

Radiological Baseline Survey and Monitoring of the Egdon Resources UK Ltd's Wressle Well-site

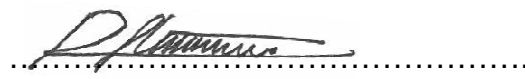
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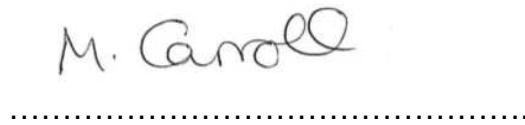
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EXECUTIVE SUMMARY

This report presents the results of a radiological baseline survey and reassurance monitoring conducted at the Egdon Resources UK Ltd Wressle well-site on 9th April 2015. The purpose was to determine whether there was significant radiological contamination arising from Naturally Occurring Radioactive Material (NORM) on the site's surface and immediate sub-surface material, and local area surrounding the site, and to produce a radiological baseline against which future sampling and monitoring could be compared. The information contained within this report can also be used as part of any future site condition report required for permit surrender.

The samples taken for the radiological baseline survey showed no significant presence of NORM and when the results were assessed against the EPR 2010 Out-of-Scope limits, all 6 samples were below the limit. Similarly, the areas that were monitored for dose-rate and surface contamination showed no significant presence of NORM.

GLOSSARY

cps	Counts per second
EPR 2010	Environmental Permitting (England and Wales) Regulations 2010, as amended
HRGS	High Resolution Gamma Spectrometry
LOD	Limit of Detection
NORM	Naturally Occurring Radioactive Material
RPA	Radiation Protection Adviser
RSR	Radioactive Substances Regulations
RWA	Radioactive Waste Adviser

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LIMITATIONS

This report has been prepared by Studsvik Limited in their professional capacity as Consultants, with all reasonable skill, care and diligence within the terms of the Contract with the Client. The advice and opinions in this report are based upon the information made available at the date of this report and on current UK standards, codes and legislation. The contents of this report do not, in any way, purport to include any manner of legal advice or opinion. This report has been produced in accordance with the terms and conditions associated with Egdon purchase order 1337.

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1 INTRODUCTION

This report presents the results of a radiological baseline survey and reassurance monitoring conducted at the Egdon Resources UK Ltd Wressle well-site on 9th April 2015. The purpose was to determine whether there was significant radiological contamination arising from Naturally Occurring Radioactive Material (NORM) on the site's surface and immediate sub-surface material, and the local area surrounding the site.

Egdon Resources UK Ltd are an established oil and gas exploration and production company operating onshore oil and gas production sites in the UK. Their Wressle well-site has recently been identified as requiring regulation under the Environmental Permitting (England and Wales) Regulations 2010 (EPR 2010) (as amended) Radioactive Substances Regulations (RSR). As a RSR permit is now held for the site, there is a requirement for radiological monitoring to establish a baseline of the radiological conditions. As the requirement for a permit has only recently been identified the survey only relates to site conditions at the time of the survey.

The information contained within this report can also be used as part of any future site condition report required for permit surrender.

2 SAMPLING RESULTS

A total of 10 samples were taken from accessible areas on-site and off-site adjacent to the perimeter boundary [Ref. 1]. The samples were made up of a minimum of 10 subsamples from each area. The areas the samples were taken from are shown in Appendix A.

Samples 3 to 10 were bulked together in North, East, and South and West perimeter pairs to produce 4 samples for analysis. A total of 6 samples were sent for analysis, as shown in Table 1.

Table 1 – Samples taken and sent for gamma spectrometry analysis

GAU ID	Studsvik ID	Location
GAU3310-1	EW/P1	On-site
GAU3310-2	EW/P2	On-site
GAU3310-3+4	EW/W1+EW/W2	West perimeter
GAU3310-5+6	EW/N1+EW/N2	North perimeter
GAU3310-7+8	EW/E1+EW/E2	East perimeter
GAU3310-9+10	EW/S1+EW/S2	South perimeter

The samples were analysed by High Resolution Gamma Spectrometry (HRGS) and the results assessed to determine whether the material could be considered as being Out-of-Scope of the EPR 2010. Note that this assumes the material is considered as a waste.

