West Newton B Wellsite Non-Technical Summary Exploratory Operations

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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. Connaught Oil & Gas Ltd is an international petroleum exploration, development and production company with operations in Western Canada and the United Kingdom. The experienced senior management team has an average of 30 years of direct operating experience in Canada and internationally. The United Kingdom operations are conducted through Rathlin Energy (UK) Limited and are directed from the Rathlin Energy office in London.

Rathlin Energy is engaged in the exploration and production of petroleum onshore United Kingdom and holds 100% interest in Petroleum Exploration and Development Licence (PEDL) 183, within which it has drilled two exploration boreholes, Crawberry Hill 1 and West Newton 1.

The West Newton B exploratory operation was the subject of a planning application submitted in December 2014 to East Riding of Yorkshire Council, which was subsequently approved in June 2015.

1.1 Site Details

The proposed West Newton B exploratory operations are being undertaken at the following location:

West Newton B Wellsite
Rathlin Energy (UK) Limited
Crook Lane
West Newton
Hull
HU11 4LP

National Grid Ref: Easting: 520425
Northing: 437202

Site Area: 1.25 hectares.

Waste Registration Number: To be applied for immediately prior to site construction.

The site surface boundary is detailed in green on the site plans included within document RE-05-EPRA-WNB-SP-004.

2 SCOPE

This Non-Technical Summary is applicable to the West Newton B wellsite and all exploratory operations permitted therein, in accordance with planning consent. It is applicable to Rathlin Energy, its contractors and subcontractors and can be used in support of applications to the Environment Agency under the Environmental Permitting (England and Wales) Regulations 2010, as amended, where there is a requirement to provide a Non-Technical Summary.

3 DEFINITIONS

Active Area:	The area of the wellsite designated for the drilling operation which has a perimeter drainage ditch and is lined with an environmental membrane.
AOD:	Above Ordnance Datum
BAT:	Best Available Technique
BGL:	Below Ground Level
Class 1 SPEL:	A separator designed to achieve a concentration of less than 5mg/l of oil within surface water discharges. Class 1 are approved by the Environment Agency.
DST:	A Drill Stem Test is a test involving the drill string with a downhole shut-in valve allowing the well to be opened and closed down the well via the drill pipe. A DST can be used for establishing reservoir pressures, permeability and determining the nature of any formation fluid.
EA:	Environment Agency
EMS:	Environmental Management System
EPR 2010:	Environmental Permitting (England and Wales) Regulations 2010
FIT:	Formation Integrity Test is the method to test the strength of a formation and integrity of the casing shoe by increasing bottom hole pressure following the installation of casing and drilling out of the shoe (next hole section).
Hazardous Waste:	As defined by Article 3(2), 7 and Annex III of the Waste Framework Directive
HCI:	Hydrochloric Acid (Aqueous Solution)
HDPE:	High-Density Polyethylene
HSE:	Health, Safety and Environment
Inert Waste:	A waste that does not undergo any significant physical, chemical or biological transformations. Does not give rise to environmental pollution or harmful to health
LCM:	Lost Circulation Material
m:	Metres
MMSCF:	Million Standard Cubic Feet

Non Active Area: The area of the wellsite designated for the siting of office accommodation, welfare facilities and parking

Non Hazardous Waste: A waste which is not classified as inert or hazardous waste

Open hole: A hole section within the wellbore that has been drilled but no casing has been installed

Pollutant: Any substance liable to cause pollution

Pollution: A direct or indirect introduction, as a result of human activity, of substances or heat into the air, water land which may;

a) Be harmful to human health or the quality of aquatic ecosystems or terrestrial ecosystems directly depending on aquatic ecosystems

b) Result in damage to material property

c) Impair or interfere with amenities or other legitimate uses of the environment

Section TD: The total depth of the hole section being drilled

SMS: Safety Management System;

Spent Acid: Calcium chloride, carbon dioxide and water

TD: Total Depth

TVD KB: True Vertical Depth below Kelly Bushing

WNB: West Newton B wellsite

WN1: West Newton 1 Well

4 ENVIRONMENTAL LEGISLATION AND APPLICABILITY

Activities associated with the exploration for oil and gas onshore in England fall to be considered within the scope of a number of pieces of environmental legislation. A review of the proposed West Newton B exploratory operations against environmental legislation has identified the following legislation as being applicable to the West Newton B exploratory operations.

4.1 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 of the West Newton B wells will be the subject of a WR11 application; the application will be included within Appendix 6 of 'West Newton B Wellsite Site Condition Report (RE-05-EPRA-WNB-SCR-006) provided in support the environmental permit application.

4.2 Environmental Permitting (England and Wales) Regulations 2010

A number of activities to be undertaken during the West Newton B exploratory operations may require permitting under the Environmental Permitting (England and Wales) Regulations 2010, as amended (EPR 2010).

4.2.1 A Groundwater Activity

Under Schedule 22 of EPR 2010, 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 West Newton B exploratory operations will include an acid wash and squeeze and liquid carbon dioxide (CO_2) injection within both the Cadeby and the Kirkham Abbey formations, should it be deemed necessary to do so and will be based on initial flowrates encountered. This activity falls within the definition of a Groundwater Activity under Schedule 22 of EPR 2010.

Schedule 22 3 (3) of EPR 2010 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, a description of the operations, together with a technical justification to exclude these operations under Schedule 22 paragraph 3 (3) of EPR 2010, is included within Section 5 of this Non-Technical Summary.

4.2.2 A Mining Waste Activity

The Mining Waste Directive 2006/21/EC require that extractive wastes are managed in such a way that it minimises harm to human health and the impact on the environment. It applies to the management of waste resulting from the prospecting, extracting, treatment and storage of mineral resources and working quarries, which the Mining Waste Directive refers to as extractive waste. The waste can take the form of a solid, liquid or gas.

Schedule 20 of EPR 2010 defines a mining waste operation as being *the management of extractive waste, whether or not it involves a waste facility.* Under EPR 2010, an environmental permit is required to authorise a mining waste operation.

The West Newton B exploratory operations will involve the management of extractive waste not involving a waste facility.

4.2.3 Industrial Emissions Activity

The Industrial Emissions Directive 2010/75/EU lays down rules on integrated prevention of pollution arising from industrial activities, whilst also laying down rules designed to prevent or, where that is not practicable, to reduce emissions into the air, water and land and to prevent the generation of waste, in order to achieve a high level of protection of the environment taken as a whole.

Part 2 of the EPR 2010 details a number of activities that are classified as an Industrial Emissions activity these include but are not limited to:

- Chapter 1 - Energy Activities
  - Section 1.1 - Combustions Activities
  - Section 1.2 - Gasification, Liquefaction and Refining Activities
- Chapter 2 - Production and Processing of Metals
  - Section 2.1 - Ferrous Metals
  - Section 2.2 - Non-Ferrous Metals
- Chapter 3 - Mineral Industries
  - Section 3.1 - Production of Cement and Lime
  - Section 3.2 - Activities Involving Asbestos
- Chapter 4 - The Chemical Industry
  - Section 4.1 - Organic Chemicals
  - Section 4.2 - Inorganic Chemicals
- Chapter 5 - Waste Management
  - Section 5.1 - Incineration and Co incineration of Waste
  - Section 5.2 - Disposal of Waste by Landfill
- Chapter6 – Other Activities
  - Section 6.1 - Paper, Pulp and Board Manufacturing Activities
  - Section 6.2 - Carbon Activities

Regulation 35 of the Environmental Permitting (England and Wales) (Amended) Regulations 2013, which transposes the requirements of the Industrial Emissions Directive, requires an environmental permit to authorise an installation operation for the incineration and co-incineration waste specifically:

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;

(b) The incineration of non-hazardous waste in a waste incineration plant or waste co-incineration plant with a capacity exceeding 3 tonnes per hour; and

(c) The incineration, other than incidentally in the course of burning landfill gas or solid or liquid waste, of any gaseous compound containing halogens.".

