



TP10



TP10

*For inspection purposes only.
Consent of copyright owner required for any other use.*



For inspection purposes only.
Consent of copyright owner required for any other use.

TP10



TP10



TP10



TP10



TP11



TP11



TP11



TP11



TP11



TP11



TP11



TP11

*For inspection purposes only.
Consent of copyright owner required for any other use.*



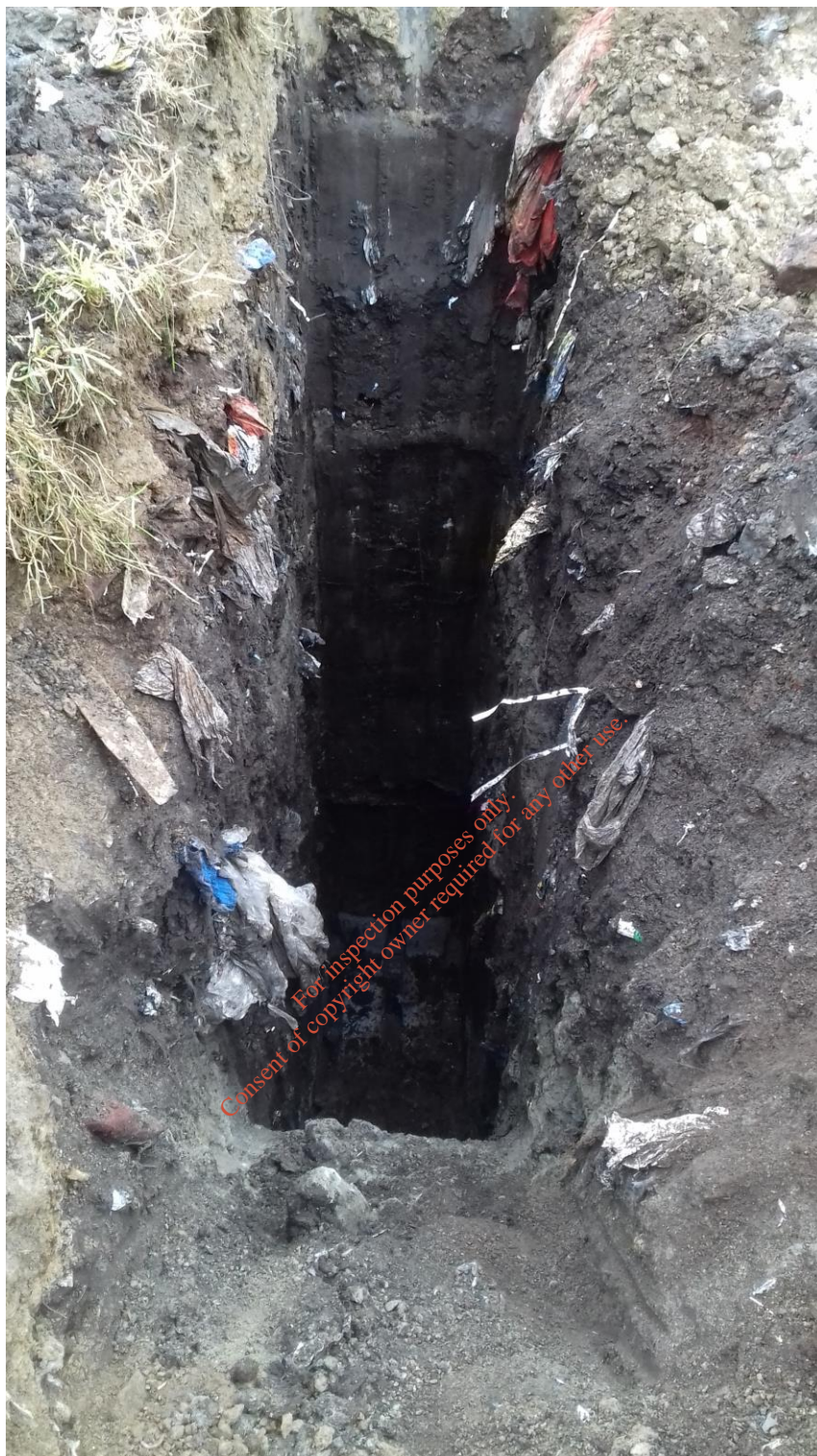
TP12



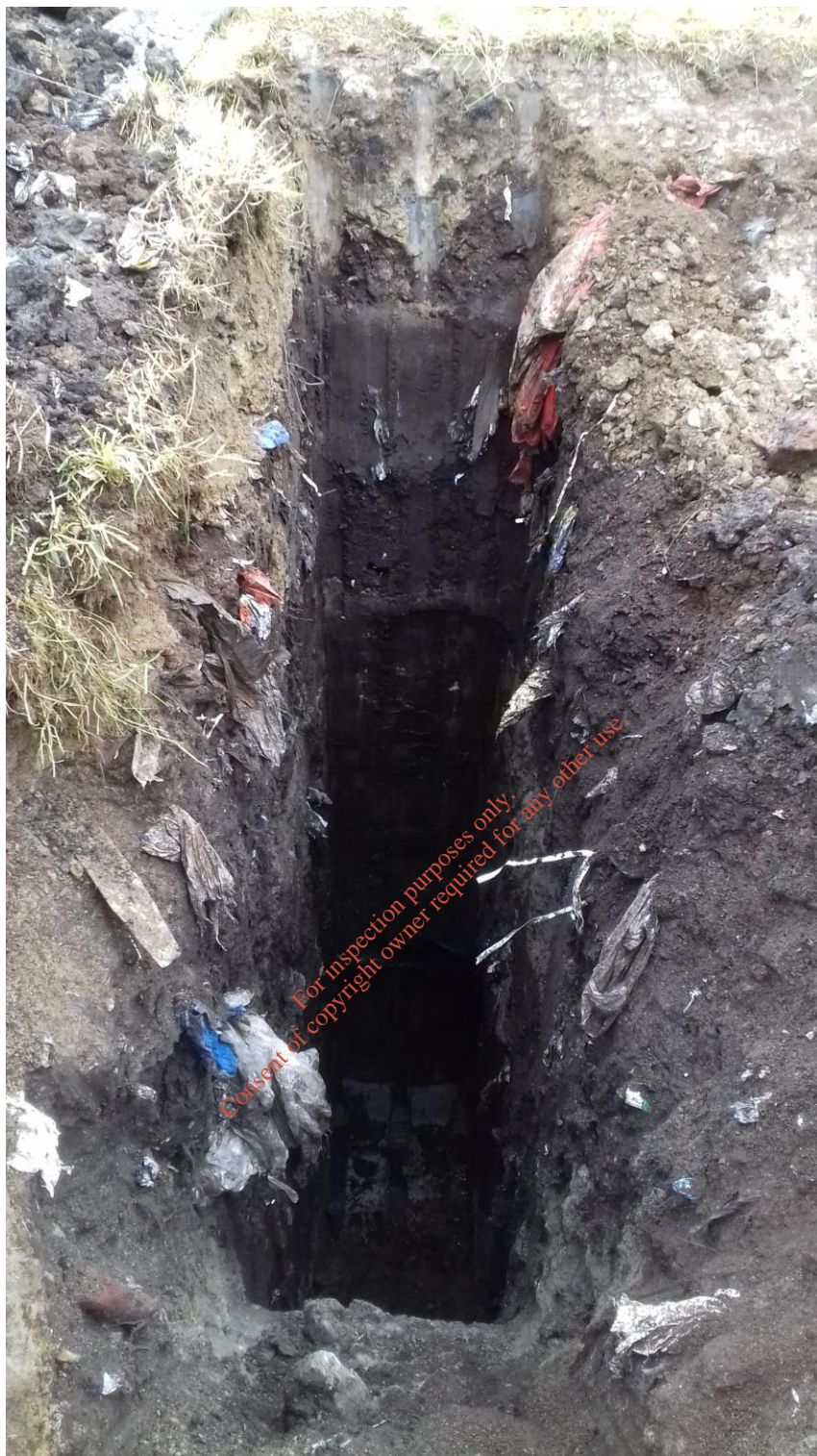
TP12



TP12



TP12

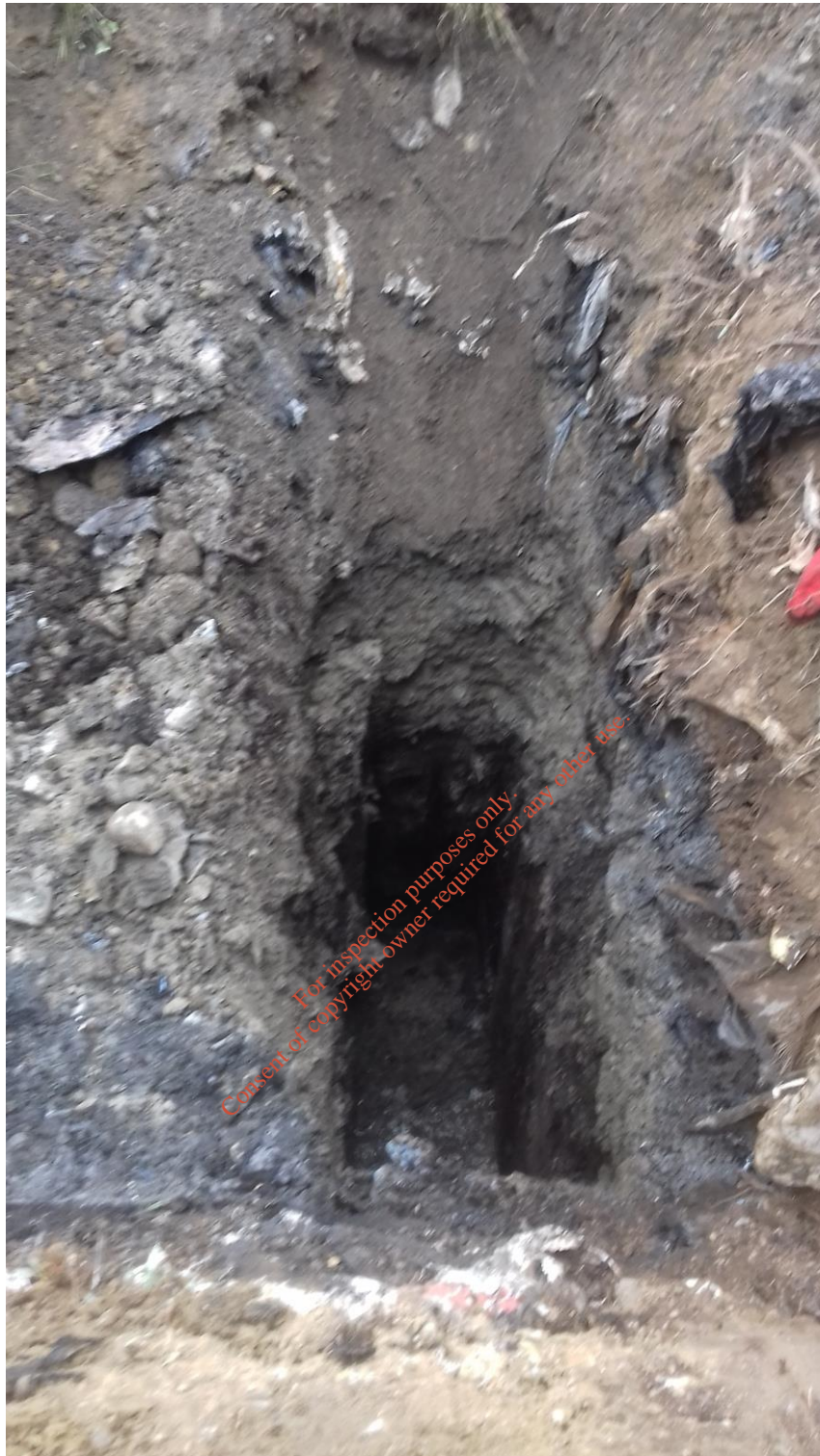


TP12



TP12

*For inspection purposes only.
Consent of copyright owner required for any other use.*



TP13



TP13



TP13



TP13

*For inspection purposes only.
