NON-TECHNICAL SUMMARY

RE-EPRA-WNA-NTS-003

Revision 5

July 2024

WNA Permit Variation

APPROVAL LIST

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1. INTRODUCTION

Rathlin Energy (UK) Limited (Rathlin) is a private company with its head office in Beverley, East Riding of Yorkshire. Rathlin is a petroleum exploration, development and production company with operations in the United Kingdom. Rathlin is the operator of PEDL 183.

Rathlin has prepared an application to the Environment Agency seeking permission to undertake a number of permitted activities in accordance with the Environmental Permitting (England and Wales) Regulations 2016 (EPR2016).

The purpose of the Non-Technical Summary is to provide a clear understanding of the proposed operations and the permitted activities to be applied for within this application.

Rathlin is the holder of a number of Environmental Permits issued by the Environment Agency in accordance with EPR2016. The current activities permitted at the West Newton A (WNA) Wellsite permit Rathlin to undertaken the following activities, as presented in Table 1.

Permit Number	Reference	Description
EPR/BB3001FT	AR1	The loading, unloading, handling or storage of, or the physical, chemical or thermal treatment of crude oil with a capacity of 500 tonnes
	AR2	The incineration of hazardous waste in a waste incineration plant or waste co-incineration plant with a capacity exceeding 10 tonnes per day.
	AR3	Operate a Medium Combustion Plant.
	AR4	Storage of additional raw materials directly associated with the production of crude oil.
	AR5	The use of up to two oil fired bath heaters with a rated thermal input <1MWth.
	AR6	The use of a diesel generator with a rated thermal input <1MW for onsite power generation
	AR7	Discharge of rainfall dependent surface water runoff.
	AR8	A mining waste operation for the management of extractive waste including gas from prospecting for mineral resources, not involving a waste facility.
EPR/PB3030DJ (SR2014 No4)	1	Accumulation of radioactive waste on the premises.
	2	Disposal of radioactive waste on or from the premises.

TABLE 1: CURRENT PERMITTED ACTIVITIES

An analysis of the well test data and further laboratory testing has indicated the need to undertake a small scale reservoir stimulation in order to overcome skin damage, which is a build-up of fine particles from the drilling operation invading the formation and blocking the natural permeability of the formation. The reservoir stimulation falls within EPR2016 and, as such, must be authorised.

As such, Rathlin Energy has prepared an application to vary the environmental permits to include a 'reservoir stimulation', which is groundwater activities under Schedule 22, 8(l) of EPR2016, namely the injection of any substance into groundwater to increase the flow of fluids or gas to a well or borehole in connection with the extraction or use of any energy source.

The 'reservoir stimulation' will produce extractive waste, referred to as Mining Waste under Schedule 20, 2(1) of EPR2016, namely the management of extractive waste, whether or not involving a mining waste facility. In addition, the formation within which the stimulation fluid is retained is considered a 'mining waste facility'.

2. SCOPE

This Non-Technical Summary is applicable to the WNA Wellsite and all operations permitted therein. It is applicable to Rathlin, its contractors and subcontractors and can be used in support of applications to the Environment Agency under EPR2016.

3. DEFINITIONS

"	Inch
BAT	Best Available Technique
CO_2	Carbon Dioxide
DFiT:	Diagnostic Fracture Injectivity Test. A pressure transient test carried out in the target formation to obtain reservoir characteristics and inform hydraulic fracture treatment parameters. Also referred to by others as Mini Fall-Off Test or a Pre-Injectivity Test.
EPR2016	Environmental Permitting (England and Wales) Regulations 2016
EWT	Extended Well Test
HDPE	High Density Polyethylene
Km	Kilometre
m	Metre
M^3	Metres Cubed
MCP	Medium Combustion Plant
MCPSG	Medium Combustion Plant & Specified Generator
MD KB	Measured Depth below Kelly Bushing
mm	Millimetre
MOT	Ministry of Transport
MW	Megawatt
NORM	Naturally Occurring Radioactive Material
PEDL	Petroleum Exploration and Development Licence
Reservoir Stimulation:	A low volume hydraulic fracture stimulation with the primary purpose of overcoming skin damage to the target formation sustained during drilling. Also referred to by others as a proppant squeeze.
RPS	Radiation Protection Supervisor
RWA	Radioactive Waste Advisor
SG	Specified Generator
TVD KB	True Vertical Depth below Kelly Bushing
WCU	Well Clean Up
WNA	West Newton A
WR11	Water Resourced Form 11

TABLE 2: DEFINITIONS

4. ENVIRONMENTAL LEGISLATION AND APPLICABILITY

The WNA Wellsite is the subject of several activities which, under current environmental legislation, requires an environmental permit. The Environment Agency regulate all permitted activities under the Environmental Permitting (England and Wales) Regulations 2016, as amended (EPR2016). Under EPR2016, Operators are required to submit environmental permit applications to the Environment Agency to seek approval to undertake such activities.

Onshore oil and gas developments are the subject of the environmental permitting regulations, as such a number of environmental permits have already been obtained. This Non-Technical Summary provides an update on the proposed operations to be conducted at the WNA wellsite and provide an explanation as to which permitted activities will be required/applied for.

4.1 Environmental Permitting (England and Wales) Regulations 2016

The Environment Agency regulate all permitted activities under EPR2016 and require 'Operators' to submit environmental permit applications to seek approval to undertake such activities. Rathlin has assessed the activities associated with the proposed operations and considers certain activities to fall in scope of EPR2016 and therefore require the necessary environmental permits.

