

Our Ref: CE1005/rac/06  
Date: 11 September 2015



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[www.stratus-environmental.co.uk](http://www.stratus-environmental.co.uk)

Dear Ian

**HAFOD QUARRY LANDFILL SITE**  
**CQA Validation Report for the 2015 Western Sidewall (Northern) Liner Construction Works**

Thank you for your comments on the draft Validation Report submitted for the above works (ref: CE1005/03, dated August 2015). We have reviewed these and would respond as follows (your comments have been included for ease of reference):

**Section 3.3.7 indicates that the geocomposite testing results confirm that the material meets the specification. However, the certificates and testing summary table indicate that the in-place flow capacity falls short of the manufacturer's data sheet values (0.78 and 0.94 l/m/s rather than >0.99 l/m/s). Given this shortfall we would like to understand whether this is sufficient to meet design requirements despite it falling short of the manufacturer's expectations. Could Stratus please confirm whether this material has sufficient flow capacity. This response needs to be added to Section 6 of the report.**

There are two issues raised by this comment, namely compliance with the design specification and compliance with the manufacturer's product data sheet. Addressing the design specification first, which is the more important of the two, it can be seen that the design requires an in-plane flow capacity from the geocomposite of 0.2 litres/m/sec (Table 1) - comparing the two conformance results obtained for the delivered product (samples GC1 and GC2) shows that both samples have significantly exceeded the minimum in-plane flow capacity required (by factors of 3.9 and 4.7 respectively).

The manufacturer's data-sheet records an in-plane flow capacity of 0.99 litres/m/sec for a hydraulic gradient of 0.5 and confining stress of 20kPa using hard/soft plattens - the data-sheet also notes that this is a typical value, not a minimum, and therefore is subject to a tolerance. We have contacted Clare Harvey at GEOfabrics, who confirmed that there is a -25% tolerance to be applied to the flow-rate, bringing the minimum flow rate to 0.75 litres/m/sec:

"Our tolerance on all our flowrates are -25% so our lower value on this product at this loading and hydraulic gradient would be 0.75l/s/m. When deciding the tolerance on our flowrates we took into account the high flowrates achieved by our cusplate range vs the actual flowrates needed on site. This lead us to believe that a tolerance of -25% would still give us an adequate flowrate for most sites / applications."



GEOfabrics' response therefore confirms that both samples meet their minimum acceptable flow-rate.

Stratus has no design involvement in the project, so cannot comment on the adequacy of the geocomposite selected, but in terms of the CQA function, we would confirm that the conformance samples demonstrate compliance with both the design specification and the manufacturer's minimum product performance criteria and therefore the material is deemed acceptable for inclusion in the works.

Section 6.3 discusses the low moisture contents determined during testing of 3 of the 25 compaction cores. Each of these were found to have a moisture content of 11%, below the 12% lower moisture limit. The text indicates that one of the shear strength test samples also had a moisture content of 11%, yet the results show that in fact two of the shear strength tests were below the 12% liner limit. This means that 5 out of the 38 tests are below the lower limit. We note that 2 of the 3 air voids failures are from these 5.

Unfortunately, this dataset does not have a permeability determination for a sample at 11% moisture content. Whilst it is noteworthy that the sample failures are 'plastic' we also note that 11% is well below the plastic limit. The high cell pressures in the test have no doubt contributed to this failure mode. We would like Stratus to check back through the past records to see whether there are any permeability results for this material at 11% moisture content that could provide reassurance that even at this moisture content the permeability requirement will still be met. The moisture content in itself is only an indicator of likely performance and providing there is evidence that at these levels, a fully functional impermeable liner can be produced, it should be possible to accept these non-conformances.

We have reviewed sample results from all project works undertaken by Stratus at Hafod in the period 2013 - 2015, and from such historic data as we have from projects undertaken by Encia Environmental during the period 2005 - 2008, and have assembled a dataset of 158 triaxial permeability results. These data cover the moisture content range 10% to 22%, although the bulk of them have moisture contents between 12% and 17%.

