Cuadrilla Bowland Ltd

Temporary Shale Gas Exploration

Preston New Road, Lancashire

Environmental Statement

Appendix B – Scheme Parameters

PNR_ES_Vol2_Appndx B_Scheme Parameters
May 2014

Cuadrilla

ARUP

Contents

B1 Location

Preston New Road Co-ordinates: X: 337408 Y: 432744.

All Co-ordinates are OSBG36 taken at pad centre

Ground Elevation (AOD): 12.5m

Taken from site survey (date: September 2013).

B2 Geology

B2.1 Preston New Road Geological Prognosis (vertical well)

Formation/Group	Depth m (TVDGL) (rounded to nearest 10m)	Lithogical Description & Notes (Source BGS Lexicon)
Mercia Mudstone	30	Dominantly red, less commonly green-grey, mudstones and subordinate siltstones with thick halite-bearing units in some basinal areas. Thin beds of gypsum/anhydrite widespread; sandstones are also present.
Sherwood Sandstone	290	Sandstone, red, yellow and brown, part pebbly; subordinate red mudstone and siltstone.
Sherwood St Bees	580	Red-brown, very fine- to medium-grained, commonly micaceous sandstones, generally cross bedded, some parallel lamination; mudstone clasts locally common, subordinate thin beds of greenish grey sandstone.
Manchester Marls	1130	Red marl (calcareous mudstone and siltstone) with thin beds of fossiliferous marine limestone and dolomite; locally green; sandy in places especially in top part; local breccias and pebbly beds.
Collyhurst Sandstone	1290	A soft red sandstone with abundant beds of "millet seed" sand grains alternating with beds of fine-grained sharp sand (Tonks, and others, 1931); some interbedded grey sandstones locally.
Millstone Grit Group	1350	Fine- to very coarse-grained feldspathic sandstones, interbedded with grey siltstones and mudstones, with subordinate marine shaly mudstone, claystone, coals and seatearths.
Upper Bowland	1540	Mainly thinly interbedded dark grey fissile mudstone and weakly calcareous or dolomitic blocky or platy, silty mudstone and siltstone. Prognosed easterly dipping fault through well bore at 1890 m TVDGL.
Lower Bowland	1930	Mudstone, dark grey to black, blocky or shaly, calcareous, pyritic, petroliferous, with subordinate interbedded limestones and sandstones. Limestones in the lower part especially include conglomerates and turbiditic debris beds.

Formation/Group	Depth m (TVDGL) (rounded to nearest 10m)	Lithogical Description & Notes (Source BGS Lexicon)
Hodder Mudstone	2740	Predominantly grey to dark grey mudstone, with subordinate and variable detrital limestone, siltstone and sandstone. Mudmound reef (Waulsortian) limestones, limestone boulder conglomerates and breccias locally, near the base. Soft sediment deformation, slumps, debris flows and gravity slides are widespread.
Faults may be encountered in the Craven Group Approximate TD 3500m TVDGL		

B3 Well pad and access track construction

B3.1 Well pad and access track construction and design parameters

Topic area	Assumptions
Construction site	Total area where earthworks might occur is approximately 2.6ha, estimated total material to be removed less than 20,000 tonnes. Total volume of buildings to be constructed less than 130,000m^3 Construction includes the building the well pad, access track, security fencing, installation of the mains water connection, and the introduction of plant species for landscaping.
Well pad design	At the Preston New Road site it is proposed to drill a maximum of four exploration wells within a single site (well pad). At the surface the wells will be separated by a horizontal distance of 5 to 25m.
Concrete	Each wellhead/drilling cellar is 2.7 x 2.7m by up to 3m clear depth. Assumed 2.7x3.0x0.20 x 5 = 8.1 m^3 concrete needed for each wellhead/drilling cellar. There will be 4 wellhead cellars
Access track	The whole access track will be paved with crushed stone except for the junction which will be surfaced with tarmac. The total area of the access track will be 0.21ha.
Security fence	The fence will be 4m in height. The estimated fence length is 600m.
Mains connections	Pressure management valve will be installed on the water supply network. Connection will be via a 150mm pipeline between the mains water connection and the Site.