4.1.1 Industrial Emissions Activity

Schedule 1, Part 2 of EPR2016 details a number of activities that are classified as an Industrial Emissions Activity including 'Energy Activities' (Chapter 1) and 'Waste Management' (Chapter 5). Energy Activities include the storage of crude oil, whilst Waste Management includes the incineration of waste.

4.1.1.1 Oil Storage

This activity is cited under EPR2016, Schedule 1, Part 2, Chapter 1, Section 1.2, Part A(1) (e)(i).

'The loading, unloading, handling or storage of, or the physical, chemical or thermal treatment of crude oil.'

The proposed operation has the potential to involve the handling and storage of crude oil within the site. Activity A4 of environmental permit EPR/BB3001FT is already in place which permits the loading, unloading, handling or storage of, or the physical, chemical or thermal treatment of crude oil. However, the location of the oil storage facility will be significantly different, as such the permit will be varied to facilitate these changes including the permit boundary.

4.1.1.2 Incineration of Natural Gas

This activity is cited under EPR2016, Schedule 1, Part 2, Chapter 5, Section 5.1, Part A(1) (a).

'The incineration of hazardous waste in a waste incineration plant or waste co-incineration plant with a capacity exceeding 10 tonnes per day.'

The proposed operations involve the incineration of natural gas exceeding 10 tonnes per day. Activity A2 of environmental permit EPR/BB3001FT is being varied to include incineration of natural gas (in excess of 10 Tonnes per day), which may be required for the Well Clean up (WCU) and Extended Well Test (EWT) activities.

4.1.2 A Mining Waste Activity

Schedule 20 of EPR2016 defines a mining waste operation as being the management of extractive waste, whether or not it involves a waste facility. Under EPR2016, an environmental permit is required to authorise a mining waste operation.

The WNA operations will continue to involve the management of extractive waste not including a waste facility. Activity AR8 of environmental permit EPR/BB3001FT is being varied to include a 'reservoir stimulation'.

Further, as a 'reservoir stimulation' will result in extractive waste being retained in the formation being tested, a mining waste facility is being applied for. Refer to Section 5 *Criteria for Determining the Classification of Waste Facilities*.

4.1.3 A Groundwater Activity

Under Schedule 22 of EPR2016, an activity that could involve the discharge of pollutants into groundwater must be notified to the Environment Agency, together with the nature of these pollutants. The Environment Agency will then determine whether the groundwater activity needs to be permitted.

The WNA operations includes a wash and squeeze, should it be deemed necessary to do so and will be based on initial flowrates encountered. These activities fall within the definition of a Groundwater Activity under Schedule 22 of EPR2016.

Schedule 22 3 (3) of EPR2016 provides that the *'The regulator may determine that a discharge, or an activity that might lead to a discharge, is not a groundwater activity if the input of the pollutant…*

(b) is or would be of a quantity and concentration so small as to obviate any present or future danger of deterioration in the quality of the receiving groundwater.

To enable the regulator to deviate from the requirement for a groundwater activity permit for the wash and squeeze, a description of the operations, together with a technical justification to exclude these operations under Schedule 22 paragraph 3 (3) of EPR2016, is included within the Waste Management Plan.

The WNA operations will also include a 'reservoir stimulation, which falls within the definition of a 'groundwater activity' under Schedule 22, 8(l) of EPR2016, namely the injection of any substance into groundwater to increase the flow of fluids or gas to a well or borehole in connection with the extraction or use of any energy source, therefore, a groundwater activity permit is being applied for.

4.1.4 Water Discharge Activity

Schedule 21 of EPR2016 relates to water discharge activities. Activity A3 of environmental permit EPR/BB3001FT has previously been obtained by Rathlin which includes the necessary surface water discharge activities. The site is due to be extended to facilitate the production facility and therefore the permitted activity will need to be updated to include the revised site layout and the surface water management process during production operations and during periods of increased activity i.e. drilling and testing.

4.1.5 A Radioactive Substances Activity

Schedule 23 of EPR2016 provides for the control of Naturally Occurring Radioactive Material (NORM). Schedule 23 defines the production of oil and gas as a NORM industrial activity and therefore any accumulation of radioactive waste, which exceeds concentrations set out in Table 1 of Schedule 23 of EPR2016. Rathlin has previously obtained a SR2014 No. 4 permit (EPR/PB3030DJ) which still remains relevant to the proposed activities.

Due to the nature of the standard rules permit it is anticipated that a new SR2014 No4 permit will need to be applied for due to the expansion of the WNA Wellsite, and therefore the expansion of the permit boundary.

4.1.6 Medium Combustion Plant and Specified Generators

Schedule 25a of EPR2016 considers activities which involve the operation of Medium Combustion Plants (MCP), specifically MCPs with a rated thermal input equal to or greater than 1 megawatt but less than 50 megawatts. Such plants are required to operate within the set Emission Limit Values as cited by EPR2016, as amended.

Schedule 25b of EPR2016 considers activities which involve the operation of combustion plants which is used for the purpose of generating electricity, but does not consider mobile units unless they are connected to an electricity transmission system or distribution system or fulfilling the role of a static generator. These Specified Generators (SG) fall in scope of this Schedule if they have a rated thermal input equal to or greater than 1 megawatt but less than 50 megawatts.

Operators of MCP and SG that are in scope will require an environmental permit under schedule 25A and 25B of EPR2016. A permit to operate both is determined by the capacity, emissions and operating hours of the plant.