Part B

(a) The incineration in a small waste incineration plant with an aggregate capacity of 50 kilogrammes or more per hour of the following waste—

(i) vegetable waste from agriculture and forestry;
(ii) vegetable waste from the food processing industry, if the heat generated is recovered;
(iii) fibrous vegetable waste from virgin pulp production and from production of paper from pulp, if it is co-incinerated at the place of production and the heat generated is recovered;
(iv) cork waste;
(v) wood waste with the exception of wood waste which may contain halogenated organic compounds or heavy metals as a result of treatment with wood preservatives or coatings;
(vi) animal carcasses.".

The West Newton B exploratory operations will involve the incineration of natural gas exceeding 10 tonnes per day and, therefore, a permit to authorise an installation operation for the incineration of natural gas is required.

4.2.4 A Radioactive Substances Activity

Schedule 23 of EPR 2010 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 EPR 2010 and its subsequent disposal requires an environmental permit to authorise a radioactive substances activity.

The West Newton B exploratory operations will involve the circulating to surface of fluids exposed to the formation during drilling and/or well testing, which may or may not contain NORM in concentrations exceeding those set out in Table 1 of Schedule 23 of EPR 2010.

Rathlin Energy will apply for a Standard Rules (SR2014) No 4 permit for the accumulation and disposal of formation water, as the production of oil and gas falls within the classification of a NORM Industrial Activity. The application will be submitted separately and will be timed such that the issuing of a Radioactive Substances Activity Permit will coincide with the issuing of all other permits associated with the West Newton B exploratory operations.

4.2.5 Water Discharge Activity & Groundwater (point source) Activity

Schedule 21 of EPR 2010 relates to water discharge activities. Although Rathlin Energy proposes to install a Class 1 SPEL Oil – Water Separator, following discussions with the Environment Agency, an application to discharge clean surface run-off will be required, as materials stored onsite may pose a hazard to surface water and groundwater if released. The issuing of a permit for the discharge of clean surface run-off water provides the Environment Agency the ability to limit and subsequently monitor such discharge activities.

The discharge of clean surface run-off water from the West Newton B wellsite is the subject of a Surface Water Management Plan, which is provided within Appendix 2 of the Site Condition Report (RE-05-EPRA-WNB-SCR-006).

5 DESCRIPTION OF THE FACILITY

5.1 Site Location

The West Newton B wellsite is located within open countryside in the county of East Yorkshire, within the Parish of Burton Constable. The site is currently in agricultural use (arable). The southern boundary is formed by Crook Lane. No physical boundary exists between Crook Lane and the application site. To the north and west of the site there are no immediate boundaries, as the site is located within an agricultural field.

A private access track is planned to be constructed prior to constructing the West Newton B wellsite. For clarity, the construction of the access track does not generate any extracted waste and therefore is not for consideration within the permit application.

5.2 Site Description and Current Status

The proposed West Newton B wellsite lies within arable farm land. The site boundary is detailed in green on site plans included within RE-05-EPRA-WNB-SP-004.

The surrounding landscape consists of flat agricultural fields with no hedgerows separating the road from the site boundary.

No utilities are present within the site area.

The wider surrounding area consists of rural landscape with small villages. An established gas storage facility, Aldbrough Gas Storage, is located 5km to the east of the proposed wellsite and a major petrochemical park, including a power generation facility, Saltend Chemical Park, is located 10km south southwest of the proposed wellsite.

5.3 Waste Generating Activities

A summary of the proposed West Newton B exploratory operations is detailed below in chronological order, with a more detailed description of each activity provided within each subsection:

- Drilling of the first of two exploratory boreholes, including possible DSTs in both the Cadeby formation and the Kirkham Abbey formation;
- Complete and test up to two formations, including an acid wash and/or squeeze in the Cadeby formation (if required), followed by an extended well test and an acid wash and/or squeeze in the Kirkham Abbey formation (if required), followed by an extended well test;
- Drilling and testing of the second exploratory borehole (if required);
- Well abandonment(s); and
- Site restoration.

5.3.1 Wellsite Construction

Construction of the wellsite will result in a low amount of non-extractive wastes being produced, a description of which is provided below together with a description of the construction operation. For clarity, the wellsite construction does not generate extractive waste and therefore is not for consideration with the permit application.

The West Newton B wellsite will be constructed by initially excavating the topsoil and relocating it on the northern and western boundary of the wellsite. The topsoil, which will be stored on the wellsite for subsequent wellsite restoration, will be formed into a bund, which will provide partial screening of the wellsite. The subsoil will then be 'cut to fill', a method of removing subsoil from the higher areas of the wellsite and relocating it within the lower areas of the wellsite to create a level plateau.

Once the wellsite is level a ditch will be excavated around the perimeter of the active area of the wellsite. The perimeter ditch will form part of the wellsite containment, collecting and storing surface run-off water.

Following excavation of the perimeter ditch, the active area of the wellsite will be overlaid with a High Density Polyethylene (HDPE) membrane to provide wellsite integrity and ensure any run off water flows to the perimeter ditch for subsequent discharge or removal via road tanker and disposed at an Environment Agency licenced waste facility. The HDPE membrane is protected by two layers of non-woven geotextile matting placed above and below the membrane to ensure damage is not incurred and integrity of the active area of the wellsite is maintained. The HDPE membrane is integrity tested during installation to ensure complete containment of the active area of the wellsite.

The perimeter containment ditches will be open along the northern and upper western boundaries of the active area of the wellsite with the southern, eastern and lower western boundaries of the active area backfilled using a twin walled perforated plastic pipe and clean aggregate to maintain containment.

Stone aggregate will be used for the site surface. The stone aggregate is used for the surface of both the active and non active areas of the wellsite. Any stone aggregate that is surplus to requirement will either be transported back to the facility from whence it came or stored onsite for subsequent use should the need arise to maintain the wellsite surface and/or access track.

Two drilling cellars will be constructed within the centre of the active area of the wellsite and form a containment area from which each of the two (2) permitted wells will be drilled, whilst also housing the wellheads. A large diameter casing, circa 6m in length, is cemented below the base of the drilling cellar to protect the base of the drilling cellar from being undermined during the drilling of the surface conductor. It also provides a conduit within which drill cuttings can circulate to surface for subsequent collection and off site disposed at an Environment Agency licenced waste facility. The drilling cellars are constructed around the large diameter casings using precast concrete rings encased in a concrete jacket surround. The impermeable membrane is incorporated into the cellar construction to maintain environmental integrity of the active area of the wellsite.

A concrete drilling pad will be constructed at surface, immediately surrounding the drilling cellars. The concrete pad will be sized and constructed to take the ground loading of the drilling rig.

Cement used for the construction of the drilling cellars and surface drilling pad will be carefully calculated to minimise waste. Cement surplus to requirement will be returned to the supplier and be reused or recycled minimising waste produced.

No wellsite construction activities result in the production of extractive waste as all excavated subsoils will be stored on site for subsequent reuse in the restoration of the wellsite.

5.3.2 Management of Surface Water Run-Off Water

The active area of the wellsite has been designed to provide complete environmental containment of surface run-off water and any potential surface pollutants during the exploratory operations.

During periods of activity within the active area of the wellsite, all water contained within the perimeter containment ditches will be removed via road tanker and disposed at an Environment Agency licenced waste facility.

During periods of inactivity within the active area of the wellsite, water contained within the perimeter containment ditch will be tested to confirm it is suitable for discharge via the Class 1 SPEL oil-water separator to an adjacent land drain, in accordance with a Surface Water Management Plan (RE-05-EPRA-WNB-SWMP-001), provided as Appendix 2 within the Site Condition Report. If the results of the test identify that the surface run-off water is not suitable for discharge, the water will be removed via road tanker and disposed at an Environment Agency licenced waste facility.

5.3.3 Drilling Operations

Rathlin Energy is applying for permission to drill and test up to two (2) exploratory boreholes from the West Newton B wellsite. The second borehole may be required to investigate and test the extents of any potential petroleum reservoir encountered during the drilling and testing of the first borehole. The second borehole may also be required to investigate and test a formation that, through interpretation, was predicted but not encountered during the drilling of the first borehole.

