

Permit with introductory note

The Environmental Permitting (England & Wales) Regulations 2010

Third Energy UK Gas Limited

Kirby Misperton A Wellsite
Off Habton Road
Kirby Misperton
North Yorkshire
YO17 6XS

Permit number

EPR/DB3002HE

Kirby Misperton A Wellsite

Permit number EPR/DB3002HE

Introductory note

This introductory note does not form a part of the permit

The main features of the permit are as follows.

This permit is for activities that relate to exploration for and extraction of natural gas from an existing well (KM8) by hydraulic fracturing. The regulated facility will comprise:

- a mining waste operation for the management of extractive waste not involving a Mining Waste Facility;
- a non-hazardous Mining Waste Facility for the accumulation of injected hydraulic fracturing fluid which will remain in the underground target formation and has become waste;
- a groundwater activity for the discharge, namely injection of fracturing fluid into the target formation, that might lead to an indirect input of a pollutant to groundwater.

The Kirby Misperton A wellsite is located at NGR SE 77079 78914.

This permit is a Tier 2 bespoke permit as defined by the Environmental Permitting Charging Scheme & Guidance.

The status log of the permit sets out the permitting history, including any changes to the permit reference number.

Status log of the permit		
Description	Date	Comments
Application EPR/DB3002HE/A001	Duly made 03/06/15	Application for mining waste and groundwater activity permit
Additional information received	14/08/15; 21/09/15; 02/10/15; 03/11/15; 11/11/15; 22/03/16.	Schedule 5 response. Schedule 5 follow up information. Updated fracture propagation technical note. Further information; updated Waste Management Plan. Revised fracture propagation technical note. Confirmed groundwater borehole locations.
Permit determined EPR/DB3002HE	11/04/16	Permit granted to Third Energy UK Gas Limited.

End of introductory note

Permit

The Environmental Permitting (England and Wales) Regulations 2010

Permit number

EPR/DB3002HE

The Environment Agency hereby authorises, under regulation 13 of the Environmental Permitting (England and Wales) Regulations 2010

Third Energy UK Gas Limited (“the operator”),

whose registered office is

Knapton Generating Station

East Knapton

Malton

North Yorkshire

YO17 8JF

company registration number 01421481

to operate a waste operation at

Kirby Misperton A Wellsite

Off Habton Road

Kirby Misperton

North Yorkshire

YO17 6XS

to the extent authorised by and subject to the conditions of this permit.

Name	Date
Principle Permitting Team Leader	11 April 2016

Authorised on behalf of the Environment Agency

Conditions

1 Management

1.1 General management

- 1.1.1 The operator shall manage and operate the activities:
- (a) in accordance with a written management system that identifies and minimises risks of pollution, including those arising from operations, maintenance, accidents, incidents, non-conformances, closure and those drawn to the attention of the operator as a result of complaints; and
 - (b) using sufficient competent persons and resources.
- 1.1.2 Records demonstrating compliance with condition 1.1.1 shall be maintained.
- 1.1.3 Any person having duties that are or may be affected by the matters set out in this permit shall have convenient access to a copy of it kept at or near the place where those duties are carried out.
- 1.1.4 The operator shall not start the closure of the mining waste facility unless agreed in writing by the Environment Agency.

1.2 Avoidance, recovery and disposal of wastes produced by the activities

- 1.2.1 The operator shall take appropriate measures to ensure that:
- (a) the waste hierarchy referred to in Article 4 of the Waste Framework Directive is applied to the generation of waste by the activities; and
 - (b) any waste generated by the activities is treated in accordance with the waste hierarchy referred to in Article 4 of the Waste Framework Directive; and
 - (c) where disposal is necessary, this is undertaken in a manner which minimises its impact on the environment.
- 1.2.2 The operator shall review and record at least every four years whether changes to those measures should be made and take any further appropriate measures identified by a review.

2 Operations

2.1 Permitted activities

- 2.1.1 The operator is only authorised to carry out the activities specified in schedule 1 table S1.1 (the "activities").

2.2 The site

- 2.2.1 The management of extractive waste not involving a waste facility (activity A1) shall not extend beyond the site, being the land shown edged in green on the site plan at schedule 7 to this permit.
- 2.2.2 The management of extractive waste by way of a waste facility for non-hazardous waste (activity A2) shall only be carried out within the Bowland Shale Formation and shall not extend beyond the area edged in red on the site plan at schedule 7 to this permit
- 2.2.3 The groundwater activity (A3) shall only be carried out within the Bowland Shale Formation and shall not extend beyond the area edged in red on the site plan at schedule 7 to this permit. The discharges

shall be made at points along the vertical well as listed in table S3.2 (discharge points) and will not exceed 400 metres lateral extent.