Upon commencement of the proposed development it is anticipated that MCP and SG (MCPSG) will be present at the wellsite. However, during construction activities, and the drilling and testing of each well it is considered by Rathlin that the generators associated with these activities fall out of the scope of Schedule 25a and Schedule 25b on account

of being mobile units and being at the wellsite temporarily and intermittently. The Environment Agency will decide whether a mobile generator is operating as a static generator.

As the development progresses into production it is foreseeable that a number of MCPSG units will be used at site to harness waste natural gas and provide electricity to the site with any surplus being exported, either by grid transmission or batteries.

As these MCPSG will be fixed and installed at the site it is reasonable to assume that Schedule 25a and Schedule 25b of EPR2016, as amended will be applicable and therefore Rathlin will apply for a permit to perform such activities. The total aggregated thermal input of the proposal is less than 50MW and as such is considered as being a MCP.

4.2 Water Resources Act 1991 (as amended by the Water Act 2003)

Under Section 199 of the Water Resources Act 1991 (as amended by the Water Act 2003), a notice of the intention to construct or extend a boring for the purpose of searching for or extracting minerals must be submitted to the Environment Agency using form WR11.

The WR11 requires that a method statement, including drilling and casing designs, together with storage and use of chemicals and drilling muds, accompanies the WR11 application form. Each additional well drilled from the WNA Wellsite will be the subject of an individual WR11 application as the wells shall be drilled at different stages throughout the lifetime of the development.

5. DESCRIPTION OF THE FACILITY

5.1 Development Location

The proposed development is being undertaken at the following location:

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

National Grid Ref: TA 19268 39131

Site Area: 3.46 hectares

A Site Location Plan has been provided within Site Plans Document (RE-EPRA-WNA-SP-004).

Figure 1: West Newton A Wellsite Location (Source: Google Earth August 2020)

5.2 Site Description and Current Status

The site is located to the north of West Newton and east of Marton. It is located within the parish of Aldbrough, in the East Riding of Yorkshire.

The surrounding landscape consists of flat open fields that are interspersed with patches of woodland and divided by hedgerows and ditches. An area of semi-improved grassland lies adjacent to the western boundary and extends 10m into the field. There are a number of mature hedgerows that border the field.

The nearest conurbations are West Newton, circa 1,130m to the south and Marton, circa 800m to the west.

A desktop study was undertaken to identify any designated sites which may be affected by the proposals. The results of the desktop survey using the Multi-Agency Geographic Information for the Countryside (MAGIC) interactive mapping tool have been provided within Table 3.

Designated Site	Search Radius[1]	Name	Location from Site[2]
RAMSAR	10km	-	-
Special Area of Conservation	10km	-	-
Special Protection Areas	10km	Hornsea Mere	6.93km North
Marine Protection Areas	10km	Greater Wash	5.44km Northeast
Sites of Special Scientific Interest	2km	Lambwath Meadows	0.79km Northeast
Schedule Ancient Monuments	2km	Burton Constable Medieval Settlement[3]	1.93 South
National Nature Reserve	2km	-	-
Local Nature Reserve	2km	-	-
Local Wildlife Site	2km	The Moors Burton Constable	0.87km South
		Wycliffe North Plantation	0.92km Southwest
		Mill Avenue Burton Constable	1.23km South
		Burton Constable Parkland	1.77km South

TABLE 3: MAGIC DESKTOP STUDY RESULTS

5.3 Historic Developments

5.3.1 Construction Works

The WNA Wellsite was constructed in the 2nd quarter of 2013, to enable the drilling and testing of up to two exploratory boreholes. further details of the construction have been provided within the Site Condition Report (RE-EPRA-WNA-SCR-006).

The topsoil was stripped from the site area and placed in a storage bund along the eastern boundary of the wellsite. Subsoil was removed to create a level surface and stored in a separate bund along the southern boundary. A ditch was excavated along the perimeter of the wellsite to provide environmental containment.

Once the surface of the site was level and the perimeter ditch excavated, an impermeable membrane, constructed from 1mm fully welded HDPE, was installed across the entire site area and perimeter ditch protected above and below by a layer of nonwoven needle punched geotextile. Stone was then installed across the site platform, leaving only one open containment ditch.

A concrete cellar was constructed, formed from pre-cast concrete rings with the impermeable membrane integrated into the cellar walls using foam back metal batons to ensure that the integrity of the site is maintained. The cellar provides an additional containment and houses the wellhead.

Following the construction of the WNA Wellsite in 2013 additional construction works have been carried out, these included:

- Replacement of perimeter stock fencing with a 1.8m high paladin fencing;
- Installation of two groundwater monitoring boreholes;
- Installation of a Class 1 Oil-Water Separator;
- Segregating part of the wellsite to create a car parking area at the northern boundary (non-active area); and
- Installation of a second well cellar in preparation for the drilling of the second borehole.

5.3.2 Drilling and Testing Operations

To date two (2) boreholes have been drilled from the WNA Wellsite, named West Newton A-1 Borehole (WNA-1) and West Newton A-2 Borehole (WNA-2).

WNA-1 was drilled in 2013 and subsequently tested in 2014 in accordance with the environmental permits in place at the time. WNA-2 was drilled in 2019 followed by initial well testing in the latter half of 2019, again all environmental permits were in place.