Of this dataset, there are three samples which have a reported moisture content below 12.0%:

Project	Sample Ref	Certificate #	Certificate Date	Moisture Content	Permeability (m/s)
Phase 1 Base	Perm 4	STR 25168	13 July 2005	10.0%	$1.4 \times 10^{-10}$
Phase 2 Base	P7	STR 39701	31 December 2005	11.9%	$1.2 \times 10^{-10}$
Phase 3 Sidewall	CP3	STR 422267	3 August 2015	11.9%	$5.9 \times 10^{-11}$

We enclose the laboratory certificates for these three samples; in addition, we enclose a summary table and graph of the whole dataset, the certificates for which are available if required.

Whilst we have found only one permeability result whose moisture content is at or below 11%, the graph shows no particular inverse trend of permeability with moisture content (with the possible exception of data from Panel 5 of the Phase 1 Upper/Phase 2 Upper construction works). Several samples across various project sub-sets of the data display very low permeabilities at or around



12% moisture content, including samples P7 and CP3 shown in the table above. Consideration of the data presented suggests it would not be unreasonable to expect a permeability result for a sample at 11% moisture content to be around  $1.5 \times 10^{-10}$  m/s; a permeability in excess of  $1 \times 10^{-9}$  m/s is considered very unlikely.

Further reassurance on the permeability performance of the lining system can be derived from the fact that although there were five samples whose reported moisture content was below the 12% lower limit, these were taken from different layers and locations across the area of the works; at any one of these five sample locations, there are another seven layers of engineered clay liner that have (statistically) been placed and compacted at moisture contents above the lower limit.

We trust that you find these responses acceptable, and look forward to your comments in due course. Should you have any queries on the enclosed, or require further details, please do not hesitate to contact the undersigned.

Yours sincerely

A handwritten signature in blue ink, appearing to read "R Clarke".

Richard Clarke  
for and on behalf of  
Stratus Environmental Limited

Enc: Celtest Certificates STR 25168, STR 39701 and STR 422267  
Tabulated permeability results  
Graphical presentation of permeability results

Cc: Dr Ewan Thomas, NRW/Geotechnology  
Ian Craven, Cory Environmental  
Andy Coxon, Stratus Environmental

