Condition 10 - 2013/00333/FUL

Coastal Oil and Gas Limited

Unit 9
Bridgend Business Centre
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CF31 3SH

St Nicholas Exploration Borehole

Information supplied for Condition 10 of Planning

2013/00333/FUL

Method Statement

&

Environmental Management Plan

December 2014

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1. Introduction

Coastal Oil and Gas Limited have an approved planning application 2013/00333/FUL:-

- **Drill a single vertical exploration borehole at Site located in field 400m along an unnamed road between the A4266 and Duffryn (grid ref 308215 : 171623)**

The purpose of this document is to provide a Method Statement and Environmental Management Plan for the site.

The site is located near Dyffryn, South West of Cowbridge in the St Nicholas and Bonvilston community council's areas of Vale of Glamorgan Borough Council. The national grid co-ordinates for the site are:-

Eastings 308215 **Northings 171623**

Figure 1: Location of site

2. Method of Work for Drilling for the Collection of Samples

2.1 Background

2.1.1 Drilling

The borehole is advanced using a rotary drilling system, which uses a rotating drill bit on the end of a drill string. The rock cuttings are returned to ground surface by a drilling fluid or 'mud', which is pumped down the drill string and back up the annulus of the hole created by the bit. The mud also serves to overcome the hydrostatic pressure of the formation to control pressures and prevent blowouts. Mud composition and properties (such as weight) can be adjusted to cope with changes in formation pressure.

At the surface, blowout preventers (BOPs) are required to allow the well to be closed off quickly should a formation give rise to a sudden increase in pressure (a 'kick') until this can be compensated for by varying the drilling fluid. BOPs are installed on the casing but a kick has not been recorded in any previously drilled boreholes in South Wales.

2.1.2 Loss of Circulation / Drilling Fluids

In the event of a loss of circulation then there are several measures that can be employed by the site crews.

Seepage Losses (0 – 5 bbl/ hr)

If seepage losses are encountered while drilling, in the first instance the mud weight should be checked and if necessary, the mud weight reduced. This can be done by circulating the mud over the shakers/cyclone to eliminate drilled solids or by the addition of fresh water to the system. A tight watch should be maintained on the system weight and the weight only reduced by 0.2 ppg per circulation.

Medium Losses (5 - 10 bbl /hr)

If medium losses are encountered, the weight should be reduced if necessary as above, and a hi-viscosity Pure-Bore pill circulated around and allowed to soak to prevent the losses.

High Losses (10 – 30 bbl/ hr)

If high losses are experienced, then pump a Lost Circulation Material pill of a hi-viscosity Pure-Bore pill mixed with fine, medium and coarse calcium carbonate to 10.0 lb/bbl which should 'bridge' the pores or fractures and stop losses.

Very high mud losses (+30bbl/hr)

It is possible to drill ahead with the addition of a small quantity of Drill-Sorb to the mud to seal a fracture, but for sealing total mud losses the following will be undertaken:

- Mix 1.0 – 1.5lbs/bbl of Drill-Sorb into a barrel of drilling fluid containing 1.0 – 2.0lbs/bbl Pure-Bore and allow the mixture to stand for 5 to 10 minutes until the Drill-Sorb starts to soften before pumping.
- A sample will be taken prior to pumping
- Pump into the loss zone making sure you displace the internal volume of the drill pipe with good thick mud.
- Pull out of hole until you get mud returns
- Wait until sample cures – typically half an hour
- Run back into hole (hopefully loss zone will be sealed and you can continue drilling).

Samples of the mud will be taken to show the time taken to cure and set. The Specification and MSDS sheets for Drill-Sorb can be seen on Appendix V and VI, the MSDA sheets for Calcium Carbonate can be seen on Appendix VII. These are both stored as a powder in the enclosed store room until required in the case of lost circulation.

2.1.3 Casing installation

Casing is the usual name for the steel pipe lowered into and generally cemented into the borehole as it is being drilled. The casing serves a number of functions, as follows:

- to permit control of pressure;
- to prevent the formation from collapsing into the well;
- to isolate different formations from each other to prevent cross flow of formation or other fluids and gases;
- to provide a means of controlling formation fluids.

