ENVIROARM LIMITED

CHADWICH LANE QUARRY LTD

CONSTRUCTION QUALITY ASSURANCE VALIDATION REPORT

EARTHWORKS CONSTRUCTION FOR SIDE WALL SEAL
GEOLOGICAL BARRIER PHASE 3
Sections 1 and 12

REF:ARM/SCM/CLQ/CQA/1.00/2009

Revision 1.00

CHADWICH LANE QUARRY LANDFILL SITE

EARTHWORKS CONSTRUCTION FOR SIDE WALL SEAL GEOLOGICAL BARRIER PHASE 3 Sections 1 and 12

CONSTRUCTION QUALITY ASSURANCE VALIDATION REPORT

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CHADWICH LANE QUARRY LANDFILL SITE

EARTHWORKS CONSTRUCTION SIDE WALL SEAL GEOLOGICAL BARRIER

PHASE 3
Sections 1 and 12

CONSTRUCTION QUALITY ASSURANCE VALIDATION REPORT

1. INTRODUCTION

In January 2009, Enviroarm Limited were requested by Chadwich Lane Quarry Ltd to carry out supervision and quality control tests on earthworks construction of an engineered geological barrier side wall seal on Phase 3 Section 1 and 12 at the Chadwich Lane Quarry landfill site.

Initial preparation works commenced during the later part of March 2009 and continued as a major push in April 2009 and then ceased and were completed in early August 2009. The breaks were due to inclement weather making it impossible to gain access to the stockpile material for the side was all seal stored on Phase 1.

Mineral liner works on Section 1 commenced on 6th April 2009 and were completed on 13th August 2009.

The mineral liner works were carried out by Chadwich Lane Quarry Ltd.

During the works, Enviroarm Limited personnel were in attendance on site on a part time basis to carry out testing, physical measurements and to ensure that the material was acceptable and complied with the latest guidance on inert landfill sites.

The following Construction Quality Plans were used during the construction of the cell:

- Enviroarm Limited Chadwich Lane Quarry Construction Quality Assurance Plan
- Enviroarm Limited Source Evaluation of material for use in Geological Barrier at Chadwich Lane Quarry.

- Environment Agency: Environmental Permitting Regulations: Inert Waste Guidance Standards and Measures for the Deposit of Inert Waste on Land. Annex 1 and 2.

2. THE SITE

The Chadwich Lane Quarry landfill site is an operational landfill as defined under the Landfill Directive for the receipt of inert waste. Phase 3 Section 1 and 12 are the first sections of the landfill site that have required an artificial geological barrier placed against the side wall to be engineered in accordance with requirements of the Permit TP3431SG. The former quarry off Chadwich Lane is situated on the south-western fringe of Birmingham at National Grid Reference SO 958 771. It is approximately 3km east of Rubery and 3km north of Catshill,

3. FORMATION

3.1 General

The excavation was in clean virgin Sherwood Sandstone. The side walls remained stable with no tension cracks visible and the base was excavated flat. The overall configuration was in accordance with the Slope Stability Risk Assessment for the site. The sand is well cemented and requires a minimum 30 tonnes excavator to break and remove the sand.

3.2 Formation Preparation

Following the excavation of sand, each section was trimmed using the hydraulic excavator to ensure that all soft material was removed from the quarry wall prior to placement of the side wall seal.

4. GEOLOGICAL BARRIER MINERAL LINER SIDE WALL

4.1 General

The geological barrier mineral liner of Phase 3, Sections 1 to 12 on the side wall were constructed using re-worked on-site clay bands excavated and previously stockpiled in Phase 1 as part of the quarrying operations which had been selectively dug and stored separately from the sand. The accepted placement specification was a target permeability of $1x10^{-7}$m/s achieved between a moisture wet of optimum. The minimum clay fraction limit was set at 10% and minimum shear strength of 50kPa, and placed at 5% air voids. The mineral liner side wall seal requires to be 1.0 metre thick horizontally.

4.2 Compaction Testing

The initial Lift 1 was used as the compaction trial on the clay with the results faxed through from the soils laboratory prior to commencement of the next lift, to ensure that the compaction had been achieved, and that the use of the hydraulic excavator tracking over the clay would achieve the necessary compaction of the liner.

The excavator was a 30 tonne Doosan DX300 and the lifts were placed at 300mm and compacted to 250mm using the tracks. Material was loaded from the stockpile using a Daewoo 170 excavator and transported using a Volvo A25 articulated dump truck. All equipment was operated by Chadwich Lane Quarry Ltd.

The same method of compaction was used for all of the Section 1 and 12 works detailed in this report.