**HAFOD HISTORICAL PERMEABILITY DATA**

	Sample Ref:	Certificate #	Certificate Date	Moisture Content	Permeability	
Egniol Source Evaluation Report	SB2	STR 153998	09/10/2008	14.6%	9.90E-11	
	SB1	STR 153988	09/10/2008	12.7%	3.00E-11	
	P4	STR 151329	09/10/2008	12.5%	1.20E-10	
	P3	STR 151328	09/10/2008	13.2%	1.30E-10	
	P2	STR 151327	09/10/2008	13.1%	1.60E-10	
	PA3	STR 159356	09/10/2008	12.5%	1.60E-10	
	PA4	STR 151362	09/10/2008	12.1%	9.30E-11	
	P1	STR 151326	09/10/2008	12.8%	1.20E-10	
	PA3	STR 159370	09/10/2008	12.8%	1.40E-10	
Encia Phase 1 (MW4553L)	Perm 1	STR 25165	13/07/2005	19.5%	1.50E-10	
	Perm 2	STR 25166	13/07/2005	18.9%	1.40E-10	
	Perm 3	STR 25167	13/07/2005	22.4%	1.70E-10	
	Perm 4	STR 25168	13/07/2005	10.0%	1.40E-10	
	Perm 5	STR 25169	13/07/2005	20.0%	3.20E-10	
Encia Phase 2 SI (MW4555L)	TP1	STR 39690	15/12/2005	12.3%	2.50E-11	
	TP2	STR 39691	15/12/2005	16.3%	5.40E-11	
	TP3	STR 39692	15/12/2005	16.7%	1.60E-10	
	TP4	STR 39693	15/12/2005	17.4%	5.40E-11	
	TP5	STR 39694	15/12/2005	13.6%	1.10E-10	
	P1	STR 39695	15/12/2005	15.1%	1.40E-10	
	P2	STR 39696	15/12/2005	12.0%	1.90E-10	
	P3	STR 39697	15/12/2005	14.6%	1.30E-10	
	P4	STR 39698	15/12/2005	13.2%	2.60E-10	
	P5	STR 39699	15/12/2005	12.7%	8.10E-11	
	P6	STR 39700	15/12/2005	12.9%	8.90E-11	
	P7	STR 39701	15/12/2005	11.9%	1.20E-11	
	P8	STR 39702	15/12/2005	13.4%	1.30E-10	
	P9	STR 39703	15/12/2005	15.4%	7.10E-11	
P10	STR 39704	15/12/2005	14.7%	1.50E-10		
Encia Phase 2 Lower VR (MW4555L)	P1	STR 67545	20/10/2006	14.3%	1.10E-10	
	P2	STR 67546	20/10/2006	14.2%	7.50E-11	
	CC2	STR 67547	20/10/2006	14.8%	4.20E-11	
	CC4	STR 67548	20/10/2006	15.5%	6.30E-11	
	CC6	STR 67549	20/10/2006	15.0%	7.80E-11	
	CC8	STR 67550	20/10/2006	14.2%	1.00E-10	
	CC9	STR 67551	20/10/2006	14.0%	7.20E-11	
	CC10	STR 67552	20/10/2006	14.6%	4.30E-11	
	CC11	STR 67553	20/10/2006	14.3%	6.90E-11	
	CC12	STR 67554	20/10/2006	14.5%	8.00E-11	
	CC13	STR 67555	20/10/2006	15.6%	8.60E-11	
	CC14	STR 67556	20/10/2006	15.5%	9.10E-11	
	CC15	STR 67557	20/10/2006	15.6%	7.00E-11	
	CC16	STR 67558	20/10/2006	15.0%	6.70E-11	
	CC17	STR 67559	20/10/2006	14.6%	7.40E-11	
	CC18	STR 67560	20/10/2006	15.9%	9.20E-11	
	CC19	STR 67561	20/10/2006	14.4%	8.40E-11	
	CC20	STR 67562	20/10/2006	14.9%	8.10E-11	
	CC21	STR 67563	20/10/2006	14.2%	7.80E-11	
	CC22	STR 67564	20/10/2006	14.6%	7.60E-11	
	Encia P1UP2U 1+2 (MW4570L)	C7	STR 89166	17/05/2007	17.5%	1.40E-10
		C8	STR 89167	17/05/2007	15.8%	1.60E-10
C9		STR 89168	17/05/2007	13.4%	1.50E-10	
C0		STR 89169	17/05/2007	17.3%	9.20E-11	
C11		STR 89170	17/05/2007	16.3%	1.30E-10	
C12		STR 89171	17/05/2007	15.7%	1.10E-10	

