

Ref. WMP1

Waste Management Plan for the management of extractive waste, not involving a waste facility, generated from onshore oil and gas prospecting activities of drill, core and decommissioning without well stimulation (using only water based drilling mud)

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1. Introduction

The process of prospective drilling, coring and well decommissioning without well stimulation or development as part of hydrocarbon prospecting operations will generate extractive waste.

The management of extractive waste falls within the scope of the Mining Waste Directive (MWD) 2006/21/EC. The management of extractive waste whether or not it involves a waste facility is a regulated activity and requires a permit under the Environmental Permitting (England and Wales) Regulations 2010 (as amended).

This document is the Waste Management Plan to accompany the application for a Standard rules permit SR2014 No.2 to comply with Article 5 of the MWD and ensure that the Article 4 objectives are met.

2. Operations and Facility Classification

Operations on site will be limited to the management of extractive waste from prospecting for hydrocarbon mineral resources through the following activities:

- Drill and core
- Well decommissioning

There will be no testing or production activities. Well stimulation of any kind, including hydraulic fracturing will not be carried out.

Extractive wastes will be generated by the drilling and associated processes of constructing a borehole to take samples, suspension and the subsequent decommissioning of the borehole only. This will include extractive waste generated by open-hole drilling at diameters which decrease with increasing depth after each well casing has been set.

As operations on site will not include any form of well stimulation, there will be no management of waste generated by such an activity. The extractive wastes which may be managed are:

- Spent drilling mud
- Drill cuttings
- Hydrocarbons
- Cement returns
- Spent spacer fluid
- Spent suspension fluid

The Drilling Process

The drilling process will employ active mud management systems whereby drilling mud is circulated down through the drill pipe and back up the well bore, maintaining hydrostatic pressure (primary well control). Partially closed loop systems, which allow continuous fluid level management, will be used for water based drilling mud. The drilling muds will transport the cuttings created by drilling the well-bore back to the surface, supporting the well bore and cooling the drill bit.

The drill cuttings are pieces of rock removed from the wellbore by the drill bit. These cuttings are transported back to surface within the drilling mud and separated at the surface by mud control equipment and including mud cleaners, “shakers” and centrifuges.

Water based drilling muds (WBDM)

Only water based drilling muds as set out in Annex 1 will be used. The operator will require the Environment Agency's prior agreement before any other additives are used.

Water based drilling muds will be passed through shaker screens to remove drill cuttings and then into tanks for recirculation as part of a loop system. Water in these muds will react with clay minerals adding fine dispersed solids to the returning drill mud. Water is added during the process to dilute these solids and centrifuges used to reduce the solids content. However, there will be a point at which the level of solids by volume results in the mud no longer providing suitable conditions for use and it becomes spent and replaced by a fresh mud. The spent mud will be extractive waste.

The drill cuttings will be separated on top of the shaker screens then transferred into skips as part of the process of being collected for transportation off site. The waste cuttings and muds will be separately characterised and taken off site for recycling or recovery by an authorised waste contractor to an appropriately authorised waste management facility as soon as it is reasonably practicable to do so.

Cuttings which have picked up hydrocarbon contamination which are properly characterised as hazardous waste will be centrifuged as well as put through the shaker and will be transported in covered skips. These will be collected and then transported off site to an authorised hazardous waste facility as soon as reasonably practicable. Drill cuttings that are hazardous waste will not be mixed with non hazardous waste.

Removal of drilling mud

Drilling mud will be displaced from the wellbore by a non hazardous aqueous spacer fluid followed by a continuous column of cement slurry to ensure a high quality integral seal between the casing and the rock formation. The displaced drilling mud and spacer fluid will be returned to the surface for reuse wherever possible or be disposed of as extractive waste.

The amount of fluid within the mud management system will be continually monitored to assess for any losses or gains. Losses will be minimised and controlled through the use of non-hazardous filter cake medium and lost circulation materials to ensure that all possible precautions have been taken to minimise both losses or gains and maintain control of the well.

Cementing the well casing

During the process of drilling, a series of steel casings will be installed within the wellbore and cemented in place to protect groundwater and maintain well integrity. The casing and cement sealing will be suitably designed, installed and tested to demonstrate that this provides protection of groundwater and other permeable zones.

The casing will be set and keyed into the low permeability formation beneath a groundwater body once that formation is reached; the maximum depth defined for a designated groundwater body is taken to be 400m.