The results for the natural radionuclides were assessed in terms of their upper limits [i.e. uncertainties were added to the reported values] to ensure a cautious approach.

For the results reported as the Limit of Detection (LOD), the LOD was assumed to be the actual activity concentration present, in order to represent a bounding activity.

Table 2 - Results of gamma spectrometry analysis and waste category assessment

GAU ID	Studsvik ID	Upper Limit (Bq/g)										Summation Quotation for Out of Scope	NORM Waste Concentration (Bq/g)	Waste Category	
		Th-232 Chain				U-235	U-238 Chain								⁴⁰ K
		²²⁸ Ac	²¹² Pb	²¹² Bi	²⁰⁸ Tl		²³⁴ Th	²²⁶ Ra	²¹⁴ Pb	²¹⁴ Bi	²¹⁰ Pb				
GAU3310-1	EW/P1	0.07	0.09	0.09	0.02	0.01	0.10	0.11	0.09	0.09	0.01	0.19	0.57	0.23	Out of Scope
GAU3310-2	EW/P2	0.06	0.09	0.07	0.02	0.01	0.07	0.11	0.10	0.10	0.01	0.15	0.55	0.23	Out of Scope
GAU3310-3+4	EW/W1+EW/W2	0.01	0.01	0.01	0.00	0.00	0.02	0.01	0.01	0.01	0.02	0.26	0.07	0.04	Out of Scope
GAU3310-5+6	EW/N1+EW/N2	0.01	0.01	0.01	0.00	0.00	0.01	0.02	0.01	0.01	0.02	0.26	0.08	0.03	Out of Scope
GAU3310-7+8	EW/E1+EW/E2	0.01	0.01	0.02	0.00	0.00	0.01	0.02	0.01	0.01	0.02	0.27	0.12	0.05	Out of Scope
GAU3310-9+10	EW/S1+EW/S2	0.01	0.01	0.01	0.00	0.00	0.01	0.02	0.01	0.01	0.02	0.23	0.08	0.03	Out of Scope
Min		0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.15		0.03	
Max		0.07	0.09	0.09	0.02	0.01	0.10	0.11	0.10	0.10	0.02	0.27		0.23	
Average		0.03	0.04	0.04	0.01	0.00	0.04	0.05	0.04	0.04	0.02	0.23		0.10	

To assess whether the material is Out-of-Scope, should it be considered as a waste, a sum of quotients was performed on the results using the Out-of-Scope limits in Schedule 23 PART 3 Table 1 of the EPR 2010. The sum of quotients for the 6 samples was less than 1, establishing that they are Out-of-Scope of EPR 2010.

The samples were also analysed for gross alpha and gross beta emitting radionuclides. The results were in agreement with the HRGS results, and confirmed the absence of any radiologically-significant contamination.

The original results were reported in GAU3310 on 26th April 2015, this is attached in Appendix B.

3 CONTAMINATION MONITORING RESULTS

In addition to the radiological baseline sampling, reassurance monitoring was also undertaken. This included direct probe dose-rate and contamination monitoring for alpha/beta contamination. The instrumentation used for monitoring is given in Table 3 and the results by area are given in Table 4. The results presented in Table 4 are an average, the full results from monitoring are given in Appendix C.

Table 3 – Instrumentation used for dose-rate and contamination monitoring

Instrument	Serial Number	Readings taken
Thermo Scientific RadEye B20-ER	0699	µSv/h
Tracerco T401	112086	cps

Table 4 – Average results of direct probe monitoring in gross dose-rate and gross counts per second (cps)

Area/item monitored	Studsvik ID	Average Dose-rate (µSv/h)	Average counts per second (cps)
Off-site North perimeter	EW/N1+EW/N2	0.14	1.2
Off-site East perimeter	EW/E1+EW/E2	0.10	1.2
Off-site South perimeter	EW/S1+EW/S2	0.14	1.2
Off-site West perimeter	EW/W1+EW/W2	0.19	1.2
On-site surface	P1a	0.29	1.8
On-site surface	P1b	0.21	1.8
On-site surface	P2a	0.28	1.9
On-site surface	P2b	0.30	1.8
Site surface - Area adjacent to well pad	N/A	-	1.8
Site surface - Area of apparent drill cuttings	N/A	-	1.3
Tubular (external only)	N/A	-	0.8
Well pad	N/A	-	1.0
Christmas Tree	N/A	-	1.2
Background	N/A	0.26	1.5

In order to demonstrate that the instruments were functioning correctly during the survey, the instruments were calibrated and function checks were performed on the instruments prior to the commencement of monitoring (pre-use function check) and after the conclusion of monitoring (post-use function check), as per Studsvik Working Practice WP/RP/060.

