West Newton A-2 Well WR11 Application Supporting Statement

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1. INTRODUCTION

Rathlin Energy (UK) Limited (Rathlin Energy) is a wholly owned subsidiary of Connaught Oil & Gas Ltd, a private company with its head office in Calgary, Canada. The United Kingdom operations are conducted through Rathlin Energy (UK) Limited and are directed from the Rathlin Energy office in Beverley.

Rathlin Energy (UK) Limited is the operator of Petroleum Exploration and Development Licence (PEDL) 183, within which it has drilled two exploration boreholes, Crawberry Hill 1 and West Newton A-1 (WNA-1).

The purpose of this document is to provide an overview of the proposed wellbore construction programme for the forthcoming West Newton A-2 (WNA-2) drilling operation, in support of a WR11 application to the Environment Agency.

1.1 Site Details

The proposed WNA-2 well will be drilled at the following location:

West Newton A Wellsite
Rathlin Energy (UK) Limited
Fosham Road,
Marton
Hull
HU11 5DA

National Grid Ref: TA 19266 39155

UTM coordinates: Easting: 519266
Northing: 439155

Site Area: 0.975 hectares.

Planning Permission: **DC/12/0413/STPLF/STRAT & DC/15/03056/STVAR/STRAT**

Environmental Permits:

- **EPR/BB3001FT/V002** – The Management of Extractive Waste, an Installation Activity for the Incineration of Natural Gas and a Water Discharge Activity; and
- **EPR/PB3030DJ** – For the accumulation and disposal of radioactive waste from NORM.

The site surface boundary is detailed in red within Site Plans; RE-05-SD-WNA2-WR11-SP-01 and RE-05-SD-WNA2-WR11-SP-02 respectively.

The West Newton A Site was constructed in March 2013. The WNA-1 well was drilled in August/September 2013 to a depth of 3,015m TVD and tested between July and November 2014. The WNA-1 well is currently abandoned below 1,850m and suspended in the uphole section.

A drilling cellar located in the centre of the site forms a containment area from which the WNA-1 well was drilled. The existing wellsite is fully sealed with an impermeable membrane which provides an environmental barrier between site operations and the underlying subsoils. In the unlikely event of a spill, the contents of the spill would percolate through the wellsite stone onto the impermeable membrane, where it would migrate outwards to the lined open ditch for subsequent collection and disposal at a licenced waste facility.

There is a class 1 oil separator installed as part of a surface water management system to enable clean surface waters to be discharged offsite. The discharge point is fully isolated whilst operations are occurring on site.

A second sealed drilling cellar will be constructed on the West Newton A site to provide a containment area for the drilling of the WNA-2 well.

2. SCOPE

This WR11 application is applicable to the WNA-2 exploratory well. It is applicable to Rathlin Energy, its contractors and subcontractors and can be used in support of applications to the Environment Agency under Section 199 of the Water Resources Act 1991, where there is a requirement to submit notice of intention to drill for minerals.

3. DEFINITIONS

Casing:	Made from steel and is used to line the wellbore to maintain stability and prevent fluids escaping from the well. It is cemented in place which provides an annular seal between formations.
Cuttings:	Small pieces of rock that break away due to the action of the drilling bit cutting through the rock
Drilling Mud:	A fluid pumped into the borehole to circulate cuttings to surface, providing hydrostatic pressure against reservoir pressure and can be adjusted in weight according to anticipated pressures
m:	Metres
mm:	Millimetre
m kb:	Meters relative to Kelly Bushing
PEDL:	Petroleum Exploration and Development Licence
TD:	Total Depth
TVD:	True Vertical Depth
TVD KB:	True Vertical Depth below Kelly Bushing
WNA-1:	West Newton A-1 Well
WNA-2:	West Newton A-2 Well

4. GEOLOGICAL SETTING

The near surface and bedrock geology is well understood across the West Newton A wellsite based on the results from the WNA-1 well.