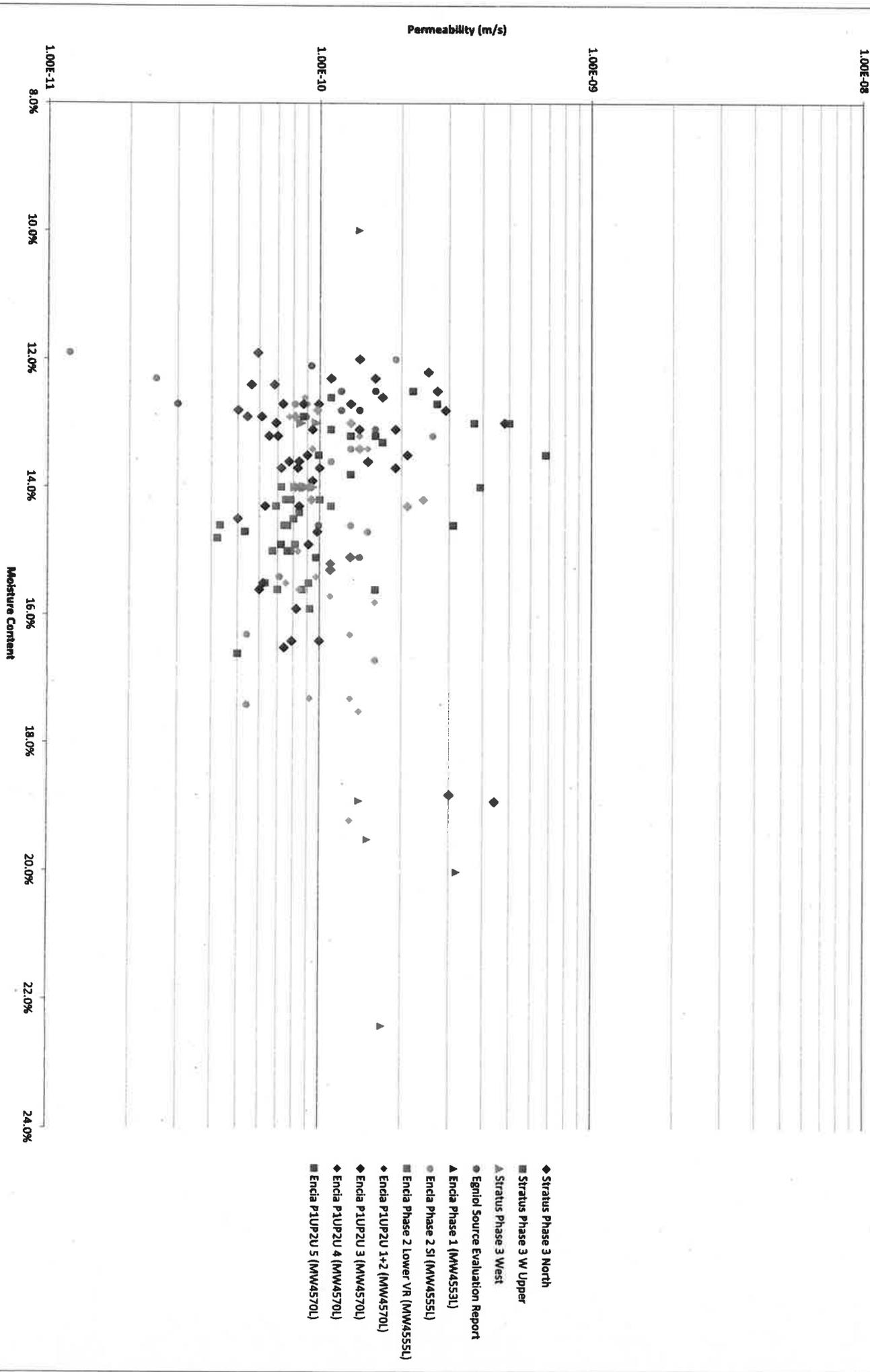
**HAFOD HISTORICAL PERMEABILITY DATA**

	Sample Ref:	Certificate #	Certificate Date	Moisture Content	Permeability
	C13	STR 89172	17/05/2007	17.3%	1.30E-10
	C14	STR 89173	17/05/2007	15.6%	8.40E-11
	C28	STR 89187	17/05/2007	15.0%	8.30E-11
	C29	STR 89188	17/05/2007	13.8%	1.30E-10
	C30	STR 89189	17/05/2007	12.6%	8.80E-11
	C31	STR 89190	17/05/2007	15.5%	7.50E-11
	C32	STR 89191	17/05/2007	19.2%	1.30E-10
	C33	STR 89192	17/05/2007	15.4%	9.70E-11
	C34	STR 89193	17/05/2007	14.2%	2.40E-10
	C35	STR 89194	17/05/2007	13.4%	9.40E-11
	C36	STR 89195	17/05/2007	13.7%	8.30E-11
	C37	STR 89196	17/05/2007	12.7%	9.00E-11
	C38	STR 89197	17/05/2007	13.2%	1.40E-10
	C39	STR 89198	17/05/2007	12.9%	7.70E-11
Encia P1UP2U 3 (MW4570L)	C15	STR 89174	17/05/2007	12.7%	1.30E-10
	C16	STR 89175	17/05/2007	12.0%	1.40E-10
	C17	STR 89176	17/05/2007	12.4%	5.60E-11
	C18	STR 89177	17/05/2007	15.5%	6.20E-11
	C19	STR 89178	17/05/2007	12.8%	2.90E-10
	C20	STR 89179	17/05/2007	18.9%	4.40E-10
	C21	STR 89180	17/05/2007	12.3%	1.10E-10
	C22	STR 89181	17/05/2007	12.7%	7.30E-11
	C23	STR 89182	17/05/2007	15.9%	8.20E-11
	C24	STR 89183	17/05/2007	13.7%	8.30E-11
	C25	STR 89184	17/05/2007	12.3%	1.60E-10
	C26	STR 89185	17/05/2007	13.1%	9.40E-11
	C27	STR 89186	17/05/2007	13.6%	7.70E-11
