

## **Appendix 1**

### **Proposed Works**

#### **Proposal**

The proposed development is for the exploration and analysis of shale gas reservoirs within the Bowland Shale formation in the Fylde district of Lancashire. The shale gas (also called methane gas or natural gas) is known to be distributed within the shale rock. The total area of the surface works is 7.34ha. In addition lateral drilling and hydraulic fracturing would be undertaken underground with horizontal wells extending up to a distance of 2km from the centre of the well pad.

A well pad would be constructed and wells would be drilled into the shale rock. A process called hydraulic fracturing would then be used to help the gas flow out of the rock by pumping water and other materials into the shale to dislodge the gas. The gas then flows back to the surface within the flow back fluid. During Initial Flow Testing (IFT) the gas would be burnt off at flare stacks and during Extended Flow Testing (EFT) the gas would flow into the gas network through new pipelines and connections to the gas grid.

The proposed development would explore the potential flow rate of the gas in order to establish whether the gas can be extracted and if it would be economically viable to do so. Following exploratory activities the site would be abandoned and restored unless the site is found to be economically viable, in which case a planning application would be submitted for production works before the site is decommissioned.

The description of the proposed works below has been divided into Surface Construction Works and Underground Exploratory Activities.

#### **Surface Construction Works**

The surface works construction phase would involve the creation a temporary well pad, drilling cellars, monitoring boreholes, drainage system, access road, pipelines and gas grid connections, ancillary facilities and boundary works. During this construction phase the seismic arrays and groundwater quality monitoring wells proposed in planning application LCC/2014/097 would also be installed.

The surface site area would be divided into 6 zones. The well pad zone would contain 4 other zones – drilling/well zone, sand silo zone, flare zone and EFT equipment zone, and would be surrounded by, and adjoined to, the sixth zone the boundary pipeline zone. Each zone would have maximum heights of equipment, with the tallest structures, up to a maximum height of 53m, located in the centre of the site, reducing down to the smallest structures, with a maximum height of 5m, on the periphery.

A description of each zone is given below:

Well Pad Zone: A 1.55ha stone well pad area would be constructed with the well/drilling cellar, sand silo, well pad, flare and EPT equipment zones all located within it. The well pad would also contain well pad drainage and an earth bund.

*Well Pad* - Construction of the well pad area would involve digging out soil to create a flat working surface area. An impermeable plastic membrane and geotextile layer with protective felt inter-layers would be laid on the flat surface to create a waterproof barrier between the well pad and the soil below. On top of the plastic membrane a 300mm (minimum) layer of clean compacted aggregate would be placed to create a firm working surface for machinery used in the exploration process. The stone well pad would have a level of 12.5m AOD. Any structures/ activities located on it, outside of the other zones, would have a maximum height of 10m and are described in the Well Pad Zone ancillary structures description below. The construction works for the well pad zone would involve general earth working equipment.

*Well Pad Drainage* - Around the edge of the well pad, an open drainage ditch would be constructed to collect surface water run-off and attenuation. The drainage ditch would be lined with an impermeable plastic membrane to create a waterproof barrier. A pollution interceptor would be used to separate oil and fuel from drainage water. Subject to meeting Environment Agency water quality standards the collected water would either be discharged into the adjacent farm drain or would be removed off site by tanker via the pipe perimeter drain. An isolation valve would be closed during exploratory operations to ensure no potentially polluting materials enter the farm drain or other adjacent surface water ditches.

*Groundwater Monitoring Wells* – Three pairs of groundwater monitoring wells would be installed around the perimeter of the well pad to a maximum depth of approximately 30m, using a small drilling rig.

*Well Pad Bunds* - Soil excavated to construct the well pad and the drainage ditch would be used to construct earth banks (bunds) to help provide visual and noise screening. The earth banks would be seeded with grass and wildflowers. These landscape bunds would have a height of 12.55 AOD and prior to planting would be laid with an impermeable plastic membrane and a 1mm thick fully welded smooth HDPE membrane.