[1] Search Radius derived from Environment Agency Guidance: Annex A – Opra Scheme for Installations.
[2] Location from new site boundary.
[3] Burton Constable medieval settlement and field system, north of Burton Constable Hall

6. PROPOSED ACTIVITIES

6.1 Wellsite Construction Activities

Details of the proposed wellsite construction have been provided within the Site Condition Report as a means to illustrate and describe the proposed construction design.

The platform for the site extension is expected to be the same as that of the existing site insofar as being levelled through a 'cut to fill' approach, before being overlaid with a HDPE impermeable liner sandwiched between two geotextile membranes. Sitting above the membrane will be at least 300mm of Type 1 MOT stone. A number of, or a single, concrete cellar(s) shall also be included within the design in preparation for drilling each borehole, though these may be installed retrospectively as and when each well is to be drilled.

6.2 Drilling Operations

Rathlin is proposing to drill up to six new boreholes from the WNA Wellsite and potential re-enter the two existing boreholes (WNA-1 and WNA-2). The purpose of splitting the drilling into multiple campaigns allows further evaluation of the target formations, learning from previous campaigns to increase efficiency of drilling and maintaining production flow.

Each wellbore shall be drilled in sections with an appropriate drilling rig. The exact well design shall be agreed with the Environment Agency by way of WR11 application prior to drilling of the wells. An example of the way the wells shall be constructed is indicated below in Figure 2.

The formation tops within Figure 2 are estimated, based on the actual formation tops from the well logs and samples collected during the construction of WNA-1 well data from offset wells including the WNA and WNB wells. The specific casing depth will not rely on the estimate provided within this application but will be determined by the actual formation tops, as determined by sample and log evaluation whilst drilling.

The actual borehole design will be confirmed by the Environment Agency under Section 199 of the Water Resources Act 1991 (as amended by the Water Act 2003), whereby a notice (WR11) of the intention to construct or extend a boring for the purpose of searching for or extracting minerals is required to be submitted to the Environment Agency.

Drilling fluid additives shall be the subject of approval by the Environment Agency prior to the undertaking of any drilling activities. Rathlin is proposing to use a number of drilling additives which have been the subject of approval within previous applications to the Environment Agency. Details of the drilling additives have been provided within the Chemical Inventory.

6.2.1 Well Design

A conductor casing shall be set from surface to approximately 80m TVD. This section is typically constructed by using a smaller drilling rig to drill a 26" hole and setting 20" casing. The conductor hole shall be drilled using water-based mud and / or air and the annulus shall be cemented back to surface. The main reason for a conductor section is usually to create a stable start to the well whilst allowing the main rig to start drilling from a deeper depth.

The surface casing shall be drilled through the Cretaceous chalk using water-based mud. This section shall be drilled in a smaller hole size than the conductor casing – typically 17.5", and steel casing (typically 13-3/8") shall be run and cemented back to surface. This casing shall isolate the cretaceous chalk from any deeper porous formations.

The intermediate section shall drill through the Sherwood Sandstone and steel casing shall be run and cemented into place. The section shall be a smaller diameter than the surface section – typically 12.25" hole with 9-5/8" casing.

Production casing shall be run across the Permian section. This hole section would typically be 8.5" with 7" steel casing set and cemented into place.

A contingency liner section of 6" hole and 4.5" liner may be run in the event of a sidetrack or needing and extra section of casing in the well.

6.2.2 Logging

Geological logging is undertaken during well construction to determine whether formations encountered during drilling may contain petroleum. The borehole logs assist Rathlin in determining specific zones, which justify subsequent testing. Coring may also be undertaken.

6.2.3 Perforation

In order to establish communication between the formation(s) being tested and the borehole the casing must be perforated.

The perforating operation, in particular the use of explosive charges, is regulated by the Police Authority and the Health and Safety Executive. Perforating may be undertaken several times as deemed necessary by Rathlin.

Once the casing has been perforated, the fired perforating guns will be recovered during the lifetime of the development.

6.2.4 Contingency Side-tracks

As a contingency, each well may require a side track in the unlikely event of a sub-surface well constraint. As this is a contingency option it is impossible to predict the size or depth of a side track, however it is standard oilfield practice to bypass the constraint. Rathlin will confirm the estimated quantity of waste in writing to the Environment Agency if a contingency side track is required.

6.2.5 Lateral Wells

Each of the wells will consist of an initial vertical borehole or deviated borehole drilled from surface into the subsurface target formation. A decision will then be made to kick off and side track followed by a deviation to a horizontal borehole. Details of wells will be written within the WR11 submission.