	C46	STR 92526	15/06/2007	16.4%	1.00E-10
	C47	STR 92527	15/06/2007	16.4%	7.90E-11
	C48	STR 92528	15/06/2007	14.7%	9.80E-11
	C49	STR 92529	15/06/2007	12.9%	6.10E-11
	C50	STR 92530	15/06/2007	13.2%	6.50E-11
	C51	STR 92531	15/06/2007	16.5%	7.40E-11
	C52	STR 92532	15/06/2007	15.6%	6.00E-11
	C53	STR 92533	15/06/2007	15.1%	1.30E-10
	C54	STR 92534	15/06/2007	13.7%	1.00E-10
	C55	STR 92535	15/06/2007	12.5%	2.70E-10
	C56	STR 92536	15/06/2007	14.3%	8.40E-11
	C57	STR 92537	15/06/2007	13.5%	9.00E-11
	C58	STR 92538	15/06/2007	12.7%	9.90E-11
	C59	STR 92539	15/06/2007	18.8%	3.00E-10
	C60	STR 92540	15/06/2007	14.3%	6.30E-11
	C61	STR 92541	15/06/2007	13.1%	1.40E-10
	C62	STR 92542	15/06/2007	13.6%	1.50E-10
	C63	STR 92543	15/06/2007	13.7%	1.90E-10
	C64	STR 92544	15/06/2007	13.0%	4.80E-10
	C65	STR 92545	15/06/2007	12.2%	2.50E-10
	C66	STR 92546	15/06/2007	14.9%	9.10E-11
	C67	STR 92547	15/06/2007	13.1%	1.90E-10
	C68	STR 92548	15/06/2007	13.9%	9.40E-11
	C72	STR 92549	15/06/2007	13.5%	2.10E-10
	C73	STR 92550	15/06/2007	12.6%	1.70E-10
	C74	STR 92551	15/06/2007	13.2%	7.00E-11
	C75	STR 92552	15/06/2007	13.0%	6.90E-11
	C76	STR 92553	15/06/2007	13.6%	8.40E-11
	C77	STR 92554	15/06/2007	12.7%	8.70E-11
Encia P1UP2U 4 (MW4570L)	C78	STR 96735	27/07/2007	14.2%	2.40E-10