The cementing material used will be in line with American Petroleum Institute API SPEC 10A or equivalent. Cementing will be carried out by an experienced well cementing contractor and staff to ensure that waste quantities are minimised whilst not impairing safety and integrity of the cementing operation.

Once the well bore and casing have been conditioned the cement will be pumped in slurry form down the inside of the cement stringer and cementing shoe and rise up through the annular space between the drilled hole and the casing, and once in place it will set hard.

After the casing has been cemented and allowed to set a cement evaluation log will be run to confirm the integrity of the cement. All cement evaluation logs and downhole testing for each section of the borehole and for the entire length of the cemented sections will be retained at least until the well decommissioning and re-instatement process is complete. They will be made available for inspection by an authorised officer of the Environment Agency, if requested.

Wastes generated during the drilling process

The drilling process will generate drill cuttings as described above. All drill cuttings separated from the drilling mud will be collected in skips and taken offsite as soon as reasonably practicable for recycling or recovery through an authorised waste management facility. Records are to be maintained of the quantities of drill cuttings and their characterisation for at least 2 years.

Drill cuttings and drilling mud will be treated through mud controls to maximise the amount of mud that can be returned to the loop system.

Protection of groundwater

Drilling activities will be designed to ensure that there are no inputs of pollutants to groundwater and be carried out in accordance with the following:

- Drilling will comply with good practice for drilling water wells, as described in the Environment Agency's [Guidance on the design and installation of groundwater quality monitoring points \(Science Report SC020093\)](#).
- Drilling will not take place within source protection zones (SPZ) 1 or 2, as defined in the Environment Agency's [Groundwater protection: principles and practice](#) (see pages 23-24).
- Drilling fluids will be used in accordance with good practice as described in the Health and Safety Executive (HSE)'s guidance on 'The Offshore Installations and Wells (Design and Construction etc) Regulations 1996' (DCR), in particular that they will be designed to prevent exchange of fluids between the borehole and any

groundwater-bearing formation; and Borehole Sites Operations Regulations 1995 BSOR

- Drilling fluids will exclude hazardous substances as defined in paragraph 4 of Schedule 22 to the EPR 2010 and [guidance](#) published by the Joint Agencies Groundwater Directive Advisory Group (JAGDAG).
- In the case of principal and secondary aquifers (for which 'groundwater bodies' are defined for the purposes of the Water Framework Directive), air flush, water only or water-based fluids will be used.
- Acceptable additives are listed in Annex 1. The operator will gain the Environment Agency's prior agreement before any other additives are used.
- If karstic or highly fissured conditions are anticipated, the operator will gain the Environment Agency's agreement to use of any additives other than inert materials. In the event that there is a loss of circulation during drilling the operator will use only those materials listed in Annex 2 to manage the loss of circulation and will inform the Environment Agency as soon as practicable.
- Casing will be set and keyed into the low permeability formation beneath the groundwater body once that formation is reached, in accordance with good drilling and casing installation practice, as described in HSE's, 'The Offshore Installations and Wells (Design and Construction etc) Regulations 1996' guidance. The maximum depth defined for a groundwater body is taken to be 400m; where the formation that contains a groundwater body extends below this, the criteria described above for protecting groundwater shall apply to the use of drilling fluids, until a low permeability formation is reached into which casing can be set.
- Measures will be taken when decommissioning the well to ensure there are no inputs of pollutants to groundwater and that there is no subsequent leakage of groundwater, including any gas or other contaminants that this may contain, into the well or to other geological horizons.
- Details of where the casing will be set and keyed into the low permeability formation beneath a groundwater body once that formation is reached must be set out in the Water Resources Act 1999 section 199 notification for this borehole

3. Waste Management and Waste Characterisation

A waste is defined in Article 3(1) of the Mining Waste Directive by reference to Article 3(1) of the Waste Framework Directive 2008/98/EC. The definition is; *'waste' shall mean any substance or object in the categories set out in Annex I which the holder discards or intends or is required to discard.* The wastes are defined in Article 3 of the Directive as inert; non-hazardous; or hazardous, as follows:

Hazardous Waste

The Waste Framework Directive (2008/98/EC) (WFD) sets out what waste is and how it should be managed. The WFD defines some wastes to be hazardous waste. A hazardous waste is defined as a waste that has one or more of the fifteen specified hazardous properties listed in Annex III to the WFD. The application of this is determined by the List of Wastes Decision (2000/532/EC).