Drilling/Well Zone: A well/drilling cellar zone would be located within the central area of the well pad area. The zone would extend 97m x 30m with a maximum equipment height, above the well pad, of 53m (65.5m AOD). At the centre of the well pad within the well/drilling zone, 4 holes called drilling cellars would be constructed using a piling rig or shallow drilling rig, with each measuring 2.7m by 3m deep. A distance of between 5 and 25m would be left between each drilling cellar. The cellar would have a concrete floor and walls. One exploration well would be drilled from each cellar, creating 4 exploration wells in total.

During drilling and initial and extended flow testing (IFT/EFT) phases a drilling rig with a mast height of between 30 and 53m (65.5m AOD) would be located in this zone along with well cementing equipment, drilling materials and fluids including drilling muds, wireline logging equipment, casings and tubular.

During hydraulic fracturing activities and testing, a service rig (up to 36m high), a coiled tubing unit (up to 36m high), a coiled tubing support tower, up to 6 hydraulic fracturing pumps, a manifold unit, a blender unit and a high volume separator would be located in this zone. Other equipment would include a monitoring cabin, generators and fuel

storage. Cranes would be used to assemble the drilling rig and other equipment as required.

Sand Silo Zone: A sand silo zone would be located in the south eastern section of the well pad zone, adjacent to the drilling/well zone. The sand silo zone would extend 109m x 15m with a maximum equipment height, above the well pad, of 15m (27.5m AOD). During drilling and IFT and EFT testing, the zone would house drilling rig equipment, mud processing, mud pumps and mud mixing facilities, cementing equipment, generators and fuel storage. Substances including diesel, chemicals and propane gas would be stored in storage units and steel containers. During hydraulic fracturing activities and testing the zone would contain sand silos, hydraulic fracturing pumps and fuel storage.

Flare Zone: A flare zone would be located towards the north eastern corner of the well pad zone. The flare zone would extend 20m x 10m with a maximum equipment height, above the well pad, of 10m (22.5m AOD). Two enclosed flare stacks up to 10m high and 3m in diameter would be located in the flare zone and would be used during Initial Flow Testing.

EFT Equipment Zone: An Extended Flow Testing (EFT) zone would be located in the north eastern corner of the well pad zone next to the Flare Zone. The EFT zone would extend 25m x 25m with a maximum equipment height, above the well pad, of 5m (17.5m AOD). The EFT zone would be bounded by a security fence.

Well Pad Zone ancillary development: The remaining area of the well pad excluding the drilling/well, sand silo, flare and EPT zones would have ancillary development located within it, including storage facilities, site offices, welfare facilities, utilities, lighting and a drainage ditch. The maximum height of the ancillary structures would be 10m (22.5 AOD).

*Storage Facilities* – During drilling and testing a separator unit and flowback tanks would be located on the well pad between the well/drilling cellar zone and the flare zone towards the northern boundary of the well pad. Mud system storage would be located primarily within the sand silo and drilling zones. During hydraulic fracturing and testing, water tanks and iron storage would be located on the southern boundary with the flowback tanks also remaining on site.

The following containment options for material/substance storage is proposed on the well pad containment system– single skinned steel tanks for fresh water; purpose designed tanks, skips and containers for the mud system (drilling fluids, additives, cuttings, displacement/spacer fluid and suspension additives); on pad containment for cement powder, firefighting foam/water, well servicing and suspension fluid/additives and hydraulic oil and maintenance lubricants; single skinned tank for foul effluent; fuel tanks with integral secondary containment for diesel; integral containment and drip tray for hydraulic oil and maintenance lubricants; separate double skinned tank for waste oil. Hydraulic fracturing fluid would not be stored in mixed form. Hydraulic fracturing fluid additives would be stored in the chemical storage area with secondary containment and drip trays. Flowback fluid would be stored in steel single skinned tanks.

*Offices and Welfare Facilities* - Modules (i.e. single storey height shipping containers) for office, welfare and onsite accommodation would be located on the eastern boundary of the well pad zone throughout the drilling, hydraulic fracturing, testing and decommissioning phases of the project.