2.3 Operating techniques

- 2.3.1 The activities shall, subject to the conditions of this permit, be operated using the techniques and in the manner described in the documentation specified in schedule 1, table S1.2, unless otherwise agreed in writing by the Environment Agency.
- 2.3.2 If notified by the Environment Agency that the activities are giving rise to pollution, the operator shall submit to the Environment Agency for approval within the period specified, a revision of any plan or other documentation ("plan") specified in schedule 1, table S1.2 or otherwise required under this permit which identifies and minimises the risks of pollution relevant to that plan, and shall implement the approved revised plan in place of the original from the date of approval, unless otherwise agreed in writing by the Environment Agency.
- 2.3.3 The operator shall review the waste management plan every five years from the date of initial approval and submit this to the Environment Agency for approval.

2.4 Pre-operational conditions

- 2.4.1 The activities shall not be brought into operation until the measures specified in schedule 1 table S1.3 have been completed.

3 Emissions and monitoring

3.1 Emissions to water, air or land

- 3.1.1 There shall be no point source emissions to water, air or land except from the sources and emission points listed in schedule 3 tables S3.1, S3.2, S3.3 and S3.4.
- 3.1.2 The limits given in schedule 3 shall not be exceeded.

3.2 Emissions of substances not controlled by emission limits

- 3.2.1 Emissions of substances not controlled by emission limits (excluding odour) shall not cause pollution. The operator shall not be taken to have breached this condition if appropriate measures, including, but not limited to, those specified in any approved emissions management plan, have been taken to prevent or where that is not practicable, to minimise, those emissions.
- 3.2.2 The operator shall:
 - (a) if notified by the Environment Agency that the activities are giving rise to pollution, submit to the Environment Agency for approval within the period specified, an emissions management plan which identifies and minimises the risks of pollution from emissions of substances not controlled by emission limits;
 - (b) implement the approved emissions management plan, from the date of approval, unless otherwise agreed in writing by the Environment Agency.
- 3.2.3 All liquids in containers, whose emission to water or land could cause pollution, shall be provided with secondary containment, unless the operator has used other appropriate measures to prevent or where that is not practicable, to minimise, leakage and spillage from the primary container.

3.2.4 The operator shall take appropriate measures:

- (a) to prevent the input of hazardous substances to groundwater; and
- (b) where a non-hazardous pollutant is not controlled by an emission limit, to limit the input of such non-hazardous pollutants to groundwater so as to ensure that such inputs do not cause pollution of groundwater.

3.3 Odour

3.3.1 Emissions from the activities shall be free from odour at levels likely to cause pollution outside the site, as perceived by an authorised officer of the Environment Agency, unless the operator has used appropriate measures, including, but not limited to, those specified in any approved odour management plan, to prevent or where that is not practicable to minimise the odour.

3.3.2 The operator shall:

- (a) if notified by the Environment Agency that the activities are giving rise to pollution outside the site due to odour, submit to the Environment Agency for approval within the period specified, an odour management plan which identifies and minimises the risks of pollution from odour;
- (b) implement the approved odour management plan, from the date of approval, unless otherwise agreed in writing by the Environment Agency.

3.4 Noise and vibration

3.4.1 Emissions from the activities shall be free from noise and vibration at levels likely to cause pollution outside the site, as perceived by an authorised officer of the Environment Agency, unless the operator has used appropriate measures, including, but not limited to, those specified in any approved noise and vibration management plan to prevent or where that is not practicable to minimise the noise and vibration.

3.5 Monitoring

3.5.1 The operator shall, unless otherwise agreed in writing by the Environment Agency, undertake the monitoring specified in the following tables in schedule 3 to this permit:

- (a) point source emissions specified in tables S3.1, S3.2, S3.3 and S3.4;
- (b) surface water or groundwater specified in table S3.5;
- (c) process monitoring specified in table S3.6;
- (d) ambient air monitoring specified in table S3.7.

3.5.2 The operator shall maintain records of all monitoring required by this permit including records of the taking and analysis of samples, instrument measurements (periodic and continual), calibrations, examinations, tests and surveys and any assessment or evaluation made on the basis of such data.

3.5.3 Monitoring equipment, techniques, personnel and organisations employed for the emissions monitoring programme and the environmental or other monitoring specified in condition 3.5.1 shall have either MCERTS certification or MCERTS accreditation (as appropriate), where available, unless otherwise agreed in writing by the Environment Agency.

3.5.4 Permanent means of access shall be provided to enable sampling/monitoring to be carried out in relation to the emission points specified in schedule 3 tables S3.1, S3.2, S3.3, S3.4 and S3.5 unless otherwise agreed in writing by the Environment Agency.

- 3.5.5 The operator shall carry out:
- (a) regular calibration, at an appropriate frequency, of systems and equipment provided for carrying out any monitoring and measurements necessary to determine compliance with this permit; and
 - (b) regular checking, at an appropriate frequency, that such systems and equipment are serviceable and correctly used.
- 3.5.6 If required by the Environment Agency, the operator shall
- (a) take such samples and conduct such measurements, tests, surveys, analyses and calculations, including environmental measurements and assessments, at such times and using such methods and equipment as the Environment Agency may reasonably specify and
 - (b) keep samples, provide samples, or dispatch samples for tests at a laboratory, as the Environment Agency reasonably specifies, and ensure that the samples or residues thereof are collected from the laboratory within three months of receiving written confirmation that testing and repackaging in accordance with the relevant legislation are complete.
- 3.5.7 The Emissions Monitoring Plan approved in accordance with PO 3 shall be implemented unless otherwise agreed in writing.