Topic area	Assumptions
Well pad design	The entire well pad area (1.55ha) is to be constructed with 300mm depth Type 1 granular sub base material over a 30kN geo-grid over a fully welded 1mm thick HDPE impermeable liner protected by underlay and overlay of 300gsm non-woven protection membrane. **Drainage** A minimum of 1000mm deep, 2.30m wide open trapezoidal drainage ditch will be constructed around part of the well pad perimeter and will be piped in other parts of the perimeter with a 300mm pipe placed in the backfilled sections of the ditch base. The top of the stone pad will lay at a level 50mm lower than the top of the outer perimeter ditch bund at 17.75mAOD (providing 50mm air freeboard) An interceptor shall be installed at the north east corner of the perimeter drainage ditch which has an inlet level of approximately 17.05mAOD. A 900L sewer bottle may be constructed in the north eastern corner of the Site.
Water usage	Typical construction usage and site welfare only
Containment volume	Based on minimum 300mm stone pad: 4% stone void ratio-180m^3 Air freeboard-775 m^3 Open ditches-190 m^3 Stoned ditch 20 m^3 Total 1170 m^3

B3.2 Well pad construction waste arisings

Source	Assumptions
Excavation waste	It is assumed that all excavated materials, top soils and sub-soils, generated during the construction of the well pad would be re-used on site to form bunds.
Concrete waste	Concrete volumes for the construction of the well chamber have been estimated using data provided by Cuadrilla. Assumed that 0.7 tonnes (0.4m3) of concrete waste will be generated.
Mixed construction waste	Estimated 32 tonnes (37m^3) mixed (non-hazardous) construction waste will be generated.

B4 Monitoring systems

B4.1 Surface array

Topic area	Assumptions
Description	10 surface array stations will be constructed that will house a 3-component broad band seismometer as part of the Traffic Light System (TLS) monitoring system.
Construction	The installation of each surface array point would involve the excavation of an approx.. 2m diameter pit to a depth of approximately 0.80m. This will require 1-2 days to install. Hole dug by hand or mini digger.
Water usage	Negligible

Topic area	Assumptions
Waste	Negligible Excavated materials from the installation of surface network would be re-used onsite and no waste would be exported offsite.

B4.2 Buried array

Topic area	Assumptions
Description	80 buried array stations will be constructed that will house several geophones that form part of the micro-seismic monitoring network
Construction	The installation of each buried array point would involve the boring of an approximately 150mm diameter hole to a depth of up to 100m and the installation of seismic monitoring equipment. This will require a water-well style drilling rig and light vehicles for personnel and equipment. It will require approximately 3-4 days to install each station
Waste	Excavated materials from the installation of surface network and buried arrays would be re-used onsite. Developing each buried array will generate approximately 3m^3 of bentonite slurry waste and 0.03 m^3 of cement waste.

B4.3 Groundwater monitoring wells

Topic area	Assumptions
Description	3 well bores will be installed on the perimeter of the site to monitor the quality of the surface ground water.
Construction	The installation of the water monitoring wells will involve the boring of an approximate 150mm diameter hole to a depth of up to 30m depth. This will require a site investigation type drilling rig and light vehicles for personnel and equipment. It will require 3-5 days to install each station
Waste	Excavated materials from the installation of surface network would be re-used onsite. Developing each groundwater monitoring well will generate approximately 3m^3 of bentonite slurry waste and 0.03m^3 of cement waste.