*Stores and Workshops* –During drilling and testing phases, single storey 40 foot shipping containers would be used for storage of equipment and workshops, and would be located on the southern area of the well pad zone.

*HGV Turning Area, Car Parking and Security* – An area for HGV turning and car parking would be located on the well pad at the western corner and western boundary of the site. Small cabins for security staff and site visitors and toilets would be provided at the well pad site entrance at the north western corner. CCTV would be located at strategic points of the site.

*Utilities* – A connection to the mains water supply would be installed to provide water for site staff welfare, drilling and hydraulic fracturing activities. A 150mm diameter pipe would be connected to a United Utilities mains located adjacent to the development site. An on-site diesel powered generator would provide electricity and small power for mains electricity and telecommunications within the site offices and welfare facilities. Domestic foul sewerage from site welfare facilities would be stored on site and tankered periodically to nearby wastewater facilities

*Lighting* – Lighting proposed within the whole well pad including the named zones would include low intensity security lighting and task lighting which would enable works to be carried out in hours of darkness. During construction of the well pad, access track and gas pipeline, security lighting would be located around the contractors site cabins, comprising low power over door bulkhead luminaries using. If required a temporary works lighting unit utilising 4No. 400W lamp floodlights would be used during working hours. During drilling and hydraulic fracturing, the site lighting would be dependent upon the type of drilling rig, the position, orientation and type of lights and luminaries mounted on the rig and other equipment. The likely lighting would be site lighting comprising 4 mobile lighting towers with 4No. 400W floodlights; drilling rig lighting comprising of 9No. 500W floodlights and 14No. 2 x 35W fluorescent luminaries and tank lighting comprising of 2No. 2 x 18W luminaries. The installation and construction of extended flow testing would be during normal working hours. Operating lighting around the well pad would use medium power, less or equal to 400W floodlights.

Boundary zone / Pipeline Zone: Boundary and pipeline works would be located around the well pad zone and would also extend to the south west towards Preston New Road. The boundary zone would include fencing, landscaping, bunds, the EFT pipeline and a National Grid compound.

*Fencing* – Around the well pad would be three types of perimeter security fencing, outer, perimeter and inner to maintain a secure site during construction and exploration activities. Around the perimeter of the earth bunds, an inner 2.5m high fence would be located. A 4m high welded mesh perimeter fence would then be located followed by screen planting and a 1.2m high outer fence.

*Well Pad Access track* –The entrance to the site would be located to the east of an existing lay-by, located approximately 2.2km along the A583 Preston New Road from Junction 4 of the M55 motorway. A new access point would be created off the highway, between Humber Wood and Staining Wood Farm buildings. The entrance would be wide enough to allow two heavy goods vehicles (HGVs) to pass each other in order to enter and exit the site. This would avoid HGVs waiting at the site entrance and potentially blocking the A583. A crushed stone track of approximately 170m would be laid with cattle crossing grids incorporated at intervals along it. The last 20m of the track at the junction with Preston New Road would be tarmac to improve durability and control rutting for turning vehicles entering the site. A fence would be installed on either side of the access track for site security.

*National Grid Compound Access* – An access to the gas grid connection would be located along the A583 Preston New road, approximately 800m west of the development site.

*EFT Pipeline/ National Grid compound* – Two buried gas mains would be constructed for use during Extended Flow Testing as part of the exploratory activities. The first gas pipeline would run from the development site south to Preston New Road to connect with a National Grid compound to be located adjacent to the access track/highway junction. The compound would be within a secured stoned area. A separate pipeline would run from the first pipeline west towards Blackpool adjacent to Preston New Road and would connect to another National Grid compound which would be located off the highway. The compound area would be stoned and would be accessed via a separate new access point from the highway. Both compounds would be fenced for site security.

## **Underground Exploratory Activities**

The underground exploratory activities would include the drilling of vertical and horizontal exploration wells, hydraulic fracturing of the shale rock and initial flow testing and extended flow testing of the natural gas released.