4.3 Site Visits and Control Testing

Part time monitoring of the works was carried out during the construction of the engineered low permeability geological barrier side wall sealing to check working procedures and to undertake quality control testing to ensure compliance with the approved Construction Quality Assurance Plan and the latest guidance from the Environment Agency. The barrier was divided into two sections, the west wall of approximately 75 metres and the south wall 25 metres, giving each side wall section over a 4 metre increase in height, equating to a placed volume of engineered clay of 400m^3.

The clay was placed at natural moisture content as this demonstrated natural moulding parameters from basic on site puddling tests.

On site moisture compliance testing was carried out as a way of Construction Quality Control for the works, using an Ashworth Speedy Moisture Gauge and temperature control for placement was using an Environment Meter.

All testing was undertaken in accordance with BS 1377: 1990 and BS 5930:1999 at frequencies listed in Construction Quality Assurance Plan for Phase 3. In-situ tests using core cutters were undertaken to ensure that the material was placed with less than 5% air voids and at the correct moisture content.

The total volume was calculated at 400m^3. The total testing required per lift was therefore as follows:

Table 1 Test Schedule

Test	Number Required	Actual taken
Core Cutters	2	10
Shear Vanes	7	12
Atterberg Limits	1	2
Specific Gravity	1	2
Permeability	1	2
Particle Size Distribution	1	2

The corroborative core cutters were taken in accordance with BS1377: 1999 and submitted to Ground Investigation and Piling Limited UKAS soils laboratory in Wolverhampton.

Ground Investigation and Piling Limited are UKAS accredited for Density, Moisture Content, Particle Size Gradings, Compactions and Specific Gravity, Atterberg Limits. The UKAS Certificates are presented at Appendix 2, Ref 1897, Issue 007, October 2007.

Permeability testing was carried out using Annex 2 of the Environment Agency Guidance.

All testing has been carried out in accordance with BS1377;1990, and reported in accordance with BS1377:1990 UKAS requirements or accepted standards.

The excavator was observed traversing each lift with a minimum number of eight passes prior to any testing being carried out. In general the excavator did on average 10 passes on each lift.

Each visit to the site during the lining works had a detailed engineers log prepared of all works and testing carried out. The logs at presented at Appendix 7.

4.4 Field Test Results

All field samples were taken by the Engineer during each day of works.

All testing carried out with the Speedy Moisture Gauge to control the moisture content of the conditioned material both at the processing area and placed in Sections 1 and 12.

No clay was placed in a freezing condition or when temperatures were below 0°C. Temperature was monitored using an environment meter. The clay was clean and had been stored separately from the sand and had been previously selectively

excavated. All of the material used was from on site out of the Phase 3 footprint.

Two permeability ring falling head/soakaway tests were carried out.
Shear strength tests were carried out using a Pilcon hand shear vane.

Core Cutter Assessment

Core Cutter tests were carried out on 10 of the 12 lifts at a rate of one test per 40m^3 of placed material opposed to the required one test per 188m^3. The testing frequency and pass-fail results are presented at Appendix 1.

The results of the cores have been correlated against the upper specific gravity test value obtained on all of the sections. All of the results are presented at Appendix 1. The results from each section have been presented as the laboratory sheet, followed by a graphical plot.

All of the plots were above the 5% air voids line.

The holes produced taking the Core Cutters were sealed using additional clay which was tampered into the hole using the core puner and then additional clay placed on top and subject to compaction with the compaction plant with a minimum 8 passes.

Specific Gravity Tests

The specific gravity or particle density value is presented at Appendix 2.

The test reported value was 2.68, consistent with the base geological testing results.

All of the holes produced taking the specific gravity bulk bag tests were sealed using additional clay which was tampered into the hole using the core puner and then additional clay placed on top and subject to compaction with the compaction plant with a minimum 8 passes.

Atterbrg Limits

One Atterberg test was taken at a frequency of one test in 140m^3 as opposed to one test per 1200m^3.

The clay used for the mineral liner would be classified as CM-clays of medium plasticity.

Placement of the clay at and above 18% showed the clay to deform plastically during compaction.

The results are presented at Appendix 2.

The only specifications set for plastic limit and classification criteria was that the plastic limit should not be greater than 65% and a plasticity index less than 10%, and that the test frequency should be not greater than one test per 1200m^3. Both of these criteria were complied with and exceeded.

No tests results were reported outside the British Standard. The plastic limit, liquid limit and therefore the plasticity index tests were reported correctly in accordance with the British Standard. The clay was placed at a moisture content of between a 17% and 19%. Corroborative bulk tests were taken for Natural Moisture Content with the Atterberg Limit determinations.

Control of moisture was carried out throughout the works using an Ashworth Speedy Moisture Tester.

The holes produced taking the Atterberg Limits and Natural Moisture Content bulk bag test were sealed using additional clay which was tampered into the hole using the core puner and then additional clay placed on top and subject to compaction with the compaction plant with a minimum 8 passes.