## HAFOD HISTORICAL PERMEABILITY DATA

	Sample Ref:	Certificate #	Certificate Date	Moisture Content	Permeability
	C79	STR 96736	31/07/2007	12.8%	9.80E-11
	C80	STR 96737	31/07/2007	14.3%	2.10E-10
	C81	STR 96738	31/07/2007	14.0%	9.30E-11
	C82	STR 96739	31/07/2007	15.2%	1.10E-10
	C83	STR 96740	31/07/2007	13.0%	1.30E-10
	C84	STR 96741	31/07/2007	13.4%	1.40E-10
	C85	STR 96742	31/07/2007	14.2%	9.30E-11
	C86	STR 96743	31/07/2007	12.9%	8.10E-11
Encia P1UP2U 5 (MW4570L)	C87	STR 92744	31/07/2007	14.9%	7.20E-11
	C88	STR 96745	31/07/2007	15.1%	9.70E-11
	C89	STR 92746	31/07/2007	14.7%	5.30E-11
	C90	STR 96747	31/07/2007	13.5%	6.80E-10
	C91	STR 92748	31/07/2007	14.6%	3.10E-10
	C92	STR 92749	31/07/2007	13.3%	1.70E-10
	C93	STR 92750	31/07/2007	13.5%	9.90E-11
	C95	STR 92751	31/07/2007	12.9%	8.70E-11
	C96	STR 92752	31/07/2007	13.8%	1.30E-10
	C97	STR 92753	31/07/2007	12.5%	2.20E-10
	C98	STR 92754	31/07/2007	16.6%	5.00E-11
	C99	STR 96755	31/07/2007	12.7%	2.70E-10
	C100	STR 92756	31/07/2007	13.2%	1.60E-10
	C101	STR 92757	31/07/2007	15.0%	7.60E-11
	C102	STR 96758	31/07/2007	13.2%	1.30E-10
Stratus Phase 3 West	TL1/02	PSL14/4019	01/09/2014	14.0%	8.70E-11
	TL1/05	PSL14/4019	01/09/2014	14.0%	9.40E-11
	CL1/01	PSL14/4019	01/09/2014	14.0%	8.40E-11
	CL2/05	PSL14/4019	01/09/2014	13.0%	9.70E-11
	CL3/10	PSL14/4019	01/09/2014	13.0%	9.70E-11
	CL4/14	PSL14/4518	22/09/2014	14.0%	8.90E-11
	CL5/16	PSL14/4518	22/09/2014	13.0%	8.50E-11
	CL6/21	PSL14/4518	22/09/2014	13.0%	8.50E-11
	CL7/25	PSL14/4518	22/09/2014	14.0%	8.80E-11
	CL8/29	PSL14/4812	02/10/2014	14.0%	8.10E-11
Stratus Phase 3 W Upper	TL1/C3B/L1	PSL15/0995	18/03/2015	13.0%	5.00E-10
	TL1/CB6/L2	PSL15/0995	18/03/2015	14.0%	3.90E-10
	A3/L2/C14A	PSL15/0995	18/03/2015	13.0%	3.70E-10
	P1	STR 407589	31/03/2015	15.6%	1.60E-10
	P2	STR 407597	31/01/2015	12.6%	1.10E-10
	P3	STR 407608	31/01/2015	13.1%	1.10E-10
Stratus Phase 3 North	CP1	STR 422275	03/08/2015	12.4%	6.80E-11
	CP2	STR 422276	03/08/2015	12.8%	5.00E-11
	CP3	STR 422267	03/08/2015	11.9%	5.90E-11
	CP4	STR 422268	03/08/2015	13.7%	7.20E-11
	CP5	STR 422287	03/08/2015	12.9%	5.40E-11
	CP6	STR 422299	03/08/2015	14.5%	5.00E-11
	CP7	STR 422314	03/08/2015	15.3%	1.10E-10
			MIN	10.0%	1.20E-11
			AVE	14.2%	1.27E-10
			MAX	22.4%	6.80E-10
			COUNT	158	158

# Hafod Landfill - Permeability Data (158 Triaxial Permeability Samples)



Encia Group Ltd.  
Stone Cross Place  
Stone Cross Lane North  
Lowton  
Warrington  
WA3 2SH

Date: 13<sup>th</sup> July 2005

Report No: STR 25168

Test Ref: SO 50a,b,cN

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Contract: Hafod Quarry Landfill

## LABORATORY TEST REPORT

### INTRODUCTION:

Requirements: To determine the Coefficient of Permeability under constant head conditions in a Triaxial Cell in accordance with BS 1377: Part 6 : 1990 : Clause 6.