### Drilling of Exploration Wells

An exploration well would be drilled from the base of each of the 4 drilling cellars. Drilling equipment would include plant and equipment specific to the drilling unit used, which would include a mast with an erected height of between 30 to 53m high. Cranes would be used to assemble the drilling rig and other equipment. Additional equipment would include drilling mud log equipment, well cementing equipment, wireline logging equipment, drilling materials and fluids and casings and tubular.

The first vertical well (Well 1) would be drilled to a maximum depth of approximately 3.5km below ground level and would provide geological information regarding the depth, thickness and characteristics of each layer of rock (strata) including the shale. The data provided would then be used to select the depth and orientation for the next stage of horizontal drilling. The lower section of the vertical well (Well 1) may be plugged with cement to a selected depth for initiating the horizontal well (Well1).

A horizontal well for Well 1 would then be drilled laterally at a depth of between 1.5-3.5km and could extend up to 2km horizontally from the drilling cellar. This drilling process would be repeated for Wells 2 -4. Vertical wells would be drilled for each of the remaining wells and the horizontal drilling depth for each well would be determined by the data obtained from drilling Well 1.

Three types of well has been designed – a vertical section of Well 1; the horizontal section of Well 1; and the subsequent combined vertical and horizontal wells for Wells 2, 3 and 4. During drilling operations, low intensity security lighting and focused task lighting at the base of the drilling rig would allow works to be undertaken during hours of darkness. Drilling operations would be undertaken 24hours a day, 7 days a week.

The drilling process involves drilling mud engineering, casing running and cementing, data acquisition (via coring and wireline logging) and directional drilling.

*Mud Engineering* - For each well a drilling fluid (also known as drilling mud) would be used to help facilitate the removal of rock fragments (drill cuttings); to prevent the release of fluids or gas during drilling by managing the hydrostatic pressure within the well; to stabilise the borehole and the drilled cuttings; to cool the drill bit; to lubricate the drill string and to minimise the loss of drill cuttings to permeable formations. A water based mud is proposed to be used when drilling through shallow formations and the permeable Sherwood Sandstone formation. A low toxicity oil based emulsion mud (LTOBM) is proposed to be used when borehole stability is problematic or where maximum lubrication is required. LTOBM would only be used after casing and cementing of all potentially sensitive groundwater receptors.

*Casing running and cementing* - Each exploration well would be lined with steel tubing (called casing) and would be cemented in place. The well casings would form physical multiple barriers between the well and the surrounding rock with the aim of preventing well contents (gases and liquids) from entering the surrounding rock. The casing would also help prevent the well being blocked which could restrict the flow of natural gas. The concrete layer would separate the well casing from the adjacent rock and the next well casing. Additional layers would be provided where sections of the wells are near the surface in order to provide greater protection between the wellbore and adjacent rock.

The steel casings have different diameters and applicable depths from ground level and would include shallow conductors (1067-762mm diameter, extend to 60m), deep conductors (473-508mm diameter, extend to 300m), surface casing (340mm diameter, extend to 1,200m), intermediate casing (245mm diameter, extend to 2,000m), drilling liner and tie back (178-245mm diameter, extend to 2,300-3,200m) and production liner (144mm diameter, depth to be determined).

Casings and liners would generally be cemented in place to seal off various subsurface formations through which they extend, with exceptions made to allow for pressure monitoring. Un-cemented sections would only be present in sections where they would always be at least one further layer of casing between a well and adjacent rock. For each well, a high-pressure wellhead would be installed onto the surface casing. To provide secondary well control when drilling the remainder of each well, a blowout preventer (BOP) would be installed onto the wellhead.

Data acquisition (via coring and wireline logging) and directional drilling would follow the completion of the casing running and cementing.

### Hydraulic Fracturing

Hydraulic fracturing would require the provision of: - a coiled tubing rig (up to a maximum height of 36m); a service rig (up to a maximum height of 36m) to install and remove the tubing up to 36m in height; 2 enclosed gas flares each 10m high, a flowback separator with line heater and associated equipment; enclosed steel flowback tanks and steel water storage tanks. The equipment would remain on site during Initial Flow Testing. The coiled tubing and service rig would be used to occasionally service the wells. Well servicing which would take approximately a week per well.