Casing also provides a foundation for surface well completion equipment and the means to install downhole equipment.

Each full length of casing of a given diameter, comprised of threaded sections, is called a 'casing string'. Casing strings are installed in stages, starting with the largest diameter at the surface. The cementing or grouting process involves pumping cement down the centre of the casing into the annulus between the outside of the casing and the borehole wall. Surface casings are cemented to ground surface, but in some instances, deeper strings may instead only be cemented some distance back inside the previous casing string.

Casing comes in a variety of diameters and grades. Each casing string in a well is run from the ground surface so that the near surface sections of a well may consist of several casing strings of decreasing diameter nested inside each other. Where a number of casing strings are used, the upper part of the well will comprise several layers of steel casing and cement.

2.2 Site Preparation

The site will be prepared for the reception of drilling and ancillary equipment.

The drilling cellar will be installed using a JCB or similar excavator to dig the hole and install the concrete rings. The concrete rings are 2m in diameter and 3m deep. The floor will be concrete. A plastic membrane will initially be installed to prevent water entering the cellar.

Around the site a trench/bund will be excavated and a land drain installed to collect surface water in an interceptor tank.

2.3 Drilling to set Casing

The hole will commence at approximately 12 inch diameter and will be drilled through the base of the drilling cellar. This borehole will be drilled approximately 50m into solid ground. This will be of a depth to penetrate through the alluvium into the top of the Jurassic Limestones. When the required depth of the borehole has been reached the drilling fluids will be circulated around the closed loop system to remove the drilling cuttings for up to 1 hour; this will also clean the sides of the borehole to allow the easier placement of the steel casing. When the hole has been drilled the drilling equipment will be removed from the hole and 9 5/8 inch N80 grade steel casing will be lowered into place. All casing is to be visually inspected on site, and a pyg to be run through the casing to highlight any deformation in internal shape; records will be kept of the lengths and the inspection of the casing. The casing will be in 6m lengths and screwed together, and the treads sealed with Bakerlok thread locking compound or similar. Once all the casing is in place the volume of the annulus between the casing and the borehole wall is calculated and 1.5 times this volume is pumped through the casing to fill the void. The cement will be pumped until the cement returns are seen at the surface. Samples of the cement will be taken to allow confirmation of cement curing. The cement will be allowed to stand a minimum of 12 hours.

A borehole of approximately 8.5 inch diameter will be drilled to a depth of approximately 200m. This will be drilled open hole utilising a tricone rotary bit or a poly-crystalline (diamond impregnated tungsten steel).

A 7 inch string casing will be extended into the Carboniferous strata; this will be installed to the base of the Barry Harbour Limestone at 475m (see Figure 3) and fully cemented (in the same method as described above). This casing is to primarily prevent any escape of gas if any high pressure is encountered deeper in the borehole. The casing will also prevent the migration of groundwater into the borehole and drilling fluids out from the borehole.

No casing will be installed in the rest of the borehole at this stage, the cored section of the borehole will remain uncased during the testing phase.

Casing will be cemented in place with a sufficient amount of cement to fill the calculated annular space. The cement will be allowed to stand a minimum of 18 hours before drilling the plug. The well will be tested at a pressure in pounds per square inch calculated by multiplying the total vertical depth of the expected hole by the local pressure gradient. On testing the casing string, if at the end of thirty (30) minutes the pressure gauge shows a drop of 10% in the test pressure or more, corrective measures will be taken to ensure it will hold the pressure for thirty minutes without a drop of more than 10%.

If in the unlikely event that Corrective Measures are required the following check list would be followed:

- Check all the seals at the surface for leaks
- Inject via a tremmy pipe a thicker weight cement to seal any potential leaks at the base of the borehole, wait for 12 hours and retest.
- The next level of remedy would be to drop a casing size and cement a secondary string of casing into place.

During the drilling of the borehole the levels and volumes of the drilling fluids will be continually monitored and recorded.

Prior to the commencement of drilling, a blow out preventer (BOP) is installed on the top of the casing. This will control the borehole in the unlikely event of a sudden increase in pressure during the drilling. The casing and BOP will be pressure tested prior to the commencement of drilling.