The plan shall be reviewed within 6 months of start of operations and a written report submitted to the Environment Agency for approval detailing the review and containing any proposals for amending the plan.

Any revised Emissions Monitoring Plan should be implemented in place of the original in accordance with the Environment Agency's written approval unless otherwise agreed in writing.

4 Information

4.1 Records

- 4.1.1 All records required to be made by this permit shall:
- (a) be legible;
 - (b) be made as soon as reasonably practicable;
 - (c) if amended, be amended in such a way that the original and any subsequent amendments remain legible, or are capable of retrieval; and
 - (d) be retained, unless otherwise agreed in writing by the Environment Agency, for at least 6 years from the date when the records were made, or in the case of the following records until permit surrender:
 - (i) off-site environmental effects; and
 - (ii) matters which affect the condition of the land and groundwater.
- 4.1.2 The operator shall keep on site all records, plans and the management system required to be maintained by this permit, unless otherwise agreed in writing by the Environment Agency.

4.2 Reporting

- 4.2.1 The operator shall send all reports and notifications required by the permit to the Environment Agency using the contact details supplied in writing by the Environment Agency.
- 4.2.2 Within 28 days of the end of the reporting period the operator shall, unless otherwise agreed in writing by the Environment Agency, submit reports of the monitoring and assessment carried out in accordance with the conditions of this permit, as follows:

- (a) in respect of the parameters and emission points specified in schedule 4 table S4.1;
- (b) for the reporting periods specified in schedule 4 table S4.1 and using the forms specified in schedule 4 table S4.4; and
- (c) giving the information from such results and assessments as may be required by the forms specified in those tables.

4.3 Notifications

- 4.3.1 The Environment Agency shall be notified without delay following the detection of:
- (a) any malfunction, breakdown or failure of equipment or techniques, accident, or emission of a substance not controlled by an emission limit which has caused, is causing or may cause significant pollution;
 - (b) the breach of a limit specified in the permit; or
 - (c) any significant adverse environmental effects.
- 4.3.2 Any information provided under condition 4.3.1 shall be confirmed by sending the information listed in schedule 5 to this permit within the time period specified in that schedule.
- 4.3.3 Where the Environment Agency has requested in writing that it shall be notified when the operator is to undertake monitoring and/or spot sampling, the operator shall inform the Environment Agency when the relevant monitoring and/or spot sampling is to take place. The operator shall provide this information to the Environment Agency at least 14 days before the date the monitoring is to be undertaken.
- 4.3.4 The Environment Agency shall be notified within 14 days of the occurrence of the following matters, except where such disclosure is prohibited by Stock Exchange rules:
- Where the operator is a registered company:
- (a) any change in the operator's trading name, registered name or registered office address; and
 - (b) any steps taken with a view to the operator going into administration, entering into a company voluntary arrangement or being wound up.
- Where the operator is a corporate body other than a registered company:
- (a) any change in the operator's name or address; and
 - (b) any steps taken with a view to the dissolution of the operator.
- In any other case:
- (a) the death of any of the named operators (where the operator consists of more than one named individual);
 - (b) any change in the operator's name(s) or address(es); and
 - (c) any steps taken with a view to the operator, or any one of them, going into bankruptcy, entering into a composition or arrangement with creditors, or, in the case of them being in a partnership, dissolving the partnership.
- 4.3.5 Where the operator proposes to make an amendment to the approved waste management plan, which is not otherwise the subject of an application for approval under the Regulations or this permit:
- (a) the Environment Agency shall be notified at least 14 days before implementing the amended waste management plan in place of the original; and
 - (b) the notification shall contain a description of the proposed amendment.

- 4.3.6 Where the operator proposes to make a change in the nature or functioning, or an extension of the activities, which may have consequences for the environment and the change is not otherwise the subject of an application for approval under the Regulations or this permit:
- (a) the Environment Agency shall be notified at least 14 days before making the change; and
 - (b) the notification shall contain a description of the proposed change in operation.
- 4.3.7 Following closure of the mining waste facility, the Environment Agency shall be notified without delay following the detection of:
- (a) any events or developments likely to affect the stability of the waste facility; or
 - (b) any significant adverse environmental effects revealed by the relevant control and monitoring procedures.

4.4 Interpretation

- 4.4.1 In this permit the expressions listed in schedule 6 shall have the meaning given in that schedule.
- 4.4.2 In this permit references to reports and notifications mean written reports and notifications, except where reference is made to notification being made “without delay”, in which case it may be provided by telephone.