B5 Well design

Formations Drilled and Depth Range (m as MD)*	Hole Size	Drilling Fluid Options (Primary Option in Bold)	Estimated Volume Required (with recycling) (m^3)**	Pore Presure. Gradient (lb/gal)	Formation Fluid
Mercia Mudstone Group 0 – 250m	24 – 26”	Polymer/$NaCl^+$ water-based mud Bentonite ‘spud mud’ Air Drilled	250	8.3	Water (brine)

Formations Drilled and Depth Range (m as MD)*	**Hole Size**	**Drilling Fluid Options (Primary Option in Bold)**	**Estimated Volume Required (with recycling) (m^3)****	**Pore Presure. Gradient (lb/gal)**	**Formation Fluid**
Sherwood Sandstone Group/ Manchester Marls 1,150 – 1,250m	16 – 17.5"	Continue with polymer/ $NaCl^+$ water-based mud Continue with bentonite	300	8.75	Water (brine)
Collyhurst Sandstone/ Millstone Grit Group: 1,575 – 2,000m	12.25"	Continue with polymer/ $NaCl^+$ water-based mud LTOBM contingency	130 (or 320 if changed to LTOBM)	9.8 (possible)	Gas possible
Bowland Shale/ Hodder Mudstone, deepest 3,500m^{++}	8.5"	Continue with previous polymer mud or replace with KCl-polymer LTOBM contingency	440 (80 as LTOBM)	9.8 – 13.3 (possible)	Gas expected
Bowland Shale/ Hodder Mudstone 2,300 – 3,600m	8.5" side-track	Continue with previous polymer mud or replace with KCl-polymer LTOBM contingency	40 (0 new as LTOBM)	9.8 – 13.3 (possible)	Gas expected
Bowland Shale/ Hodder Mudstone 3,300 – 4,700m	6" lateral	KCl-Polymer mud with lubricant LTOBM contingency	170 (130 as LTOBM)	9.8 – 13.3 (possible)	Gas expected
Design total with Recycling (m^3) (Contingency if LTOBM is used)			1,330 (as water based muds only) 540 from water based muds, 530 from LTOBM		
Bulk liquid mud disposal (m^3)			420 - water-based mud (if used alone) 280 - water-based mud (if used with LTOBM, which is not disposed in bulk but recovered)		
Wet cuttings disposal (tons)			3000 (with only water-based mud) 2300 (water-based in conjunction with LTOBM)		

Notes:

* MD is the measured depth along the length drilled directionally, rather than vertical depth.

** The design volume is estimated assuming that total estimated mud volume will be partially made up of recycled fluids from the previous drilled section, where this is appropriate.

+ Sodium chloride salt is added to water-based polymer muds when drilling through halite-bearing formations, to avoid dissolving salt from the formation. Halite is anticipated within the Mercia Mudstone and the Manchester Marls.

++ Only included in initial well installation for vertical exploration to the total exploration depth.

