SalierGeotechnical Limited
Site Investigation, Gas Monitoring, Chemical Analysis, Data Analysis

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RF Aggregates (South West) Limited
Yalberton Tor Quarry Landfill
Yalberton Road
Paignton
Devon
TQ4 7PD

23rd December 2017

With Regard to Permit EPR/GP3498VW

For the attention of Mr Darren Cripps

Visit to the site on the 23rd December 2017

Six gas monitoring boreholes were installed at the beginning of November 2015 in order to comply with the terms of the aftercare policy described in the EA Documents, Landfill (EPR 5.02), LIT_8220, RFAggregates Permit and EPR Compliance Assessment Report dated 19/08/2015.

Current description of site

The site is now relatively flat, sloping towards the northeast area. RF Aggregates (UK) Ltd has confirmed that this present profile is the final completed surface. No further work is intended to be carried out above the current elevation; however, the remaining stockpiles of aggregate on the south east quarter have been gradually reduced.

Offices and site facilities have been removed together with the electrical generator and oil tanks. The weighbridge remains and is awaiting a buyer. No plant remains on site although, currently, there is still a little of the stone stockpiles.

A modified plan shows generalized contour lines together with the locations of the 6 No gas monitoring boreholes. The water monitoring boreholes are also shown in their respective original positions surrounding the site.

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Previous topological surveys determined that the level at the gate to be OD 50 +/- 1 mm. The site levels have now been found to be at between OD 49 and 51 towards the center of the site falling to a minimum, of OD 47.5 along the Northern perimeter.

Tests are being carried out on both the gas monitoring boreholes and the water-monitoring borehole every three months until the period of aftercare is complete in December 2017, after which time the central BH No 1 to 6 will be de-commissioned.

The plan, shown in the permission, gives an indication of the profile of the quarry in 2007 together with, both the positions of the monitoring installations surrounding the quarry, and the nominal positions of the Borehole Monitoring Location on the site.

Estimates of the depth of fill, that has been emplaced, since the onset of the work have been made by extracting the level data from the periodic topographical surveys. The final finished level approximates an average OD of about 49.5 and as such can be used to calculate the total amount of fill mobilized to infill the void.

Photographs taken at the time of the September 2015 cycle of testing show the surface materials deposited were light red and brown very stony cohesive clays. Photographs taken during the installation of the gas monitoring boreholes were indeterminate because the site was saturated by very heavy rain that continued throughout the three day it took to carry out the work.

The first set of aftercare tests were carried out on the 12th December 2015.
Gas was measured in each of the 6 boreholes.
Gas testing and water samples were taken in the 4 surrounding boreholes.
The final topological survey was carried out on the 12th January 2016. Continuous rain since November 2015 period largely prevented the final survey being performed until this date when there was a short window without rain.
The final survey was completed and the data provided to RF Aggregates
Further sets of monitoring have now been completed.
The continuous result are recorded on the graphical test data sheets

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The aftercare specified in the Permit Document requires that gas testing should be carried in general area of the site using the Gas Monitoring Installations.

The Gas Monitoring Boreholes are now used to determine the various parameters included in the aftercare requirement. The locations of the boreholes are shown on the attached detail. (See also the List of Results)

The Gas Monitoring apparatus is shown in the photograph included in this report.

A pipe connected to the Gas Monitoring Device is attached to the tap on off the standpipe and any gas being emitted from the ground is recorded.

Table S3.2 in the Permit specifies that the values for Methane, Carbon Dioxide, Oxygen and the Atmospheric Pressure should be recorded. The values for six test locations are shown attached report.

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Extracted from Permit

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) Groundwater specified in table S3.1;

(b) Landfill gas specified in table S3.2;

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 A topographical survey of the site referenced to Ordnance Datum shall be carried out:
(a) annually, or prior to the disposal of waste in any new cell or new development area of the landfill whichever is the shorter period, and

(b) Following closure of the landfill or part of the landfill. The topographical survey shall be used to produce a plan of a scale adequate to show the surveyed features of the site.