Schedule 1 – Operations

Table S1.1 activities		
Activity reference	Description of activities for waste operations	Limits of activities
A1	<p>The management of extractive waste, not involving a waste facility.</p> <p>The management of extractive waste generated by well abandonment.</p>	<p>Permitted waste types shall conform to the description in the approved waste management plan.</p> <p>No more than 1330 cubic metres of flowback fluid shall be stored on site at any one time.</p> <p>Waste shall not be stored on site for a period of more than 1 year.</p> <p>Flowback fluid shall be re-used wherever possible.</p>
A2	The management of extractive waste by way of a waste facility for non-hazardous waste	<p>Permitted waste types shall conform to the description in the approved waste management plan.</p> <p>Hydraulic fracturing fluid shall not contain substances other than those additives specified in the Waste Management Plan and approved in writing by the Environment Agency.</p>
A3	The injection of hydraulic fracturing fluid to ground via KM8 well.	<p>Injection of hydraulic fracturing fluid to ground via KM8 well for the purposes of fracturing the Bowland Shale Formation to access natural gas resources at 5 depths on the vertical well; approximately 2,126m, 2,250m, 2,655m, 2,763m and 3,040m below ground level.</p> <p>There shall be no injection of hydraulic fracturing fluid (which may include reused flow back fluid) for disposal.</p> <p>Hydraulic fracturing fluid shall not contain substances, other than those additives specified in the Waste Management Plan and approved in writing by the Environment Agency; and flowback water that is suitable for reuse, produced from previous hydraulic fracturing events at this location.</p> <p>In the event of suspension of activities at</p>

Table S1.1 activities		
Activity reference	Description of activities for waste operations	Limits of activities
		KM8, as required by the agreed Hydraulic Fracture Plan, the well integrity shall be confirmed prior to resumption of activity A3. This confirmation should include, but is not limited to, any comments provided by the Health & Safety Executive.

Table S1.2 Operating techniques		
Description	Parts	Date Received
Application EPR/DB3002HE/A001	Documents provided in response to section 3a – technical standards, Part B4 of the application form.	03/06/15
Response to Schedule 5 Notice dated 28/07/15	Environmental Risk Assessment (TE-EPRA-KM8-HFS-ERA-07 11/08/15); Technical Note: Seismicity (TE-KM8-TN-EPR-SCH5-Seismicity 11/08/15) Technical Note: Hydrogeological Risk Assessment and Baseline Water Quality Report (14/08/15);	14/08/15
Additional information; follow up to Schedule 5 notice.	Waste Management Plan (TE-EPRA-KM8-HFS-WMP-05 18/09/15); Emissions Monitoring Plan (TE-EPRA-KM8-HFS-EMP-09 18/09/15); Hydraulic Fracture Fluids and Chemical Inventory (TE-KM8-TN-EPR-SCH5-HFF); Site Condition Report (TE-EPRA-KM8-HFS-SCR-06) Appendix 3 Flood Risk Assessment;	21/09/15
Additional information	Updated Waste Management Plan (TE-EPRA-KM8-HFS-WMP-05 03/11/15) Revision 3	03/11/15
Additional information	Envireau Water Technical Note KM8 Fracture Propagation r4 (dated 10/11/15)	11/11/15

Table S1.3 Pre-operational measures	
Reference	Pre-operational measures
PO 1a	Prior to the operation of the regulated facility the Operator shall conduct a well integrity test on the existing borehole in accordance with section 4.3.1 of the Waste Management Plan.
PO 1b	Prior to the operation of the regulated facility the Operator shall submit a written report to the Environment Agency including the results of the integrity test carried out in accordance with PO 1a which should include, but is not limited to any comments provided by the Health & Safety Executive.
PO 2	Prior to the operation of the regulated facility the Operator shall submit to the Environment Agency a written Hydraulic Fracture Plan (as referred to in Waste Management Plan (WMP) section 4.3.2) and obtain the Environment Agency's written approval to the sections relevant to the permitted activities and WMP.