Permeability Tests

Two soakaway tests were carried out on Lifts 11 and 12.Both exceeded the requirements set out in Annex 2 of the Environment Agency Guidance, indicating a permeability greater than 1 x 10^{-7}m/s.Summarty results are presented at Appendix 3.

Previous permeability testing has been between two and three orders of magnitude lower than required.

All of the holes produced taking the permeability soakaway tests were sealed using additional clay which was tampered into the hole using the core puner and then additional clay placed on top and subject to compaction with the compaction plant with a minimum 8 passes.

Particle Size Grading

A particle size grading was carried out at a frequency of approximately 1 per 200m^3 as opposed to the CQA test frequency of one test per 1200m^3. The clay content was in excess of 24% and silt content in excess of 44%. Gravel was less

than 1%. The results are presented at Appendix 4. GIP is UKAS accredited for particle size gradings.

The holes produced taking the grading bulk bag tests were sealed using additional clay which was tampered into the hole using the core puner and then additional clay placed on top and subject to compaction with the compaction plant with a minimum 8 passes.

Shear Strength Tests

12 shear strength tests were undertaken at a rate of at least one test per 33m^3 using an EDECO/Pilcon hand shear vane at random locations on the side lifts, within each section of geological barrier mineral liner placed, and are presented on summary sheets Appendix 5.

All of the results are well in excess of 50kPa.

Puddle Tests

Tests were carried out in accordance with the Environment Agency guidance to ensure that the clay could be rolled in to ball and form a sausage shape without cracking. The results are presented at Appendix 6. Compaction moulding was assessed viewing a removed core cutter also presented at Appendix 6. No fissures of major voids were reported.

4.5 Assessment of Earthworks Construction

The Section 1 and 12 of Phase 3 side wall seal locations are presented on Drawing PPC6.

General

All moisture controls on site were by use of the Ashworth Speedy Moisture Gauge which had been calibrated on site against core cutters. The moisture gauge readings were found to be within 0.2% of laboratory tests. In addition the feel of the clay was easy to determine the plasticity.

Shear strength was recorded on each lift using a Pilcon hand shear vane.

Engineers daily logs were provided for each visit, presented at Appendix 7.

Plate 1: View of clay stockpile

4.6 Non-Conformance

Some material had fallen onto the liner during the cessation of works and highlighted during an Environment Agency visit. This was subsequently cleaned off prior to placement of additional lifts. No other non-conformances were reported during the placement of the geological barrier side wall seal in Phase 3 Lifts 1 to 12.

Plate 2: Soil removed off geological barrier

5. CONCLUSIONS

The procedures carried out on site were in accordance with the Construction Quality Assurance Plan with appropriate layer thickness and the number of passes of the compaction plant. All materials incorporated within the earthworks were therefore placed satisfactorily.

The results of the permeability tests on soakaway tests were in compliance with the Environment Agency Guidance and indicate that the target permeability of 1.0×10^{-7}m/s or better has been achieved.

The mineral liner had in excess of 24% clay fraction, and a fines content in excess of 50%. The mineral liner was over 1 metre in thickness horizontally as proved by physical measurements by the engineer on site.

The testing carried out on the geological barrier side wall seal liner both by independent laboratory testing at UKAS accredited soils laboratory and field tests exceeded the required test frequencies in the agreed CQA Plan and new guidance and showed that the geological barrier had achieved and exceeded the required minimum standards on all testing.

Detailed and full comprehensive engineers daily logs have recorded during each visit.

