for the development of fine particulates that can migrate through the Kirkham Abbey reservoir and accumulate in pore throats or within fine fractures causing significant reductions in permeability. In the presence of water-based fluids, fines migration represents an important potential formation damage mechanism in the Kirkham Abbey reservoir from the WN A-2 well. The same RO testing was undertaken on the same Kirkham Abbey samples from WNA-2, but the fluid utilised for the testing was diesel, as a proxy for oil-based drilling and completion fluids. This resulted in a substantial reduction in the sensitivity and erodibility of all samples, suggesting that through the use of oil-based drilling and completion fluids, this mechanism of formation damage can be mitigated. The RPS review of the drilling and completion practices identified a couple of issues associated with the previously used methodologies and made a number of recommendations. Consistent with the CoreLab study, the use of water-based drilling and completion fluids was seen as detrimental to the reservoir. The acid stimulations were also identified as ineffective as the acid only accessed small sections of the perforated interval in conjunction with the fact that the dilute 15% HCl acid is also water-based. The use of oil-based fluids for drilling and completion operations was recommended. 
19	Provide an updated SWMP which covers the permit extension area.	Reason: (Subject to your response in question 3 above). A change to surface water discharge (Activity A3) is requested and an extension to the permit boundary for WNA. A revised SWMP should be provided which takes into consideration the periods of increased activity on site and the changes requested in the application. It should also consider any impacts climate change could have which may affect site activities.	No change is being sought to the SWMP techniques to those already approved. SWMP Rev5 is included for reference.
20	Provide a copy of the Waste Gas Management Plan	Reason: A review of this document is needed to approve the request to the AR2 Activity, which seeks to add natural gas incineration.	No additional gas shall be incinerated as a result of this operation that has not already been accounted for in the previous assessments.
21	Clarify the composition of the chemicals listed below from the chemical inventory: Product Name Hazardous Chemical Composition (SDS Section 3) Dynared (All Grades) "No Hazardous Materials" - confirm actual chemical composition of the product Defoam Plus NS "No Hazardous Materials" - confirm actual chemical composition of the product M-I Pac (All Grades) "No Hazardous Materials" - confirm actual chemical composition of the product Pure Bore "No Hazardous Materials" - confirm actual chemical composition of the product Safe Scav* CA "No Hazardous Materials" - confirm actual chemical composition of the product MO-IV BREAKER - "This chemical is not considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200). The product contains no substances which at their given concentration, are considered to be hazardous to health." - confirm actual chemical composition of the product Note: Where there are significant updates required to documents associated with the application, we would ask that you provide a summary reference table to show which elements in the revised documents have been changed or added to answer the questions in the schedule 5 response. This will reduce the time we have to spend reviewing the documents.		Only additional product is MO-IV Breaker. All other products have previously been approved. Breakdown of this chemical shall be submitted in due course.