

Permit

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Environmental Permit documentation is controlled by internal Cuadrilla Procedures. Submitted documentation to external agencies represent the current version of the document.

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1.0 Site Details

1.1 Applicant

Cuadrilla Bowland Limited Cuadrilla House Sceptre Court, Sceptre Way Preston Lancashire PR5 6AW

1.2 Address of Site Operations

Preston New Road Exploration Site Preston New Road Plumpton Flyde Lancashire

1.3 Grid Reference

E337408, N432740

2.0 Conditions of the land at Permit Issue

A desktop study and pre operational site visit (19th November 2013) of the land underlying and adjacent to the exploration site was undertaken by Ground Gas Solutions Ltd. The desktop study used a range of information including:

- Landmark Envirocheck Report No.: 03 October 2013;
- Landmark Historical Mapping. 1:2,500 & 1:100,000;
- Geological Survey of Great Britain, 1989, Sheet 74: Southport, Solid & Drift Edition, 1:50,000;
- British Geological Survey, Geology of the country around Blackpool. Memoir for 1:50 000 geological sheet 66 New Series (England and Wales), 1990;
- Selected borehole records:
- Coal Authority Report: 51000386734001. 03 October 2013; and
- Site inspection and walkover survey.

This was performed with a detailed search radius of up to 1,000m of the center of the site. The key findings are reported in section 2.1.

A further 10km search radius was performed accounting to identify designated sites. No statutory designations are located within the proposed development site or within a 3km radius surrounding it. The following designations have been identified within a 10km radius surrounding the Site:

- Marton Mere Blackpool Site of Special Scientific Interest (SSSI) and Local Nature Reserve (LNR) located approximately 3.2km to the north;
- Ribble and Alt Estuaries SPA and Ramsar Site located approximately 6.7km south;
- Ribble Estuary SSSI and National Nature Reserve (NNR) located approximately 8.7km south;
- Lytham Coastal Changes SSSI located approximately 6.4km south-west;
- Lytham St Annes Dunes SSSI located approximately 6.5 km south-east;
- Newton Marsh SSSI located approximately 8.7km south-east;
- Morecambe Bay SPA and Ramsar located approximately 6.7km to the north;
- Wyre Estuary SSSI located approximately 6.7km to the north; and
- Liverpool Bay SPA located approximately 7.4km to the south-west. There are no statutory designated sites located adjacent to the Site, or in the immediate surroundings.

2.1 Environmental setting

The Site is located between Blackpool and Kirkham on the south-west of the Fylde coastal plain. The Site is approximately 400 metres west of the village of Little Plumpton and around one kilometre west of the village of Great Plumpton.

The site is currently accessed through a gate from Preston New Road (A583) and is approximately 150m north of the gate across a field. The site is currently covered in short grass and is used for livestock grazing. The site ground level slopes gently from east to west, with the lowest part of the site being in the north west corner of the field. A pond was noted to be present approximately 50m to the south-east of the site. No other surface water features/systems were noted as being present within the immediate vicinity of the site.

The site is surrounded by agricultural land on all sides generally comprising grassland for livestock grazing with the occasional pond.

The nearest properties are located approximately 300m south-west of the site (off Preston New Road), and 350m east of the site (also off Preston New Road). The properties are a mixture of residential and farm buildings.

Nearby properties that have been recorded on historical and current Ordnance Survey mapping of the area are indicated in Table 1 below.

Table 1 - Nearby properties

Distance from site (m)	Direction	Property Details & Dates Present From-To		
300	SW	Staining Wood Cottages, 1970 – 2013		
350	SW	Staining Wood Farm, 1912 – 2013		
400	Е	Buildings in Little Plumpton, 1847 – 2013		
800	NW	Moss House, (labelled as Moss Cottages from 1970), 1847 – 2013		
800	NW	Moss House Farm, 1895 – 2013		
900	NE	Buildings in Great Plumpton, 1847 – 2013		

The surrounding land uses contain further agricultural land, as well as small areas of woodland, the closest of which is Humber Wood at approximately 100m south of the site boundary. There are several farms in the surrounding area, as well as the hamlet of Little Plumpton.