A summary of the geology is provided in Figure 4.1 and is derived from a true representation of the subsurface geology encountered during the WNA-1 drilling operation.

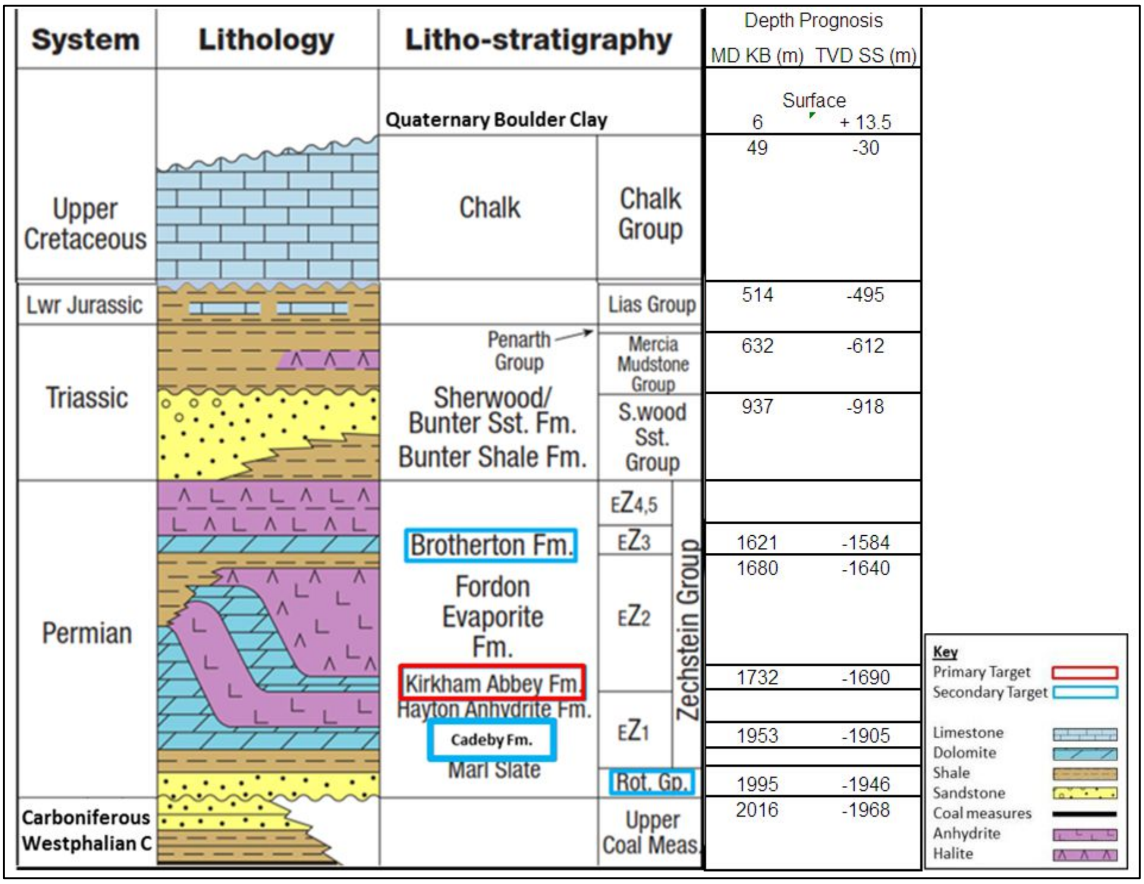


Figure 4.1: Anticipated Formation Tops 1

5. PROPOSED WORK - DRILLING OPERATIONS

Rathlin Energy plans to drill an appraisal well from the West Newton A wellsite. WNA-2 will investigate the extent of the petroleum reservoir encountered during the drilling of WNA-1.

A description of the drilling and construction of the proposed borehole, WNA-2, is provided together with a well schematic presented as Figure 5.1.