Casing (or Liner) Type	Casing OD / Hole Size (inches)	Proposed Low Permeability Strata Set Into	Proposed Set Depth (m MD)*	Grade / Weight lb/ft/ Connection	Cement Details	Purpose of Casing/ Liner and Cement Barriers
Shallow Conductor	36 – 42 / augered hole	Superficials**	10 – 30**	X52 / 0.5-1" wall thickness Welded	Grouted in place using HSR Portland cement and solid admixes as shallow soils may require.	Provide structural support against weak unconsolidated soils. Protect shallow groundwater from well fluids during deeper drilling. Provide a permanent seal across the superficial deposits.
	28 – 30 / up to 36" hole	Mercia Mudstone Group	50 – 70			
Deep Conductor	18 $^{5}/_{8}$ – 20" casing 24 – 26" hole	Mercia Mudstone Group	230 – 270	K55 / 87.5 – 94lb/ft / Buttress or multi-thread	Light-weight/high-strength lead cement slurry with standard density tail cement.	Protect shallow groundwater from well fluids during drilling. Provide a permanent seal across the Mercia Mudstone.
Surface Casing	13$^{3}/_{8}$ casing 16 – 17.5" hole	Manchester Marls Formation	1,150 – 1,250	K55 – L80-1 / 61-68lb/ft / Gas-tight	Light-weight/high-strength lead cement slurry with standard density tail cement; specifications tailored to cementing across Sherwood SST.	Protect the Sherwood Sandstone from well fluids during deeper drilling. Prevent fluids migration into Sherwood Sandstone from underlying units (for example the Collyhurst Sandstone).
Intermediate Casing	9 $^{5}/_{8}$ casing / 12.25" hole	Upper Bowland Shale	1,575 – 2,000	P110 – L-80-1/ 47 – 53.5lb/ft / Gas-tight	Gas blocking cement from base of 9 $^{5}/_{8}$" casing and high strength/ light weight cement up above the base of the 13 $^{3}/_{8}$" shoe. ECP *** installed close to 13 $^{3}/_{8}$" shoe.	Casing across Collyhurst Sandstone and Millstone Grit for well control purposes. Provides additional barrier between Sherwood SST and well fluids.
Production Liner and Tie-Back+	7" casing / 8.5" hole	Target Formation	2.300 – 3,600+	P110 / 32lb/ft / Gas-tight	High resilience / high flexural strength cement designed to withstand the hydraulic fracturing pressure cycles.	Part of primary barrier preventing uncontrolled release of well fluids to adjacent formations. Casing string for conducting hydraulic fracturing.
Production Liner	4 ½" casing / 6" hole	Target Formation	3,300 – 4,700+	P110 / 13.5 – 15.1lb/ft/ Gas-tight	High resilience / high flexural strength cement designed to withstand the hydraulic fracturing pressure and perforations cycles.	Provides isolation within the lateral section to be hydraulically fractured.

Notes: (see next page)

Notes:
Well Fluids – Drilling fluid, produced liquids and gases, hydraulic fracture fluid, flowback fluid.
OD – outside diameter.
MD – Measured depth refers to measured length along the well.
Weight – refers to the weight per unit length of casing steel, expressed in lb/ft.
Connection – refers to the coupling type between casing / liner segments.
ECP – External casing packer.
Gas-tight – refers to connections which are designed to provide a gas-tight seal.
All casings and liners are mild steel to API Specification 5CT / ISO 11960.
High sulphate resistive cement is used for all cement designs, to API 10A (Class G-H).
Casing sizes are subject to detailed design e.g. 20" is an alternative to 18 5/8", hence range is indicated.
* Actual setting depth will depend on geologic conditions encountered during drilling, hence range is indicated.
** Contingency conductor casing in the event that shallow loose sands are encountered.
*** A stage collar may also be added above the ECP to allow circulation or placement of additional cement.
+ Following installation of the production liner, a 7" tie back casing will be connected to the top of the 7" liner via mechanical anchor and a seal nipple stabbed into a polished bore receptacle (PBR). Following the first well, the 4-1/2" liner becomes a contingency as it may be possible to drill to well total depth in 8-1/2" hole and set the 7" liner throughout, or alternatively reduce to a smaller single liner size such as 5-1/2".
++ The set depth will vary depending on target interval for hydraulic fracturing.

B6 Drilling

B6.1 Drilling details

Topic area	Assumptions
Steel casing	Total steel is estimated at 2,000 tonnes for all four wells.
Cement	The estimated total cement usage is 1,250 tonnes for all four wells.
Water usage	Water consumption is 7,500m^3 during drilling, The source of water is from the UU mains as well as potentially from drainage ditches. 1 x80m^3 steel water tank. Plus 1x15m^3 water tank for use in welfare facilities.
Mud system comprising drilling fluids and additives and drill cuttings	Vessel/container volume for mud products and mixed mud – Based on the HH220 rig that has 4 x 63m^3 mud tanks, 252m^3 total. Cuttings tanks 3 x 32m^3. Plus silos 95m^3.