Table S3.2 *Landfill* gas monitoring requirements

Monitoring point Ref. /description	Parameter	Monitoring frequency	Monitoring standard or method
During operational phase of each stage: Borehole locations as illustrated on Drawing 3.	Methane Carbon Dioxide Oxygen Atmospheric pressure	Quarterly or at every 4m of waste deposited whilst a phase is operational, which ever is reached first.	-
After the completion of each phase: Borehole locations as illustrated on Drawing 3.	Methane Carbon Dioxide Oxygen Atmospheric pressure	Quarterly	In accordance with Environment Agency guidance LFTGN03 Guidance on the Management of Landfill Gas

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Gas Monitoring Boreholes BH 1 to 6

On the day of the current tests the atmospheric pressure was found to be 1002 mb.

CO_2 values were recorded in BH's 2, 3 and 5 showing values below the 1.5% recommended action level. The previous set of results was higher than this and it is thought that some stabilization has occurred.

CH4 Boreholes 2, 3 and, 5 gave values of 0.1%, 0.3% and 0.4% respectively. The LEL% Values were calculated for these holes giving values of 2%, 6%. And 8% (See Guidance Notes). None of these values are above the stipulated maximum of 20%.

There are now currently references to the potential difficulties associated with deep gas monitoring standpipes:-

CL:AIRE RB17 – A Pragmatic Approach to Ground Gas Risk Assessment
NHBC – Guidance on Evaluation of Development of Proposals on Sites where Methane and Carbon Dioxide are Present REPORT EDITION 04

CIRIA/Environmental Protection UK Ground gas seminar – September 2011.

CIRIA C665 Assessing risks posed by hazardous ground gases to buildings. 2007.

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The implications of each of these documents makes it apparent that, for various reason, in some instances, deep gas monitoring standpipe can tend to generate higher gas levels.

For instance – Where any small amount gases may be present distributed as small bubbles throughout a soil matrix, there can be a tendency for changes in temperature and pressure to release and concentrate these gases towards the standpipe. Without the presence of the standpipe soil pressures at the depth of 6 to 7 meters would tend to contain the vesicles and gas would not be released.

Equally, the work was lined with an impervious clay blanket, therefore, water would tend to collect in the “sump” and being unable to escape, could tend to stagnate at the base of the standpipe monitoring well. The anaerobic condition may then produce some methane and carbon dioxide. It should also be noted that the temperature at depth could be in the region of 20 to 25 degrees C.

Though there may be other factor involved in the process it is suggested that investigation are carry out to determine the water level in the 6 No borehole and where applicable take sample and carry out analysis for dissolved oxygen, organics and dissolved solids.

This operation was performed and the results confirmed that the water in some of the most active borehole contained organic residues most likely responsible for the generation of methane and carbon dioxide at elevated levels.

There is some suggestion that there is a relationship between atmospheric pressures and gas emissions. It would seem logical to suggest that a lower atmospheric pressure would tend to allow any trapped gases to be emitted more readily and higher pressure would tend to contain the gas in the ground.

However, changes in moisture content and ground temperature also affect the gas emissions. Some increase in gas emission has often been recorded when the ground temperature has increased over a period of time. Equally, as the ground temperature reduces lower emissions are often recorded. It also seems that bacterial and chemical activity may be attenuated when buried

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soils are exposed to oxygen and to a higher temperature. The natural moisture content of the ground may also be a factor in the amount and type of gas being emitted. Once buried and well compacted these factors are often ameliorated and the material can become less active.
The surface materials were found relatively dry and firm. Clover and other plants are beginning to pioneer the site.

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Gas Monitoring Apparatus

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Water Test Boreholes

There are a series of boreholes surrounding the quarry boundary which were installed a number of years ago. The permit requires that these boreholes should be sampled for water and tested for gas periodically as specified in the permit. Site 'Aftercare' requires that this monitoring continue for a 2 year period

The four boreholes were located (see location plan) and gas tests were performed on each one as required. It has now been found that each of the boreholes contains water. The results of the gas emissions from these may be found on the data log for these boreholes.