The formation tops are estimates, based on the actual formation tops from the well logs and samples collected during the construction of WNA-1 well together with the 3D seismic programme covering the West Newton area. The specific casing depths will be determined by the actual formation tops, as determined by sample and log evaluation whilst drilling.

Casing sizes (diameters) may be subject to change based on availability of casing, wellheads and drilling rigs. In the event casing sizes are changed Rathlin will provide details on final 'as built'.

5.1 Surface Conductor (0 – 80m TVD KB)

Upon completion of the cellar construction, a vertical 24” (609.6mm) hole will be drilled and a 20” (508mm) conductor casing will be run and cemented in the top section of the wellbore. The top section will be drilled with a conventional waterwell drilling rig to a depth of approximately 80m TVD KB. This initial section will be drilled with air and/or water/bentonite.

Once the 24” (609.6mm) hole has been drilled a 20” (508mm) conductor casing will be run and cemented to surface. The primary purpose of this conductor is to create stable foundation for the main drilling rig and to isolate any permeable sand stringers in the Boulder Clay (0-49m) and the top section of unconsolidated Cretaceous Chalk. The waterwell rig will be demobilised once this hole section has been completed.

5.2 Main Drilling Operation (80m – 2000m TVD KB)

Once the surface hole has been cased and cemented, a conventional oilfield drilling rig will be used to drill the remainder of the borehole.

Hole Section 17.5” (80m – 519m TVD KB)

A 17.5” (444.5mm) hole will be drilled from 80m to approximately 519m to the top of the Lias Group using a bentonite polymer water based mud system. This section of the well will be drilled vertically.

Once this hole section has been drilled a 13.375” (339.8mm) casing will be run and cemented back to surface. This will isolate the whole of the Cretaceous Chalk prior to drilling into any further permeable strata.

A formation Integrity Test will be carried out on the 13.375” (339.8mm) casing immediately following the drilling out of the shoe, at the start of the next hole section.

Hole Section 12.25" (519m – 1538m TVD KB)

A 12.25" (311.15mm) hole will be drilled from approximately 519m to 1,538m TVD KB using a bentonite polymer water based mud system. This section of the well will TD within the upper Permian section. The well will be drilled vertically and kick off from 860m TVD KB building to an angle of 14° on an azimuth of 65°.

Once this hole section has been drilled an 8.625" (219.1mm) casing will be run and cemented to at least 100m within the 13.375" (339.8mm) casing. The 8.625" (219.1mm) casing will isolate the Sherwood sandstone from any hydrocarbon bearing reservoirs in the following section. Once cemented, the casing will be pressure tested to confirm its integrity.

A Formation Integrity Test will be carried out on the 8.625" (219.1mm) casing shoe immediately following the drilling out of the shoe, at the start of drilling the next hole section.

Hole Section 7.875" (1538 – 2000m TVD KB)

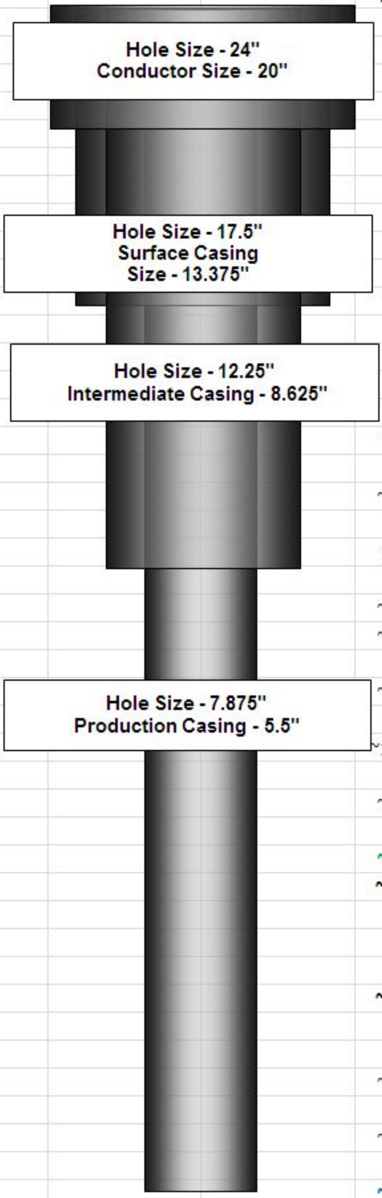
The 7.875" (200mm) hole will continue at an angle of 14° from a depth of 1538m TVD KB to a depth of 2,000m TVD KB using a KCl/NaCl polymer water based mud system and will TD at 2,000m, in the Base Permian or top Carboniferous section.