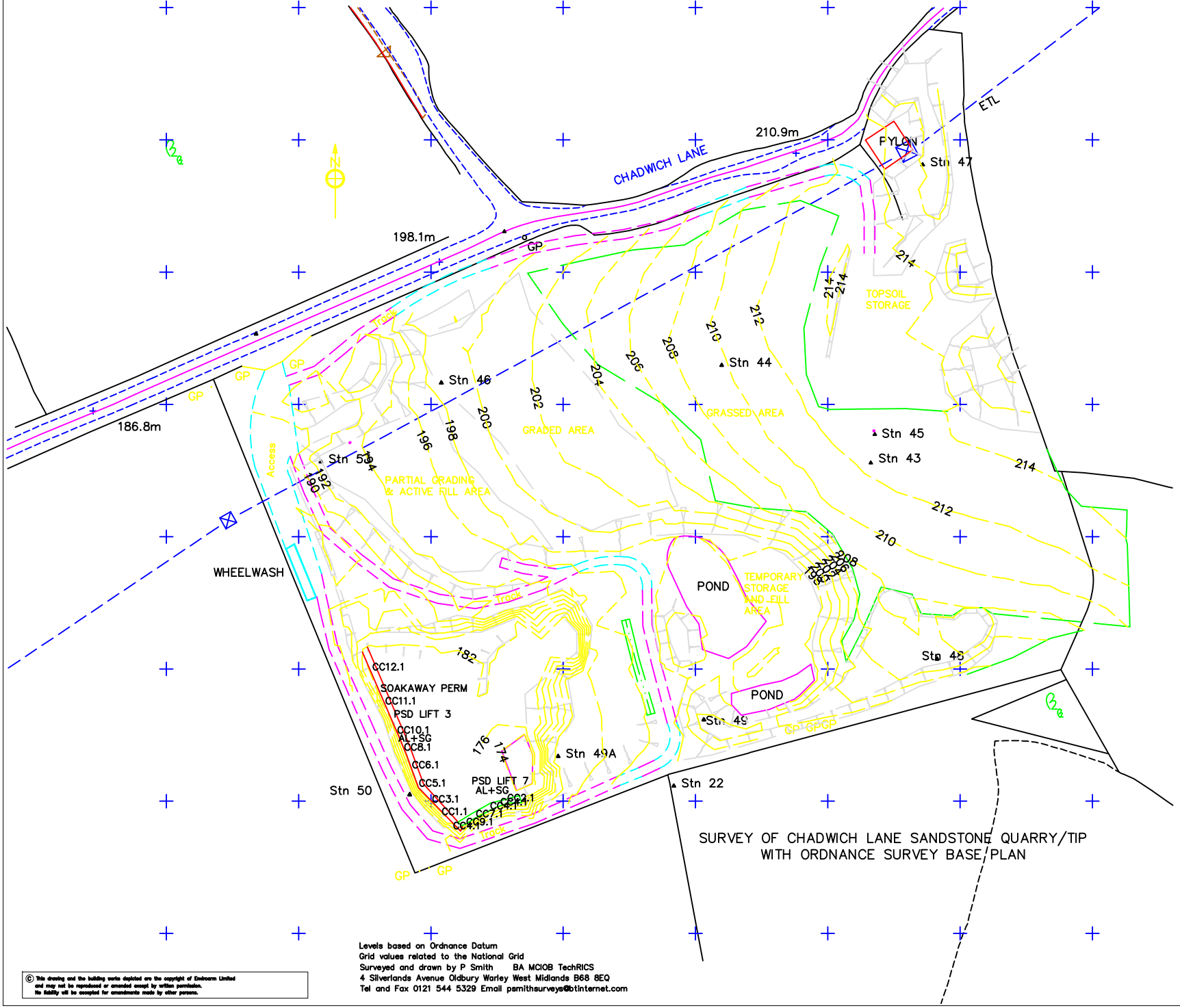
In conclusion all of the materials have been tested to and above the required frequency and all of the materials have exceeded the minimum standard requirements.

The Phase 3 Sections 1 and 12 side wall seal are therefore acceptable for the receipt of inert waste as it has been constructed in accordance with the approved Construction Quality Assurance Plan and new Environment Agency Guidance for inert landfill sites.

Report prepared by A.R.Morris Date: 29.08.09.

A.R.Morris

DRAWING



SURVEY OF CHADWICH LANE SANDSTONE QUARRY/TIP
WITH ORDNANCE SURVEY BASE PLAN

Levels based on Ordnance Datum
Grid values related to the National Grid
Surveyed and drawn by P Smith BA MCIOB TechRICS
4 Silverlands Avenue Oldbury Warley West Midlands B68 8EQ
Tel and Fax 0121 544 5329 Email psmithsurveys@btinternet.com

The Contractor is to check and verify all building and site dimensions, levels and sewer invert levels at connection points prior to the commencement of works.

This drawing must be read with and checked against any structural or other specialist drawings provided by the client.

The Contractor is to comply in all respects with the current Building Regulations and CDM regulations whether or not specifically stated on these drawings.

This drawing is not intended to show details of foundations, ground conditions or ground contaminants. Each area of ground relied upon to support the proposed works, including drainage, depleted must be investigated by the contractor, suitable methods of foundation be provided and any suspect contaminants on or within the ground covered by the works be further investigated by a suitable expert.