A description of the drilling and construction of the first exploratory borehole, WNB-1 has been provided below together with a well schematic presented as Figure 5.1.

The second of the two exploratory boreholes will be drilled and constructed in a similar way to the first. The exact design and construction will be determined using information obtained during the initial drilling operation.

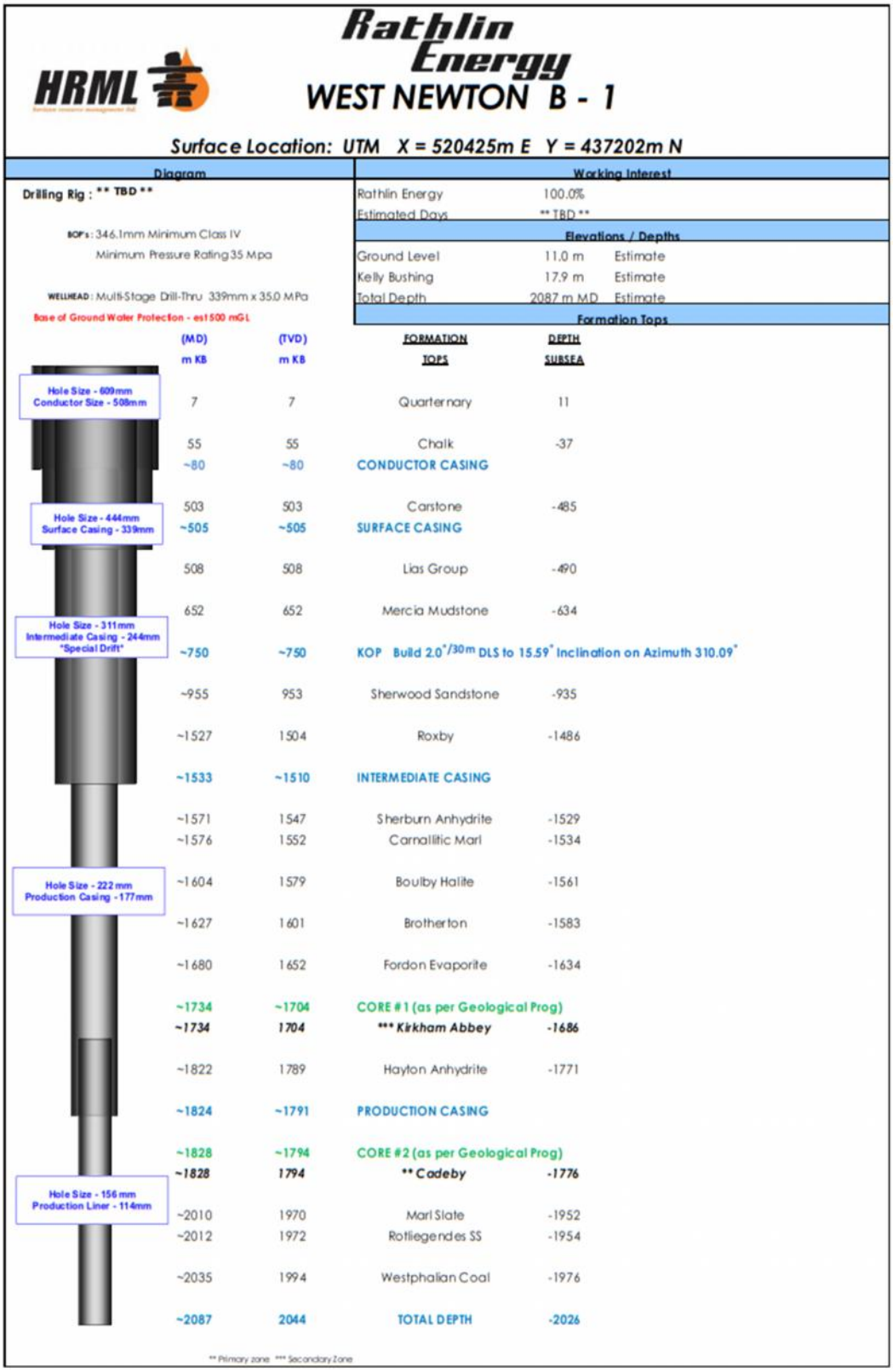


Figure 5.1: WNB-1 Well Schematic

5.3.3.1 Surface Conductor

Upon completion of the site construction, a conductor casing will be drilled and cemented in the top section of the wellbore. The top section will be drilled with a geotechnical drilling rig to a depth of circa 80m TVD KB. This initial section will be typically drilled with air and/or water. Once the 24" (609mm) hole has been drilled a 20" (508mm) conductor casing will be run and cemented back to surface.

5.3.3.2 Main Drilling Operation

Once the surface conductor has been set, a conventional oilfield drilling rig will be used to drill the remainder of the exploratory borehole, which is described below in order of sequence.

Hole Section 17 ½"

A 17 ½" (444mm) hole will be drilled from circa 80m TVD KB to circa 505m TVD KB using a bentonite polymer water based mud system and will Section TD within the lower Jurassic formation.

Once this hole section has been drilled a 13 $^{3}/_{8}$" (339mm) casing will be run and cemented back to surface. The 13 $^{3}/_{8}$" (339mm) casing will provide isolation of the shallow aquifer located within the Upper Cretaceous formations. Once cemented to surface the casing will be pressure tested to confirm its integrity.

A Formation Integrity Test will be carried out on the 13 $^{3}/_{8}$" (339mm) casing shoe immediately following the drilling out of the shoe, at the start of drilling the next hole section.

Hole Section 12 ¼"

A 12 ¼" (311mm) hole will be drilled from a depth of circa 505m TVD KB to a depth of circa 1,510m TVD KB using a KCl polymer water based mud system and will Section TD within the Permian formation.

Once this hole section has been drilled a 9 $^{5}/_{8}$" (244mm) casing will be run and cemented back to surface. The 9 $^{5}/_{8}$" (244mm) casing will then be pressure tested to confirm its integrity.

A Formation Integrity Test will be carried out on the 9 $^{5}/_{8}$" (244mm) casing shoe immediately following the drilling out of the shoe, at the start of drilling the next hole section.

Hole Section 8 ½"

The 8 ½" (222mm) hole section will be drilled from circa 1,515m TVD KB using a mixed salt saturated polymer water based mud system to a final depth of approximately 2,044m TVD KB, at the base of the Permian formation. The Section TD is subject to change and may result in the 8 ½" (222mm) hole Section TD being shallower than 2,044m TVD KB with the remaining formation to 2,044m TVD KB being drilled in a 6" (156mm) hole.

Once drilled, a 7" (177mm) casing will be run in and cemented back to surface. The 7" (177mm) casing will then be pressure tested to confirm its integrity. In the event that the Section TD is shallower than 2,044m TVD KB and the remaining formation is to be drilled in 6" (156mm) hole, a Formation Integrity Test will be carried out on the 7" (177mm) casing shoe immediately following the drilling out of the shoe, at the start of drilling the 6" (156mm) hole section.

Hole Section 6"

Rathlin Energy would like to retain the ability to drill from the base of the $9\,^{5}/_{8}$" (244mm) casing shoe to 2,044m TVD KB in two hole sections, 8 ½" (222mm) hole and a 6" (156mm) hole. This will result in the depth of the 8 ½" (222mm) hole Section TD being shallower than 2,044m TVD KB and the remaining formation to 2,044m TVD KB being drilled in 6" (156mm) hole. For clarity, this option would not deepen the overall wellbore depth.

For the purpose of this Non-Technical Summary, waste volumes have been provided based on a 8 ½" (222mm) hole being drilled from circa 1515m TVD KB to 2,044m TVD KB, which is considered a worst case scenario with respect to extracted waste volumes. The possible part drilling of this section in 6" (156mm) will be result in less extractive waste being generated.