Consent of copyright owner required for any other use.*



CAUSEWAY
— GEOTECH

APPENDIX F

VARIABLE HEAD PERMEABILITY TEST RESULTS

*For inspection purposes only.
Consent of copyright owner required for any other use.*

VARIABLE HEAD PERMEABILITY TEST (Standpipe)

Project Name: Monaghan Landfills - Killycard

Borehole No.: GW01

Project No.: 18-0838A

Date: 09/10/2018

Test No.: Test 1

Type of test: **Falling** Head

Diameter of standpipe (D): 0.05 (m)
 Depth to top of filter bgl: 6.50 (m)
 Depth to bottom of filter bgl: 10.00 (m)
 Length of test section of filter (L): 3.50 (m)
 Diameter of Filter (D): 0.20 (m)
 Standing ground water level (SWL) bgl: 1.52 (m) on 09 October 2018

TIME ELAPSED (mins)	WATER LEVEL* (m)	HEAD H (m)	HEAD RATIO H/Ho
0	-0.30	1.82	1.00
1	0.74	0.78	0.43
1.5	0.88	0.64	0.35
2	0.97	0.55	0.30
2.5	1.06	0.46	0.25
3	1.11	0.41	0.23
3.5	1.16	0.36	0.20
4	1.20	0.32	0.18
4.5	1.24	0.28	0.15
5	1.27	0.25	0.14
10	1.39	0.13	0.07
15	1.43	0.09	0.05
20	1.45	0.07	0.04
25	1.46	0.06	0.03
30	1.46	0.06	0.03
45	1.47	0.05	0.03
60	1.48	0.04	0.02

CALCULATION OF PERMEABILITY OF SOIL:

Employing Horslev Method (1951)

$$k = \frac{2.3A}{F(t_2 - t_1)} \log \frac{h_1}{h_2}$$

where

k is the permeability of soil

A is the cross-section area of borehole/standpipe

F is the shape factor (see below)

h_1 and h_2 are the hydraulic heads measured respectively at the times t_1 and t_2