### SAMPLE DETAILS:

Certificate of Sampling Received:	No
Certificate Enclosed:	N/A
Laboratory Ref. No:	S11979
Client Ref. No:	Perm 4
Date and Time of Sampling:	27/06/2005
Date of Receipt at Lab:	28/06/2005
Date of Start of Test:	30/06/2005
Sampling Location:	Unknown
Name of Source:	Unknown
Method of Sampling:	Core Cutter
Sampled By:	Unknown
Soil Description:	Red brown gravelly sandy very silty CLAY
Type of Sample:	Undisturbed
Were any unrepresentative lumps present?	None

### METHOD OF TEST:

Laboratory Test Method and Procedure Ref.:	SO 50a,b,cN
Departure from specified procedure	NONE

### RESULT:

See attached

## TEST RESULTS

Sample condition:

**Undisturbed/~~Remoulded~~**

(Delete as appropriate)

Method of Remoulding (If applicable):

**~~2.5kg rammer/4.5kg rammer~~**

(Delete as appropriate)

Specimen Details:

**Initial:**

**Final:**

Diameter:

**101 mm**

**N/A**

Height:

**102 mm**

**N/A**

Moisture Content:

**10.0 %**

**10.2 %**

Bulk density:

**2.204 Mg/m<sup>3</sup>**

**2.248 Mg/m<sup>3</sup>**

Dry density:

**2.004 Mg/m<sup>3</sup>**

**2.040 Mg/m<sup>3</sup>**

Saturation stage: **Performed in accordance with Clause 5.4.3**

Initial pore pressure coefficient,B:

**0.62**

Final pore pressure coefficient,B:

**1.00**

Duration of stage:

**8 days**

Consolidation stage:

Effective pressure:

**100 kPa**

Duration of state:

**1 day**

Permeability stage:

Pressure difference across specimen:

**20 kPa**

Mean effective stress:

**90 kPa**

Duration of stage

**3 days**

**Coefficient of Permeability (k<sub>v</sub>) at 20°C =**

**1.4 x 10<sup>-10</sup> m/s**



E. N. Jones - Soils Laboratory Manager

# celtest

independent materials testing  
diamond core drilling & sawing



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Encia Group Ltd.  
Stone Cross Place  
Stone Cross Lane North  
Lowton  
Warrington  
WA3 2SH

Date: 15<sup>th</sup> December 2005

Report No: STR 39701

Test Ref: SO 50a,b,cN

Page 1 of 2

Contract: Hafod Quarry Landfill

## LABORATORY TEST REPORT

### INTRODUCTION:

Requirements: To determine the Coefficient of Permeability under constant head conditions in a Triaxial Cell in accordance with BS 1377: Part 6 : 1990 : Clause 6.