In the event that the 8 ½" (222mm) hole TD is shallower than 2,044m TVD KB and the remaining formation is drilled in 6" (156mm) hole, a 4 ½" (114mm) liner would be run to TD and cemented back to inside the 7" (177mm) casing to a depth of circa 1,700m TVD KB. The 4 ½" (114mm) casing will then be pressure tested to confirm its integrity.

5.3.3.3 Drill Stem Testing

A Drill Stem Test (DST) may be carried out during the drilling operation to determine whether petroleum is present in the target formation(s). It is undertaken in open hole, prior to running and setting casing across the target formation(s).

A DST is a short duration test to provide an initial analysis of the petroleum composition and its flow characteristics within the formation. The initial information obtained during the DST will be used to inform a decision whether to run casing across the formation and, if so, to establish a more detailed and specific longer term testing programme, often referred to as an Extended Well Test (EWT). Such longer term testing is also a consideration within the West Newton B environmental permit application, although it will be contingent on the success of the DST.

In order to perform a DST, a packer will be run on drill pipe and set immediately above the formation being tested to provide isolation from the wellbore. The formation will then be flowed, with fluids being flowed to surface through the drill pipe.

Once at surface, fluids will be diverted by temporary pipework to a three phase separator, which will separate out oil, gas and produced liquids. Oil and produced liquids will be diverted via temporary pipework to dedicated storage tanks onsite for subsequent offsite removal for sale and disposal

respectively. Oil, which for clarity is not considered a waste, will be transported by a licenced haulier to a permitted refinery for sale. Produced liquids, which are considered a waste, will be transported 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 diverted by temporary pipework to a ground flare located onsite for incineration. At the point of incineration the natural gas is considered a waste. The flare is equipped with a propane fuelled permanently lit pilot, which ensures that ignition takes place as soon as natural gas is present and reignites if there is a break in flow. Air dispersion modelling and assessment of the flare has been undertaken and is included as Appendix 5 of the Waste Management Plan. The flare proposed for the West Newton B exploratory operations is a single tip shrouded flare with a 'tube type' burner provided by PW Well Services Limited, which is considered BAT by Rathlin Energy and has been previously approved by the Environment Agency for use at the Crawberry Hill wellsite during well testing operations.

Formation water produced during the DST 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).

5.3.4 Well Completion and Testing Operations

In addition to a DST, geological logging is undertaken during well construction to determine whether formations encountered during drilling may contain petroleum. The borehole logs assist Rathlin Energy in determining specific zones, which justify subsequent testing.

Well completion and testing may involve various different processes, all of which are intended to obtain a greater understanding of the formation properties and ultimately determine whether the formations are capable of producing commercial quantities of petroleum. Well testing process does vary, depending on the formation being tested. An overview of the various well testing processes to be undertaken during the West Newton B exploratory operations is detailed below and will be undertaken following the running and setting of casing across the target formation(s).

In order to establish communication between the formation(s) being tested and the wellbore, perforating guns will be run into the wellbore and fired. The perforating operation involves the use of shaped explosive charges, which are set within a perforating gun assembly and orientated for individual requirements. Upon detonation from surface, each shaped charge produces a jet, which

penetrates the casing and the formation, providing a direct communication between the formation and the wellbore.

The perforating operation, in particular the use of shaped explosive charges, is regulated by the Police Authority and the Health and Safety Executive. For the purpose of this Non-Technical Summary, only the management of extractive waste associated with the perforating operation will be regulated by the Environment Agency.

Once the casing has been perforated, the fired perforating guns will be brought back to surface.

5.3.4.1 Acid Wash/Squeeze and Flow Test within Upper Permian

To improve the flow of petroleum within the Upper Permian formation, an acid, most commonly hydrochloric acid (HCl) at 15% concentration with water (i.e. 150kg of HCl with 1,000kg of water), is applied to the formation through the wellbore. The operation is very much akin to acidisation of boreholes in the water well industry and results in high permeability channels through which water or petroleum can flow.

An acid wash is applied using low pressure and can be used to clean out the natural fractures, having potentially been blocked as a result of the initial drilling operation. An acid squeeze is applying the acid to the formation under pressure not exceeding the fracture pressure of the formation, resulting in the acid being squeezed through the natural fractures within the formation and increasing the near hole permeability.

The proposed dilution of hydrochloric acid is 15%, which is circulated across the perforations using $1m^3$ of HCl solution. The process of washing the perforations is repeated a further four times. Following the washing of the perforations, HCl is then selectively squeezed into the formation at $1m^3$ of HCl per metre of perforation.

It is anticipated that between $6m^3$ to $11m^3$ of HCl will be pumped into the formation during the operation, with all spent acid being recovered to surface.

If more than one interval within the Permian interval is to be tested, the operation will be repeated.

If required, the acid wash and squeeze will be performed within the Upper Permian reservoir targets.

The HCl reacts with the calcite through dissolution to produce carbon dioxide (CO_2), water (H_2O) and chloride ions (Cl). The chloride ions exist in the water and pair to form calcium chloride ($CaCl_2$). The chemical equation is as follows:

$2HCl + CaCO_3 \rightarrow CaCl_2 + H_2O + CO_2$

Calcium chloride (salt) is not a hazardous substance and must therefore be considered as a non-hazardous pollutant.

Formation water produced in petroleum production wells in North Yorkshire from the Permian interval is considered representative of the formation water anticipated within the Permian interval

at West Newton B, East Riding of Yorkshire with a natural salinity of some 349,000mg/l. The Permian interval lies at a depth of some 1,400m below ground level (BGL) and is isolated from near surface aquifers, groundwater and those users and the environment dependent on them by some 1,150m of overlying low permeability formations.

Deeper aquifers within the Jurassic, Triassic and Permian are not considered to be important receptors due to their depth and likely high salinity or mineralised groundwater quality.

The quantity and concentration of acid introduced to the formation must be considered in the context of the naturally occurring concentrations in the receiving water. In this case, given the natural salinity levels of the Permian interval in the North Yorkshire wells and this being considered representative of the same formation at West Newton B, the receiving water is hyper-saline and the addition of the calcium carbonate as a result of introducing acid to the formation will obviate any present or future danger of deterioration in the quality of the receiving groundwater.

Whilst the injection of hydrochloric acid 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 EPR 2010. The acid wash/squeeze within the Permian Carbonate does not, therefore, require a groundwater permit.

5.3.4.2 Liquid CO_2 Injection

The purpose of CO_2 injection 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 injection, CO_2 injection allows for greater fluid volume injection, which in turn provides greater formation penetration rates and the recovery of wellbore debris.

Each CO_2 injection treatment requires circa $2m^3$ and $3m^3$ litres of liquid CO_2 per 10m interval being treated, which is pumped in liquid state from surface through the wellbore and into the formation.

Due to the temperature of the formation, 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 formation fluid and near wellbore debris from the formation 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 separator.

Whilst the injection of liquid CO_2 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 EPR 2010 from requiring a groundwater activity permit.

5.3.4.3 Extended Well Test

The purpose of an extended well test is to analyse the flow characteristics of a formation, which may contain petroleum, over an extended period of time. The duration of the extended well test will differ, whether oil or gas is being flow tested. A description of the extended well test is provided below.

To aid the initial flow of petroleum, nitrogen may be injected into the wellbore to displace wellbore 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.

EWT - Oil

Ordinarily, to aid the flow of oil to surface, a pumping mechanism is required. For the purpose of an EWT, the pumping mechanism will be a beam pump (nodding donkey).Oil will be pumped to surface, together with any other produced fluids (condensate and formation water) and associated natural gas. Once at surface, produced fluids and associated natural gas will be diverted by temporary pipework to a three phase separator, which will separate out oil and condensate, formation water and associated 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.

Any associated natural gas separated during the three phase separation will be diverted by temporary pipework to a ground flare located onsite for incineration. At the point of incineration the natural gas is considered a waste. The flare is equipped with a propane fuelled permanently lit pilot, which ensures that ignition takes place as soon as natural gas is present and reignites if there is a break in flow. Air dispersion modelling and assessment of the flare has been undertaken and is included as Appendix 5 of the Waste Management Plan. The flare proposed for the West Newton B exploratory operations is a single tip shrouded flare with a 'tube type' burner provided by PW Well Services Limited, which is considered BAT by Rathlin Energy and has been previously approved by the Environment Agency for use at the Crawberry Hill wellsite during well testing operations.