Table S1.3 Pre-operational measures	
Reference	Pre-operational measures
PO 3	<p>At least 4 weeks prior to commencement of permitted activities the operator shall submit to the Environment Agency for approval an updated Emissions Monitoring Plan (EMP) which will include, but is not limited to:</p> <ul style="list-style-type: none"> • Complete details of the baseline air quality study undertaken prior to activities commencing; and details of any changes made to the ambient air monitoring programme proposed, • Complete details of the baseline surface water and groundwater study undertaken prior to activities commencing; and details of any changes made to the surface water and groundwater monitoring programme proposed. Baseline monitoring shall include as a minimum the parameters listed in table S3.5; and the locations, depth, construction method of the monitoring boreholes. • The plan shall also address the requisite surveillance requirements to monitor groundwater both pre-operation and over the lifetime of the activities authorised by this permit • Complete details of the surface water management procedures, and related process monitoring, <p>and shall obtain the Environment Agency's written approval to the updated EMP.</p>
PO 4	<p>Prior to the operation of the regulated facility the operator shall provide a written report that provides the following information for each groundwater monitoring borehole installed:</p> <ul style="list-style-type: none"> (a) casings/linings (length, diameter, material, type of grout or filter media and whether slotted or plain); (b) depths and diameters of unlined sections; (c) records of groundwater ingress during construction and standing groundwater levels on completion; (d) details of strata encountered during drilling; (e) reference levels for the individual criteria specified in 4(a) to (c) above in metres above ordnance datum; (f) a location plan at a suitable scale showing the boreholes in relation to the point of discharge; (g) national grid references of the boreholes in the form AB 12345 67890; <p>any other information obtained from the boreholes relevant to the interpretation of water sample analysis.</p>
PO 5	<p>Prior to the operation of the regulated facility the Operator shall submit a written report to the Environment Agency including the details from the deep monitoring borehole (BHE) at KM8 drilled into the Corallian Limestone Formation. The report will include but is not limited to, the location of the faults and a description of how the currently used groundwater in the Corallian Limestone will be protected.</p>

Schedule 2 – Waste types, raw materials and fuels

The disposal or recovery of non-extractive wastes are not permitted activities and there are no restrictions on raw materials or fuels under this schedule.

Schedule 3 – Emissions and monitoring

Emission point ref. & location	Parameter	Source	Limit (including unit)	Reference Period	Monitoring frequency	Monitoring standard or method
There are no point source emissions to air	-	-	-	-	-	-

Emission point ref. & location	Parameter	Limit (incl. unit)	Reference Period	Monitoring frequency	Monitoring standard or method
The injection of hydraulic fracturing fluid via KM8 well into the Bowland Shale Formation.	Maximum fracture discharge volume	1250m ³	per main fracture	per fracture 1 to Zone E	-
	Maximum fracture discharge volume	701m ³	per main fracture	per fracture 2 to Zone D	-
	Maximum fracture discharge volume	475m ³	per main fracture	per fracture 3 to Zone C	-
	Maximum fracture discharge volume	442m ³	per main fracture	per fracture 4 to Zone B	-
	Maximum fracture discharge volume	425m ³	per main fracture	per fracture 5 to Zone A	-
	15-minute instantaneous or averaged flow	No limit set. Record as l/s	-	Continuous	-
	Acrylamide Alaklinity (total) as CaCO ₃ Ammoniacal Nitrogen as N Arsenic Aluminium Antimony Barium Beryllium BOD (settled) Boron Bromide δ13C-CH ₄ δ13C-CO ₂	no limit set	per fracture injection	Instantaneous (spot sample) per fracture injection	-

Table S3.2 Point Source emissions to water (other than sewer) and land – emission limits and monitoring requirements

Emission point ref. & location	Parameter	Limit (incl. unit)	Reference Period	Monitoring frequency	Monitoring standard or method
	Cadmium Calcium Carbon Dioxide Chloride Chromium (total) Cobalt COD (settled) Copper Dissolved Butane Dissolved Propane Dissolved Ethane Dissolved Methane Fluoride Iron (total) Lead Lithium Magnesium Mercury Nickel Nitrate as NO3 Nitrite as NO2 Oxidation Reduction Potential pH Potassium Salinity Selenium Silver Sodium Strontium TPH (including Benzene, DRO (nC10 ro nC24, GRO (nC5 to nC10), m/p Xylenes, o Xylene, MTBE, Toluene, Xylene, Ethyl Benzene) Total dissolved solids Total suspended solids Vanadium Zinc				

Effluent Name	Discharge Point	Discharge point NGR	Receiving water/Environment
Hydraulic Fracturing fluid	KM8 well fracture zones: Fracture 5 Zone A at 2,123 – 2,129m depth; Fracture 4 Zone B 2,247 – 2,253m Fracture 3 Zone C 2,652 – 2,658m Fracture 2 Zone D 2,760 – 2,766m Fracture 1 Zone E 3,037 – 3,043m	SE 77136 79004	Groundwater via vertical borehole constructed in Bowland Shale Formation

Effluent name	Monitoring type	Monitoring point NGR	Monitoring point reference
Hydraulic fracturing fluid	Fracture fluid volume	SE 77136 79004	KM8 well into the Bowland Shale Formation
	Fracture fluid composition	SE 77136 79004	KM8 well into the Bowland Shale Formation

Location or description of monitoring points	Parameter as Instantaneous - spot sample	Monitoring frequency	Monitoring standard or method	Other specifications
Groundwater monitoring borehole BHA at SE 7715 7903 on wellpad.	Methane (excluding S1, S2, S3 & G6)	Weekly during fracturing operations (to include workover activities) for boreholes: BHA, BHB, BHC, BHD, BHE and surface water: S1. Monthly thereafter	BS ISO 5667 and condition 3.5.3	The boreholes must be purged appropriately prior to sampling. Samples must be filtered samples.
Groundwater monitoring borehole BHB at SE 7710 7899 on wellpad.	Acrylamide Alkalinity (total) as CaCO ₃ Ammoniacal Nitrogen as N Arsenic Aluminium			
Groundwater monitoring borehole BHC at SE 7716 7896 on wellpad.	Antimony Barium Beryllium			