According to the **Offshore Installations and Wells (Design and Construction Etc) Regulations 1996 (DCR) Regulation 13 -** *The Well Operator shall ensure that a well is so designed, modified, commissioned, constructed, equipped, operated, maintained, suspended and abandoned that –*

a) *so far as is reasonably practicable, there can be no unplanned escape of fluids from the well; and*

b) *risks to health and safety of persons from it or anything in it, or in strata to which it is connected, are as low as reasonable practicable.*

2.4 Drilling to collect samples

Once the casing is installed a cement bond log will be run in the borehole to check the seal of cement between the casing and borehole.

The borehole will continue drilling to collect HQ (External diameter of 96mm and core size of 63.5mm) cores to Total Depth.

2.5 Materials used

A number of different materials are used during the construction of the borehole.

- Grout: Standard oil field sulphate resistant cement
- Casing: Weight 23lb/ft API N80R3 Collapse Pressure 3830psi Internal Yield 6340psi
- Drilling fluid: Purebore will be added to water to make the drilling fluid.

2.6 Expected Geological Section

The borehole will continue drilling to collect samples (cores) to Total Depth of the borehole.

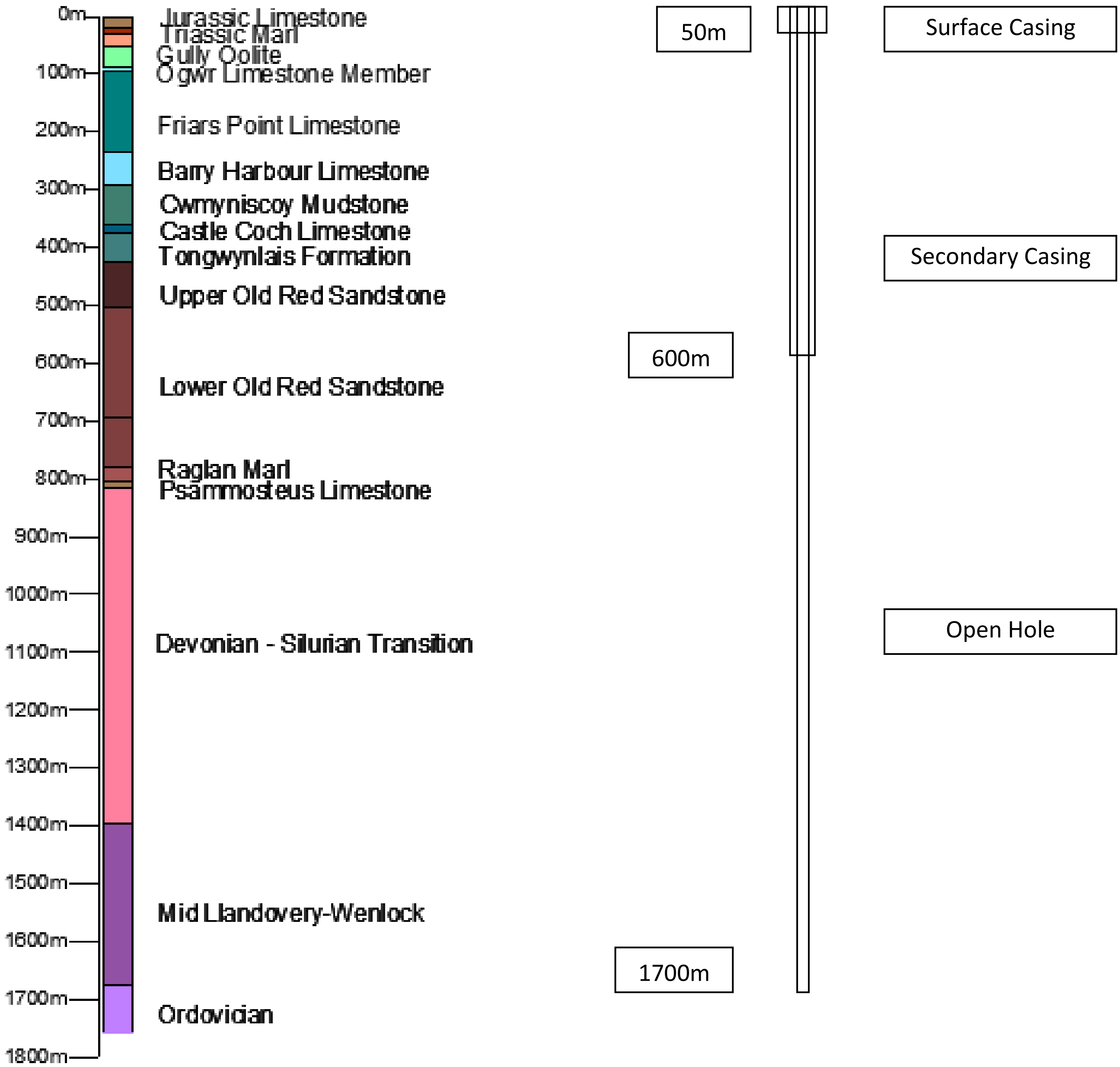

Figure 3: Expected geological section of the proposed borehole

2.7 Geophysical Logging

When the drilling of the borehole has been completed a suite of electric logs will be run in the borehole.

The different probes will be lowered down the borehole to measure:-

- Caliper
- Gamma – Gamma
- Natural Gamma
- Neutron
- Resistively
- Sonic
- Temperature
- Density
- HRAT - High Resolution acoustic televiewer

The geophysical logs will provide details of the variability of the geology and the properties of the potential reservoirs. During the geophysical logging the borehole will be maintained full of drilling fluids.

2.8 Environment Agency Good Practice

This review has found that the following is considered currently to be good practice:-

- The well should be designed to protect groundwater, particularly through the design and placement of casing.
- Good use should be made of modelling to aid the well design
- The well should be drilled carefully to ensure that drilling fluids do not invade the formations, to avoid flow into the well during drilling and to create a wellbore of known dimensions.
- The wellbore should be conditioned (that is, cleaned to remove contaminants by circulating fresh drilling fluid) before casing installation.