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).

The duration of an EWT associated with oil bearing formations is likely to be up to ninety (90) days, during which time sufficient storage, in the form of cylindrical tanks, will be available on site,

supported by 24 hour tanker haulage to remove oil and condensate or formation water for sale or disposal respectively.

EWT - Natural Gas

Ordinarily, natural gas flows to surface unaided. Natural gas is flowed to surface, together with any produced fluids (oil, condensate and formation water). 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, 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.

Natural gas separated during the three phase separation will be diverted by temporary pipework to a ground flare located onsite for incineration. At the point of incineration the natural gas is considered a waste. The flare is equipped with a propane fuelled permanently lit pilot, which ensures that ignition takes place as soon as natural gas is present and reignites if there is a break in flow. Air dispersion modelling and assessment of the flare has been undertaken and is included as Appendix 5 of the Waste Management Plan. The flare proposed for the West Newton B exploratory operations is a single tip shrouded flare with a 'tube type' burner provided by PW Well Services Limited, which is considered BAT by Rathlin Energy and has been previously approved by the Environment Agency for use at the Crawberry Hill wellsite during well testing operations.

Should the formation be capable of flowing natural gas, a suitable flow rate for an EWT would be 53 tonnes (2.5mmscf) of natural gas per day, which for clarity exceeds the threshold values of 10 tonnes per day set out in Regulation 35 of EPR 2010, albeit for a short duration.

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).

The duration of an EWT associated with natural gas bearing formations is likely to be approximately fourteen (14) days, during which time sufficient storage, in the form of cylindrical tanks, will be available on site, supported by 24 hour tanker haulage to remove oil and condensate or formation water for sale or disposal respectively.

5.3.5 Drilling of the Second Borehole

For the purpose of this Non-Technical Summary, the design and construction of the second exploratory borehole will be similar to that of the first, insofar as the depths, borehole diameter and produced wastes. For clarity, the expected waste quantities detailed within section 6.3.1 of this Non-Technical Summary represents the construction and subsequent testing of a single borehole.

The second borehole will be subject to a separate WR11 application to the Environment Agency, should a decision be taken to drill the second borehole.

5.3.6 Well Abandonment and Partial Well Abandonment

In the event that the well(s) is not successful in establishing commercially producible petroleum, 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 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. Construction of the boreholes will therefore provide adequate sealing of these zones when cementing in the various steel casing strings, ensuring compliance with the Oil & Gas UK guidance.

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). Retainers are positioned within the internal casing string immediately below the required cement depth, which prevents the cement from moving or slumping during setting.

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.

5.4 Classification of the Operations

A review of the proposed West Newton B exploratory operations against applicable environmental legislation has identified the following classifications as being applicable to the wellsite.

5.4.1 Mining Waste Operation

The Environmental Permitting (England and Wales) Regulations 2010, as amended, transposes the requirements of the Mining Waste Directive 2006/21/EC, requires mining waste operations to be authorised. A mining waste operation is defined in Schedule 20 paragraph 2 (1) of EPR 2010 as *'the management of extractive waste, whether or not involving a mining waste facility*'.

For the purpose of this Non-Technical Summary, the West Newton B exploratory operations are classified as a mining waste operation, namely, the management of extractive waste not involving a waste facility.

5.4.2 Installation

Regulation 35 of the Environmental Permitting (England and Wales) (Amendments) Regulations 2013, which amends EPR 2010, transposes the requirements of the Industrial Emissions Directive 2010/75/EU, defines an 'installation' as an activity specified within Part 2 of Schedule 1 of EPR 2010, disposal or recovery of waste in waste incineration plants or in waste co-incineration plants for hazardous waste with a capacity exceeding 10 tonnes per day.

As the West Newton B exploratory operations anticipate the incineration of natural gas with a capacity exceeding 10 tonnes per day, albeit for a short duration, the West Newton B wellsite is expected to be classified as an installation under the Environmental Permitting (England and Wales) Regulations 2010.

5.4.3 Radioactive Substances Activity

Schedule 23 of EPR 2010 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 EPR 2010 and its subsequent disposal requires an environmental permit to authorise a radioactive substances activity.

5.4.4 Water Discharge Activity & Groundwater (Point Source) Activity

Schedule 21 of EPR 2010 relates to water discharge activities. Although Rathlin Energy proposes to install a Class 1 SPEL oil – water separator, following discussions with the Environment Agency, an application to discharge clean surface run-off will be required, as materials stored onsite may pose a hazard to surface water and groundwater if released. The issuing of a permit for the discharge of clean surface run-off water provides the Environment Agency the ability to limit and subsequently monitor such discharge activities.

6 EXTRACTIVE AND NON EXTRACTIVE WASTE MANAGEMENT

The following section describes the various extractive wastes arising from the West Newton B exploratory operation, their classification and anticipated quantities. Non-extractive wastes, which

are not subject to environmental permits under the Mining Waste Directive, are listed in Section 6.3.2.

This section also describes the objectives of Rathlin Energy to appropriately manage waste and how these objectives are achieved through waste minimisation, methods of treatment and disposal.

6.1 Operator Waste Objectives

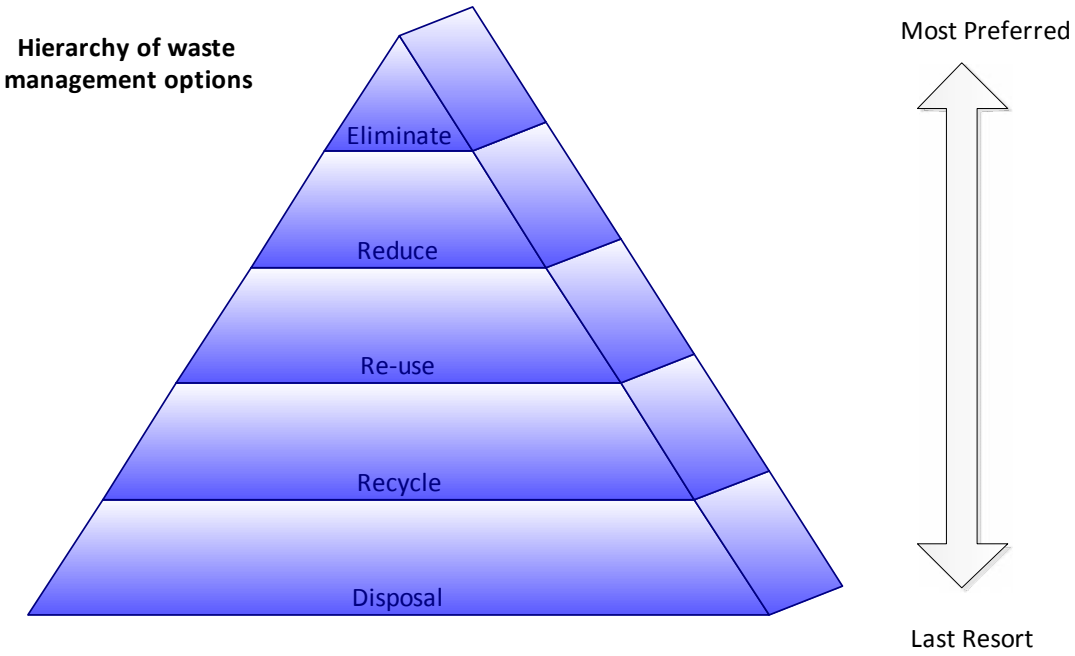
The Rathlin Energy policy on waste Duty of Care, waste segregation, waste handling and waste transfer are set out in the Rathlin Energy Environmental Policy Manual (RE-02-002), which is provided within Appendix 2 of the Waste Management Plan.