Existing BH No.	Ground level	SGL No.	Depth of Borehole (m)	Depth to Water (m)	Water Sampled Y/N	Gas Tested Y/N
MH3	50.29	1	32.6	24.1	Y	Y
MH4	41.14	2	34.0	30	Y	Y
MH5	42.97	4	29.9	21.6	Y	Y
MH6	43.81	3	25.0	20.2	Y	Y

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Water Sample Test Results

Please find attached copies of the test report supplied by Alcontrol Ltd (Now ALSGlobal Ltd) giving details of four water samples taken from Yalberton Quarry on the 23rd December 2017.

The details concerning the four surrounding boreholes are giving in the body of the main report; however, they are repeated below for clarity.

Existing Borehole Monitoring

There are a series of boreholes surrounding the quarry boundary which were installed a number of years ago. The permit requires that these boreholes should be sampled for water and tested for gas periodically as specified in the permit.

Table S3.2 Landfill gas monitoring requirements

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During operational phase of each stage: Borehole locations as illustrated on Drawing 3.	Methane Carbon Dioxide Oxygen Atmospheric pressure	Quarterly or at every 4m of waste deposited whilst a phase is operational, which ever is reached first.	-
After the completion of each phase: Borehole locations as illustrated on Drawing 3.	Methane Carbon Dioxide Oxygen Atmospheric pressure	Quarterly	In accordance with Environment Agency guidance LFTGN03 Guidance on the Management of Landfill Gas

The four boreholes were located (see location plan) and gas tests were performed on each one as required. On this occasion all of the boreholes were found to contain water; hence, four samples were taken.

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Resume' of Gas Tests Value found in the Boreholes Surrounding the Site

BH No	Barometric Pressure	Relative Pressure	CH4 %	CO2 %	O2 %	Bal %	Peak CH4	LEL %	H2S	CO	Water Depth (m)
MH3	1003	-0.35	0.3	1.0	8.6	90.1	0.3	6.0	0.0	0.0	24.1
MH4	1003	-0.20	0.0	1.5	8.2	90.3	0.0	0.0	0.0	0.0	30
MH5	1003	-0.20	0.0	0.0	9.3	90.7	0.0	0.0	0.0	0.0	21.6
MH6	10	-0.20	0.0	0.0	9.1	90.9	0.0	0.0	0.0	0.0	20.2

CH4% was found in boreholes MH3 of 0.3% giving an LEL% of 6.0%.

Boreholes MH3 and MH4 gave CO2% of 1.0% and 1.5%% respectively. MH4 gave a value of 1.5% at the lower recommended action level but below the mandatory action level of 5%.

It was initially thought there may have been a general trend of groundwater flow towards the stream within the valley to the north; however, it appears that the Yalberton Watercourse level is above the level of the water table found in these boreholes. Hence, the ultimate outfall (if any) for the groundwater flow in this area remains unknown. It has now been confirmed that the patterns of rainfall has an effect on the amount of water found in these borehole, however, current observation seem to suggest that the water flow at depth of approximately 30 m is more complex. Further inspections may show some pattern though at the moment it is not discernible.

The four boreholes were located (see location plan) and gas tests were performed on each one as required. On this occasion all of the boreholes were found to contain water; hence, four samples were taken.

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Chemical Analysis Test Results together with the Environment Agency Trigger Levels

Existing BH No.	Ground level (m)	SGL No.	Depth of Borehole (m)	Depth to Water (m)	Ammoniacal Nitrogen (mg/l)	Chloride (mg/l)	Sulphate (mg/l)
					Trigger Level 0.42mg/l	Trigger Level 250 mg/l	Trigger Level 250 mg/l
MH3	50.29	1	32.6	24.1	<0.2	30.1	20.5
MH4	41.14	2	34.0	30.0	<0.2	25.3	10.3
MH5	42.97	4	29.9	21.6	<0.2	35.1	18.2
MH6	43.81	3	25.0	20.2	<0.2	88.2	124.5

Other observations -: pH values MH3 = 7.21 MH4 = 7.67 MH5 = 7.18, MH6 = 7.3+

These results show that, the chloride, sulphate an Ammoniacal Nitrogen values are below the trigger levels.

Report Compiled by

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