The technical guidance document 'Hazardous waste Interpretation of the definition and classification of hazardous waste (3rd Edition 2013) WM2' provides a common technical basis for applying the definition of hazardous waste in the UK. This can be found at. <https://www.gov.uk/government/publications/hazardous-waste-technical-guidance-wm2>

Non-hazardous waste is waste which is neither classed as inert or hazardous.

Inert Waste is waste which does not undergo any significant physical, chemical or biological transformations. Inert waste will not dissolve, burn or otherwise physically or chemically react, biodegrade or adversely affect other matter with which it comes into contact in a way likely to give rise to environmental pollution or harm human health. The total leachability and pollutant content of the waste and the ecotoxicity of the leachate must be insignificant and in particular not endanger the quality of surface water and/or groundwater.

Extractive Wastes

The wastes that are generated on the site will be assessed prior to operations commencing. The waste types shall be limited to those within the characterisations and codes set out below. The estimated quantities of extractive wastes to be produced are as set out in the application for this permit.

Waste water based drilling muds

Waste water based drilling muds will be non inert non hazardous waste and shall limited to the following waste types;

01-05-04 fresh water drilling muds and wastes applies to water-based mud/fluids.

- 01-05-07 water based drilling fluids weighted with barite, barite-containing drilling muds and wastes other than those mentioned in 01 05 05 and 01 05 06.
- 01-05-08 water based drilling fluids containing significant levels of chlorides (such as salt-saturated and potassium chloride drilling fluids), chloride-containing drilling muds and wastes other than those mentioned in 01 05 05 and 01 05 06.

Processed drill cuttings

Before being transported off site drill cuttings will be screened on site as part of the drilling operation to reduce the surface contamination by water based drilling muds and fluids. The processed drill cutting will be categorised as follows;

- 01-04-07* wastes containing dangerous substances from physical and chemical processing of non-metalliferous minerals

The decision as to which one of these codes is applicable will depend on whether the waste displays any hazardous properties.

Spent Spacer and Suspension Fluid

Spacers are used primarily when changing mud types and to separate mud from cement during cementing operations. Suspension fluid is a sodium/potassium brine solution used when wells are temporarily capped off. Dependent upon their nature these fluids will be categorised as follows;

- 01 05 04 freshwater drilling muds and wastes or it contains chlorides:
- 01 05 08 chloride containing drilling muds and wastes other than those mentioned in 01 05 05 and 01 05 06 unless it contains low toxicity oil based mud when it will be classified as absolute hazardous entry:
- 01 05 05* oil-containing drilling muds and wastes
- 01 05 06* drilling muds and other drilling wastes containing dangerous substances

Hydrocarbons

Natural Gas, should it arise, will display one of the hazardous properties listed in Annex III of the revised Waste Framework Directive and is therefore defined as hazardous waste ("Highly flammable": gaseous substances and preparations which are flammable in air at normal pressure"). The applicable code for this, when waste, is;

- 16 05 04* gases in pressure containers (including halons) containing dangerous substances

If oil is encountered it will also display one of the hazardous properties listed in Annex III and when mixed with drilling muds and cuttings will be waste coded as

01 05 05* oil-containing drilling mud and wastes. This entry is an absolute hazardous waste so will always be hazardous.

Cement

Cement is classed as an irritant and is given the risk phrase R41 (Risk of serious damage to the eyes) .The nearest descriptor for returned waste cement is;

17 01 01 concrete

Non-Extractive Wastes

Wastes will be generated by prospecting that do not directly result from prospecting operations. Examples include office/canteen waste, lubricating oils and greases, diesel, sewage, dirty and surface water.

There will be no treatment or disposal of these wastes on site. Non extractive wastes will be temporarily stored in a secure place, on site pending collection and for no longer than 3 months.

The operator will produce a waste management plan setting out how non-extractive wastes will be monitored, recorded and managed for disposal via an authorised waste carrier. This non extractive waste management plan will be made available to the Environment Agency on request.

4. Waste Management and the Waste Hierarchy

Article 4 of the revised EU Waste Framework Directive (Directive 2008/98/EC) sets out five steps for dealing with waste, ranked according to environmental impact - the 'waste hierarchy'. <https://www.gov.uk/government/publications/guidance-on-applying-the-waste-hierarchy>

The onsite activities will be conducted so as to prevent waste generation wherever possible, and all appropriate measures will be taken to reduce the quantities generated in all other cases. The waste hierarchy will be applied to all wastes; this means consideration will be given to all possible reuse or recycling of any material either solid, liquid or gas, and the best option selected.