4 SUMMARY AND CONCLUSIONS

In April 2015, a radiological baseline survey and reassurance monitoring was undertaken on the Egdon Resources UK Ltd Wressle well-site and immediate surrounding area. The purpose was to determine the presence, or otherwise, of radiologically significant contamination related to NORM.

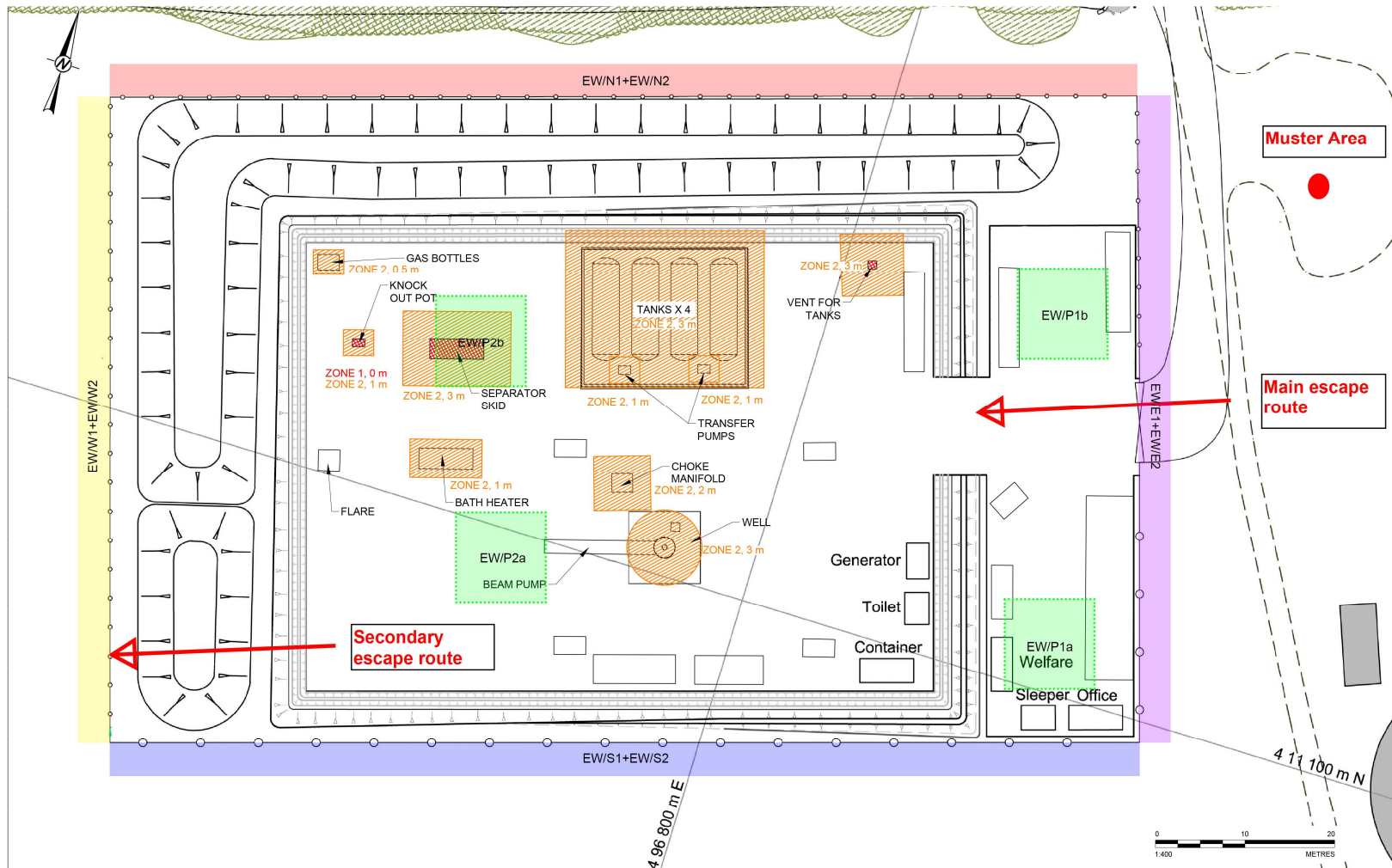
The samples taken for the radiological baseline survey showed no significant presence of NORM or any other radiologically-significant contamination and when the results were assessed against the EPR 2010 Out-of-Scope limits, all 6 samples were below the limit. Similarly, the areas that were monitored for dose-rate and surface contamination showed no significant presence of NORM.