Topic area	Assumptions
Well design	First Well: Drill vertically to a maximum depth of 3,500m below ground level and then side track from a selected point to a maximum measured depth of 4,700m. Maximum lateral TVDGL 3,500m Remaining wells: Drill J-shaped lateral wells to a maximum measured depth of 4,700m.

B6.2 Drilling muds waste

Type	Waste (m3)	Waste (Tonnes)
Polymer based drilling muds	420	622
Polymer covered drill cuttings	3,000	4,400
Cement	80	96
General waste	120	177.6
Total Non-hazardous Waste	3,736	5,381
Type	Waste (m^3)	Waste (Tonnes)
Drill cuttings contaminated with low-toxicity oil-based emulsion muds	2,300	3,404
Total Hazardous Waste per well	2,300	3,404
Industrial Wastewater (primarily rainwater)	Up to 40.5m^3 per day during drilling for the Site (well pad only).	40.5

B7 Hydraulic Fracturing

B7.1 General parameters

Topic area	Assumptions (volumes based on all four wells)
Freshwater usage	Up to 112,000m^3 during 150 stages of hydraulic fracturing, including a mini-frac for each stage and no reuse of flowback water. Up to 89,500m^3 during 150 stages of hydraulic fracturing, including a mini-frac for each stage with reuse of flowback water. Note: early stages are not the full 765 m^3
Hydraulic fracturing fluid	Cuadrilla is proposing to use a fracturing fluid formed of the following: water and sand (99.95% by vol) and a polyacralamide friction reducer (0.05%). 10% HCl v/v acid is also planned as a spear head.
Flowback during fracturing treatment (not post fracturing flowback)	15% to 25% of the fracturing fluid is expected to flowback between fracturing stages and will be reused.
Volumes of hydraulic fracturing fluid	Up to 765m^3 per fracture stage, including 15 m^3 for optional mini-fracture.
Fresh water	Piped to site via UU mains

Topic area	Assumptions (volumes based on all four wells)
storage	20x150m^3 steel water tanks, max 3,000m^3 additional tankage may be used to allow for buffering flowback.
Fracturing depth	The shallowest level fracturing would occur is 1.54km
Fracturing Sand	Total is 50 tonnes x 150 stages = 7,500 tonnes.
Drainage	During initial mobilisation, the water discharging from the well pad will be discharged through the interceptor valve. For purposes of this assessment it is assumed all water charged will be tankered off Site. During well drilling, hydraulic fracturing and flow-back testing, all water from the well pad will be used in the processes as far as possible.
Foul effluent – blackwater (toilets)	Tank approx. 5m³
Foul effluent – greywater (washbasins etc)	Tank approx. 5m³
Diesel	No on site storage of diesel during fracturing except in vehicle and plant fuel tanks.
Hydraulic fracturing fluid (mixed fluid)	Not stored in mixed form. Potential max volume of release relating to high pressure equipment failure 3m^3
Hydraulic fracturing fluid additives (in liquid form): Friction reducer including polyacrylamide), hydrochloric acid	Polyacrylamide based friction reducer up to <6m^3 stored on site in a custom truck or lorry with integral bund. <10% dilute hydrochloric acid - up to 20m^3, in shipping totes or specialised transport trailer in bunded area.
Hydraulic oil in plant	Quantities will vary depending on what equipment is on site. Frac pumps 155litres x6 on site =930 litres (lube oil system). Service rig has similar volume to a frac pump.
Maintenance lubricants	<100 litres
Well servicing and suspension fluids and additives	100m^3 mixed fluid containing permitted oxygen scavenger and corrosion inhibitor temporarily stored on site

B7.2 Industrial waste water arisings

Industrial Wastewater	Waste (m^3)
Industrial Wastewater (primarily rainwater)	Daily quantity the same as drilling above.