Such measures will include, but are not limited to, those specified in this plan.

Drilling mud and drill cuttings

The well size will be optimised to reduce the amount of drilling mud required and the drill cuttings produced whilst maintaining a design with satisfactory well control.

Drill cuttings will be separated from the drilling mud, as far as reasonably practicable, at the surface so that the maximum amount of drilling mud can be reused on site. The use of shakers and centrifuges, to separate the mud from the cuttings, increases the amount of drilling mud that can be reused. It therefore reduces the amount of waste generated.

The following measures will be taken at all times to minimise both the loss of drilling muds and gains of fluids.

- The design of filter cake which has been matched to the formation
- Lost circulation materials to be included in the drilling mud which are non-hazardous and taken from the list in Annex 2 of this plan
- Mud weights suitable for the anticipated formations being drilled

Hydrocarbons

Target formations are expected to be normally pressurised with no over pressure. Well control will be maintained by the weight of the drilling mud used. In the unlikely event formations are found to be over pressurised, anywhere gas is produced this must be managed at the surface.

A blow out preventer will be in place to ensure the wellbore is sealed and any oil or gas circulated out is safely managed. The mud weight will then be adjusted to prevent any further release of gas or oil.

Water management

Modelling of the formation, well design and the use of appropriate mud formulation will be used to minimise the potential for water intrusion during the drilling and construction of the well. If any such water is produced to the surface it should be used in water drilling mud where possible to reduce the amount of waste.

Cement

Sufficient cement will be pumped to seal off the formations when installing casing and during well abandonment. Calculations will be made to estimate the amount of cement required and the volumes measured to reduce the amount of cement waste generated by excess. If returning cement cannot be reused on site, the solidified cement will be sent for recycling at an authorised waste management facility.

During well decommissioning the open hole cement plug will be tagged which will enable a more accurate calculation of how much is required to seal off the entire wellbore from the formation.

5. Site operations and waste handling

Drilling muds and cuttings

Drill cuttings will be collected and transferred into skips designated for cuttings and separate from any spent drilling muds pending collection. The waste cuttings and water based muds will be individually characterised and removed from site as soon as reasonably practicable for recycling or recovery where possible, by an authorised waste contractor to an appropriately authorised waste management facilities.

The site waste controller will inspect all waste storage containers during drilling operations to ensure the discharge of cuttings and spent muds are placed in the correct containers. No containers will be over filled and all reasonable precautions will be taken to prevent spillages occurring. Containers should be covered and the contents removed to an authorised waste management facility as soon as reasonably practicable.

Cement

Any excess cement will be stored as concrete in skips prior to being removed from site as soon as reasonably practicable by an authorised waste carrier to an authorised waste management facility. Estimated quantities are between 20m³ to 30m³ per well.

6. Risk Management measures

All appropriate measures will be taken to avoid pollution, the measures employed will include but not be limited to the following

Site containment

1. The site pollution prevention plan which identifies and minimises the risk of pollution from the materials to be used and the activities to be undertaken will be in place before operations begin and will be implemented throughout the operational phase.
2. An impermeable membrane will be installed across the site before the start of any drilling operations using appropriate construction quality assurance standards for the materials being installed. Attention will be paid to ensure the continued integrity of seals in all areas, particularly areas that are trafficked, used for the storage of extractive wastes or where structures are built. All areas for the storage of extractive wastes will be constructed in accordance with CIRIA R164 and C736
3. Only covered skips and enclosed tanks will be used for the temporary storage of extractive waste awaiting collection.
4. A daily visual inspection of all following areas will be conducted to ensure full control and containment of any extractive waste materials:
 - Pipes and tanks (mud),
 - All storage facilities,
 - Shakers, mud cleaners or centrifuges and any other separator equipment.

Any equipment failures will be rectified without delay.

5. Spill kits will be available in all areas where extractive wastes are transferred or stored.
6. All surface water drains will have locked valves enabling the site drainage system to be securely isolated and will drain to an interceptor for disposal offsite, or to a watercourse or soakaway, subject to obtaining a separate permit.
7. All wastes will be removed from site prior to decommissioning of the site and the removal of site containment systems.
8. There will be continuous supervision of the cuttings skips when active mud management is in operation
9. All equipment cleaning and washing down will take place in a suitably bunded area

Chemicals held on site (Prior to use)

10. All substances used will have a Material Safety Data Sheets available on site
11. All chemical storage areas will be clearly marked and will be bunded in accordance with the standards of CIRIA C736
12. No chemicals will be stored on site longer than operationally necessary.