### SAMPLE DETAILS:

Certificate of Sampling Received:	No
Certificate Enclosed:	N/A
Laboratory Ref. No:	S13073
Client Ref. No:	P7
Date and Time of Sampling:	Unknown
Date of Receipt at Lab:	13/10/2005
Date of Start of Test:	21/10/2005
Sampling Location:	South East edge of Colomendy
Name of Source:	Site Won
Method of Sampling:	Disturbed Bulk Sample
Sampled By:	Client
Soil Description:	Red/brown slightly gravelly very sandy very silty CLAY
Type of Sample:	Disturbed
Were any unrepresentative lumps present?	None

### METHOD OF TEST:

Laboratory Test Method and Procedure Ref.:	SO 50a,b,cN
Departure from specified procedure	NONE

### RESULT:

See attached

# celtest

Report No.: STR 39701 - Page 2 of 2

## TEST RESULTS

Sample condition:

**Undisturbed/Remoulded**

(Delete as appropriate)

Method of Remoulding (If applicable):

**2.5kg rammer/4.5kg rammer**

(Delete as appropriate)

Specimen Details:

**Initial:**

**Final:**

Diameter:

**101 mm**

**N/A**

Height:

**102 mm**

**N/A**

Moisture Content:

**11.9 %**

**12.1 %**

Bulk density:

**2.114 Mg/m<sup>3</sup>**

**2.176 Mg/m<sup>3</sup>**

Dry density:

**1.889 Mg/m<sup>3</sup>**

**1.941 Mg/m<sup>3</sup>**

Saturation stage: **Performed in accordance with Clause 5.4.3**

Initial pore pressure coefficient,B:

**0.42**

Final pore pressure coefficient,B:

**1.00**

Duration of stage:

**4 days**

Consolidation stage:

Effective pressure:

**100 kPa**

Duration of state:

**5 days**

Permeability stage:

Pressure difference across specimen:

**20 kPa**

Mean effective stress:

**90 kPa**

Duration of stage

**1 day**

Coefficient of Permeability ( $k_v$ ) at 20°C =

**1.2 x 10<sup>-10</sup> m/s**



E. N. Jones - Soils Laboratory Manager

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Date: 03 August 2015  
Test Report Ref: STR 422267

LS15 8GB

Order No: 929/CE1005/RC  
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Contract: Haford Landfill - Sidewall

**LABORATORY TEST REPORT**

**TEST REQUIREMENTS:** To determine the Coefficient of Permeability under constant head conditions in a Triaxial Cell in accordance with **BS 1377: Part 6 : 1990 : Clause 6.**

**SAMPLE DETAILS:**

Certificate of sampling received:	No
Laboratory Ref. No:	S53576
Client Ref. No:	CP3
Date and Time of Sampling:	25/06/2015
Date of Receipt at Lab:	07/07/2015
Date of Start of Test:	13/07/2015
Sampling Location:	Sidewall
Name of Source:	Unknown
Method of Sampling:	Core Cutter
Sampled By:	Client
Material Description:	Red/brown sandy very silty CLAY
Target Specification:	N/A

**RESULTS:**

See attached

**Comments**

None

Certificate  
Prepared by:-



Meical Owen  
Assistant Laboratory Manager

Approved by: - 

Eric Goulden  
Technical Manager

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**TEST RESULTS**

**Sample condition:** **Undisturbed**

**Method of Remoulding (If applicable):** **N/A**

<b>Specimen Details:</b>	<b>Initial:</b>	<b>Final:</b>
Diameter:	101 mm	N/A
Height:	100 mm	N/A
Moisture Content:	11.9 %	12.6 %
Bulk density:	2.226 Mg/m <sup>3</sup>	2.343 Mg/m <sup>3</sup>
Dry density:	1.989 Mg/m <sup>3</sup>	2.081 Mg/m <sup>3</sup>

**Saturation stage:** Performed in accordance with clause 5.4.3 - Saturation by increments of cell pressure and back pressure.

Initial pore pressure coefficient, B:	0.46
Final pore pressure coefficient, B:	1.00
Duration of stage:	7 days

**Consolidation stage:**

Effective pressure:	100 kPa
Duration of stage:	4 days

**Permeability stage:**

Pressure difference across specimen:	20 kPa
Mean effective stress:	90 kPa
Duration of stage	2 days
Coefficient of Permeability (k <sub>v</sub> ) at 20°C =	5.9 x 10 <sup>-11</sup> m/s