Values of shape factors (F) for various conditions,

Cases (a)-(e), are given in Annex B of BS EN ISO 22282-1:2012

L/D= 17.50

Assumed condition: Case **E**, hence:

$$F = (2 * \pi * L) / (\ln(2 * (L/D)))$$

$$F = 6.19$$

$$\text{and } A = 0.0020 \text{ (m}^2\text{)}$$

$$\text{and } h_1 = 1.82 \text{ (m)}$$

$$\text{and } h_2 = 0.04 \text{ (m)}$$

$$\text{and } t_1 = 0 \text{ (s)}$$

$$\text{and } t_2 = 3600 \text{ (s)}$$

hence, $k = 3.361E-07$ m/s



VARIABLE HEAD PERMEABILITY TEST (Standpipe)

Project Name: Monaghan Landfills - Killycard

Borehole No.: GW02

Project No.: 18-0838A

Date: 09/10/2018

Test No.: Test 1

Type of test: **Falling** Head

Diameter of standpipe (D): 0.05 (m)
 Depth to top of filter bgl: 7.00 (m)
 Depth to bottom of filter bgl: 10.00 (m)
 Length of test section of filter (L): 3.00 (m)
 Diameter of Filter (D): 0.20 (m)
 Standing ground water level (SWL) bgl: 2.22 (m) on 09 October 2018

TIME ELAPSED (mins)	WATER LEVEL* (m)	HEAD H (m)	HEAD RATIO H/Ho
0	-0.20	2.42	1.00
0.5	0.90	1.32	0.55
1	1.20	1.02	0.42
1.5	1.48	0.74	0.31
2	1.60	0.62	0.26
2.5	1.70	0.52	0.21
3	1.78	0.44	0.18
3.5	1.82	0.40	0.17
4	1.86	0.36	0.15
4.5	1.90	0.32	0.13
5	1.92	0.30	0.12
10	2.04	0.18	0.07
15	2.09	0.13	0.05
20	2.11	0.11	0.05
25	2.13	0.09	0.04
30	2.14	0.08	0.03
45	2.15	0.07	0.03
60	2.16	0.06	0.02
90	2.17	0.05	0.02

CALCULATION OF PERMEABILITY OF SOIL:

Employing Horslev Method (1951)

$$k = \frac{2.3A}{F(t_2 - t_1)} \log \frac{h_1}{h_2}$$

where

k is the permeability of soil

A is the cross-section area of borehole/standpipe

F is the shape factor (see below)

h_1 and h_2 are the hydraulic heads measured respectively at the times t_1 and t_2

Values of shape factors (F) for various conditions,

Cases (a)-(e), are given in Annex B of BS EN ISO 22282-1:2012

L/D= 15.00

Assumed condition: Case **E**, hence:

$$F = (2 * \pi * L) / (\ln(2 * (L/D)))$$

$$F = 5.54$$

$$\text{and } A = 0.0020 \text{ (m}^2\text{)}$$

$$\text{and } h_1 = 2.42 \text{ (m)}$$

$$\text{and } h_2 = 0.05 \text{ (m)}$$

$$\text{and } t_1 = 0 \text{ (s)}$$

$$\text{and } t_2 = 5400 \text{ (s)}$$

hence, $k = \underline{2.541E-07}$ m/s



VARIABLE HEAD PERMEABILITY TEST (Standpipe)

Project Name: Monaghan Landfills - Killycard

Borehole No.: GW03

Project No.: 18-0838A

Date: 09/10/2018

Test No.: Test 1

Type of test: **Falling** Head

Diameter of standpipe (D): 0.05 (m)
 Depth to top of filter bgl: 6.00 (m)
 Depth to bottom of filter bgl: 10.00 (m)
 Length of test section of filter (L): 4.00 (m)
 Diameter of Filter (D): 0.20 (m)
 Standing ground water level (SWL) bgl: 1.71 (m) on 09 October 2018

TIME ELAPSED (mins)	WATER LEVEL* (m)	HEAD H (m)	HEAD RATIO H/Ho
0	-0.25	1.96	1.00
0.5	0.35	1.36	0.69
1	0.64	1.07	0.55
1.5	0.76	0.95	0.48
2	0.82	0.89	0.45
2.5	0.86	0.85	0.43
3	0.88	0.83	0.42
3.5	0.89	0.82	0.42
4	0.90	0.81	0.41
4.5	0.91	0.80	0.41
5	0.91	0.80	0.41
10	0.92	0.79	0.40
20	0.93	0.78	0.40
30	0.93	0.78	0.40
45	0.94	0.77	0.39
60	0.95	0.76	0.39
90	0.96	0.75	0.38

CALCULATION OF PERMEABILITY OF SOIL:

Employing Horslev Method (1951)

$$k = \frac{2.3A}{F(t_2 - t_1)} \log \frac{h_1}{h_2}$$

where

k is the permeability of soil

A is the cross-section area of borehole/standpipe

F is the shape factor (see below)

h_1 and h_2 are the hydraulic heads measured respectively at the times t_1 and t_2