Notes

ENVIROARM LIMITED
Enviroarm Ltd.
597, Walsall Road, Great Wyrley, Walsall. WS6 6AE.
Tel: 01922-412209 Mobile 07801960864
email: enviroarm@btconnect.com

Client: CHADWICH LANE QUARRY LTD

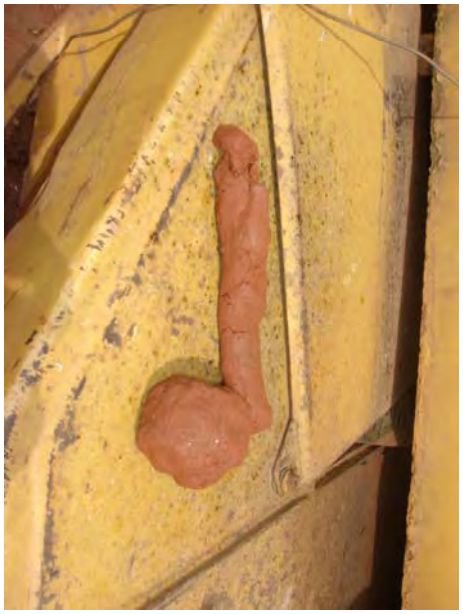
Project: GEOLOGICAL BARRIER PHASE 3.1

Title: CHADWICH LANE QUARRY
PHASE 3.1
LIFTS 1-12 TEST LOCATIONS

Date : AUGUST 09	Scales: 1:1250		
Drawn: PS	Project No. PPC	Drg No. 6	Rev.
Checked: ARM			

PHOTOGRAPHS






APPENDIX 1:

Core Cutter Test Results and Graphs

IN - SITU DENSITY TEST REPORT

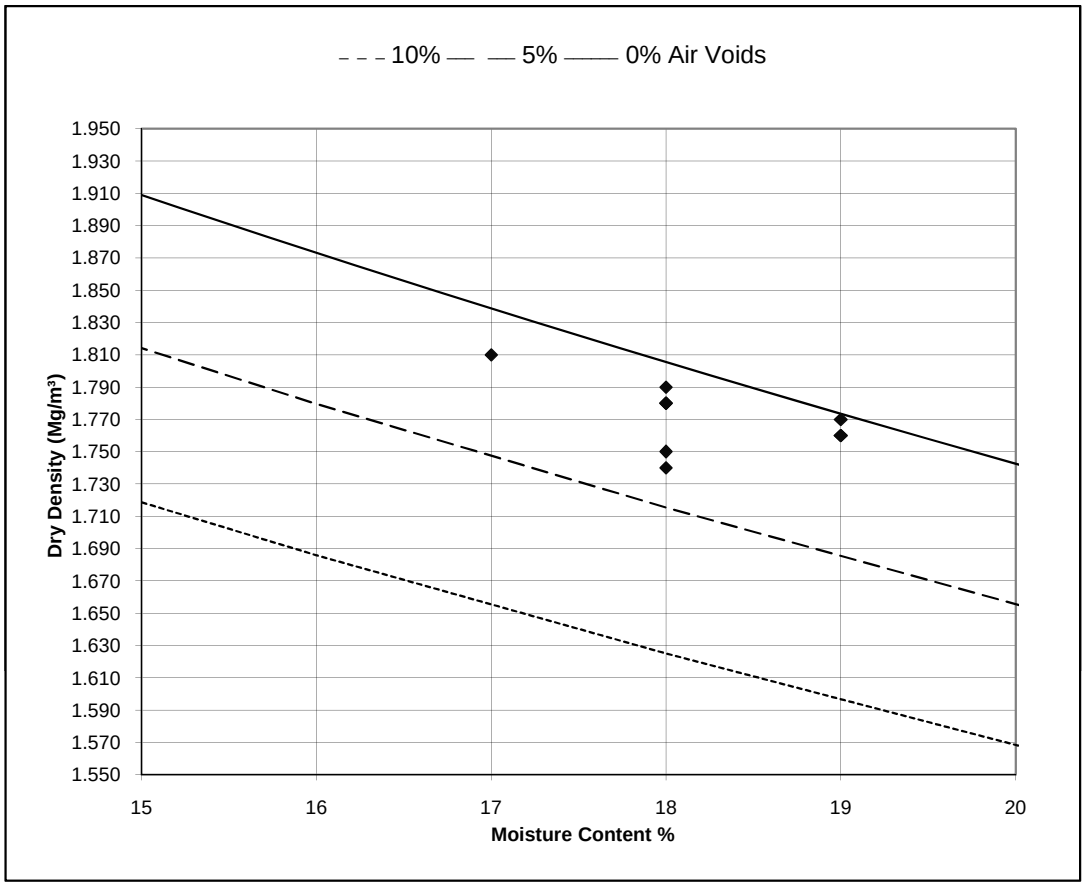
Site:- Chadwich Lane Phase 3.	Customer:- Enviroarm Limited.	GIP Ltd. Ground Investigation & Piling Limited
Job No:- L/7159	Page No:- 1 of 1	Devonshire House, Ettingshall Road, Wolverhampton. WV2 2JT
Date Issued:- 23.04.09		Phone 01902 459558, Fax 01902 459085, email lab@gipuk.com