Groundwater monitoring borehole BHD at SE 7713 7896 on wellpad.	BOD (settled) Boron Bromide $\delta^{13}\text{C}-\text{CH}_4$	unless otherwise agreed in writing with the Environment Agency. Monthly for boreholes: G1, G2, G3, G4, G5, G6 and surface water S2 and S3.
Groundwater monitoring borehole BHE at SE 7710 7897 on wellpad.	$\delta^{13}\text{C}-\text{CO}_2$ Cadmium Calcium	
Groundwater monitoring borehole G1(offsite - see Appendix 2 of EMP)	Carbon Dioxide Chloride Chromium (total) Cobalt	
Groundwater monitoring borehole G2 (offsite - see Appendix 2 of EMP)	COD (settled) Copper Dissolved Butane Dissolved Propane	
Groundwater monitoring borehole G3 (offsite - see Appendix 2 of EMP)	Dissolved Ethane Dissolved Methane Fluoride	
Groundwater monitoring borehole G4 (offsite - see Appendix 2 of EMP)	Iron (total) Lead Lithium Magnesium	
Groundwater monitoring borehole G5 (offsite - see Appendix 2 of EMP)	Mercury Nickel Nitrate as NO_3 Nitrite as NO_2	
Groundwater monitoring borehole G6 (offsite - see Appendix 2 of EMP)	Oxidation Reduction Potential pH Potassium Salinity	
Surface water monitoring point S1 at SE 77003 78781	Selenium Silver Sodium	
Surface water monitoring point S2 at SE 78730 79637	Strontium TPH (including Benzene, DRO (nC10 to nC24, GRO (nC5 to nC10), m/p Xylenes, o Xylene, MTBE, Toluene, Xylene, Ethyl Benzene)	
Surface water monitoring point S3 at SE 75701 77456	Total dissolved solids Total suspended solids Vanadium Zinc <u>Fracture fluid additives:</u> Acetic acid, Aluminium sulphate, Aluminium sulphate octadecahydrate, Citric acid triethyl ester, Hemicellulase enzyme, Maltodextrin, Potassium chloride,	

	<p>Sodium bicarbonate, Sodium carboxymethyl cellulose, Sodium chloride, Sodium gluconate, Sodium lauryl sulphate, Sodium persulphate, Sorbitan monododecanoate poly(oxy1,2-ethanediyl), Sulphuric acid,</p> <p><u>Other chemical inventory:</u> Triacine Glycine Formaldehyde Ammonium Bisulphate Ethylene glycol Hydrochloric acid Sodium hydroxide 2-ethylhexyl zinc ditiophosphate</p>	
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Table S3.6 Process monitoring requirements

Location or description of monitoring points	Parameter	Monitoring frequency	Monitoring standard or method	Other specifications
Buried microseismic array of seismometers	Location, orientation and extent of induced fractures.	During the hydraulic fracturing events and in accordance with the Hydraulic Fracture Plan (HFP).	As set out in the approved HFP	-
KMA wellsite: Open perimeter ditch on KM8 wellpad,	no visible oil or grease	Prior to any release to interceptor	-	No contamination present prior to release of water to interceptor and drain, and obtain written agreement of Environment Agency to reconnect drainage system during periods of inactivity. No contamination present prior to release of water from the interceptor.
Interceptor on KM1 wellpad		Prior to any release to Sugar Hill Drain		

Table S3.7 Ambient air monitoring requirements

Location or description of point of	Parameter	Monitoring frequency	Monitoring standard or method	Other specifications
Locations specified in approved EMP specified in table S1.2	Parameters specified in approved EMP specified in table S1.2	Frequencies specified in approved EMP specified in table S1.2	In accordance with EMP specified in table S1.2	-

Schedule 4 – Reporting

Parameters, for which reports shall be made, in accordance with conditions of this permit, are listed below.

Parameter	Emission or monitoring point/reference	Reporting period	Period begins
Emissions to water Parameters as required by condition 3.5.1	KM8 well – injection point	per fracture	start of each fracture operation
Groundwater and surface water monitoring Parameters as required by condition 3.5.1	Monitoring points as detailed in table S3.5	weekly / monthly as per monitoring schedule	as per monitoring schedule
Ambient air monitoring Parameters as required by condition 3.5.1	Locations as specified in approved EMP	as specified in approved EMP	as specified in approved EMP

Parameter	Units
n/a	-

Parameter	Frequency of assessment	Units
Water usage	Quarterly	m ³
Solid waste disposal	Quarterly	tonnes
Fluid waste disposal	Quarterly	m ³

Media/parameter	Reporting format	Date of form
Water and Land	Form water 1 or other form as agreed in writing by the Environment Agency	11/04/16
Water usage	Form water usage 1 or other form as agreed in writing by the Environment Agency	11/04/16
Performance parameters	Form performance 1 or other form as agreed in writing by the Environment Agency	11/04/16
Groundwater & surface water	Form groundwater 1 or other form as agreed in writing by the Environment Agency	11/04/16

Schedule 5 – Notification

These pages outline the information that the operator must provide.