All available historical mapping, from 1847 to 2013 indicates that the site is undeveloped and lies within the boundary of an agricultural field; it has remained unchanged since the earliest available mapping. Reviewing the data there are no updated to be included in the data set in 2018.

Historical potential contaminative features within 1km of site:

- 1847 mapping shows three ponds approximately 200m north of the site. Two of the ponds had been
 infilled by 1970 and 2001; the third pond was still present upon 2013 mapping. The EnviroCheck
 report indicates that the ponds were used for "Extractive Industries or Potential Excavations" between
 1950 and 1980.
- 1912 historical mapping indicates a 'sand pit' approximately 300m south east of the site, on the edge
 of Little Plumpton. Mapping after 1912 does not label the sand pit, but a small, triangular shaped 'pit'
 is indicated until 2013 mapping.
- Four further ponds are indicated upon 1893 mapping 150m to the south west, 130m west, 120m north
 east and 50m south of the site respectively. The pond to the south west is still present upon 2013
 mapping, however Google Earth aerial photography from 2012 indicates that it is occupied by a dense
 patch of trees. The other three ponds to the west, north east and south remain present and have not
 been infilled.
- Approximately 25 further ponds are indicated upon historical mapping from 1912 and are located around the site between 250m and 1000m of the site boundary. The majority are still present upon the 2013 mapping.
- Preston New Road runs east to west at c.70m south of the site, shown on all mapping from 1847 to 2013. Between 1912 and 1932 this road appears to have been straightened in an area approximately

100m south west of the site boundary, The ground level is shown to have been lowered upon 1932 mapping along a short section of the road, presumably as a measure to level the road during straightening works.

- Carr Bridge Brook flows east to west approximately 300m north of the site. Between 1932 and 1978 a small slope down into the brook is indicated on mapping, this may have been caused by a manmade cutting to deepen the brook, or a natural cutting created by erosion.
- A railway line c550m north of the site running from east to west, with an aqueduct to the north east, was indicated upon the 1912 mapping. The 1970 mapping labelled it as 'dismantled'. The M55 motorway (Blackpool to Preston) was constructed on the route of the former railway line in 1958 and is still present.
- Three old clay pits are labelled upon the 1912 mapping, c.1100m to the north and east of the site respectively. These are not marked on 1932 mapping and are presumed infilled with unknown materials.
- Extensive nurseries and piggeries were present c.1000m west of the site from 1970. By 2001 the
 piggeries were not labelled on mapping and Maple Farm had been constructed. In 2013, Maple Farm
 and at least one nursery remain present.

Current potential contaminative features within 1km of site:

The Landmark Envirocheck report indicates one potentially contaminative industrial site within 1,000m of the site. The feature is identified based upon current industrial data and is present upon the 'Current Land Uses' map within the report.

The feature is a scrap metal merchants, located c.800m east of the site and is unlikely to impact upon the site but may impact upon receptors within the vicinity.

Industries or activities which may reduce air quality or air pollution are discussed later on in the report.

Superficial Geology

The superficial deposits beneath the Site are glacial in origin. The British Geological Survey (BGS) geological map indicates Glacial Till at the Site and extending for over 1km radius from the Site The published geological maps indicate drift deposits directly beneath and nearby the site to comprise:

- Devensian Till present immediately below and adjacent to the site comprising diamicton, poorly sorted sediments, likely to contain sands and gravels of varying particle size. Local lenses of organic material are also likely to be present beneath the site considering the nearby drift geology;
- A small area of Glaciofluvial Sands and Gravels present c.200m south-east of the site and a larger area (c.500m across) 1km north west of the site. The Glaciofluvial deposits are likely to comprise sand and gravel, possibly with local lenses of silt, clay or organic material;
- At 400m west of the side is the tip of a peat outcrop which extends eastwards towards the site. Peat
 deposits are likely to comprise an accumulation of wet, dark brown, partially decomposed vegetation;
- Tidal Flat Deposits, c.600m north west and c.1km south of the site. Tidal Flat Deposits are likely to comprise clay and silt;
- A small area of alluvium, c.600m east of the site, likely to comprise clay, silt, sand and gravel.