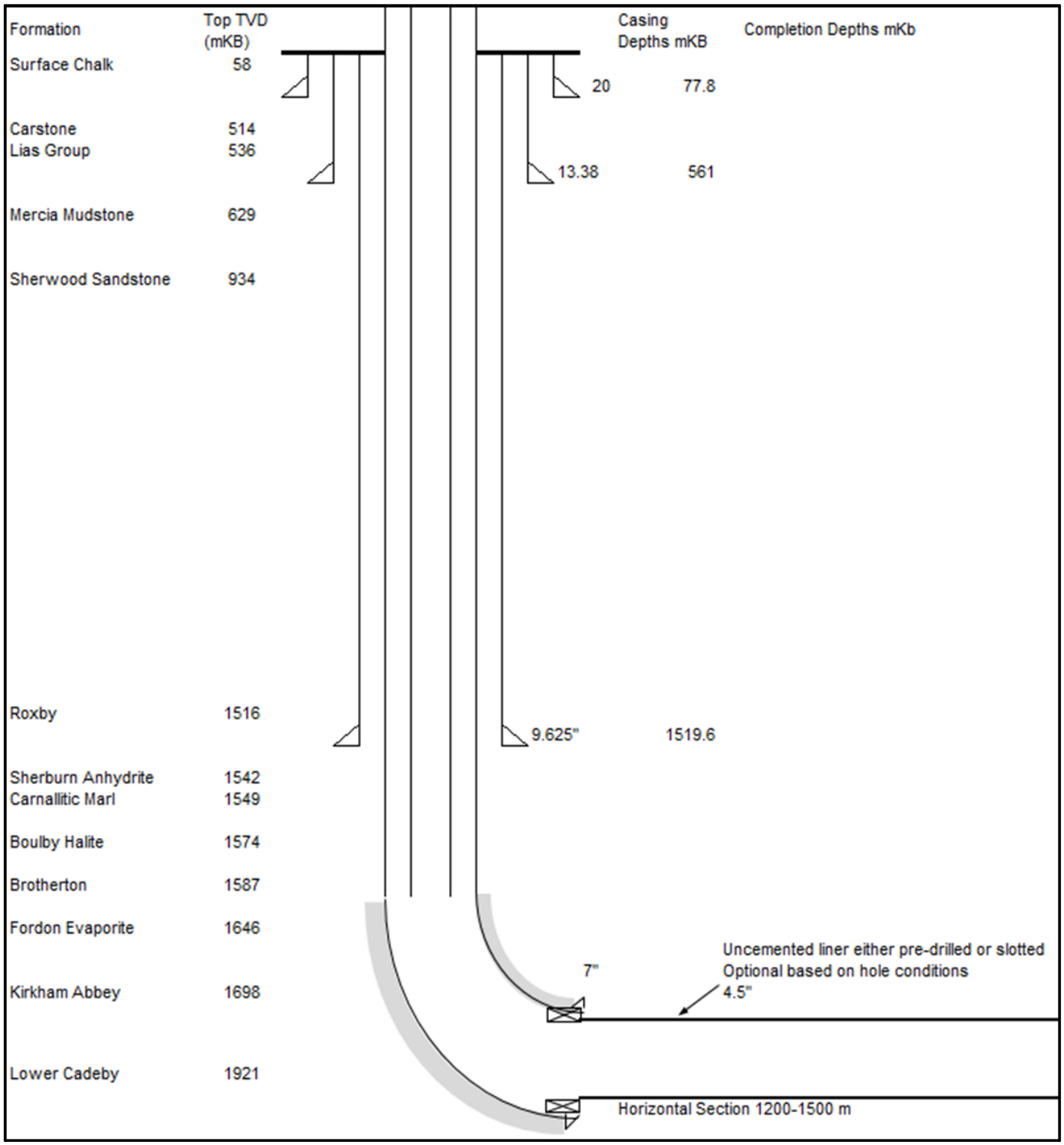

Figure 2: Indicative Well Schematic

6.3 Well Testing

Upon completion, the well(s) will be the subject to subsequent, clean up and testing. The purpose of the well test is to evaluate the commercial viability of the hydrocarbon reservoir, if encountered. The test will be conducted in 2 (two) parts consisting of a Well Clean Up (WCU) and an Extended Well Test (EWT). During the well test hydrocarbons will be produced. A Waste Gas Management Plan has been developed for the purpose of demonstrating Best Available Technique (BAT) for the management of waste gas as a result of each well testing phase and the production phase.

For clarity, the WCU and EWT may be undertaken several times throughout the development after each well is drilled. The proposal is to target several isolated zones within the Permian section, each zone has the potential to contain oil, gas or a combination of the two. The reason for multiple well tests is due to the zones within the Permian section being distinct and isolated. Information obtained from a specific zone is highly unlikely to inform the behaviour of the other zones within the target formation due its natural variability.

6.3.1 Well Clean-up Phase

A WCU is conducted when trying to bring the reservoir fluids to surface for the first time, either after drilling, after a period of in-operation or after any maintenance has been conducted in the well. The aim of the WCU is to get the reservoir fluids to surface and flowing at a consistent rate for testing or production.

A WCU will involve the use of a well testing spread, typically consisting of at least a choke manifold, surface safety valve, three-phase separator, fluid storage tanks, vent line(s) and a combustion unit(s). Waste gas produced as a result of the well clean-up operations shall be managed in accordance with the approved BAT as demonstrated by the Waste Gas Management Plan.

Ordinarily, natural gas flows to surface however, during a WCU the rate of natural gas produced is likely to fluctuate unpredictably. Any natural gas composition data acquired during WCU may not be accurate due to being comingled with wellbore fluids. Once at surface, natural gas and produced fluids will be diverted by temporary pipework to a three-phase separator, which will separate out oil and condensate, water and natural gas. Oil and condensate, which for clarity is not a waste, will be diverted via temporary pipework to dedicated storage tanks onsite for subsequent offsite removal by a licenced haulier to a permitted refinery for sale. Produced water, which is considered a waste, will be diverted via temporary pipework to dedicated storage tanks onsite for subsequent offsite removal by a licenced haulier to an Environment Agency permitted water treatment facility where it is processed, treated and discharged in accordance with the permitted controls of the water treatment facility.

Any natural gas separated during the three-phase separation will be managed in accordance with the identified BAT as identified within the Waste Gas Management Plan.