- Casing must be installed in stages, with casing strings of decreasing diameter installed inside each other as the well is drilled to greater depths.
- Casing should be cemented in place. Cement should fill the annulus of surface casing and must prevent movement of fluids and gases from permeable formations at all depths.
- The quality of cementing should be demonstrated by pressure testing and supplemented, where necessary by geophysical methods.
- Real-time monitoring should be undertaken during drilling and cementing to allow response to adverse effects.
- Well abandonment (that is, the activities involved in decommissioning) should be undertaken to ensure that all hydrocarbon bearing formations are separated from the surface by at least two permanent plugs.

2.9 Timing of Drilling

Summary of Time Scale

	Weeks
Drilling and associated operations	8
Establishment and Site Clearance	4
Laboratory Testing	4
Gas Testing	36

3. Drilling Fluids Management

There are three main purposes for the drilling fluids:-

- Cool and lubricate the drilling bit
- Assisting with lifting the cuttings to the surface
- Act as the primary well control

The drilling fluids will comprise of a viscosifer to increase the viscosity of the fluid to increase the ability to lift the cuttings to the surface. Appendix 1 shows the specification of Purebore which is a typical additive to the drilling fluids.

Pure-Bore has recently been granted approval under regulation 31(4)a of the Water Supply (Water Quality) Regulations 2000 and the Water Supply (Water Quality) Regulations 2010 and therefore approved for use in public water supplies and included in the "List of Approved Products for use in Public Water Supply in the United Kingdom" (The approval confirmation is seen on Appendix 2). Pure-Bore was developed and manufactured by the Clear Solutions Group of Companies in the UK.

Pure-Bore is PLONOR (pose little or no risk) to the environment, and the CEFAS registration for Pure-Bore was granted in March 2012, with Pure-Bore achieving the best possible environmental rating under this registration scheme (Gold rating).

Prior to mixing Purebore is stored in the store shed as a powder in 25kg sacks.

A complete chemical breakdown of Purebore is shown on Appendix 3.

The Purebore drilling fluids are mixed on the surface in an above ground tank. A venturi system is used to mix the powder and water to insure a consistent mix. Agitators are placed in the tank to continually mix the drilling fluids. The drilling crew will be responsible for the mixing of the drilling fluids.