Once this hole section has been drilled a 5.5" (139.7mm) casing will be run and cemented to at least 100m within the 8.625" (219.1mm) casing. Any permeable formations encountered within this hole section will be isolated from any subsequent operations. The 5.5" (139.7mm) casing will then be pressure tested to confirm its integrity.

Rathlin Energy

WEST NEWTON A- 2

Diagram		Elevations / Depths	
Drilling Rig :	** TBD **	Ground Level	13.5 m
BOP's :	346.1mm Minimum Class IV	Kelly Bushing	19.5 m
	Minimum Pressure Rating 35 Mpa	Total Depth	2031 m MD
WELLHEAD :	339mm x 35.0 MPa		



(MD) m KB	(TVD) m KB	FORMATION TOPS	DEPTH SUBSEA
6	6	Quarternary	14
49	49	Chalk	-30
~80	~80	CONDUCTOR CASING	
510	510	Carstone	-491
514	514	Lias Group	-495
~519	~519	SURFACE CASING	
632	631	Mercia Mudstone	-612
	860	/30m DLS to 14° Inclination on Azimuth 64.02747°	
~937	937	Sherwood Sandstone	-918
~1528	1512	Roxby	-1492
1538	1522	INTERMEDIATE CASING	
~1573	1556	Sherburn Anhydrite	-1537
~1580	1563	Carnallitic Marl	-1543
~1609	1591	Boulby Halite	-1571
~1621.5	1603	Brotherton	-1584
~1680	1660	Fordon Evaporite	-1640
~1732	1710	CORE #1 (as per Geological Prog)	
~1732	*1710*	*Kirkham Abbey*	*-1690*
		Hayton Anhydrite	
~1933	*1905*	*Lower Cadeby*	*-1885*
~1995	1965	Rotliegendes SS	-1946
~2016	1987	Westphalian Coal	-1968
~2031	2000	TOTAL DEPTH	-1980

Figure 5.1: WNA-2 Well Schematic 1

6. WELLBORE AND FORMATION FLUID CONTROL

At the proposed drilling site the Cretaceous Chalk aquifer is understood to contain naturally saline formation water and under the WFD classification has been designated by the EA as poor quality and is not located within a designated SPZ catchment. The Sherwood Sandstone aquifer, and the Cretaceous Chalk are separated by the over 400m of impermeable Lower Lias and Mercia Mudstone unit.

The 24” (609.6mm) hole section (0 – 80m TVD KB), will be drilled with by a conventional waterwell drilling rig with air and/or water/bentonite then 20” (508mm) conductor casing will be run and cemented to surface. This will isolate any potable aquifers intersected within the Boulder Clay section and the upper more fractured Cretaceous Chalk from the lower portion of the Cretaceous Chalk and the rest of the well.

The 17.5” (444.5mm) hole section (80-519m TVD KB) will be drilled with a water based drilling fluid to below the base of the Cretaceous chalk and the 13.375” (339.8mm) casing will be cemented back to surface;

The 12.25” (311.15mm) hole section (519 – 1538m TVD KB) will be drilled with a water based drilling fluid to the base of the Sherwood Sandstones and 8.625 (219.1mm)” casing will be cemented in place;

The 7.875” (200mm) hole section (1522-2000m TVD KB) will be drilled through the Permian section with a salt saturated drilling fluid to a TD of 2000m TVD KB and 5.5” (139.7mm) casing cemented in place.