B8 Initial flow testing

B8.1 General parameters

Topic area	Assumptions
Flare gas	Assumed a maximum flow of 130,000m^3/day of natural gas.
Flaring	Assume the flare combustion efficiency is 98%
Flaring	The initial flow testing phase would take place over 360 days (90 days per well)
Flow back fluid volume	Based on industry knowledge of similar dry shales, flowback during initial flow testing is estimated to be 40% of injected volume.
Forecast Gas composition	Forecast is based on Preese Hall-1 analysis: C1 = 96.4% (methane) C2 to C5 = 1.6% (Propane to Pentane) C6+ = <0.1% (other hydrocarbons) N2 = 1.6% CO2 = <1% H2S = 0 H2 = 0
Initial flow testing noise sources	The main noise source will be plant associated with a service rig or coiled tubing unit. A generator will supply the offices and site lighting (24hrs). The flare stacks, whilst flaring.
Drainage design	There is sufficient capacity within the pad drainage design to ensure any flow back waters in inventory will be contained within the Site if spilt on the pad.
Water usage	Negligible

B8.2 Industrial waste water arisings

Flowback Fluid Waste	Waste (m^3)
Flowback fluid waste – with reuse, 40% flowback	21,500
Industrial Wastewater (primarily rainwater)	Same as drilling above (on a daily basis).

B9 Extended flow testing

B9.1 General Parameters

Topic area	Assumptions
Flare gas	Assumed a maximum flow of 130,000m^3/day of unprocessed gas.
Propane storage	25 tonnes
Propane injection	4-6 tonnes per day, refilled with 10 ton LPG HGVs
Length of pipelines	Pipeline approximately 200m long (from the well pad, parallel to the access track and connecting to the gas grid pipeline running along

Topic area	Assumptions
	Preston New Road. Approximately 800m in length (from the Site access track in westerly direction).
Depth of pipeline	Up to 1.2m below ground level.
Diameter of pipeline	150mm diameter pipe.

B9.2 Industrial waste water arisings

Low Level Waste	Waste (m3)
Industrial Water (rain water discharges to land drain).	negligible

B10 Decommissioning and restoration

Topic area	Assumptions
Waste/Recycle	95% of the sub base material and liners that formed the pad would be recycled.
Waste/Recycle	5% of the sub base material and liners that formed the pad would be disposed as hazardous waste.
Waste/Recycle	100% of the concrete chamber is recycled.
Waste/Recycle	100% of the access track is recycled.
Water usage	Typical construction and site welfare only.

B11 Equipment and facilities specifications

Topic area	Assumptions
Enclosed Flare chimney	The enclosed flare chimney is 10 metres high. There will be two chimneys installed on site.
Tanks	All tanks are single skin, except drilling rig diesel double skin tank.
Rig Diesel Tank	Drill rig diesel storage tank 40m^3 (double skinned).
Cement Storage	Vessel/container and estimated max volume for cement components: Delivered to site and stored in cement bulker trailers (approx. 30t) or in cement silo. Up to 4 trailers/silos on site at one time.
Foul effluent – blackwater (toilets)	Tank approx. 5m³
Foul effluent – greywater (washbasins etc)	Tank approx. 5m³
Hydraulic oil and Maintenance lubricants	HH220 drill rig has capacity to hold 6m^3 of hydraulic oil and lubricants in the oil stores container.
Waste oil	2.5m^3 From servicing of engines and rig equipment.
Flowback fluid storage	The flowback tanks each have a capacity of approximately 70m^3 and are connected together to provide a total of 140m^3 combined storage capability. The water tanks are the same design and could provide additional flowback capacity.