Site control

13. The site will be securely fenced so as to ensure no entry by un-authorised persons
14. An environmental management system which identifies and minimises the risk of pollution will be in place prior to the commencement of any drilling operations
15. The site will be appropriately manned and supervised by competent and suitably trained personnel during operational periods.
16. All site personnel supervising, loading or transferring wastes on site will be trained to use spill kits which will be available at all times.

Waste removal

17. Each consignment of waste will be sampled and characterised prior to despatch (and a reference sample retained).
18. Records are to be maintained of the quantities of drill cuttings and their characterisation for at least 2 years
19. Records of all waste transfers will be retained by the operator for a minimum of 2 years and made available for inspection by the Environment Agency on request.

Borehole construction and monitoring

20. Constructed well cellars will be water tight and provide control of any well head spills.
21. Well head methane monitoring using an explosive atmosphere monitor, will be conducted during all stages of drilling
22. A blow out preventer will be tested, operated and installed on the well which conforms to API Standard 53
23. Well cellar integrity will be checked before commencing drilling
24. All casings and tubing will be tested to the appropriate API 5 standards and specifications and be appropriate to the pressures and conditions under which they are to be deployed.
25. the mud management system will be continually monitored to assess for any losses or gains

Well Cementing

26. Cementing will use recognised cement standard American Petroleum Institute API 10 or equivalent
27. Cement evaluation logs will be run on casing strings which pass through groundwater-bearing formations. These will be made available for inspection by an authorised officer of the Environment Agency, if requested.
28. A competent cementation contractor will be used for well construction
29. Cementing process and quantities of cement used will be monitored and records made available for inspection by the Environment Agency.

Loss control

30. All necessary and reasonable measures will be taken to prevent loss of pollutants to groundwater, including the use of filter cake systems where appropriate.
31. Only lost circulation material listed in Annex 2 will be used during well construction.

Borehole testing

32. Well head methane monitoring using flammable atmosphere detector will be conducted during all stages of drilling.
33. Mud pit volume totaliser will be used to identify loss of drilling mud to formation or fluid gains
34. The operator will ensure mud which may be left in the wellbore does not migrate/leach into rock matrix by the use of loss control measures

7. Control and monitoring

Baseline monitoring

Prior to the commencement of any operations the permit holder is required to undertake a programme of monitoring and sampling to establish the existing environmental conditions of the site. This will include surface water, soil and ground gas sampling and will provide a baseline against which the site closure report will be assessed.

Spills and pollution control

The site will have impermeable containment systems in all bunded areas in line with CIRIA R164 and C736. The operator will have a spill management plan which ensures that any material spilt on site will be contained and removed such that this minimises the potential for environmental harm. Staff will be trained in the deployment and use of spill kits prior to commencement of drilling operations.

The pipework and the associated storage tanks of the drilling mud system will be inspected daily for leaks and damage. Where leaks or damage are identified the equipment will be immediately repaired or taken out of service. Any spills will be cleaned up and recorded.

All equipment used on site for the movement of fluid materials will have spill kits available and be operated by or supervised by staff trained in the use of the spill kit.

Details of all spills/accidents will be notified to the Environment Agency in accordance with the permit requirements.

Odour and Noise

The extractive wastes that will be generated are not anticipated to be malodorous and nor are any of the associated processes that will be performed. Measures will be taken to minimise all fugitive emissions which may cause odours.

Wastes management

The quantity of each waste will be recorded as it is removed from site. All records of waste movements (extractive and non-extractive wastes) will be retained by the operator and made available for inspection by the Environment Agency on request.

Water management

In the event that water enters the borehole from formations during drilling operations it will be contained at surface and where possible used to make drilling fluid. Details of the volume of encountered water collected, reused or disposed of by authorised waste contractor shall be retained by the operator and made available to the Environment Agency on request.

Natural gas or oil

In the event of any unexpected gas or oil releases the Environment Agency will be notified in accordance with the permit requirements as set out in Standard rules SR2014 No 2. Details of the quantities of any oil or gas releases will be recorded by the operator along with the measures taken to manage them and made available to the Environment Agency on request.

Complaints

If any complaints are received about the mining waste operations, they will be recorded, investigated and responded to without delay in accordance with the operator's complaints handling procedures. Complaints will additionally be reported to the Environment Agency within 3 days and a plan detailing appropriate measures to resolve any issue identified.