If the well does not flow on its own after perforation then a number of processes, which are described below, may be conducted in order to bring the reservoir fluids to surface.

6.3.2 Extended Well Test

Should the WCU phase indicate that hydrocarbons are present then testing operations will continue with the EWT stage. An EWT is a longer duration test, which is carried out to assess the commercial viability of the well and establish detailed gas and oil composition.

Once at surface, produced fluids and hydrocarbons will be diverted by temporary pipework to a three-phase separator, which will separate out oil and condensate, formation water and natural gas. Oil and condensate, which for clarity is not a waste, will be diverted via temporary pipework to dedicated storage tanks onsite for subsequent offsite removal by a licenced haulier to a permitted refinery for sale. Formation water, which is considered a waste, will be diverted via temporary pipework to dedicated storage tanks onsite for subsequent offsite removal by a licenced haulier to an Environment Agency permitted water treatment facility where it is processed, treated and discharged in accordance with the permitted controls of the water treatment facility.

Again, any natural gas separated during the three-phase separation will be managed in accordance with the identified BAT as identified within the Waste Gas Management Plan.

Formation water produced during the EWT has the potential to contain low levels of Naturally Occurring Radioactive Material (NORM). Samples of formation water will be sent to a laboratory holding the appropriate accreditations for radionuclide analysis by gamma spectrum. Depending on the outcome of radionuclides analysis, formation water will be transported via a licenced haulier to either an Environment Agency permitted waste water treatment works facility where it is processed, treated and discharged in accordance with the permitted controls of the water treatment facility, or to a bespoke RSR permitted waste treatment facility for treatment and disposal in accordance with the Best Available Technique (BAT).

6.4 Well Completion

Once the well has been drilled (in accordance with details included in the WR11) a completion assembly shall be run into the well to allow the production of reservoir fluids. The completion may consist of production tubing, packers, sliding sleeves, down hole pumps or other equipment to allow the reservoir fluids to move to surface. The completion is semi-permanent and will be retrieved at the end of the life of the well or during well maintenance.

On completion of the drilling phase, or prior to testing, circulation runs will be conducted to remove residual muds or debris from the drilling using a clean fluid, as shown in the chemical inventory. The waste from the circulation run will be managed at surface using the same techniques as the drilling phase.

6.5 Borehole Clean Up

A clean up assembly may be run into the well and will scrape and remove any debris from the perforations. A clean fluid will be circulated down the work string during the borehole cleaning operation and will circulate out to surface any debris. The debris, consisting of small steel scrapings, will be separated from the fluid at surface using conventional shakers and circulating tanks. The steel scrapings are anticipated to be de minimus, due to the design of the perforation guns, insofar as they have been designed to minimise debris by reducing external burrs (steel edges) which form as the jet exists the casing.

6.6 Solvent Treatment

Due to the nature of the oil bearing formation and its mineralogy, a solvent treatment pre-flush may be required in advance of any wash and squeeze activity taking place. The solvent pre-flush is a process of removing the build-up of hydrocarbons on the rock within the near wellbore area. It generally consists of up to 15m^3 ethylene glycol monobutyle ether (EGMBE), which is pumped down the well in a carrier fluid of 5% KCL brine. The solvent strips the hydrocarbon coating from the near wellbore formation allowing any the subsequent acid/alkali wash and squeeze treatment to make efficient and uninterrupted contact with the near wellbore formation. For clarity, no solvent remains within the formation as it is brought back to surface, comingled with produced oil, or displaced with brine or spent acid/alkali.

6.7 Wash and Squeeze

To improve the flow of petroleum an acid or alkali may be applied to the formation through the borehole. The operation is very much akin to treatments of boreholes in the water well industry and results in high permeability channels through which fluids can flow.

A wash is designed to remove scale or similar deposits from perforations and well-completion components. The wash can be used to repair formation blinding and help restore the natural porosity of the formation and is applied to the formation under pressure not exceeding the fracture pressure of the formation.

A dilute acid / alkali solution is used and is circulated across the formation perforations, the process of washing the perforations is repeated until there is adequate clean-up of the immediate area (face of the formation). The acid or alkali is then squeezed into the near formation again to clean out the near borehole perforation channels. Again the process may be repeated several times as necessary to ensure a reaction within the target formation has restored natural pathways.

Whilst the injection of acid or alkali within deep saline water bearing formations is a ‘groundwater activity’, the activity is considered de minimis and can be excluded under Schedule 22 3 (3) of EPR2016. The wash/squeeze does not, therefore, require a groundwater permit.

6.7.1 Treatment of Surplus Acid and Alkali

Following the retrieval of acid or alkali to surface it is anticipated that it will be considered ‘spent’ i.e. neutralised following the chemical reaction with the formation. As a contingency, the returns will be tested at surface to determine pH. In the event the acid is not fully spent, Rathlin will treat the acid using soda ash (sodium carbonate) and surplus alkali with citric acid. The treatment will take place at surface and will not be used within the well.

6.8 Reservoir Stimulation

In order to re-establish permeability within the target formation, it may be necessary to undertake a reservoir stimulation, which is designed to create channels of communication through the near wellbore formation, having been blocked by formation damage as a result of the initial drilling and completion operations. For clarity, the primary purpose of the reservoir stimulation is to re-establish permeability, however, due to the design of the reservoir stimulation, although as minimal as is reasonably practicable, the reservoir stimulation will extend beyond the near wellbore damage, providing some degree of secondary benefit in the form of enhanced permeability within the target formation.