Topic area	Assumptions
Drilling rig	Drilling rig up to 53m in height
Service rig	Service rig of up to 36m in height
Sand storage	Various sand storage units are available, depending on the contractor. This could be a single lorry size unit or two sand storage silos, each of approximately 15m in height
Lighting	The site will typically be illuminated during drilling operations with the following lighting equipment: Site lighting: four mobile lighting towers with 4No. 400W floodlights Drilling rig: 9No. 500W floodlights and 14No. 2x35W fluorescent luminaires Tank lighting: 2No. 2x18W luminaires The drilling rig lighting is located at various heights around the rig

B12 Other parameters

Topic area	Assumptions
Staff travel	Assume 80% of staff travel will be made from local destinations such as Blackpool (6 miles), a further 10% from the Midlands (118 miles), and the final 10% from London region (235 miles)
Materials transportation	Assume the majority of equipment used will be delivered from the Midlands (118 miles); common construction materials will be sourced from the NW region (60 miles); more specialised materials will be sourced from further afield (330 miles); and fuel will be sourced locally (6 miles)
Waste transportation	Flowback fluid will be treated at specialised approved/permitted water treatment facilities within 100 miles.
Fire fighting foam or water	On site extinguishers or brought to site by fire service in emergency only
Decommissioning	Decommissioning would involve the restoration of the Site to its former condition and would be limited in its extent to the development area.

B13 Durations

Topic area	Duration	Average No. Site Personnel*	Operating Hours**	Site Lighting Requirements
Construction	Overall – 1 to 2 months	9	Daytime, working week	Operational lighting for winter evenings / mornings
Initial Construction	3 weeks	9		
Materials to site	3 weeks	9		
Completion of construction	2 weeks	9		
Drilling-Well 1, vertical and horizontal sections	Overall - 4-5 months	44	24 hrs/day 7 days/week	Drill site lighting during all hours of darkness
Mobilisation	1 week	43		

Topic area	Duration	Average No. Site Personnel*	Operating Hours**	Site Lighting Requirements
Drilling	19 weeks or 4-5 months	44		
Demobilisation	1 week	43		
Drilling wells 2-4, per well	Overall 2-3 months per well		24 hrs/day 7 days/week	Drill site lighting during all hours of darkness
Mobilisation	1 week	43		
Drilling	10 weeks or 2-3 months	44		
Demobilisation	1 week	43		
Hydraulic fracturing, per well	Overall 1-2 months Assume 50 days for a 30 stage hydraulic fracturing and 65 days for a 45 stage for hydraulic fracturing per well to the start of flowback/testing.		24 hrs/day 7 days/week (high-pressure pumping only during daytime)	Frac site lighting during hours of darkness
Mobilisation	1 week This includes the primary flowback equipment as it is used during the fracturing process	21		
Fracturing	1-2 months	30		
Demobilisation	Demobilisation is included in the initial flowback numbers			
Initial flow testing	Overall 3 months		24 hrs/day 7 days/week	Test site lighting during hours of darkness
Mobilisation/Set-up	1 week Concurrent with the end of hydraulic fracturing and includes the demobilisation of the primary fracturing equipment	21		
Fracturing	3 months	11		
Demobilisation	<1 week	14		

Topic area	Duration	Average No. Site Personnel*	Operating Hours**	Site Lighting Requirements
Extended flow testing	Overall 2 years		24 hrs/day 7 days/week	Test site lighting during hours of darkness
Flow testing	2 years	1, part time		
Maintenance	Twice per month with small HGV	2		
Well servicing and suspension	As required for specific workscope			Rig site lighting during hours of darkness
Installation of production packers	<1 week	10	24 hrs/day 7 days/week	
Ad-hoc well servicing	<1 week	10	24 hrs/day 7 days/week	
Suspension at end of flow testing	<1 week	10	Daytime, working week	
Decommissioning and Restoration	Overall – 1 to 2 months	9	Daytime, working week	Operational lighting for winter evenings / mornings
Initial de-Construction	3 weeks	9		
Materials from site	3 weeks	9		
Completion of restoration	2 weeks	9		

Notes:

Night-time (23:00 – 07:00)
Daytime Monday-Friday (07:00 – 19:00) Daytime Saturday (07:00 – 13:00)
Other: Weekday evenings (19:00 – 23:00) Saturday afternoon & evenings (13:00 – 23:00) Sundays (07:00 – 13:00)

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