The hydraulic fracturing process would involve the following stages – testing of the wellhead, well casing perforation, mini fracturing, hydraulic fracturing and flowback fluid and testing.

*Wellhead testing* - A 'Frac Tree' would be installed on each wellhead, to provide a seal and prevent the release of gas and liquids to the surface. The Frac Trees would include primary and secondary valves capable of withstanding maximum hydraulic fracture pressure.

*Well casing perforation* - To control where fractures are created, the well casing would be perforated at target locations. The perforations would be pre-set in the well casing by installing frac sleeves during well construction. The sleeves would be mechanically opened prior to fracking. If the sleeves fail to open, an abrasive jetting technique or a small shaped explosive charge would be used. If jetting is used, coiled tubing would be placed into the well and jetting fluid (water, sand, and friction reducer) would be injected through the tube under pressure. After jetting perforation, the jetting fluid could be recovered. The sand would settle in the surface collection tanks and the recovered jetting fluid could be reused. Sand would be damaged and not reusable.

*Mini fracturing* - Pilot hydraulic fracturing would take place involving the pumping of small volumes of fracturing fluid, without a proppant, into a well. A mini-fracture to evaluate the injection pressure required to generate fractures in the rock would be undertaken. The process would also be used to calibrate the micro-seismic monitoring network. Additional mini fracture tests would take place during hydraulic fracturing.

*Hydraulic fracturing* - Hydraulic Fracturing would take place on Well 1 first and then for each of the subsequent wells. The process involves pumping fracturing fluid under high pressure down the well and into the shale rock. The fluid would open up millimetre sized cracks or gaps with the aim of releasing the natural gas trapped within the shale. The fracturing fluid would be composed of mains water and silica sand (approximately 99.95%) and polyacrylamide (approximately 0.05%).

Silica sand would be used as a proppant to hold open the cracks in the shale after the hydraulic pressure is released. Polyacrylamide would be used as a friction reducer to minimise the pressure losses incurred due to friction between the water and well casings. Polyacrylamide is non-toxic and classified as non-hazardous to groundwater.

by the Environment Agency. Dilute hydrochloric acid (comprising 10% acid and 90% water) may be pumped into the wells before the fracking fluid to dissolve any well drilling mud or cuttings.

Hydraulic fracturing would be carried out in stages along the well with between 30 to 45 stages expected per well, which would be undertaken at intervals of 30 to 50m per stage. The initial stage would be at the end of the horizontal well at the furthest distance from the well pad. Successive fracturing stages would take place, with operations working backwards along the well length towards the vertical section. Pressure would be applied at target intervals and the amount of sand proppant would be adjusted to optimise the fracturing process. Each fracturing stage would last for 3hours.

*Flowback fluid and testing* - Once a hydraulic fracturing stage has been completed, pressure at the surface would be reduced and a portion of the injected fracturing fluid would be allowed to return to the surface as flowback fluid. The flowback fluid would pass into a choke manifold unit which would maintain full pressure during the flowback fluid process and prevent excessively high flowback velocities.

The flowback fluid would be a mixture of injected hydraulic fracturing fluids, sand, water from the shale rock, dissolved minerals and any released hydrocarbons. Naturally occurring radioactive materials (NORM), soluble NORM in shale, may also return in the flowback fluid. If LTOBM has been used as part of the drilling process, the flowback fluid may also contain small amounts of LTOBM. Testing of the flowback fluid would ensure the appropriate waste classification for the flowback fluid and subsequent waste management. Gas flow rates would also be measured and recorded with samples taken for analysis of the hydrocarbons.

The flowback fluid would be deposited in an enclosed 4 phase separation system at the surface which would separate solids, water, condensate and gases to be separated for optimal waste recovery and management. Any solids such as sand and NORM (in its solid form) would be removed and the remaining fluid's quality would be tested. Flowback fluid materials would be stored temporarily on site in enclosed tanks prior to removal off site.