The reservoir stimulation will be carried out as a single stage treatment in the WNA-2 borehole. Carrier fluid volumes for a single stage treatment are 60m^3 - 70m^3 with 12.5 tonnes of proppant entrained. The fluid mix is injected at a surface pressure of 9,000psi at a low rate for less than one (1) hour, then flowed back to surface in a controlled manner through well clean-up equipment.

The proposed reservoir stimulation falls within the definition of a 'groundwater activity' under Schedule 22, 8(l) of EPR2016, namely the injection of any substance into groundwater to increase the flow of fluids or gas to a well or borehole in connection with the extraction or use of any energy source.

Approximately 30% to 50% of the proppant carrier fluid will be returned to surface via the well clean-up equipment and stored on site for subsequent offsite transfer to an Environment Agency approved waste treatment facility for disposal in accordance with the receiving waste treatment facility's environmental permits. The remaining 50% to 70% of the proppant carrier fluid will be retained in the target formation. As such, the target formation will be classified as a waste facility under Schedule 20 (2)(1) of EPR2016

The authorisation of surface activities necessary to undertake a reservoir stimulation does not fall within the purview of the EPR2016, which are temporary works of minimum duration, but do, however, fall within the purview of the Minerals Planning Authority. As such, emissions relating to noise and air quality directly from the surface activities associated with the reservoir stimulation are not considered within this application to vary the environmental permits.

6.9 Well Lifting Techniques

If the well does not flow (lift) naturally, the following techniques are available to artificially lift hydrocarbons to surface:

- Nitrogen or Carbon Dioxide lift (Gas Lift); and/or
- Mechanical lift.

6.9.1 Nitrogen Lift

To aid the initial flow of hydrocarbons (oil and gas), Nitrogen may be injected into the borehole to displace borehole fluids, reducing its hydrostatic weight. Nitrogen is classified as an inert waste and venting of such considered a closed loop system, insofar as Nitrogen is extracted from the atmosphere and is vented back atmosphere. No Nitrogen would remain in the formation.

6.9.2 Carbon Dioxide Lift

The purpose of CO2 cleanout is to assist in the removal of all wellbore fluids and near wellbore debris sustained during the drilling operation, thus restoring near wellbore permeability. In comparison to Nitrogen lift, a CO2 cleanout allows for greater debris lifting as it is circulated down as a liquid and produced back as a gas.

Due to the pressure decrease when opening the well to flow back, the state of the CO_2 changes rapidly from a liquid to a gas. This process results in a rapid expansion of CO_2, which forces the near wellbore debris from the perforations into the wellbore and back to surface. All liquid CO_2 injected into the formation will return to surface in a gaseous state and will be passed through the three-phase phase separator.

Whilst the pumping of liquid CO_2 into the perforations within deep saline water bearing formations is a 'groundwater activity', the liquid CO_2 will return to surface in a gaseous state. No injected CO_2 will remain in the formation and therefore the injection of liquid CO_2 is considered de minimus and can be excluded under Schedule 22 3 (3) of EPR2016 from requiring a groundwater activity permit.

6.9.3 Mechanical lift

In the event the well(s) are not able to flow to surface naturally a number of lifting techniques are available to the onshore oil and gas industry, including the aforementioned Nitrogen / Carbon Dioxide lift. Another lifting technique is a mechanical lift. The use of mechanical lifting techniques is common place within oil production wells and can take a number of forms.

As a contingency Rathlin may use a mechanical lifting technique known as swabbing to aid in the lifting of wellbore fluids to surface. Swabbing is performed by unloading liquids from the well using a specific tool string incorporating a swab cup assembly that can be run into the wellbore by various means (wireline, coiled tubing or drillpipe).

When the assembly is run, the specially shaped swab cups have a tight tolerance on the wellbore casing or tubing and allow both lifting of the liquids from the wellbore and temporary removal of the hydrostatic column within the well.

The methods of longer term mechanical lifting include 'Beam Pump', 'Rod Pumping Hydraulic Pump Jack' and an 'electric submersible pump. both of which are lifting techniques Rathlin has identified as being suitable for the well(s). The techniques involve running a rod string into the well attached to a downhole pump located in the bottom of the tubing string. The rods are then lifted and lowered into the well by the surface equipment.

If larger quantities of associated gas are expected from the reservoir then the gas will flow up the annulus and be directed straight from the wellhead to the gas incineration unit, whilst the rest of the fluids will be handled as previously described.

In both instances the gas will be separated from produced fluids by physical separation, again this does not produce any additional waste streams, and the management of each waste stream will remain the same as currently permitted.

A downhole pump does not work effectively when completing a gas reservoir. Downhole pumps are required to be submerged in liquid to avoid becoming 'gas locked'. Therefore, the operator requires certainty that the reservoir fluids to be lifted are mainly liquids prior to running a completion with a downhole pump.

As it is not possible to be certain of the reservoir fluids that will be encountered in an exploration well, a gas lift may be necessary to evacuate the borehole of wellbore liquids to flow reservoir fluids into the well to ascertain their composition in the first instance.

Furthermore, if the reservoir liquids are known to have a high concentration of gas, a downhole pump would not be run but a means to evacuate the wellbore of liquids maybe required. In this instance a gas lift may be deemed the most effective method.