Units of measurement used in information supplied under Part A and B requirements shall be appropriate to the circumstances of the emission. Where appropriate, a comparison should be made of actual emissions and authorised emission limits.

If any information is considered commercially confidential, it should be separated from non-confidential information, supplied on a separate sheet and accompanied by an application for commercial confidentiality under the provisions of the EP Regulations.

Part A

Permit Number	
Name of operator	
Location of Facility	
Time and date of the detection	

(a) Notification requirements for any malfunction, breakdown or failure of equipment or techniques, accident, or emission of a substance not controlled by an emission limit which has caused, is causing or may cause significant pollution	
To be notified within 24 hours of detection	
Date and time of the event	
Reference or description of the location of the event	
Description of where any release into the environment took place	
Substances(s) potentially released	
Best estimate of the quantity or rate of release of substances	
Measures taken, or intended to be taken, to stop any emission	
Description of the failure or accident.	

(b) Notification requirements for the breach of a limit	
To be notified within 24 hours of detection unless otherwise specified below	
Emission point reference/ source	
Parameter(s)	
Limit	
Measured value and uncertainty	
Date and time of monitoring	
Measures taken, or intended to be taken, to stop the emission	

Time periods for notification following detection of a breach of a limit	
Parameter	Notification period

(c) Notification requirements for the detection of any significant adverse environmental effect	
To be notified within 24 hours of detection	
Description of where the effect on the environment was detected	
Substances(s) detected	
Concentrations of substances detected	
Date of monitoring/sampling	

Part B – to be submitted as soon as practicable

Any more accurate information on the matters for notification under Part A.	
Measures taken, or intended to be taken, to prevent a recurrence of the incident	
Measures taken, or intended to be taken, to rectify, limit or prevent any pollution of the environment which has been or may be caused by the emission	
The dates of any unauthorised emissions from the facility in the preceding 24 months.	

Name*	
Post	
Signature	
Date	

* authorised to sign on behalf of the operator

Schedule 6 – Interpretation

“accident” means an accident that may result in pollution.

“Annex I” means Annex I to Directive 2008/98/EC of the European Parliament and of the Council on waste.

“Annex II” means Annex II to Directive 2008/98/EC of the European Parliament and of the Council on waste.

“application” means the application for this permit, together with any additional information supplied by the operator as part of the application and any response to a notice served under Schedule 5 to the EP Regulations.

“approved” means that we have formed a view that a Plan contains what we consider to be appropriate measures in the light of information available to us at the current time. The approval does not mean that the measures in the plan are considered to represent all appropriate measures covering every eventuality throughout the life of the permit. In light of the potential for environmental harm on site and the surrounding area you should keep this plan under constant review and revise it if pollution or a risk of pollution arises from operations on site.

“approved waste management plan” means a plan of the type described in Article 5(1) of Directive 2006/21/EC of the European Parliament and of the Council of 15 March 2006 on the management of waste from extractive industries and amending Directive 2004/35/EC, approved as part of the grant or variation of an environmental permit and as revised from time to time.

“*aquifer*” means a subsurface layer or layers of rock or other geological strata of sufficient permeability to allow either a significant flow of groundwater or the abstraction of significant quantities of groundwater (WFD Art 2.11)

“authorised officer” means any person authorised by the Environment Agency under section 108(1) of The Environment Act 1995 to exercise, in accordance with the terms of any such authorisation, any power specified in section 108(4) of that Act.

“emissions to land” includes emissions to groundwater.

“emissions of substances not controlled by emission limits” means emissions of substances to air, water or land from the activities, either from the emission points specified in schedule 3 or from other localised or diffuse sources, which are not controlled by an emission limit.

“EP Regulations” means The Environmental Permitting (England and Wales) Regulations SI 2010 No.675 and words and expressions used in this permit which are also used in the Regulations have the same meanings as in those Regulations.

“exploration” means activities carried out to provide information about geological structures and the presence or absence of gas reserves together with assessments to determine whether the reservoir development is economically feasible.

“extractive waste” means waste resulting from the prospecting, extraction, treatment and storage of mineral resources and the working of quarries, excluding waste which does not directly result from these operations.

“groundwater” means all water, which is below the surface of the ground in the saturation zone and in direct contact with the ground or subsoil.

“hazardous waste” has the meaning given in the Hazardous Waste (England and Wales) Regulations 2005 No.894, the Hazardous Waste (Wales) Regulations 2005 No. 1806 (W.138), the List of Wastes (England) Regulations 2005 No.895 and the List of Wastes (Wales) Regulations 2005 No. 1820 (W.148).