The HRGS results from two samples taken on-site (EW/P1 and EW/P2) did show slightly elevated levels of radionuclides in the natural decay series (Th-232 and U-238) when compared to samples taken off-site. It is a reasonable assumption that the elevated levels are due to the use of foundry slag to cover made ground. This by-product can contain elevated concentrations of naturally occurring radionuclides as a result of the smelting process.

5 REFERENCES

1. P0753/SP/001 – Rev. B – Egdon Wressle 1 well-site baseline sampling plan

APPENDIX A – SAMPLE LOCATION MAP



APPENDIX B – SAMPLE RESULTS



Report **Gamma and gross alpha beta analysis of 10 sediment samples**

(Sample IDs: EW/P1, EW/P2, EW/W1, EW/W2, EW/N1, EW/N2, EW/E1, EW/E2, EW/S1, EW/S2.)

Studsvik UK Ltd

Customer	Studsvik UK Ltd, Ribble House Meanygate Bamber Bridge Lancashire PR5 6UP
Customer purchase number	8305
GAU job number	GAU3310
Date samples received	24 th April 2015
Report date	26 th May 2015
Report produced by	Madeleine Cobbold (Technical Support, GAU-Radioanalytical)
Signed	
Report authorised by	Prof P. E. Warwick (Deputy Director, GAU-Radioanalytical)
Signed	

Job reference number

GAU3310

Methodology

The samples were received in good condition by GAU-Radioanalytical on 24th April 2015.

Sample Preparation

10 sediment samples were received with the request that the samples labelled 1 + 2 for letters W, N, E and S be bulked together to form a total of 6 samples for analysis (see Sample Summary table below).

A sub-sample was taken from each pot and dried at 100°C over the weekend. 20g of each sample to be bulked was taken and combined to form 4 bulk samples of 40g each. These bulk samples were homogenised and a sub-sample was taken for gamma analysis from all 6 samples. After counting, a sub-sample of the gamma spectrometry fraction was ground and sieved prior to gross alpha beta analysis.

Gamma spectrometry (GAU/RC/2032: Accredited to ISO/IEC 17025:2005)

High resolution gamma spectrometric analysis was performed using HPGe detectors. Detectors were calibrated against a mixed radionuclide standard solution. The standard was used to prepare a source of identical geometry to that of the samples. Gamma spectra were analysed and individual radionuclides quantified using Fitzpeaks spectral deconvolution software (JF Computing Services). All anthropogenic gamma emitting radionuclides detected were reported.

Gross alpha and beta in solid samples using GFPC (GAU/RC/2028)

The samples were dried, ground and sieved through a 125µm sieve, approximately 125mg of the sieved material was mounted on a filter paper. The samples were counted by gas flow proportional counting. Gross alpha and beta activities were determined relative to ²⁴¹Am (alpha) and ¹³⁷Cs (beta).

Limits of detection / quantification

For gamma data, limits of quantification, LQ, is calculated as defined by Currie (1968) and Gilmore & Hemingway (2000)

Limits of detection for other radiochemical analyses are quoted as L_D as defined by Currie, 1968.

References

Currie L.A. (1968). Limits of qualitative detection and quantitative determination. *Analytical Chemistry*, **40** (3), 586-593.