During the drilling of the borehole the levels of the drilling fluids are constantly monitored by the drilling crew and tests on the fluids are made during the drilling of a length of drill rod. The properties tested by the drill crew are:-

- Density of the fluid
- Viscosity of the fluid
- Colour of the fluid
- Sand Content of the fluid

The water / fluids used for drilling are contained in a closed loop system; the volume of fluid required will depend on the depth of the well. The drilling fluid will be held in above ground tanks so that they can be checked for levels and leaks.

When the drilling fluids return to the surface the rock cuttings need to be separated from the drilling fluids that are then re-used in the borehole. The cuttings are separated by:-

- Shaker screen – the drilling fluid is passed over a fine vibrating sieve of various sizes to allow the drill cuttings to pass into a covered skip for disposal and the drilling fluid to drop through and return to the closed loop system. This separates the solid drill cuttings from the fluid so that it can be re-circulated back down the well bore. In oilfield industry, linear motion shale shakers are widely used.

- Cyclone – The drilling fluid is spun in a hydro cyclone closed system to remove the finer grained material from the system. The fine drilling cuttings drop out into a covered skip for disposal at a licensed facility.

At the end of the drilling operation all excess drilling fluid will be tankered off site to a licensed disposal facility.

As all drilling fluids are maintained in a closed loop system this can easily be monitored for leaks. In the event of a loss of fluid to the system then the source of that loss will be investigated. If there is a leak to a tank / pipe then this will be repaired immediately. The tanks will be placed so that they can be observed by the drilling crew and site staff. In the event that there is an increase in drilling fluid that may allow a spillage from the tanks, drilling will cease until additional tanks can allow for the increase in fluid or the additional fluid is tankered off site to an appropriate facility.

Purebore drilling fluid will be used for all stages of the drilling and sample collection.

4. Volumes of Drilling Fluid

The volume of drilling fluids varies with the depth and diameter of the borehole.

Depth	Diameter	Maximum Volume
M	M	M^3
60	0.15	4.40
500	0.10	16.30
1200	0.07	22.00

5. Control of Surface Water

In order to prevent the discharge of surface water from the site a cut off ditch / Bund and a submerged sealed interceptor tank will be constructed on the boundary across the lowest point.

A 10,000 gallon bowser will be kept onsite to allow the interceptor to be regularly emptied in the event of rain / surface run off. The bowser that the tank is pumped into will be sent off site to a licensed facility when it has been filled.

A flood map supplied by the Landmark Information Group shows that the site is not classed as being on a flood plain; the scheme is in an area that is unlikely to flood.

6. Control of Groundwater

"Groundwater" is used in the context of environment law. Groundwater is defined as "all water which is below the surface of the ground in the saturation zone and in direct contact with the ground or subsoil".

Aquifers are underground layers of water-bearing permeable rock or drift deposits from which groundwater can be extracted.

The control of groundwater during the drilling of this borehole will be the density of the drilling fluids which would prevent any major water ingress. The hydrostatic pressure created by the column of fluid in the borehole will reduce the ingress of groundwater. The drilling fluid creates a barrier against the wall of the borehole (Filter Cake) to prevent water ingress.

The Jurassic Limestones that form the upper section of the borehole are predominately limestones and occasional mudstones; this is a local aquifer. The majority of the flow of groundwater through this unit is fracture controlled. Jurassic Limestones will be completely sealed with steel casing cemented into place.

The Carboniferous Limestone is the main water bearing strata in the area, and is classified by the Environment Agency as a major aquifer. Due to diagenetic process causing compactions and recrystallisation, the primary porosity and permeability of the Carboniferous Limestone is very low. Within such an aquifer it is the secondary network of solution-enlarged fractures (conduits) that provide the majority of the water bearing horizons, and which can form complex branching systems with scales ranging from microfractures to extensive cave systems.