Values of shape factors (F) for various conditions,

Cases (a)-(e), are given in Annex B of BS EN ISO 22282-1:2012

L/D= 20.00

Assumed condition: Case **E**, hence:

$$F = (2 * \pi * L) / (\ln(2 * (L/D)))$$

$$F = 6.81$$

$$\text{and } A = 0.0020 \text{ (m}^2\text{)}$$

$$\text{and } h_1 = 1.96 \text{ (m)}$$

$$\text{and } h_2 = 0.75 \text{ (m)}$$

$$\text{and } t_1 = 0 \text{ (s)}$$

$$\text{and } t_2 = 5400 \text{ (s)}$$

hence, k = **5.118E-08** m/s





CAUSEWAY
— GEOTECH

APPENDIX F
GEOTECHNICAL LABORATORY TEST RESULTS

*For inspection purposes only.
Consent of copyright owner required for any other use.*



CAUSEWAY
— GEOTECH



+44 (0)28 2766 6640
info@causewaygeotech.com
www.causewaygeotech.com

SOIL AND ROCK SAMPLE ANALYSIS LABORATORY TEST REPORT

Project Name:	Monaghan Landfills - Killycard
Project No.:	18-0838A
Client:	Monaghan County Council
Engineer:	Fehily Timoney & Company
Date:	09/10/18

We are pleased to attach the results of laboratory testing carried out for the above project. This memo and its attachments constitute a report of the results of tests as detailed in the Contents page(s).

The attached results complete the testing requested and we would therefore wish to confirm that samples will be retained without charge for a period of 28 days from the above date after which they will be appropriately disposed of unless we receive written instructions to the contrary prior to that date.

We trust our report meets with your approval but if you have any queries or require additional information, please do not hesitate to contact the undersigned.

Approved Signatory

Stephen Watson
Laboratory Manager

Signed for and on behalf of Causeway Geotech Ltd

Causeway Geotech Ltd

8 Drumahiskey Road, Ballymoney
Co. Antrim, N. Ireland, BT53 7QL

Registered in Northern Ireland. Company Number: NI610766





Project Name: Monaghan Landfills - Killycard

Report Reference: 18-0838A – Soils Schedule 1

The table below details the tests carried out, the specifications used, and the number of tests included in this report.

Tests marked with* in this report are not United Kingdom Accreditation Service (UKAS) accredited and are not included in Causeway Geotech Limited’s scope of UKAS Accreditation Schedule of Tests. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

Material tested	Type of test/Properties measured/Range of measurement	Standard specifications	No. of results included in the report
SOIL	Moisture Content of Soil	BS 1377-2: 1990: Cl 3.2	3
SOIL	Liquid and Plastic Limits of soil - 1 point cone penetrometer method	BS 1377-2: 1990: Cl 4.4, 5.3 & 5.4	3
SOIL	Bulk and dry density by Linear Measurement Method	BS 1377-2: 1990: Cl 7.2	3
SOIL	Particle size distribution - wet sieving	BS 1377-2: 1990: Cl 9.2	3
SOIL	Particle size distribution - sedimentation hydrometer method	BS 1377-2: 1990: Cl 9.5	3

Causeway Geotech Ltd

8 Drumahiskey Road, Ballymoney
Co. Antrim, N. Ireland, BT53 7QL

Registered in Northern Ireland. Company Number: NI610766




Summary of Classification Test Results

Project No. 18-0838A	Project Name Monaghan Landfills - Killycard
-------------------------	--

Hole No.	Sample				Soil Description	Density		w	Passing 425µm	LL	PL	PI	Particle density	Casagrande Classification
	Ref	Top	Base	Type		bulk Mg/m3	dry							
TP02	1	0.50		B	MADE GROUND: Brown sandy gravelly SILT with fragments of plastic and glass.	2.00	1.68	11.0	52	52 -1pt	35	17		MH
TP07	1	0.50		B	MADE GROUND: Brown sandy gravelly SILT/CLAY with fragments of red brick and plastic.	2.04	1.69	20.0	55	48 -1pt	28	20		MI/CI
TP13	1	0.50		B	MADE GROUND: Brown sandy gravelly silty CLAY with fragments of plastic and glass.	2.07	1.80	15.0	50	45 -1pt	26	19		CI

For inspection purposes only.
 Consent of copyright owner required for any other use.