A series of shallow (15m bgl) boreholes drilled in 2005 for the purposes of geotechnical testing of the nearby M55 motorway help to corroborate the published drift geology. Available logs¹ from these boreholes indicate finding sand, with layers of gravel, clay and occasional peat.

Bedrock Geology

Other existing sources of onshore hydrocarbon in the region include The Elswick Gasfield which comprises one-well (known as 'Elswick-1') drilled by British Gas in 1990. It was brought into production in 1996 and is still in operation today². This borehole is located 6.5km north east of the Plumpton Site.

The 'Elswick-1' borehole composite log was obtained from the BGS and is summarised in Table 2 below.

Table 2 - Elswick-1 Geology

Depth to base (m below ground level bgl)	Thickness (m)	Strata/Group	Description
c.18	c.18	Drift	No description on log – likely to be Peat and Glacial Sands overlying Glacial Till. Inferred from published geological maps.
c.319	c.301	Mercia Mudstone	Red-brown mudstones with subordinate siltstone
c.637	c.318	Sherwood Sandstone	Red-brown, orange, fine to medium, subangular to subrounded sandstone
c.846	c.209	'Silicified Zone'	Red-brown, orange very fine to fine sub-angular to sub-rounded sandstone with Anhydrite. Anhydrite proven in the borehole (c.662, c. 701, c.755 & c.829m bgl)
c.1040	c.194	Manchester Marl	Red-brown grey claystone and light grey limestone. Anhydrite proven at c.920 & c.969m bgl
c.1596	c.556	Collyhurst Sandstone	Red-brown sandstone with interbedded grey sandstone
c.1616 (Base not proved)	c.20 (Base not proved)	'Carboniferous'	Purple, red-brown siltstone.

Coal Mining

The Landmark Envirocheck report confirms that the site is not located within a known coal mining affected area.

² The Hydrocarbon Prospectivity of Britain's Onshore Basins. 2003. DTI



¹ Available on-line at: http://www.bgs.ac.uk/geoindex/

Groundwater

The Environment Agency aquifer classification (EA, 2013c) identifies the glacial till deposits, mapped at surface at the Site, as unproductive strata, with predominantly granular deposits such as Middle Sands as 'Secondary A' Aquifer. The Environment Agency has not identified any groundwater vulnerability classification due to the presence of unproductive strata at surface.

The site is located above the Mudstone of the Mercia Mudstone Group. This stratum is classified by the Environment Agency as a 'Secondary B' Aquifer. These are generally lower permeability layers which may store or yield limited amounts of groundwater.

Some fracture flow may occur in this unit but, due to its low permeability, it is unlikely to yield groundwater at useful quantities. Furthermore the quality of the groundwater is likely to be poor due to dissolution of salt minerals. The Environment Agency classify the Mercia Mudstone Group as a 'Secondary B' Aquifer and it is not defined as a groundwater body under the Water Framework Directive.

At the Site the Sherwood Sandstone underlies the Mercia Mudstone. In the Fylde area the north-south trending faults are reported to act as barriers or partial barriers to flow in the Sherwood Sandstone (Seymour et al, 2006). The overlying low permeability Mercia Mudstone reduces infiltration recharge to the Sherwood Sandstone. Consequently the Sherwood Sandstone groundwater beneath the Site is effectively isolated. As it receives little recharge where overlain by Mercia Mudstone the Sherwood Sandstone groundwater beneath the Site is likely to be old and to contain a high mineral content, from processes such as sandstone cement dissolution and interaction with the overlying Mercia Mudstone (Griffiths et al., 2003; and Sage and Lloyd, 1978). Groundwater quality data from an Environment Agency observation borehole at Kirkham indicates chloride concentration of 53,000mg/L to 91,000mg/L, compared to drinking water standard of 250mg/L, indicating that the Sherwood Sandstone is saline west of the Woodsfold Fault.