Date of Test	Test No.	Test Type	MC%	Bulk Density Mg/m³	Dry Density Mg/m³	Percentage Compaction %	DESCRIPTION	REMARKS
22.04.09	Lift 1 CC1.1	CC	18	2.10	1.78		MADE GROUND: Firm to stiff friable red brown slightly sandy slightly gravelly CLAY. Gravel is quartzite.	
22.04.09	Lift 2 CC2.1	CC	19	2.09	1.76		As above.	
22.04.09	Lift 3 CC3.1	CC	18	2.06	1.74		As above.	
22.04.09	Lift 4 CC4.1	CC	19	2.10	1.77		As above.	
22.04.09	Lift 5 CC5.1	CC	18	2.11	1.79		As above.	
22.04.09	Lift 6 CC6.1	CC	18	2.07	1.75		As above.	
22.04.09	Lift 7 CC7.1	CC	18	2.11	1.78		As above.	
22.04.09	Lift 8 CC8.1	CC	17	2.12	1.81		As above.	
22.04.09	Lift 9 CC9.1	CC	18	2.11	1.78		As above.	
22.04.09	Lift 10 CC10.1	CC	19	2.09	1.76		As above.	

MC	BS1377:PART2:1990:3	CC	BS1377:PART9:1990:2.4* (Core Cutter)	SR	BS1377:PART9:1990:2.1 or 2.2* (Sand Replacement)

Client:- **Chadwich Lane Quarry**
Site:Chadwich Lane Quarry Landfill

Graph 1 2.675 Average SG
SIDE WALL



MC	Density
18	1.780
19	1.760
18	1.740
19	1.770
18	1.790
18	1.750
18	1.780
17	1.810
18	1.780
19	1.760
0	0.000

Particle density	2.675

APPENDIX 2:

Specific Gravity and Classification Tests

LABORATORY TEST REPORT

Contract: Chadwich Lane, Phase 3.

Customer: Enviroarm Limited,
597 Walsall Road,
Great Wyrley,
Nr.Walsall
Staffordshire.
WS6 6AE.

GIP Ltd
Ground Investigation & Piling Limited
Devonshire House, Ettingshall Road,
Wolverhampton. WV2 2JT
Phone 01902 459558, Fax 01902 459085, email lab@gipuk.com

Job No:- L/7159 | Page No:- 1 of 1

Date Received:- 22.04.09 | Date Issued:- 13.05.09

SAMPLE DETAILS			TEST DATE	CLASSIFICATION					CHEMICAL		% PASSING BS SIEVE SIZE		DENSITIES		*TRIAXIAL STRENGTH					DESCRIPTION
				Index Properties																
SAMPLE No.	DEPTH m	SAMPLE TYPE		W %	W_L 1pt %	W_P %	I_P	Particle Density Mg/m³	Soluble SO_4 g/L	pH Value	2.00 mm	0.425 mm	BULK Mg/m³	DRY Mg/m³	TYPE	DIA mm	σ_3	$\frac{\sigma_1-\sigma_3}{2}$	C_u kPa	
Lift 2	-	B	27.04.09	18	38	16	22	2.67				97								MADE GROUND: Firm friable red brown slightly sandy slightly gravelly CLAY. Gravel is sandstone and occasional shale.
Lift 8	-	B	27.04.09	19	39	16	23	2.68				93								MADE GROUND: Firm friable red brown slightly sandy slightly gravelly CLAY. Gravel is quartzite.

Sample type		Test abbreviations		Test methods - Unless otherwise stated.		
D	Disturbed	W	Moisture Content	W%	BS1377:PART2:1990:3	σ_3 *Cell pressure; $\frac{\sigma_1-\sigma_3}{2}$ *Deviator stress
B	Bulk disturbed	W_L	Liquid limit	W_L	BS1377:PART2:1990:4.3/4.4	Cu *Cohesion value
U	Undisturbed	W_P	Plastic limit	W_P	BS1377:PART2:1990:5.3	
S	SPT split spoon	I_P	Index property	I_P	BS1377:PART2:1990:5.4	
W	Ground water	PD	Particle Density	PD	BS1377:PART2:1990:8.2	
T	Tub	pH	pH Value	pH	BS1377:PART3:1990:9	
		SO_4	Soluble sulphate	SO_4	BS1377:PART3:1990:5.5	

Approved signatories:-

A.L.Pearce, Laboratory director.....

P.R.Smart, Laboratory manager.....

UKAS TESTING 1897

Tests marked * are not UKAS accredited.

The reported results relate only to samples received.