All tests performed in accordance with BS1377:1990 unless specified otherwise

Key Density test Liquid Limit Particle density Linear measurement unless : 4pt cone unless : sp - small pyknometer wd - water displacement cas - Casagrande method gj - gas jar wi - immersion in water 1pt - single point test	Date Printed 10/09/2018 00:00	Approved By Stephen.Watson	 10122
---	---	--	---



PARTICLE SIZE DISTRIBUTION

Job Ref **18-0838A**

Borehole/Pit No. **TP02**

Site Name **Monaghan Landfills - Killycard**

Sample No. **1**

Soil Description **MADE GROUND: Brown sandy gravelly SILT with fragments of plastic and glass.**

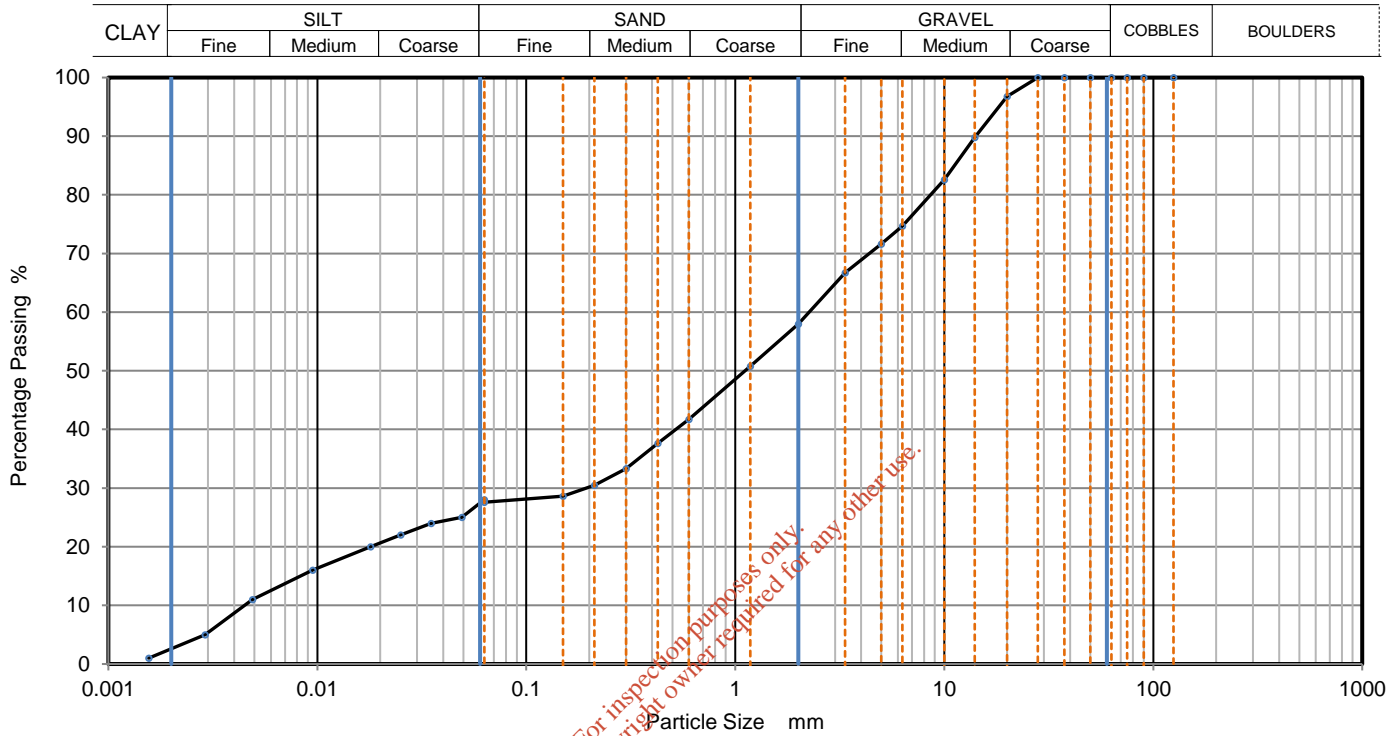
Depth, m **0.50**

Specimen Reference **8** Specimen Depth **m**

Sample Type **B**

Test Method **BS1377:Part 2:1990, clauses 9.2 and 9.5**

KeyLAB ID **Caus2018092988**



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	28
90	100	0.0492	25
75	100	0.0350	24
63	100	0.0251	22
50	100	0.0180	20
37.5	100	0.0095	16
28	100	0.0049	11
20	97	0.0029	5
14	90	0.0016	1
10	83		
6.3	75		
5	72		
3.35	67		
2	58		
1.18	51		
0.6	42	Particle density (assumed)	
0.425	38	2.65 Mg/m3	
0.3	33		
0.212	31		
0.15	29		
0.063	28		

Dry Mass of sample, g 2328

Sample Proportions	% dry mass
Cobbles	0
Gravel	42
Sand	30
Silt	25
Clay	3

Grading Analysis	
D100	mm
D60	mm
D30	mm
D10	mm
Uniformity Coefficient	490
Curvature Coefficient	3.6

Remarks
Preparation and testing in accordance with BS1377 unless noted below



Approved

Stephen.Watson

Sheet printed

09/10/2018 17:26



PARTICLE SIZE DISTRIBUTION

Job Ref **18-0838A**

Borehole/Pit No. **TP07**

Site Name **Monaghan Landfills - Killycard**

Sample No. **1**

Soil Description **MADE GROUND: Brown sandy gravelly SILT/CLAY with fragments of red brick and plastic.**