The site waste champion for the West Newton B wellsite is the Rathlin Energy HSE Adviser. He will:

- Promote awareness of the Waste Management Plan;
- Monitor and report on waste generation;
- Monitor and enforce waste segregation;
- Monitor the effectiveness of the Waste Management Plan;
- Form a good working relationship with the waste management contractor; and
- Encourage suggestions for better waste management onsite.

6.2 Waste Prevention and Minimisation

The following is an extract from the Rathlin Energy Environmental Policy Manual (RE-02-002), which details the hierarchy of waste management. This hierarchy of waste management has been used when assessing the appropriate waste management arrangements for extractive and non-extractive wastes arising from the West Newton B exploratory operations. Specific waste prevention and minimisation arrangements, together with treatment and disposal methods are provided within Section 6.3.



Eliminate the waste

Every effort will be made to eliminate the waste produced at source. Control measures will include:

- Avoiding packaged material where practicable;
- Ordering correct quantities;
- Avoiding damage by handling and storing correctly.

Reduce the amount of waste produced

This includes planning to reduce over ordering of materials, providing suppliers with sufficient information to supply correctly, avoiding damage or deterioration from poor handling or storage.

Re-use

Only dispose of waste which cannot economically or practically be re-used or recycled. Materials such as drilling fluids can be readily re-used.

Recycle

Waste will be segregated onsite to allow for recycling off site. Additionally, materials that are recycled **shall** be procured for use onsite where practicable and where specification permits.

Dispose

Waste that cannot be reused or recycled practicably **shall** be disposed of responsibly and in compliance with Rathlin Energy's duty of care obligations. All waste **shall** be removed from site by a licenced waste carrier to a licenced waste site.

6.3 Waste Description and Management Arrangements

An assessment of the potential extractive waste arising from the West Newton B exploratory operations has been undertaken. The potential waste, together with its classification, anticipated quantities, prevention, minimisation, treatment and disposal is provided within the section.

6.3.1 Extractive Waste

Waste Clays and Sand (Exploratory Well)

Waste Clays and Sand may be produced during drilling of the exploratory borehole commencing with the drilling and installation of a casing string known as a surface conductor. The drilling operation will be carried out using a waterwell drilling rig which will auger or conventionally drill the near surface clays and sands within which the surface conductor casing will be set and cemented into position. The clay and sand will be circulated out of the well and return to the surface where it is transferred to an open square tank. The clay and sand will be transported offsite via a licenced haulier to a permitted composting facility where it is blended into compost after compost has been sanitised.

- Classification Non Hazardous
- EWC Code 01 04 09
- Estimated Quantity 24m^3 per well
- On Site Storage 1 x 31m^3 Open Square Tank
- Storage Duration Maximum 7 Days
- Odour Potential No Odour Anticipated

Water Based Rock Cuttings (Exploratory Well)

Water Based Rock Cuttings are circulated to surface by the drilling mud system. They are removed by vibrating screens (shakers) into an open top tank, which is also a fluid separator tank. 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. Rock Cuttings will be transferred from the rock cuttings tank to a sealed road bulker by a hydraulic grab arm fitted to the rock cuttings tank and transported offsite via licenced haulier to a permitted composting facility where it is blended into compost after compost has been sanitised.

- Classification: Non Hazardous
- EWC Code 01 04 08
- Estimated Quantity 66m^3 per well
- On Site Storage 1 x 31m^3 Open Top Fluid Separator Tank (Drill Cuttings) and 1 x 20m^3 Open Top Tank (Centrifuge)
- Storage Duration Maximum 7 Days
- Odour Potential No Odour Anticipated

Salt Saturated and KCL Rock Cuttings (Exploratory Well)

Salt Saturated and KCL Rock Cuttings are circulated to surface by the drilling mud system. They are removed by vibrating screens (shakers) into an open top tank, which is also a fluid separator tank. 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. Rock Cuttings will be transferred from the rock cuttings tank to a sealed road bulker by a hydraulic grab arm fitted to the rock cuttings tank and transported offsite via licenced haulier to a permitted composting facility where it is blended into compost after compost has been sanitised.

- Classification: Non Hazardous
- EWC Code 01 05 08
- Estimated Quantity 101m^3 – (based on TD with 8 ½" hole) per well
- On Site Storage 1 x 31m^3 Open Top Fluid Separator Tank (Drill Cuttings) and 1 x 20m^3 Open Top Tank (Centrifuge)
- Storage Duration Maximum 7 Days
- Odour Potential No Odour Anticipated

Fresh Water Drilling Muds and Waste (Exploratory Well)

Fresh Water Drilling Muds and Waste will be produced during the drilling of the exploration well. Drilling muds are used 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 to prevent the uncontrolled release of natural gas or formation pressure. 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. Drilling muds are used in a closed loop system and become a waste when no longer required for use in the operation. In such an event the drilling mud will be transferred from the active mud system on the drilling rig to a vacuum tanker for removal offsite via licenced haulier to a permitted composting facility where it is blended into compost after compost has been sanitised.

- Classification Non Hazardous
- EWC Code 01 05 04
- Estimated Quantity 208m^3 per well
- On Site Storage Minimum 95m^3 Open Top Active Tank System on Rig. 1 x 31m^3 Open Top Tank (Drill Cuttings) and 1 x 20m^3 Open Top Tank (Centrifuge)
- Storage Duration Maximum 7 Days
- Odour Potential No Odour Anticipated

Chloride Containing Drilling Muds and Waste (Exploratory Well)

Chloride Containing Drilling Muds and Waste will be produced during the drilling of the exploration well. Drilling muds are used to aid in the drilling process by lubricating the drill head, circulating to surface the rock cuttings from the drilling process and for well control by maintaining a prescribed hydrostatic pressure within the well to prevent the uncontrolled release of natural gas or formation pressure. 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. Drilling muds become a waste when no longer required for use in the operation. In such an event the drilling mud will be transferred from the active mud system on the drilling rig to a vacuum tanker for removal offsite via licenced haulier to a permitted composting facility where it is blended into compost after compost has been sanitised.

- Classification Non Hazardous
- EWC Code 01 05 08
- Estimated Quantity 208m^3 per well
- On Site Storage Minimum 95m^3 Open Top Active Tank System on Rig. 1 x 31m^3 Open Top Tank (Drill Cuttings) and 1 x 20m^3 Open Top Tank (Centrifuge)
- Storage Duration Maximum 7 Days
- Odour Potential No Odour Anticipated

Cement (Casing Cementation)

On completion of the drilling of every hole section, steel casing is installed and cemented into position. Cement is batch mixed onsite and pumped through and out of the steel casing filling the void (annulus) between the borehole wall and the outside of the steel casing. In the shallow sections of the well, cement volumes are designed and required to return to surface and therefore cement as a waste is anticipated. Excess returns to surface will be transferred to a number of open top builders skips onsite for subsequent removal and disposal to an environmental agency permitted waste facility where it recycled as building rubble for use within the building industry.

- Classification Non Hazardous
- EWC Code 17 01 01
- Estimated Quantity 25m^3 per well
- On Site Storage 5 x 6m^3 Open Top Builder's Skip
- Storage Duration Maximum 7 Days
- Odour Potential No Odour Anticipated

Spent Hydrochloric Acid (Calcium Chloride)

Hydrochloric acid is used to wash and clean out natural fractures within carbonate formations, which may be blocked as a result of the initial drilling operations. In addition, hydrochloric acid is squeezed into the natural fractures of the carbonate formation under pressure, increasing the near wellbore permeability.

The reaction of the hydrochloric acid with the calcite produces calcium chloride and is unavoidable, which is classified as non-hazardous. The calcium chloride, a result of the reaction with the carbonate formation ($2HCl + CaCO_3 \rightarrow CaCl_2 + H_2O + CO_2$), will be reverse circulated out of the wellbore into $1m^3$ IBC containers and stored onsite for subsequent removal via a licenced haulier to 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.