The circulation of groundwater within the aquifer relies on the interconnectivity of these conduits. Limestone which is interbedded with other non-calcareous sediments tends to have a restricted development of small independent and poorly connected conduits. Circulation can also be enhanced or impeded by tectonic activity, with folding and faulting potentially creating areas of high or low permeability. National Rivers Authority (1993) states that the Carboniferous Limestone aquifer in South Wales is unconfined where it outcrops at the surface, and is likely to only be confined in places where clay bands are present in the Quaternary deposits, or where the limestone is overlain by Jurassic Lias deposits. As Carboniferous Limestone is known to have a low primary porosity, the flow type is likely to be dominated by fracture/fissure flow. Only the uppermost 100m of the aquifer is likely to be effective in transmitting water (NRA, 1993). Installing steel casing at depths well below 100m at 450m the flow of groundwater at these depths will be very restricted.

Steel and cement casing is a recognised method of sealing an aquifer by the Environment Agency. (Evidence - Review of assessment procedures for shale gas well casing installation Environment Agency – October 2012). This coupled with the restoration proposals outlined below will ensure that there will be no risk to aquifers and any nearby licensed and private groundwater or spring water abstractions during this exploration stage. It is considered therefore that there is no need to carry out a detailed Hydrogeological Risk Assessment for this current application.

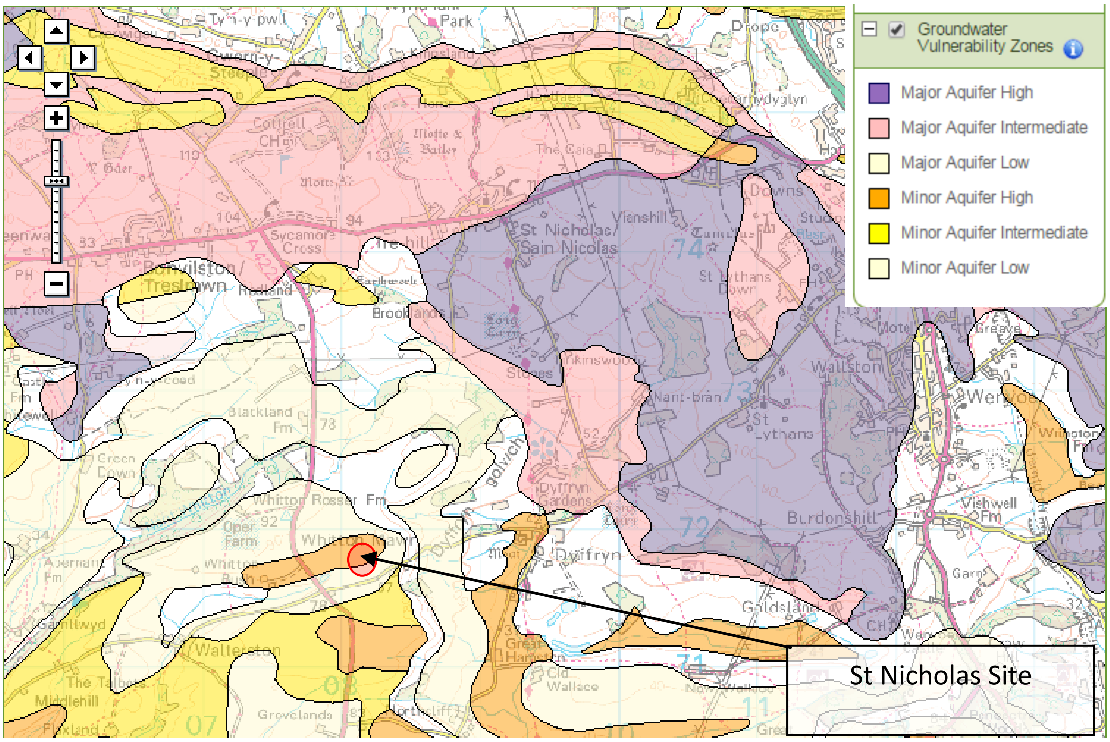

Figure 4: Map taken from the Environment Agency Website showing Groundwater Vulnerability Zones. This shows the site in a minor aquifer low vulnerability zone.