The Leak Detection and Repair Plan and Fugitive Risk Assessment provides for review following installation of the well test equipment and shall therefore be revised following installation of equipment, prior to commencement of operations and as part of its inspection programme. The mechanical lifting equipment will be included within the Leak Detection and Repair Plan, the Odour Risk Assessment and the Environmental Risk Assessment.

The waste associated with this operation is the same as previously assessed and will be managed at surface as previously described.

6.10 Production Operations

The main phase of the proposed development is the production of oil and/or gas from the WNA wellsite. During the development it is anticipated that an increasing number of wells will be drilled and eventually brought online into production.

Production will be conducted through surface-based equipment, which provides for:

- Shutting in the well at any time with remotely operable safety valves;
- Control of the production via a "choke manifold";
- Flow of produced reservoir fluids through pipework;
- Separation of the produced fluids into individually controllable and metered flow streams; and
- Storage of produced oil and produced water in segregated, vented tanks.

Produced fluids (oil and production water) will either free flow to the surface naturally or with the aid of pumps, artificially lifting fluids to surface.

At surface, produced fluids and natural gas may be diverted by pipework to a crude oil heater, preheating the fluid to aid in the three phase separation process, which will separate out oil, water (if present) and natural gas. Oil, which for clarity is not a waste, will be diverted via pipework to dedicated storage tanks onsite for subsequent offsite removal by a licenced haulier to a permitted refinery for sale.

Water, if present, will be diverted via pipework to dedicated storage tanks onsite for subsequent offsite removal by a licenced haulier to either Environment Agency permitted water treatment facility where it is processed, treated and discharged in accordance with the permitted controls of the water treatment facility.

Water produced during hydrocarbon production has the potential to contain low levels of Naturally Occurring Radioactive Material (NORM). A competent Radiation Protection Supervisor (RPS) and/or Radioactive Waste Advisor (RWA) shall be appointed to ensure that NORM is managed correctly.

Waste Natural Gas will be managed in accordance with BAT as disclosed within the Waste Gas Management Plan.

During production operations drilling and testing on subsequent wells may also be taking place resulting in simultaneous operations.

6.11 Discharge of Surface Water

As with the previous arrangements at the WNA Wellsite surface water collected on the active area of the site will be collected within the containment system and shall be the subject of treatment prior to being discharged into the nearby watercourse. It is proposed to expand the current containment system to facilitate the larger site footprint, however the greenfield run-off rate shall remain the same and the mitigation measures currently in place shall continue to operate.

It is the intention of Rathlin to continue to discharge surface water to the nearby surface water course via an installed Class 1 Oil Separator during period of normal operations i.e. production or suspension. Rathlin consider the risk of contamination during normal operations as being low when compared to that of workovers or other exploratory operations, due to all hazardous substances being contained within a secondary containment system.

A Surface Water Management Plan has been developed for the proposed activities.

6.12 Well Abandonment and Partial Well Abandonment

In the event that the well(s) is not successful in establishing commercially producible petroleum or the well comes to the end of its producing life, the well(s) will be abandoned in accordance with Oil & Gas UK Guidelines for the suspension and abandonment of wells, which requires all distinct permeable zones penetrated by the well to be isolated from each other and from surface by a minimum of one permanent barrier. If any permeable zone penetrated by the well is hydrocarbon-bearing or over-pressured and water-bearing then the requirement is for two permanent barriers from surface, the second barrier being a back-up to the first.

In addition to the Oil & Gas UK Guidelines for the suspension and abandonment of wells, the well abandonment(s) 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

The Oil and Gas UK guidelines stipulate a well must be constructed by taking into consideration the abandonment of the borehole. Therefore, the initial design and construction of the well(s) takes into consideration the permeable zones encountered during the drilling operation and whether any of these zones are hydrocarbon-bearing or over-pressured and water-bearing.

Based on a borehole construction, which complies with Oil & Gas UK guidance for the suspension and abandonment of wells, the internal section of last cemented casing sting will be subject to well abandonment. The operation involves the setting of cement barriers, extended above and below the permeable zone(s).

Once the well(s) is abandoned, the casing strings will be mechanically cut off at 1.5m below original ground level and a steel plate welded over the top. The pre-cast concrete drilling cellar would then be removed, and the site restored to its former use.

7. PRODUCTION OF EXTRACTIVE WASTE

A list of the waste generating activities associated with operations at the WNA Wellsite is outlined below.

- Well Maintenance;
- Drilling of up to six additional boreholes;
- Well Testing of up to six additional boreholes;
- Well Treatments;
- Long term production of up to eight boreholes; and
- Well Suspension and Abandonment.

The anticipated extractive wastes which may be generated from these activities include:

- Well Suspension Brine;
- Metal Debris;
- Spent Acid/Alkali;
- Hydrocarbon-Based Carrier Fluid;
- Proppant (sand);
- Nitrogen;
- Natural Gas and oil; and
- Formation Water.

The arrangements for the management of extractive waste during the WNA operations are detailed in the Waste Management Plan, submitted in support of the environmental permit application.

8. SUPPORTING DOCUMENTATION

In accordance with the requirements of EPR2016 the following documents have been prepared in support of an application for an Environmental Permit under EPR2016.

- Site Location and Site Layout Plans. RE-EPRA-WNA-SP-004;
- Waste Management Plan. RE-EPRA-WNA-WMP-005;
- Site Condition Report. RE-EPRA-WNA-SCR-006;
- Environmental Risk Assessment. RE-EPRA-WNA-ERA-007;
- Chemical Inventory. RE-EPRA-WNA-CI-008; and
- Odour Management Plan.