Gilmore G. and Hemingway J. (2000). Practical gamma-ray spectrometry. John Wiley, Chichester, UK

Job reference number
GAU3310

Summary of samples and Results

GAU ID	Customer ID	Sample type	Wet dry ratio	Comments
GAU3310-1	EW/P1	Sediment	1.04	-
GAU3310-2	EW/P2	Sediment	1.08	-
GAU3310-3	EW/W1	Sediment	1.11	Bulked together
GAU3310-4	EW/W2	Sediment	1.09	
GAU3310-5	EW/N1	Sediment	1.11	Bulked together
GAU3310-6	EW/N2	Sediment	1.10	
GAU3310-7	EW/E1	Sediment	1.12	Bulked together
GAU3310-8	EW/E2	Sediment	1.16	
GAU3310-9	EW/S1	Sediment	1.08	Bulked together
GAU3310-10	EW/S2	Sediment	1.09	

Gross alpha and gross beta results

GAU ID	Gross alpha	+/-	Gross beta	+/-
GAU3310-1	1.7	0.3	0.9	0.2
GAU3310-2	1.3	0.3	1.0	0.2
GAU3310-3+4	<0.2	-	<0.4	-
GAU3310-5+6	<0.2	-	0.5	0.2
GAU3310-7+8	<0.2	-	0.4	0.2
GAU3310-9+10	<0.2	-	0.4	0.2

Results are quoted in Bq/g of dry sample.
 Uncertainties are based on combined standard uncertainties.
 Coverage factor k = 2 S.D.

Job reference number
GAU3310

Gamma spectrometry*

Artificial Radionuclides*

GAU ID	⁶⁰ Co	+/-	¹³⁷ Cs	+/-	²⁴¹ Am	+/-
GAU3310-1	<0.002	-	<0.001	-	<0.001	-
GAU3310-2	<0.001	-	<0.0006	-	<0.001	-
GAU3310-3+4	<0.002	-	0.0022	0.0007	<0.0009	-
GAU3310-5+6	<0.0009	-	0.0015	0.0004	<0.0007	-
GAU3310-7+8	<0.001	-	0.0018	0.0006	<0.0009	-
GAU3310-9+10	<0.0009	-	0.0022	0.0004	<0.0008	-

*Indicates results obtained using an accredited method.
 Results are quoted in Bq/g of sample dried.
 All anthropogenic radionuclides detected were reported.
 Uncertainties are based on combined standard uncertainties.
 Coverage factor k=2 S.D.
 Reference date: 24/04/2015

Job reference number

GAU3310

Natural Radionuclides*

GAU ID	²³⁴ Th	+/-	²²⁶ Ra	+/-	²¹⁴ Pb	+/-	²¹⁴ Bi	+/-	²¹⁰ Pb	+/-
GAU3310-1	0.08	0.02	0.08	0.03	0.083	0.005	0.086	0.006	<0.01	-
GAU3310-2	0.07	0.02	0.08	0.03	0.090	0.005	0.093	0.006	<0.007	-
GAU3310-3+4	0.011	0.006	<0.009	-	0.009	0.001	0.009	0.002	0.015	0.007
GAU3310-5+6	0.011	0.005	0.009	0.007	0.0074	0.0007	0.008	0.001	0.012	0.005
GAU3310-7+8	0.010	0.005	0.014	0.009	0.010	0.001	0.011	0.002	0.012	0.007
GAU3310-9+10	0.011	0.005	0.010	0.007	0.0114	0.0009	0.012	0.002	0.011	0.005

GAU ID	²²⁸ Ac	+/-	²¹² Pb	+/-	²¹² Bi	+/-	²⁰⁸ Tl	+/-	²³⁵ U	+/-	⁴⁰ K	+/-
GAU3310-1	0.062	0.006	0.081	0.005	0.08	0.01	0.018	0.001	0.006	0.002	0.17	0.02
GAU3310-2	0.055	0.005	0.084	0.006	0.063	0.007	0.016	0.001	0.006	0.002	0.14	0.01
GAU3310-3+4	0.008	0.002	0.0091	0.0009	<0.01	-	0.0018	0.0006	0.0013	0.0005	0.24	0.02
GAU3310-5+6	0.007	0.001	0.0092	0.0009	0.007	0.004	0.0018	0.0003	<0.002	-	0.24	0.02
GAU3310-7+8	0.010	0.002	0.0089	0.0009	0.014	0.007	0.0017	0.0006	<0.002	-	0.24	0.03
GAU3310-9+10	0.006	0.001	0.0094	0.0009	0.007	0.004	0.0019	0.0004	<0.002	-	0.21	0.02