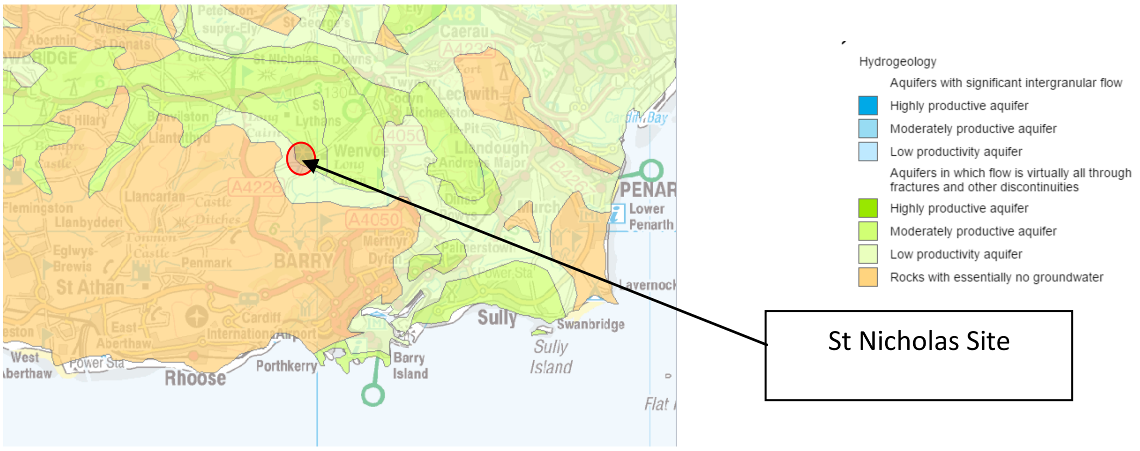

Figure 5: Map taken from the BGS, stating that the Jurassic Limestone has very little groundwater

7. Storage of Oils and Fuels

The storage of all oils and fuels will be within a bunded fuel tank where the volume of the bund is 1.5 times the capacity of the tank. During fuel transfer absorbent matting will be placed below the fuel fill point to catch any drips. Drip trays lined with absorbent matting will be placed under the drilling rig at all times.

Prior to mixing, the drilling muds are stored in powder form in bags at the drilling store. The site storage is a steel box container located on site.

If any leak occurs then the Environment Agency will be informed via the Environment Agency Pollution Hotline 0800 807 060.

8. Environmental Risk Assessment

As part of the application for environmental permits from Natural Resources Wales (NRW) an Environmental Risk Assessment (ERA) has been prepared for the drilling of a exploration stratigraphic well near Llandow in support of an Environmental Permit application. The assessment has been undertaken in accordance with:-

- The Environment Agency horizontal guidance H1 Environmental Risk Assessment for Permits, Version 2.1, December 2011
- EPR6.14 How to comply with your environmental permit

Additional guidance for:-

- Horizontal Guidance Note H6 - Environmental Management Systems, April 2010
- Mining Waste Operations, Version 2, February 2011

The ERA has identified a number of potential sources and used qualitative methods for determining the level of risk these may present to the environment. Within the ERA it has been identified whether the following three factors exist:-

1. **Source** - The activity or ' hazard' - something with the potential to cause a risk
2. **Pathway** - The route by which exposure from the source may occur
3. **Receptor** - Features in the environments that are valued, which could be harmed and may be adversely affected if the contamination / pollutants reach it.

Only when the source - pathway - receptor route occurs does an environmental risk exist. The ERA has considered the various sources, pathways and receptors to identify the routes (potential risks) which have then been subject to a risk assessment.

Where the risks have been identified mitigation measures in the form of:-

1. **Control** -Monitoring of the risks
2. **Isolation** - Remove the pathway
3. **Reduction** - Reduction of the source
4. **Elimination** - Elimination of source and pathway have been undertaken to reduce the risks.

The detailed methodology and risk assessment can be seen in Appendix I and II.

9. Environmental Management Plan

As part of the application for environmental permits from Natural Resources Wales (NRW) an Environmental Management Plan has been submitted. This can be seen on Appendix III. This sets out the roles and responsibilities of the company and the staff on site.

10 Pollution Incident Plan

As part of the application for environmental permits from Natural Resources Wales (NRW) a Pollution Incident Plan has been submitted. This can be seen on Appendix IV. This sets outs the procedures in the event of a spillage of oils / drilling fluids and the reporting procedures in the event of an incident.