- Classification Non Hazardous
- EWC Code 16 10 02
- Estimated Quantity $11m^3$ per well
- On Site Storage 11 x $1m^3$ IBC Containers (Bunded)
- Storage Duration Maximum 7 Days
- Odour Potential Refer to Odour Management Plan

Well Suspension Brine

The West Newton B well will be subject to a period of suspension using suspension brine and mechanical plugs. The brine is measured at 988g/ltr and is used to fill the wellbore to prevent the ingress of natural gas to the wellbore. Following suspension any further operations will require the suspension brine to be circulated out of the well to an onsite storage tank via temporary surface pipework. Once the suspension fluid has fully served its purpose at the wellsite, the suspension brine will be removed from site via a licenced haulier to 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.

- Classification Non Hazardous
- EWC Code 01 05 08
- Estimated Quantity $116m^3$ per well
- On Site Storage 1 x $60m^3$ Horizontal Cylindrical Closed Tank
- Storage Duration Maximum 7 Days
- Odour Potential Refer to Odour Management Plan

Carbon Dioxide

Liquid Carbon Dioxide is injected into the well to assist in the removal of all wellbore fluids and near wellbore debris sustained during the drilling operation, thus restoring near wellbore permeability. The use of liquid Carbon Dioxide can be classified as a closed loop system due to the carbon dioxide having been first taken from the atmosphere during its manufacture process where it is cooled to a liquid state before being injected into the well. The temperature of the formation changes the state of the Carbon Dioxide from a liquid to a gas, which is then returned to surface and vented back into the atmosphere. Carbon Dioxide that has been extracted from the atmosphere will be vented back into the atmosphere via the ground flare without any treatment being necessary.

- Classification Not Classified
- EWC Code 16 05 05
- Estimated Quantity Circa $2m^3$ and $3m^3$ per 10m interval being treated
- On Site Storage None – Vented to Atmosphere
- Storage Duration Not Applicable
- Odour Potential No Odour Anticipated

Nitrogen

Nitrogen is injected into the well to aid the initial lifting of wellbore fluids, thus reducing the hydrostatic pressure and allowing natural gas to flow to surface. As an inert gas, nitrogen that has been extracted from the atmosphere will be vented back into the atmosphere without any treatment being necessary.

- Classification Inert
- EWC Code Not Applicable
- Estimated Quantity Not Known at this Time
- On Site Storage None – Vented to Atmosphere
- Storage Duration Not Applicable
- Odour Potential No Odour Anticipated

Formation Water

Formation water may be produced during flow testing operations entrained with the petroleum. Formation water is separated from the petroleum on the surface using temporary fluid separation equipment and transferred via a temporary pipework to cylindrical storage tanks located onsite for offsite removal. The formation water 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 environmental 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.

- Classification Non Hazardous
- EWC Code 16 10 02
- Estimated Quantity $16m^3$ per test
- On Site Storage $4 \times 60m^3$ Horizontal Cylindrical Closed Tank
- Storage Duration Up to 3 Months to Allow for Radionuclide Analysis
- Odour Potential Refer to Odour Management Plan

Natural Gas

Natural Gas is likely to be produced during flow testing operations of the formation and flowed at different rates to determine characteristics of the formations, allowing Rathlin Energy to determine whether or not the reservoir is capable of producing commercial quantities of natural gas. A period of flowing the natural gas is followed by a period of shutting in the well to monitor pressure build up. At the point of incineration natural gas is considered a waste. Natural gas is separated from produced fluids at surface and diverted via temporary pipework to a ground flare located onsite for incineration. The ground flare will be fitted with a pilot and an electrical ignition system. The flare will also be continuously propane fed to allow for a continuous flame.

- Classification Hazardous
- EWC Code Not Applicable
- Estimated Quantity $66{,}940m^3$ per day (22 days) per well
- On Site Storage None – Incineration by Ground Flare
- Storage Duration Not Applicable
- Odour Potential Refer to Odour Management Plan

6.3.2 Non Extractive Waste

During the West Newton B exploratory operations there will be non extractive wastes generated on site:

- Surface run-off water
- Waste water and sewage
- Potential minor fuel oil spills
- Waste engine, gear and lubricating oils
- Waste hydraulic oils
- Oil rags and absorbents
- Waste oil filters
- Paper and cardboard
- Canteen waste
- Wood
- Metal

There will be no treatment or disposal of non extractive waste on site and any storage will be limited to temporary storage, pending collection. No temporary storage of non-extractive waste will exceed 12 months.

7 ENVIRONMENTAL RISK ASSESSMENT

An environmental risk assessment has been carried out in support of a permit application and is based upon the Horizontal Guidance Note H1 Environmental Risk Assessment for permits. (Version 2.1, December 2011) and the EPR6 14: How to comply with your environmental permit: Additional guidance for: mining waste operations, Version 2, February 2011.

The West Newton B Environmental Risk Assessment adopts the following H1 structure:

- Identify the risk from the activity
- Assess risks and check they are acceptable
- Justify appropriate measures to control the risk (if needed)
- Present the risk assessment

In assessing the risk the appropriate H1 annexes have been referenced:

- Annex (a) Amenity and accident risks from installations and waste operations
- Annex (d) Discharges to Surface Water
- Annex (f) Air emissions
- Annex (g) Disposal and recovery of waste produced onsite
- Annex (h) Global warming potential
- Annex (j) Groundwater

A copy of the environmental risk assessment, together with a supporting statement and conventional model is included within 'West Newton B Wellsite Environmental Risk Assessment' (RE-05-EPRA-WNB-007) provided in support the environmental permit application.

8 MEASURES TO MINIMISE ENVIRONMENTAL IMPACT

Measures to minimise the environmental impact of the operation have been incorporated as part of the initial site selection process, site design and construction through to subsequent exploration operations. The measures to mitigate long term environmental impact are:

- Site located suitable distance from residential properties
- Site located away from any statutory designated areas
- Baseline monitoring of ecology, noise, water
- Hydrogeological risk assessment
- Site design to include impermeable membrane and containment ditches
- Wellbore lifecycle design to protect groundwater
- Hierarchy of waste management
- Operating procedures and inductions
- Waste handling, storage and disposal regime
- Continuous Training and development
- Environmental monitoring
- Restoration and aftercare

9 CONTROL AND MONITORING OF WASTE

The environmental risk assessment has identified the requirement to control and monitor waste generated from the exploratory operation. The following waste shall be monitored:

9.1 Release to Groundwater

The potential for a release to ground water exists both at surface and within the subsurface.

9.1.1 Surface Release

Incorporated into the design of the wellsite is an impermeable membrane constructed using fully welded 1mm HDPE, protected above and below with non-needle punch geotextile. The impermeable membrane prevents surface fluids (mainly rainwater) penetrating the underlying subsoils. Surface fluids will migrate along the surface of the impermeable membrane to a perimeter ditch, where it will be contained.

Daily inspections of the drainage ditch will be undertaken to ensure the level does not exceed the maximum containment of the ditch. If the level is close to reaching the maximum containment of the ditch, the surface fluids will be tested. Disposal method will be as follows:

- During periods of activity within the active area of the wellsite, all water contained within the perimeter containment ditches will be removed via road tanker and disposed at an Environment Agency licenced waste facility.
- During periods of inactivity within the active area of the wellsite, water contained within the perimeter containment ditch will be tested to confirm it is suitable for discharge via the Class 1 SPEL oil-water separator to an adjacent land drain, in accordance with a Surface Water Management Plan (RE-05-EPRA-WNB-SWMP-001), provided as Appendix 2 within the Site Condition Report. If the results of the test identify that the surface run-off water is not suitable for discharge, the water will be removed via road tanker and disposed at an Environment Agency licenced waste facility.

A daily inspection of all tanks and other waste storage containers shall be undertaken to ensure they remain fit for purpose. The inspections will aid early identification of any potential release to site from equipment which deteriorates over time.

9.1.2 Subsurface Release

Drilling muds and other fluids used in well operations will be strictly monitored to ensure an accurate understanding of fluid volumes lost, gained or, in the case of cement, placed in the subsurface. During drilling operations, the volumes of fluids pumped, together with the volumes of fluid within the tanks will be continually monitored by a geological logging company (mud loggers). Such monitoring can identify loss of drilling muds to the formation. In the event that subsurface fluid losses occur, lost circulation material (LCM) is provided onsite to stem the losses.