At the Site, groundwater within the Permian and Carboniferous rocks is highly unlikely to be utilised for water supply in the future due to its great depth and high salinity. The Manchester Marls Formation underlying the Sherwood Sandstone Group is a mudstone unit containing primary and diagenetic evaporite minerals, resulting in reduced permeability that effectively forms a barrier to upward flow. It is highly unlikely that the Permian and Carboniferous units are contributing to, or in hydraulic continuity with, shallow groundwater or surface water bodies. Data from deep wells across the Fylde (including Thistleton, Elswick and Cuadrilla wells) identified little to no hydrocarbons above the Manchester Marls Formation but significant hydrocarbons below, which is further evidence of the capping properties of the Manchester Marls Formation.

There is no Groundwater Source Protection Zones (GSPZ) within 1km of the site.

The Landmark Envirocheck report indicates that there are no non-potable Groundwater Abstraction Licences within 1km of the site.

Surface Water

The Landmark Envirocheck report and the historical mapping identify Carr Bridge Brook approximately 300m north of the site, which flows from east to west. A smaller brook issues approximately 200m west of the site and flows north west for 300m until it feeds into Carr Bridge Brook. The source of the smaller brook is likely to be the point at which the phreatic surface comes above ground level, at the lowest point of relief. Groundwater in this area may be a shallow layer of 'perched' water on top of the relatively impermeable Devensian Till. The north westerly flow of the brook is likely to be indicative of the direction of shallow perched groundwater flow.

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A series of small ponds have been identified upon the historical and current mapping; the nearest of which is approximately 50m south of the site boundary. Another pond lies approximately 140m west of the site boundary, which is downhill of the site

Air Quality

The local area to the site is dominated by agricultural land uses (mainly crop fields) with small rural villages and farmsteads.

Predominant wind direction is from a westerly direction with periods of wind from other directions. Therefore the most likely sensitive receptors for emission to air are the agricultural fields adjacent and residential communities including Little Plumpton and Great Plumpton located approximately 0.5km east and 1km east-north-east respectively.

There are several local roads in the vicinity of the site to emissions to air which will be a contributing factor to emissions to air. The M55 Motorway is located approximately 1km north of the site running in a west-southwest to east-north-east direction and is considered to be a potentially locally significant contributor to air emissions. The A585 (Preston New Road) is located approximately 150m to the south of the pad. This is also likely to be a locally significant contributor to air emissions.

Agricultural emissions are likely to be locally significant contributor to air quality and greenhouse gas emissions. Main pollutants include dusts (inclusive of particulate matter), oxides of nitrogen (particularly nitrous oxide from fertilisers and manure) from farm vehicle/plant exhaust emissions and biomass burning, ammonia from livestock, slurry and soil emissions; and secondary pollutants such as and ozone and secondary particulate matter. A major contributor to UK methane emissions is from livestock farming (enteric fermentation and manure management). Agricultural land uses may show significant seasonal variation (e.g. use of fertilisers, burning of biomass and harvesting).

Blackpool International Airport is located approximately 4.5km west-south-west of the site and is likely to form a regional contributor to air emissions.

The nearest reference air quality monitoring station to the site is located in the Marton area of Blackpool (NGR 333768, 434759) and operated as part of the Defra UK Air Quality Monitoring Network. Table 3 outlines the available data from the station obtained during 2017.

Table 3 - Blackpool Air Quality Monitoring Station:

Air Pollutant	Annual Average (µg/m³)	Maximum Value (μg/m³)	Air Quality Screening Criteria (μg/m³)
Nitric Oxide	3	169	310 (Long Term EAL)
TVILLIC OXIGE	3		4400 (Short Term EAL)
Nitrogon Diovido	13	88	200 (1hr mean)
Nitrogen Dioxide			40 (annual mean)
Nitrogen oxides as nitrogen dioxide	17	338	30 (annual mean)
Ozone	56	134	100 (8hr mean) Max. 10 exceedences a year
PM _{2.5} particulate matter	7	188	25 (annual mean)

It should be noted that the above monitoring station is located in an urban background setting and is therefore unlikely to be representative of near site conditions, however it does provide data for consideration. It should also be noted that the station only monitors a select number of air pollutants, with ozone currently exceeding screening criteria.