 # = Sample mass smaller than BS1377 requirements.

Opinions and interpretations are outside the scope of UKAS accreditation

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APPENDIX 3:

Particle Size Gradings

GROUND INVESTIGATION & PILING LIMITED
TEST REPORT FOR PARTICLE SIZE DISTRIBUTION

Job No:- L/7159
Received:- 22.04.09
Tested:- 27.04.09
Report:- 08.05.09

Site:- Chadwich Lane, Phase 3.
Customer:- Enviroarm Limited,
597 Walsall Road, Great Wyrley,
Nr Walsall, Staffs.

Lift 3

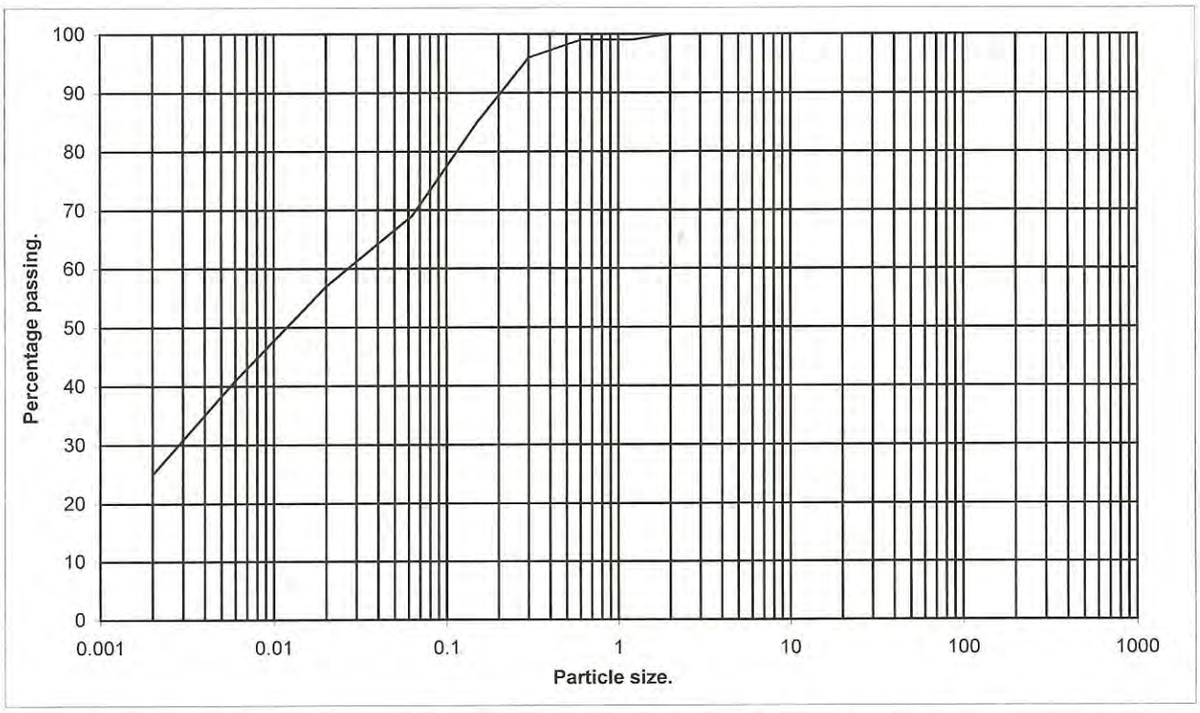
TEST METHODS:-
Particle Size Distribution:-
BS 1377: Part 2: 1990
Clause 9.2 & 9.3

Sedimentation:-
BS 1377: Part 2: 1990
Clause 9.4

Sample Description: MADE GROUND: Firm friable red brown slightly sandy CLAY.

TEST METHODS:-
Sample Preparation:
BS1377:Part1:1990:
Clause 7.3.4, 7.3.5, 7.4.5

Authorized by P.R.Smart
Laboratory Manager



CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	COBBLES	BOULDERS
	SILT			SAND			GRAVEL				

Sieve Size mm	% Passing	Sieve Size mm	% Passing
200	100	3.35	100
150	100	2	100
125	100	1.18	99
90	100	0.6	99
75	100	0.3	96
63	100	0.15	85
37.5	100	0.063	69
20	100	0.02	57
10	100	0.006	41
6.3	100	0.002	25

% Clay	25
% Silt	44
% Sand	31
% Gravel	0
% Cobbles	0

UKAS TESTING
1897

The reported results relate only to samples received

GROUND INVESTIGATION & PILING LIMITED
TEST REPORT FOR PARTICLE SIZE DISTRIBUTION

Job No:- L/7159 Site:- Chadwich Lane, Phase 3.
Received:- 22.04.09 Customer:- Enviroarm Limited,
Tested:- 27.04.09 597 Walsall Road, Great Wyrley,
Report:- 08.05.09 Nr Walsall, Staffs.