Site Closure Reporting

The results of all monitoring information collected by the permit holder during the lifetime of this site will be used to update the Site Condition Report for the permitted activities and should include;

- Mud Logs
- Cement evaluation logs
- Waste disposal
- Waste storage on site
- Spills on site

This information will be used to inform the final site surrender report.

8. Measures for the prevention of environmental pollution

The operator will keep a hazard register updated throughout the life time of the well. The risk reduction methods outlined in section 7 above are considered to meet the requirements of the Mining Waste Directive, including the need to prevent water status deterioration and soil pollution.

9. Proposed plan for closure

Once the decision has been taken to abandon the well the closure will be in accordance with established procedures and the following regulatory provisions:

- The Borehole Sites and Operations Regulations 1995 [BSOR];
- the land-based requirements of the Offshore Installations and Wells (Design & Construction etc) Regulations 1996 [DCR];
- Petroleum Exploration and Development Licence (PEDL) 1988.

The process of plugging and abandoning the well will require the sealing of any permeable layers within the well, the remainder of the well will be filled with cement between two cement plugs the lower of which should be located at such a level as to prevent any further migration of material from the well into surrounding strata.

The wellhead will be removed and the casings cut and sealed three 3m below ground level. This process will follow the Oil & Gas UK Guidelines for Suspension and Abandonment, and be reviewed by an independent well examiner and the HSE. The site will then be reinstated back to pre-operative state.

The principle extractive waste streams arising from this process will be:

- surplus cement from well plugging, and
- broken concrete and cement from the removal of the well cellar and conductor

When the site is closed, a closure plan will be developed that covers all the required measures detailed in section 3.4 of the Environment Agency's guidance "How to comply with your environmental permit at the following webpage; <https://www.gov.uk/government/publications/how-to-comply-with-your-environmental-permit>

Additional guidance for: "mining waste operations" as part of any application to surrender the environmental permit. This will cross-reference the updated Site Condition Report and take into account any changes in site conditions.

Annex 1

Limitations on the range of drilling mud which will be used.

Water based drilling mud (WBDM): Drilling fluids shall exclude hazardous substances as defined in paragraph 4 of Schedule 22 to the EPR 2010 and guidance published by the [Joint Agencies Groundwater Directive Advisory Group](#) (JAGDAG). In the case of principal and secondary aquifers (for which 'groundwater bodies' are defined under the Water Framework Directive) air flush, water only or water-based fluids shall be used. Acceptable additives for water-based fluids in such groundwater bodies are bentonite, food-grade thickeners (e.g. xanthan or guar gums) and inert materials used to increase density (e.g. barite - barium sulphate, haematite - iron oxide). In the event that troubled clay formations are drilled and in order to set the casing and cover the aquifer adding 3-7% of KCL

No other additives will be used without prior agreement from the Environment Agency.

Annex 2

Lost circulation materials

Clay

Cedar Fibre

Sawdust

Calcium Carbonate MS

Mica

Groundnut shells

Walnut

Cement plugs

Annex 3

Glossary

Blow out preventer

Is a valve device placed on the top of the well which can be closed. It is a safety feature used in case the drill enters an over pressure formation which could result in the entire drill string being blown out of the well

CIRIA R164 and C736: Construction standards for containment systems for the prevention of pollution, used by the Environment Agency to describe good practice.

Formation Integrity Test: The method to test strength of formation by increasing Bottom Hole Pressure (BHP) to designed pressure. FIT is normally conducted to ensure that formation below a casing shoe will not be broken while drilling the next section with higher BHP or circulating gas influx in a well control situation.

Formation testing: This term covers all aspects of determining the tensile strength of the formation and improving its porosity and through this the permeability of the rock.

Formation water: is water which occurs naturally within the pore space of the rock formation

Hydrocarbons: collective term used to describe all mineral oils and natural gas

Lithology - The different geology and characteristics of the rock

Mud Pit Volume Totaliser – MPVT: system for monitoring in the real time any losses or gain of fluids within the mud system

Produced water: This term describes the water produced back from the formation to the well bore.

PVT: - abbreviation for pressure, volume, temperature.

Rheology: the study of how matter deforms and flows, including its elasticity, plasticity and viscosity. In geology, rheology is particularly important in studies of moving ice, water, salt and magma, as well as in studies of deforming rocks

Well Bore - The inside of the borehole which has been drilled through the different lithologies