The site is not located within any designated Air Quality Management Areas.

2.1.1 Sensitive Land Use Sites

Searches from the MAGIC (Multi Agency Geographic Information) records identify no sensitive sites within 1km of the site.

The Landmark Envirocheck report states that there are no designated environmentally sensitive sites located within 1,000m of the Plumpton site.

2.2 Pollution history

The available historical records have been reviewed to identify possible contamination sources in the vicinity of the well site that could impact upon and affect the 'Baseline' conditions.

Historical mapping suggests that the site has previously been utilised for agricultural purposes (consistent field boundaries noted since 1847). No other significant land-use has been identified on the mapping.

Based upon the above the expected contamination status of the surface soils is likely to be low. No significant potentially polluting activities have been carried out upon the site. Agriculture is the sole historic land use for the site. As such there could potentially be elevated concentrations of fertilizers, pesticides and herbicides, associated with agricultural land use, within the shallow soils.

A site walkover revealed no obvious signs of contamination in the immediate vicinity of the site, with no evidence of stressed vegetation and no odorous deposits that would signal the presence of potentially

2.3 Evidence of historic contamination

Landfill data has been provided within the Landmark Envirocheck Report which contains data from Fylde Borough Council and the Environment Agency.

There are no records of active/operational or historic landfill sites within 1,000m of the site

A search from the Groundsure report did not reveal any evidence of historic contamination incidents linked to the site under Section 78R of the Environmental Protection Act 1990 or within 1000m of the study site.

The search also did not identify any Environment Agency recorded pollution incidents within 1000m of the site.

2.4 Baseline data

Soil

Prior to Cuadrilla starting operations at the site a series of soil sampling was conducted by Ground Gas Solutions Ltd, November 2013. The aim of the analysis is to provide data so that a datum level of possible contaminants can be assessed prior to the commencement of exploration works on the site. The report shall also be used to benchmark soil quality after site decommissioning.

Six surface soil and three shallow subsoil samples were retrieved from the site and were submitted for laboratory analysis for a broad suite of physical and chemical properties. The suites were selected based upon general parameters, potential contaminants identified in the Baseline Desk Study and consideration of the potential future use of the site.

Soil samples were submitted for solid analysis and leachate analysis; and then compared against relevant generic assessment criteria for human health and the environment. Statistical analysis was carried out on the results, in accordance with relevant prevailing UK guidance, and compared to appropriate screening values for soils (Soil Guideline Values (SGVs) and Generic Assessment Criteria (GACs) derived using the Environment Agency contaminated land exposure model (CLEA). All soil results are found to be below sensitive residential criteria. Based upon the samples analysed no significant risks to human health are posed by the shallow soils present below the site.

All soil results are also below assessment criteria obtained from the Ministry of Agriculture Fisheries and Food (MAFF, 1998) Code of Good Agricultural Practice for the Protection of Soil.

The leachate results from the soils are within expected ranges for the soils encountered and the agricultural setting of the site. Although some substances, including dissolved copper and dissolved iron failed the Environmental Quality Standards (EQS), the leachate test applied to the soil is aggressive and the results are considered normal for soils, particularly peaty soils.

Groundwater

Groundwater data specific to the site has been collected at 4 monitoring boreholes. The objective of the monitoring wells are to establish pre exploration groundwater quality and determine the presence of ground gas. The determinants shall include, dissolved methane and carbon dioxide, electrical conductivity, total dissolved solids (TDS), salinity, Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), pH, total suspended solids (TSS), heavy metals, total petroleum hydrocarbons (TPH) criteria working group split, bromide and chloride.

Data collection has been submitted to the Environment Agency in accordance with the permit conditions on a quarterly basis.

The following table outlines the installation of groundwater monitoring boreholes.