Lift 7

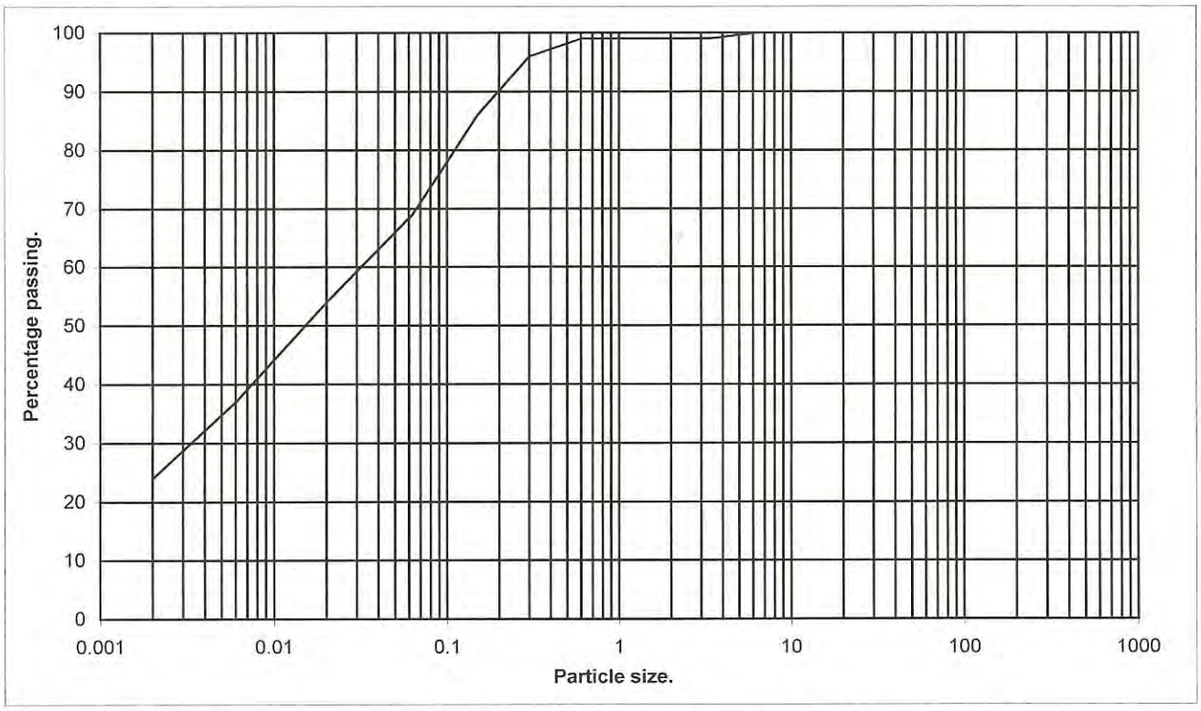
TEST METHODS:-
Particle Size Distribution:-
BS 1377: Part 2: 1990
Clause 9.2 & 9.3

Sedimentation:-
BS 1377: Part 2: 1990
Clause 9.4

Sample Description: MADE GROUND: Firm friable red brown slightly sandy slightly gravelly CLAY. Gravel is siltstone.

TEST METHODS:-
Sample Preparation:
BS1377:Part1:1990:
Clause 7.3.4, 7.3.5, 7.4.5

Authorized by P.R.Smart
Laboratory Manager



CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	COBBLES	BOULDERS
	SILT			SAND			GRAVEL				

Sieve Size mm	% Passing	Sieve Size mm	% Passing
200	100	3.35	99
150	100	2	99
125	100	1.18	99
90	100	0.6	99
75	100	0.3	96
63	100	0.15	86
37.5	100	0.063	69
20	100	0.02	54
10	100	0.006	37
6.3	100	0.002	24

% Clay	24
% Silt	45
% Sand	30
% Gravel	1
% Cobbles	0

UKAS TESTING
1897

The reported results relate only to samples received

APPENDIX 4:

Shear Strength Tests

Shear Vane Test Results:

Date	Test Location:	Passes:	Shear Vane Results kPa
06.04.09	South Wall	Lift 1	87
	West Wall	Lift 2	76
07.04.09	South Wall	Lift 3	83
	West Wall	Lift 4	94
14.04.09	South Wall	Lift 5	81
	West Wall	Lift 6	74
	South Wall	Lift 7	72
22.04.09	West Wall	Lift 8	96
	South Wall	Lift 9	74
	West Wall	Lift 10	98
03.08.09	South Wall	Lift 11	86
13.08.09	West Wall	Lift 12	95
AVERAGE			**98.8kPa**

APPENDIX 5:

Puddle Tests

CHADWICH LANE QUARRY

PUDDLE TESTS

CORE CRACKING VOID AND PUDDLING ASSESSMENT