The flowback fluid may be used with new mains water, sand and polyacrylamide to fracture the next section of well. The recycling of the flowback fluid would reduce the quantity of mains water being used and the quantity of flowback fluid to be removed for treatment and disposal offsite. If the flowback fluid contains any bacteria, the bacteria would be killed using UV treatment. Unused flowback fluid would be transported off site by tanker and taken to an Environment Agency permitted treatment centre for treatment and disposal. Rainwater collected in the drainage ditches may also be used as part of the fracturing fluid.

Once hydraulic fracturing has been completed on a Well 1, the process would be continued on Wells 2, 3 and 4. On completion of hydraulic fracturing for individual wells, Initial Flow Testing would commence.

#### Initial Flow Testing



After hydraulic fracturing has been completed for a well and the flowback of hydraulic fluid has commenced, natural gas would flow into the well. Eventually more gas would flow from the well than flowback fluid and at that point Initial Flow Testing would begin.

Each well would have Initial Flow Testing for up to 90 days, depending on the amount of gas flowing. The gas would be burned off at two flare stacks, which would be approximately 10m tall and 3m in diameter. The flare stacks would be fully enclosed within a flare shield. The shield would help to retain the flare in a confined area and would minimise the level of noise generated, light spillage and visual impact.

### Extended Flow Testing

If sufficient gas is measured during Initial Flow Testing, the exploratory activities would move into Extended Flow Testing. For each well this could last between 18 and 24 months. Gas produced would not be burned in the flare stacks but instead would flow through a new connection into the gas grid. This process would require the installation of equipment within the boundary of the well pad to filter and prepare the gas.

The gas would be filtered to separate sand, liquid and gas. The gas would then be dried to remove any remaining water and would pass through a carbon filter to remove any impurities. Following testing of the hydrocarbon levels, propane may be added to increase the calorific value of the gas. Data would be gathered regarding the flow rates and well pressure. A regulator would be installed to limit pressure to 75bar prior to injection into the gas grid. Declining rates of gas flow would be measured along with an assessment of the amount of flowback fluid produced.

Two gas grid pipeline connections would be made to carry the gas from the well pad to the nearest gas main. The 6inch diameter pipelines would be buried at a depth of 1.2m. One pipeline would run parallel to the access track and connect to the gas grid pipeline which runs parallel to Preston New Road. The other pipeline would run west towards Blackpool, running parallel with Preston New Road and would connect to a gas main located to the west of the development site. Where the pipelines connect to the gas grid, a fenced off area of approximately 8m x 9m would be installed as required by National Grid. The fenced off areas would include a small kiosk building, which would contain telemetry and gas quality monitoring equipment.

### Abandonment Activities

*Decommissioning* - On completion of the exploratory activities the site would be decommissioned by plugging and abandonment. The drilling cellars would be removed and the wells would be cut off at least 2m below ground level and sealed with concrete. A service rig would be used to plug and abandon the wells.

Plant, equipment and temporary buildings would be removed off site. The stone and plastic membranes used to construct the well pad would be removed along with the access track, fencing and lighting. The ditches would be emptied and all utilities disconnected. Extended flow testing equipment would be removed and any connections to the gas grid would be removed to the connection point and capped in

line with National Grid requirements. It is estimated that the decommissioning activities would take 3 months to complete.

*Restoration* – The site would be restored to its former use as agricultural land in accordance with an agreed Restoration Plan. Subsoil and topsoil from the two earth banks would be treated with herbicides and would be redistributed across the site including the infilling of the drainage ditch. The site would then be grassed over and returned to agricultural land use. Fences, gates and field drains would be reinstated. The restoration activities are estimated to take 3 months, with an additional 3 month contingency provided to take account of any seasonal constraints which could affect the timing of the works. Ongoing monitoring of the caverns would be carried out for a further as yet unspecified period.

*Long term gas production* – if the exploratory activities demonstrate that the flow of natural gas from this area of the Bowland Shale would support long term shale gas production from the application site, then a new planning application and Environmental Statement may be produced and submitted for planning approval. A planning application could be submitted prior to abandonment and restoration of the proposed development.