9.2 Air Emissions

A scheme of air emissions monitoring will be implemented prior to the well being constructed, which will provide a baseline for air quality. The scheme will be implemented during well construction and will be conducted during the subsequent exploratory operations. The potential of releases to air has been assessed by way of an Air Dispersion Modelling and Report, which is included as Appendix 5 of the Waste Management Plan in support of the West Newton B environmental permit application.

9.3 Noise

Planning permission for the West Newton B wellsite required the submission of a Noise Impact Assessment. Noise monitoring was undertaken during fourth quarter of 2014 at the nearest residential locations. The Noise Impact Assessment concludes that noise levels associated with the operation (including all operations associated with extractive waste) are relatively low.

9.4 Contractor Performance

Rathlin Energy is ultimately responsible for any waste generated onsite during the West Newton B exploratory operations. Rathlin Energy will not delegate its responsibilities or accountabilities as Operator to a contractor.

Contractors, who are involved in the generating of waste and subsequent reuse, recycle or disposal will first have been selected in accordance with Rathlin Energy's Management of Contractor's Safety and Performance Standard (RE-03-002) and, under that standard, are then subject to periodic monitoring of their performance.

9.5 Security

Security of the wellsite is to be provided in the form of fencing and lockable gates. Additional fencing is to be provided around the wellhead when the site is unmanned. When the site is unmanned and a roaming security detail will be provided, carrying out routine visits to the wellsite.

During well operations, 24 hours onsite security will be provided. Security Officers will control access and egress to the wellsite and play a key role in the control of personnel in the event of an emergency situation, in accordance with the Site Safety Document, a requirement of the Borehole Sites and Operations Regulations 1995.

9.6 Complaints

In the event that a complaint is received from stakeholders, including neighbours, the complaint shall be recorded and investigated in accordance with Rathlin Energy's safety and environmental management system.

Complaints relating to the environment will be reported to the Environment Agency within the required timescales, as determined by the severity and environmental impact and/or permit conditions. In some cases, permit conditions may require notification the Environment Agency within 24 hours or without delay for a potentially polluting incident.

Following notification, measures to prevent reoccurrence will be agreed with the Environment Agency, together with a programme for implementation. Implementation of the actions will be monitored and the Environment Agency informed.

10 ENVIRONMENTAL INCIDENT MANAGEMENT

The potential for an environmental incident to occur during the operation is minimal. The wellsite and operations undertaken therein are designed to contain the source of any such incident within the wellbore and/or the wellsite.

10.1 Containment within the Wellbore

Well control equipment is deployed on the well in accordance with API RP53 'Recommended Practice for Blowout Prevention Equipment Systems for Drilling Wells'. Primary well control is achieved by the hydrostatic weight of the fluid column in the wellbore. Blowout prevention equipment is considered secondary well control in the event that the primary well control is compromised and is subject to a schedule of certification and testing, together with a requirement for those operating the equipment to be certified competent.

10.2 Wellsite Containment

Incorporated into the design of the wellsite is an impermeable membrane constructed using fully welded 1mm HDPE, which prevents any environmental spillages onsite penetrating the underlying subsoils and contains the spill within a containment ditch for subsequent disposal.

In addition to general spill containment and clean up equipment provided onsite, a comprehensively equipped environmental incident response trailer will be provided. The trailer contains equipment necessary to minimise and if possible contain an environmental incident in the unlikely event that the impermeable membrane or containment ditch is compromised. The equipment provides for damming of any nearby water course and subsequent clean up, including temporary bunding for used clean-up equipment prior to offsite disposal at an Environment Agency licenced waste facility.

In the very unlikely event of an environmental incident occurring beyond the capabilities of the equipment or personnel onsite then a specialist contractor, Veolia Environmental Services, based in Hull will be called to assist Rathlin Energy in dealing with the incident.

10.3 Fire Response

Whilst a fire is associated more so with the health and safety of the personnel onsite, a fire does have the potential to lead to an environmental incident. It is imperative, therefore, that any potential for a fire and subsequent emergency response is identified and included in the operational planning. The Site Safety Document, which is a requirement under Regulation 7 of the Boreholes Sites and Operations Regulations 1995, specifies the arrangements for identification and mitigation in the event of a fire, including consultation with the local Fire & Rescue Service.

Containment of any firefighting fluid is provided by the impermeable membrane incorporated in to the design of the wellsite. In the event that such requirements were to be necessary, continued monitoring of the containment ditch shall be implemented to ensure it does not exceed its containment capacity.

Additional water is available onsite and should be used to keep the areas adjacent to the fire cool to avoid any damage being sustained to the impermeable membrane.

10.4 Incident Reporting and Investigation

All incidents, no matter how minor, are reported in accordance with Rathlin Energy's Incident Accident Reporting and Investigation Standard (RE-03-008). The standard provides for the investigation of all incidents to ensure lessons are captured and actions implemented to avoid reoccurrence.

In addition, the standard provides for the notification to the relevant Regulatory Authority in the event of an incident which extends beyond the containment of the wellsite.

Environmental incidents will be reported to the Environment Agency within the required timescales, as determined by the severity and environmental impact of the incident and/or permit conditions. In some cases, permit conditions may require notification the Environment Agency within 24 hours or without delay for a potentially polluting incident.

Following notification, measures to prevent reoccurrence will be agreed with the Environment Agency, together with a programme for implementation. Implementation of the actions will be monitored and the Environment Agency informed.

11 ALTERATIONS TO THE PLAN

Any required changes or deviations from this plan are to be referred to the Rathlin Energy HSE & Planning Manager or to the site HSE Adviser in the first instance. No changes to or deviations from this plan are to be implemented until the required changes or deviations have been reviewed and approved by Rathlin Energy and the relevant approvals obtained in writing from the Environment Agency for any changes to the plans and operating techniques approved under the environmental permit to be issued.

Within the environmental permit there will be a requirement the operator, Rathlin Energy, to review the waste management plan every five (5) years and amend where necessary. The review date shall take place five (5) years from the date of permit issue. Reviews and amendments will also be required in the event of a substantial change(s) to the operations taking place onsite.

In some cases, changes to operations may require the environmental permit to be varied in order to accommodate such changes. In this instance an application will be made to the Environment Agency to vary the existing permit or apply for a new permit.

12 PLAN FOR CLOSURE

In the event that the well(s) is deemed not capable of producing commercial quantities of petroleum a decision will be made to abandon the well in accordance with Oil & Gas UK Guidelines for the *suspension and abandonment of wells* and restore the site. In such an event, a closure plan will be created in accordance with section 3.4 of the Environment Agency's guidance "How to comply with your environmental permit, additional guidance for: mining waste operations" as part of any application to surrender the environmental permit.

Other regulations relevant to the closure plan include:

- The Borehole Sites and Operations Regulations 1995;
- Offshore Installations and Wells (Design & Construction Regulations 1996; and
- Petroleum Act 1998 (Petroleum Exploration and Development Licence).

In the event that the well is deemed capable of producing commercial quantities of petroleum then applications to vary existing permits and/or acquire new permits to permit the subsequent production of petroleum will be submitted to the Environment Agency.

Until such time as the new permits are obtained, which for clarity may include a new planning permission to produce petroleum, the well will be suspended using well suspension brine and mechanical plugs set within the borehole to safely isolate the well from the surface. All equipment associated with the exploratory operations will be removed and the wellsite made secure. The wellsite will then be inspected and monitored routinely by Rathlin Energy.

13 APPENDICES

The following appendices are included in the Waste Management Plan to provide additional information.

- Appendix 1 – Rathlin Energy (UK) Limited Corporate Information;
- Appendix 2 – Rathlin Energy (UK) Limited Environmental Policy;
- Appendix 3 – Roles and Responsibilities;
- Appendix 4 – Chemical Inventory during Exploratory Operations;
- Appendix 5 – Air Dispersion Modelling and Report; and
- Appendix 6 – Odour Management Plan