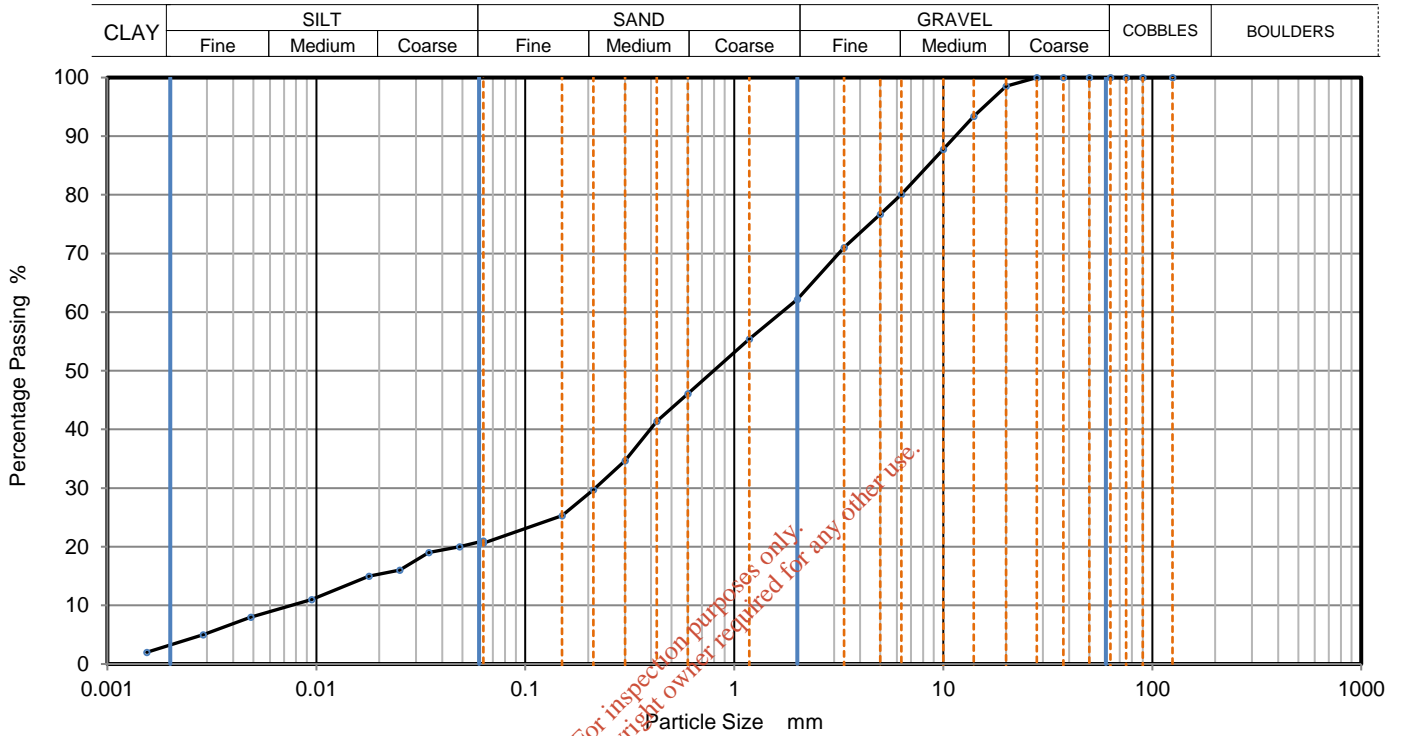
Depth, m **0.50**

Specimen Reference **8** Specimen Depth **m**

Sample Type **B**

Test Method **BS1377:Part 2:1990, clauses 9.2 and 9.5**

KeyLAB ID **Caus2018092989**



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	21
90	100	0.0485	20
75	100	0.0346	19
63	100	0.0251	16
50	100	0.0179	15
37.5	100	0.0095	11
28	100	0.0049	8
20	99	0.0029	5
14	93	0.0015	2
10	88		
6.3	80		
5	77		
3.35	71		
2	62		
1.18	55		
0.6	46		
0.425	41	Particle density (assumed)	
0.3	35	2.65 Mg/m3	
0.212	30		
0.15	25		
0.063	21		

Dry Mass of sample, g 2213

Sample Proportions	% dry mass
Cobbles	0
Gravel	38
Sand	42
Silt	17
Clay	4

Grading Analysis	
D100	mm
D60	mm
D30	mm
D10	mm
Uniformity Coefficient	240
Curvature Coefficient	4