#### Waste Treatment

*Welfare Facilities* - Domestic foul drainage from site welfare facilities would be routed into temporary storage facilities on site and then periodically tankered to nearby wastewater treatment works.

*Waste Streams* – Waste streams would be present from all phases of the development, well pad construction, drilling, hydraulic fracturing, initial flow testing, extended flow testing, decommissioning and restoration. Some of the waste streams would be stored on site pending removal for treatment and/or disposal offsite by a licensed waste management contractor. The following waste recovery and disposal options are proposed.

Excavation materials would be reused on site, with vegetation waste composted or residual waste to landfill. Concrete would be subject to waste recovery off site and/or disposal at landfill. Packaging/food etc. waste would be subject to recycling or landfill disposal. Oils and lubricants would go for treatment at a hazardous waste facility.

Drilling waste materials would be a variety of non-hazardous and hazardous waste. Non-hazardous waste including polymer based water drilling muds and drill cutting, cement waste from well casings and spacer fluid would be recycled or treated at a specialist waste facility for recovery or disposal. LTOBM waste would be classified as non-waste and the muds reconditions for reuse. Drill cutting LTOBM and any contaminated materials (e.g. oil, diesel, waste oil, lubricants) would be hazardous and treated at a hazardous waste facility. General waste (paper, timber, scrap metal, food) would be recycled or disposed of at landfill. Foul and industrial wastewater (rain captured on well pad during drilling) would go to wastewater treatment works.

Hydraulic fracturing, IFT and EFT waste materials would be a variety of non-hazardous and hazardous waste. Flowback fluid, solid scale and materials/equipment

contaminated by NORM, would be analysed to ensure appropriate waste classification and adequate handling and disposal. Radioactive waste with non-hazardous composition would be stored on site in enclosed tanks and removed to a treatment centre permitted by the Environment Agency with a licence to receive NORM. Jetting fluids sand used in the perforation process would not be reused and would be for disposal. Flowback fluid may also be reused on site in the hydraulic fracturing process. Hazardous waste including oils would be recycled or treated at a specialist waste facility for recovery or disposal. Any non-hazardous sand would be recycled as secondary aggregate. General waste would be recycled or disposed of at landfill. Foul and industrial wastewater would go to wastewater treatment works. Surplus natural gas would be flared on site.

Decommissioning waste materials would include hazardous and non-hazardous waste. Clean aggregate and the well pad membrane liner and felt liner and inert concrete would be non-hazardous and could be reused offsite. Contaminated aggregate and the contaminated well pad impermeable membrane would go to a hazardous waste treatment centre for waste recovery or disposal.

### Traffic

The applicant proposes to access the site via a new access from the north side of the A583 (Preston New Road). Traffic to the site could travel either east or west along the A583 in order to gain access to the M55 at junctions 3 or 4. Both routes to the motorway are comprised of major roads and would not require HGV traffic to pass through major built up areas.

The access would be created by breaking through the existing hedgerow on the north side of the A583 to create an access point of sufficient width to allow two way passages of HGV's. The access road to be surfaced to withstand HGV traffic would then lead to the site compound. The works to create the access would require the removal of approximately 190m of hedgerow including two trees in order to create the required visibility splays.

In the vicinity of the site access, the A583 has a large central hatched area arising from when the road used to have three lanes with a central overtaking lane. The applicant proposes to use part of the central hatched area in order to create a right turning lane for vehicles entering the site from the east.

The traffic movements associated with the development would vary over the duration of the project depending upon the activities being undertaken. During stage 1 (construction of the site), which would last approximately 2 months, there would be an average of 22 two way HGV movements per day (maximum of 48). During stage 2 (mobilisation of rig, drilling of first borehole and demobilisation of rig) lasting five months, there would be an average of 14 two way HGV movements (maximum of 50). For drilling of the subsequent three wells, the duration of the movements would be over a shorter period of three months but would equate to around 17 two way HGV movements per day. For hydraulic fracturing, (taking one to two months for each well) the average two way HGV movements would be around 10 per day. For the initial flow testing, (around three months), it is anticipated that the average two way movements would be around 5 per day. The extended flow testing would generate minimal HGV

movements whilst the decommissioning and restoration of the site over approximately 2 months would generate an average of 22 two way HGV movements.