Permit #	Borehole Designation (Reference)	Easting	Northing	SD Grid Reference (As detailed within Permit EPR/AB3101MW)	Elevation (m AOD)
A1	BH01 (A&B)	337372	432659	SD 37373 32666	13.64
A2	BH02 (A&B)	337322	432742	SD 37487 32739	11.353
A3	BH03 (CMT)	337438	432830	SD 37435 32820 (to be updated)	13.125
A4	BH04 (A&B)	337497	432737	N/A (see section)	13.498

Surface Water

Surface water quality condition have been established at 5 locations and benchmarked against appropriate EQS. A 12 month baseline has been established for the site. Sampling locations have been identified based on proximity to the site, the direction of stream flow and the direction of potential runoff from the site.

The surface water sampling regime continues throughout the lifecycle of the operation in accordance with Waste Management Plan for details HSE-Permit-INS-PNR-006, and permit conditions. Hydrocarbons are included within the sampling suite.

Air Quality

Four air quality monitoring stations have been deployed for 12 months before the start of operations to collect baseline data. The four locations have been established to account for wind direction and orientation of the site. The monitoring shall continue throughout operations and form part of the site decommissioning monitoring to ensure air quality levels are in line with baseline conditions.

A range of parameters including but not limited to include; methane, oxides of nitrogen, sulphur dioxide and particulate matter.

3.0 Site Drainage & Surfacing

The site pad construction will require top soil to be stripped and stored in a mound adjacent to the pad. The top soil will be reinstated at the site restoration phase of the project.

- The pad will comprise an area of approx. 1.55 hectares with a minimum depth of 300mm clean, compacted aggregate laid on a High Density Polyethylene "HDPE" membrane and geotextile layer with protective felt inter-layers. The top of the stone pad will lay at a level 50mm lower than the top of the outer perimeter ditch bund, thus providing 50mm air freeboard (creating a bath tub effect).
- A 1.0m deep, minimum 2.3m wide open trapezoidal drainage ditch will be constructed around part of the well pad perimeter to collect surface water and any spillages. The ditch will be isolated with double isolation valve preventing discharge to surface waters.

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The quantity of rainwater will vary over the year depending on rainfall and evaporation rates. The period between September to March is the peak period for overall rainfall and the least solar evaporation and hence the highest potential need to discharge excessive rainwater collected within the drainage ditch.

The nature of the site wide impermeable membrane design, which will remain in place throughout the lifetime of the operating pad, collects and stores rainwater within a site drainage ditch. The purpose of the membrane is to protect surface water and groundwater from surface spills. The current practice of disposing surface water collected within the drainage ditch is to tanker the fluid to an offsite waste water treatment facility. By replicating the current practice of using an offsite treatment facility, which cleans the drainage ditch water before discharging into rivers and streams, a packaged waste water treatment plant will be installed at Preston New Road Site. The package treatment plant will be sized to a specific flow rate and treatment requirement. The discharge will clean the water to an acceptable quality not impacting the local watercourse (Carr Bridge Brook).

Before the discharge water (effluent) is released from the site the effluent will be sampled and tested before discharge to Carr Bridge Brook.

Operations could have the potential to change the chemistry of the drainage ditch water quality and subsequently the process contribution from the discharge. As a result monitoring of the discharge water quality will take place before and during the discharge. This will include a range of parameters including pH, metals and hydrocarbons. The results from the monitoring will be benchmarked against Environmental Quality Standards ("EQS"). If surface water is deemed to require treatment the water will flow through a treatment plant cleaning the water to the required levels. Before discharge the water will be held in a holding tank and tested. During the discharge the flow rate will be controlled to ensure the levels do not exceed the natural runoff rate into Carr Bridge brook.

4.0 Permitted Activities

The site has the following permitted activities and planning permission granted for the site:

- 1. EPR/AB3101MW Installation Permit
- 2. EPR/KB3395DE Radioactive Substances Permit
- 3. Planning APP/Q2371/W/15/3134386 from Lancashire County Council Granted 6th October

5.0 Non-Permitted Activities

Non-permitted activities to be performed at the site will include (but are not limited to):

- Car parking for staff vehicles;
- Provision of welfare facilities for site staff;
- Well maintenance;
- Storage and disposal of non-hazardous and hazardous wastes not directly associated with the permitted activities; and
- Discharge of uncontaminated rainwater run-off to controlled waters.