6.1 Control while Drilling:

Flow into, out from and between different formations and hydrogeological units while drilling is prevented by the presence of drilling fluid or “mud” in the wellbore. The drilling fluid acts in 2 ways to prevent wellbore fluids entering the formation and formation fluids entering the wellbore or other formations;

1.) The West Newton A-2 well will be drilled with an “overbalanced” mud system. This means that the drilling fluid exerts pressure in the wellbore, based on the weight of the drilling fluid (typically noted in ppg or pounds per gallon) that will exceed the pressure of fluids in the formations. This excess pressure prevents reservoir fluids (oil, gas, water) from entering the wellbore, fluid will not flow from a lower pressure environment to a higher pressure environment.

    WNA-1 was drilled with an overbalanced mud system through both the Chalk and Sherwood sections. The average mud weight was 9.4 ppg which is equivalent to a pressure gradient of 0.488 psi/ft.

    This pressure gradient exceeds (overbalances) the normal pressure gradient associated with the Chalk and Sherwood Sandstone formations in the West Newton area, which would range between 0.433 psi/ft for fresh water system (Chalk) and 0.454 psi/ft for formation fluid (Sherwood) of approximately 70,000 ppm TDS.

Fluid gains and losses, which were tracked while drilling the WNA-1 well, indicated that no fluid gains (indicating inflow from a formation to the mud system) or losses (indicating wellbore fluid inflow to a formation) were recorded during the time the Sherwood Sandstone was 'exposed' in the open wellbore section.

Based on the experience from the drilling of WNA-1, it is evident that the Chalk and the Sherwood Sandstone formations in the West Newton region are normally pressured aquifers. This would be consistent with the relative proximity of the surface outcroppings, and potential recharge sites, of the aquifers. The Chalk outcrops at surface approximately 10 miles west of West Newton and the Sherwood Sandstone outcrops approximately 30 miles west of West Newton.

Monitoring mud weight and any fluid gains and losses while drilling all hole sections at WNA-2 will ensure the wellbore remains overbalanced and prevents the potential for any formation fluid inflow to the wellbore.

2.) Another primary function of the drilling fluid, "mud" is to build a thin, impermeable "filter cake" on the sides of the borehole wall which prevents the higher pressure drilling fluid from flowing into the lower pressure formation. This filter cake is usually made up of clays, starch, and/or long chain polymers in the drilling fluid which build a thin, tough, protective layer over permeable formations. Drilling fluid formulation is carefully designed to build such a filter cake, with particular polymers, clays and inert materials to be compatible with the host rock. During drilling, the drilling fluid is constantly monitored to make sure it is building an impermeable filter cake by conducting API Filtrate Tests, which simulate downhole conditions and measures the thickness and durability of the filter cake against a standard permeable membrane. These tests are carried out at least once every 12 hours and the drilling fluid formulation will be adjusted accordingly to maintain optimal filter cake.

If fluid flow should occur, it would be seen as either "Gains" or "Losses" to the volume of drilling fluid in the hole. The volume of drilling fluid in the hole is constantly monitored by two separate systems while drilling with a conventional oilfield rig: the mud logging system and the drilling fluid system. Early detection of changes in the drilling fluid volume is of vital importance in maintaining wellbore safety – it is the first line of defence against a loss of well control or a blowout. If losses or gains in the drilling fluid are seen, drilling halts immediately while the situation is resolved. If losses are seen, Lost Circulation Material (LCM) is added to the drilling fluid or is pumped down the hole as a separate "pill" to stop the losses. Different types of LCM are available for different types of losses and rock features: high permeability sands, fractures or faults. If gains are seen, then drilling will stop immediately and well control procedures, such as flow checks and shutting the well in, will be carried out.

These standard drilling practices will ensure that adequate levels of protection are in place to prevent any detrimental impact to groundwater quality through fluid gains or losses into permeable formations such as the Cretaceous Chalk and the Sherwood Sandstone during drilling.