*Indicates results obtained using an accredited method.
 Results are quoted in Bq/g of sample dried.
 Uncertainties are based on combined standard uncertainties.
 Coverage factor k=2 S.D.
 Reference date: 24/04/2015

APPENDIX B – CONTAMINATION SURVEY

1/2

RADIATION AND CONTAMINATION SURVEY REPORT "ENTER SITE SPECIFIC DETAILS OR LOCATION AS APPROPRIATE"

Studsvik

Date: 09.04.15	Building: B300N WIRELESS 1	Area Designation	R	C	Type of Survey	(Tick)	Instruments Used	Serial No	Survey No. or QP Ref:
Area Surveyed: WELLPAD		Controlled			Routine		RADEYE B20	0699	P0753
		Supervised			Special / Request	<input checked="" type="checkbox"/>	TRACER T401	112586	
		Non-designated	<input checked="" type="checkbox"/>		Reclassification		ROTEM RANGE	12807-178	
Details (include background if significant) SITE PARKING AREA (NE CORNER OF PAD)		Radiation (circle units) μ Sv/h or mSv/h		Contamination (circle units) Bq/cm ² or Counts/second		Comment or Diagram			
Background: B20: 0.60/0.80/1.20/1.20/0.60 cps 0.18/0.33/0.25/0.33/0.15 μ Sv/h		T401: 1.33/1.52/1.62/1.54 μ Sv/h		T401		Approx. locations			
BOUNDARY (SAMPLE LOCATIONS)		Boundary		Boundary		Wellhead.			
N1		0.15/0.67/0.14	0.14		α/β				
N2	OFF-SITE	0.25/0.03/0.18	0.18						
E1	ADJACENT TO	0.67/0.67/0.75	0.75						
E2	BOUNDARY	0.07/0.04/0.18	0.18						
S1	FENCE	0.14/0.25/0.14	0.14						
S2		0.07/0.03/0.18	0.18						
W1		0.25/0.22/0.18	0.18						
W2		0.14/0.22/0.11	0.11						
P1a		0.25/0.37/0.18/0.31	0.31						
P1b		0.22/0.37/0.07/0.18	0.18						
Survey Completed By: N CHAMBERS		RPS/RPA Comments:		~100 mL samples taken from					
Survey Date: 09.04.15		# ~0.17 μ Sv/h @ C GROUND		~1 L surface sediment @ CH					
RPS / RPA Approval: N Chalmers		# ~1.05 cps @ CH		approx. 10 spots over ~3-5 m ² .					
Date: 09.04.15		* AU' = BEND		@ to ~150 mm below ground level.					

2/2

RADIATION AND CONTAMINATION SURVEY REPORT "ENTER SITE SPECIFIC DETAILS OR LOCATION AS APPROPRIATE"

Studsvik

Date:	Building:	Area Designation	R	C	Type of Survey	(Tick)	Instruments Used	Serial No	Survey No. or QP Ref:
09.04.15		Controlled			Routine				P0753
Area Surveyed: EGDON WRESSLE 1		Supervised			Special / Request	SEE PREVIOUS			
Details (include background if significant)		Non-designated	-	-	Reclassification				
Background: SEE PREVIOUS		Radiation (circle units) µSv/h or mSv/h		Contamination (circle units) Bq/cm² or Counts/second		Comment or Diagram			
Area adj. to well-head (site surface with adjacent mortar/concrt?)		βγ	γ	n	α/β	βγ	EC, γ	Probe (P) or Smear (S)	See over for locations.
P2 b					1.78			AMU (P)	
P2 ca		0.12 / 0.25 / 0.22 / 0.11.0							
DC (Patch of cuttings, overlying ballast/aggregate)		0.23 / 0.25 / 0.33 / 0.33							
Tubular ext @ 10mm (+ - 0.6m above ground, struck by 5kg hammer)									
Concrete open adj. wellhead									
Survey Completed By: N CHAMBERS		RPS/RPA Comments:							
Survey Date: 09.04.15		Time: 08:30 - 12:30							
RPS / RPA Approval: N CHAMBERS									
Date: 09.04.15		Well-head valves / Flange							
		0.50-1.80 cps							