“MCERTS” means the Environment Agency’s Monitoring Certification Scheme.

“mining waste facility” means a waste facility as defined in Article 3(15) of Directive 2006/21/EC of the European Parliament and of the Council of 15 March 2006 on the management of waste from extractive industries and amending Directive 2004/35/EC, where a mining waste operation is carried out.

“prospecting” means prospecting as defined by article 3(21) of the Mining Waste Directive as ‘the search for mineral deposits of economic value, including sampling, bulk sampling, drilling and trenching, but excluding

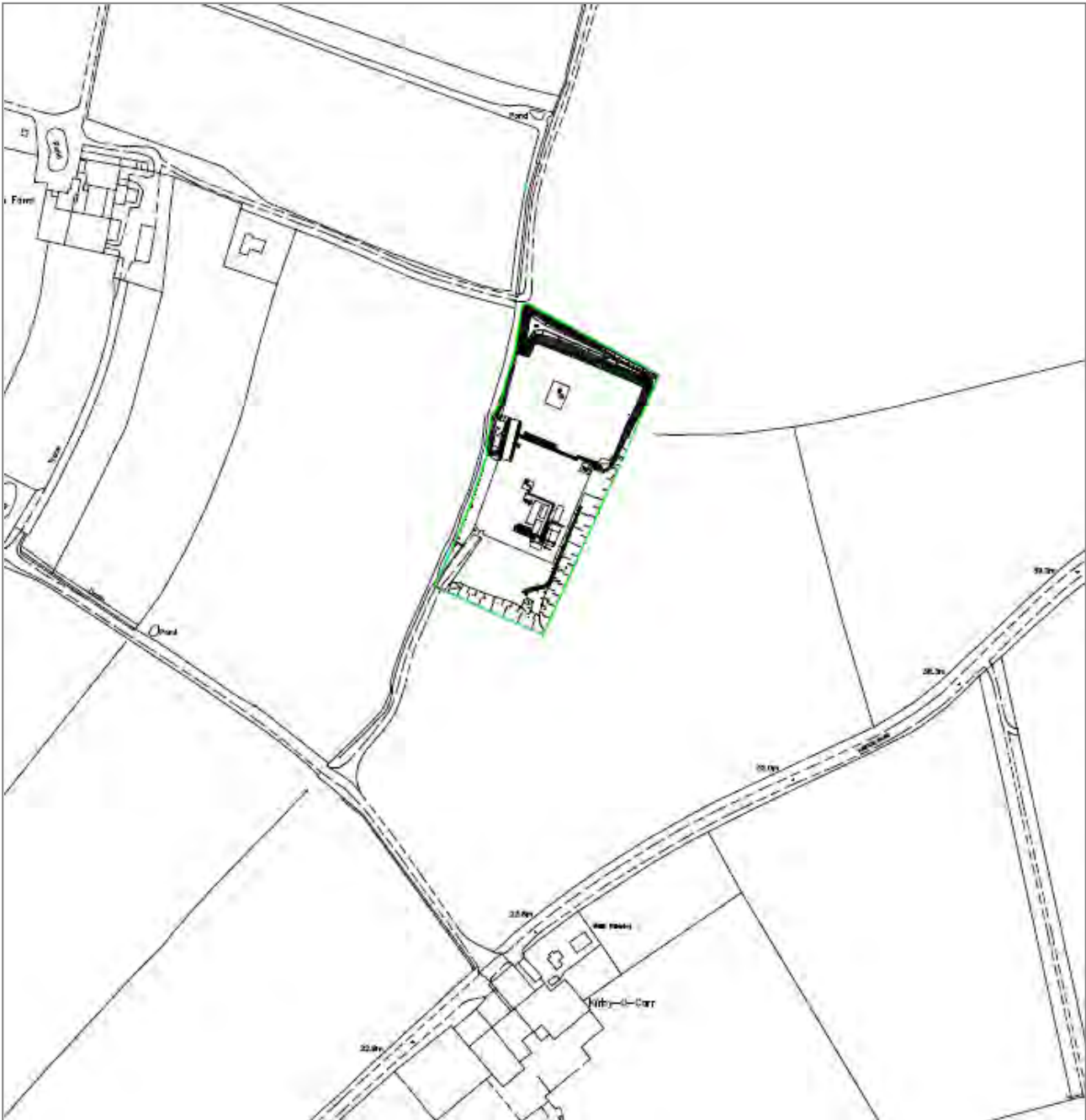
any works required for the development of such deposits, and any activities directly associated with an extractive operation.

“requisite surveillance” means the monitoring of groundwater that is required, in particular its quality, to ensure groundwater is not impacted by the permitted activity. It is the monitoring necessary to confirm control measures are working and there is no pollution of groundwater occurring.

“Waste Framework Directive” or “WFD” means Waste Framework Directive 2008/98/EC of the European Parliament and of the Council on waste.

“year” means calendar year ending 31 December.

Schedule 7 – Site plan





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END OF PERMIT