6.2 Protection by Casing and Cementing:

After drilling each hole section, the formations will be permanently isolated from each other by running steel casing into the hole and then pumping cement into the annulus between the outside of the casing and the borehole wall. All operations will follow good engineering practise to ensure a good quality cement sheath all the way around the casing to programmed tops.

These practises include: centralising the casing correctly in the middle of the hole with the correct number and the correct design of centralisers, conditioning the mud correctly before cementing to make sure the mud can be removed easily by the cement; pumping a properly designed "spacer" of adequate volume ahead of the cement to ensure mud removal ahead of the cement and to ensure the casing is "water wet" to achieve good adhesion of the cement to the casing; pumping the correct volume of cement to entirely fill the annulus between the casing and the hole (in practise, excess cement over the theoretical volume is pumped); moving the casing while cementing, for example rotating and / or reciprocating the casing slowly while pumping cement to encourage the cement to flow all around the casing.

The cementing of casing is key to overall well integrity and isolation of any permeable zones. Further precautions to ensure a good cement sheath may include running a "stage collar" to allow a second stage of cement pumping to reach the planned top; use of external casing packers on the outside of the casing, which are packers that can be inflated on the outside of the casing making a permanent seal between the casing and the borehole wall; using specially formulated "Non Shrinking Cement".

Once the casing and cementing of each hole section is completed there is no potential for fluid loss or gain to permeable formations, or cross flow between the formations, behind casing or the rest of the wellbore.

6.3 Summary

The WNA-2 well is designed specifically to maintain adequate isolation between all potential aquifers both while drilling and once the well is cased and cemented.

Water based drilling fluids formulated, monitored and maintained during drilling of the various hole sections will provide an impermeable filter cake that will prevent cross flow between any aquifers present within the same openhole section.

The 20" (508mm) conductor set at 80m depth and cemented to surface will isolate any shallow aquifers encountered within the Boulder Clay interval and the upper fractured portion of the Cretaceous Chalk from the rest of the wellbore.

The 13.375" (339.8mm) casing run and cemented below the Cretaceous chalk to surface will isolate the chalk aquifer from the rest of the strata encountered within the wellbore.

8.625" (219.1mm) casing run from top Permian to surface and cemented within the 13.375" (339.8mm) casing string will isolate the Sherwood Sandstone from the rest of the strata encountered in the wellbore.

5.5" (139.7mm) casing run from TD to surface and cemented within the 8.625" (219.1mm) casing string will isolate the Permian section from the previous hole sections.

7. DISPOSAL OF WELLBORE FLUIDS

Drilling muds are also designed to aid in the drilling process by lubricating the drill bit, circulating to surface the rock cuttings from the drilling process and for well control by maintaining a prescribed hydrostatic pressure within the well as previously described. Drilling muds are used in a closed loop system, within which the rock cuttings are circulated to surface and removed by vibrating screens (shakers). Finer particles of rock cuttings are then extracted from the drilling mud by a centrifuge and the drilling mud is circulated back down the well. Once the drilling muds are surplus to requirements the drilling mud will be transferred from the active mud system on the drilling rig to a vacuum tanker for removal offsite via a licenced haulier to an Environment Agency approved permitted composting facility where it is blended into compost after the compost has been sanitised.

8. WELL ABANDONMENT AND PARTIAL WELL ABANDONMENT

In the event that the well is not successful, the well will be abandoned in accordance with Oil & Gas UK *Guidelines for the suspension and abandonment of wells*.

In addition to the Oil & Gas UK *Guidelines for the suspension and abandonment of wells*, the well abandonment and/or suspension will be undertaken in accordance with the following regulations:

- The Borehole Sites and Operations Regulations 1995, and
- Offshore Installations and Wells (Design & Construction) Regulations 1996

Following suspension or abandonment operations all equipment associated with the operations will be removed and the wellsite made secure. The wellsite will then be inspected and monitored routinely by Rathlin Energy.