The peak traffic flows would occur as a result of combined traffic associated with activities at more than one well. The total traffic numbers in the ES are based on such conditions. The peak traffic generated would be around 50 two way HGV movements per day which would occur for around one week on eight occasions over the life of the project.

#### Job creation

19 new full-time jobs would be created.

#### Timeframe

The development works (exploration and restoration) would have a proposed duration of 6 years from the start of construction works on site to the completion of the restoration activities. If the site moves into full production the decommissioning period would not take place.

Exploratory activities would take place concurrently for each of the 4 wells. The indicative sequence for the development is as follows:

1. Install surface seismometer and buried seismometer arrays (LCC/2014/097)
2. Install groundwater quality monitoring wells (LCC/2014/097)
3. Construct well pad and access track and commence gas pipeline
4. Drill Well 1
5. Hydraulic fracture Well 1 and Drill Well 2
6. Initial Flow Testing (IFT) Well 1, Hydraulic Fracture Well 2, Drill Well 3
7. Extended Flow Testing (EFT) Well 1, IFT Well 2, Hydraulic fracture Well 3, Drill Well 4
8. EFT Wells 1&2, IFT Well 3, Hydraulic Fracture Well 4
9. EFT Wells 1,2 &3, IFT Well 4
10. EFT Wells 1-4
11. Plug and abandon all wells – unless application for full production submitted
12. Restoration of site

Site mobilisation and construction of the well pad would take 2 months. Equipment mobilisation period for the drilling of each well would typically last for two weeks. Once commenced, drilling operations must take place 24hours a day, 7 days per week. The first well would take around 5 months to complete to enable geological data to be analysed as the well is drilled. The other 3 wells are expected to take 3 months each to complete.

Each fracturing stage of hydraulic fracturing is expected to last 3 hours with approximately 30 to 45 stages per well. For each well the approximate time period for hydraulic fracturing would be 2 months. The duration of hydraulic fracturing would be dependent on the total number of hydraulic fracturing stages undertaken for each well. Hydraulic fracturing pumping equipment would operate between 07:00 and 19:00hrs

Monday to Friday and between 07:00 and 13:00hrs on Saturdays. Operatives would be on site 24hours a day, 7 days a week for operational and monitoring purposes.

Initial Flow Testing would take place for a period of 90days per well with the gas flow flared. Extended Flow Testing would take between 18 and 24 months per well to complete. Decommissioning and restoration of the site is expected to take between 7 and 9 months depending on weather conditions. A two month contingency would cover any delays.

An indicative timeline for the works activities is summarised below

Year 1	Site mobilisation, installation of seismic arrays, groundwater monitoring Commence pipeline construction Well 1 – Drilling, Hydraulic Fracturing, Initial Flow Testing Well 2 – Drilling
Year 2	Well 1 – Initial Flow Testing, Extended Flow Testing Well 2 – Drilling, Hydraulic Fracturing, Initial Flow Testing Well 3 – Drilling, Hydraulic Fracturing
Year 3	Well 1– Extended Flow Testing Well 2– Extended Flow Testing Well 3– Extended Flow Testing Well 4 –Initial Flow Testing, Extended Flow Testing
Year 4	Well 1– Extended Flow Testing Well 2– Extended Flow Testing Well 3– Extended Flow Testing Well 4 –Extended Flow Testing
Year 5	Well 3– Extended Flow Testing Well 4 –Extended Flow Testing Plug and abandon wells
Year 6	Site restoration completed

In view of the concerns expressed to the impacts of noise during the drilling and hydraulic fracturing stages, most particularly noise associated with night time drilling operations, the applicant submitted further information in January 2015. The information included details of noise attenuative fences and structures which would be used around the noisiest plant and equipment. It is also proposed to restrict the height of the drill rig to 36m.