Remarks
Preparation and testing in accordance with BS1377 unless noted below



Approved

Stephen.Watson

Sheet printed

09/10/2018 17:26



PARTICLE SIZE DISTRIBUTION

Job Ref **18-0838A**

Borehole/Pit No. **TP13**

Site Name **Monaghan Landfills - Killycard**

Sample No. **1**

Soil Description **MADE GROUND: Brown sandy gravelly silty CLAY with fragments of plastic and glass.**

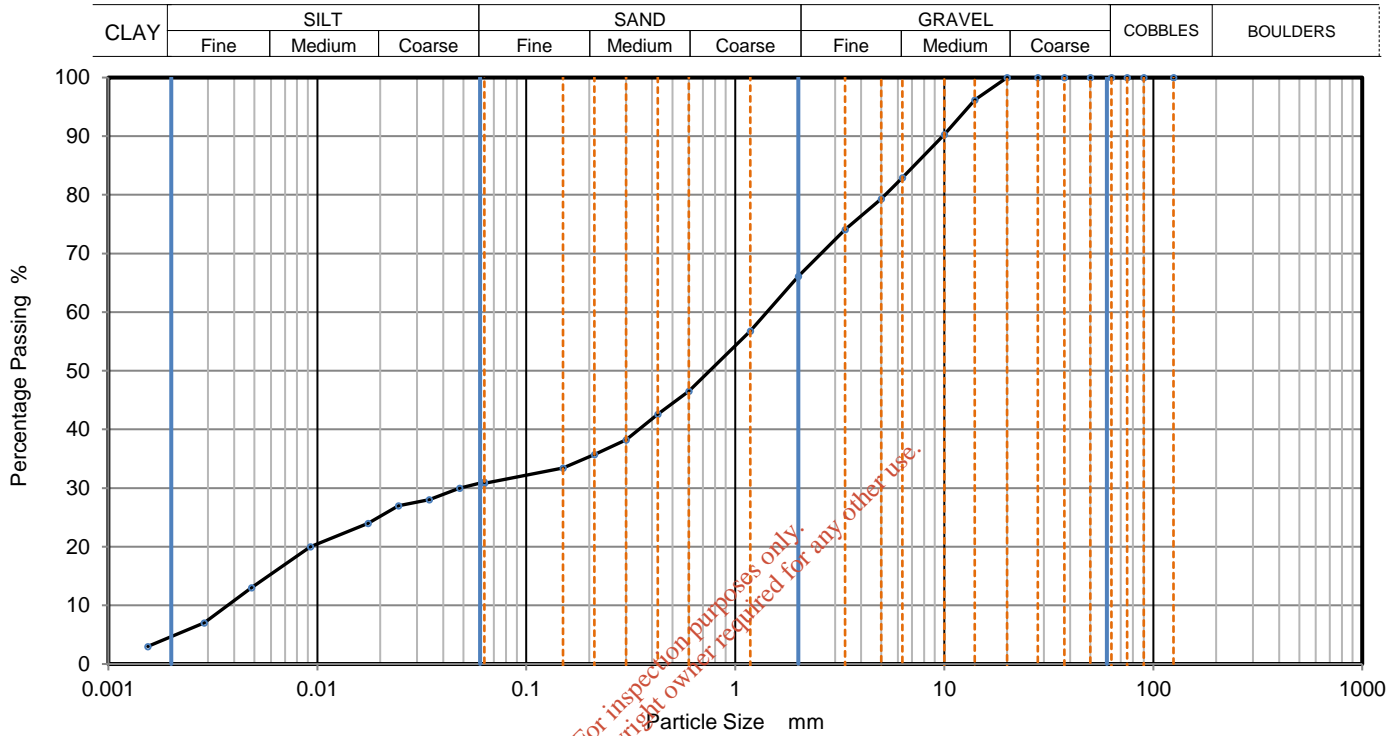
Depth, m **0.50**

Specimen Reference **8** Specimen Depth **m**

Sample Type **B**

Test Method **BS1377:Part 2:1990, clauses 9.2 and 9.5**

KeyLAB ID **Caus2018092990**



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	31
90	100	0.0479	30
75	100	0.0343	28
63	100	0.0244	27
50	100	0.0175	24
37.5	100	0.0093	20
28	100	0.0048	13
20	100	0.0029	7
14	96	0.0015	3
10	90		
6.3	83		
5	79		
3.35	74		
2	66		
1.18	57		
0.6	47	Particle density (assumed)	
0.425	43	2.65 Mg/m3	
0.3	38		
0.212	36		
0.15	33		
0.063	31		

Dry Mass of sample, g 3145

Sample Proportions	% dry mass
Cobbles	0
Gravel	34
Sand	35
Silt	26
Clay	5

Grading Analysis	
D100	mm
D60	mm 1.41
D30	mm 0.0513
D10	mm 0.00369
Uniformity Coefficient	380
Curvature Coefficient	0.5

Remarks
Preparation and testing in accordance with BS1377 unless noted below



Approved

Stephen.Watson

Sheet printed

09/10/2018 17:26