



CAUSEWAY
— GEOTECH

APPENDIX E

GEOTECHNICAL LABORATORY TEST RESULTS





CAUSEWAY
GEOTECH

HEAD OFFICE
Causeway Geotech Ltd
8 Drumahiskey Road, Ballymoney
Co. Antrim, N. Ireland, BT53 7QL
NI: +44 (0)28 276 66640
Registered in Northern Ireland.
Company Number: NI610766

REGIONAL OFFICE
Causeway Geotech (IRL) Ltd
Unit 3 Balbriggan Business Park, Balbriggan
Co Dublin, Ireland, K32 EH36
RO: +353 (0)1 526 7465
Registered in Ireland.
Company Number: 633786

www.causewaygeotech.com

**SOIL AND ROCK SAMPLE ANALYSIS
LABORATORY TEST REPORT**

13 August 2020

Project Name:	Galway Historic Landfills - Tuam
Project No.:	19-1465A
Client:	Galway County Council
Engineer:	Feehily Timoney

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.

Stephen Watson

Laboratory Manager

Signed for and on behalf of Causeway Geotech Ltd



Project Name: Galway Historic Landfills - Tuam

Report Reference: 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	2
SOIL	Liquid and Plastic Limits of soil-1 point cone penetrometer method	BS 1377-2: 1990: Cl 4.4, 5.3 & 5.4	2
SOIL	Particle size distribution - wet sieving	BS 1377-2: 1990: Cl 9.2	2
SOIL	Particle size distribution - sedimentation hydrometer method	BS 1377-2: 1990: Cl 9.5	2
SOIL	Moisture Condition Value / Moisture Content Relationship	BS 1377-4: 1990: Cl 5.5	2
SOIL	Undrained shear strength – triaxial compression without measurement of pore pressure (loads from 0.12 to 24 kN)	BS 1377-7: 1990: Cl 8	2

Summary of Classification Test Results

Project No. 19-1465A	Project Name Galway Historic Landfills - Tuam
-------------------------	--

Hole No.	Sample				Soil Description	Density		w %	Passing 425µm %	LL %	PL %	PI %	Particle density Mg/m3	Casagrande Classification
	Ref	Top	Base	Type		bulk Mg/m3	dry							
TP01	1	0.10		B	Brown sandy gravelly clayey SILT.			28.0	78	47 -1pt	40	7		MI
TP02	1	0.00		B	Brown sandy gravelly clayey SILT.			26.0	71	47 -1pt	41	6		MI

All tests performed in accordance with BS1377:1990 unless specified otherwise LAB 01R Version 4

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 <div style="text-align: center;">13/08/2020</div>	Approved By <div style="text-align: center;">Stephen.Watson</div>	
---	--	---	---



PARTICLE SIZE DISTRIBUTION

Job Ref **19-1465A**

Borehole/Pit No. **TP01**

Site Name **Galway Historic Landfills - Tuam**

Sample No. **1**

Soil Description **Brown sandy slightly gravelly clayey SILT.**

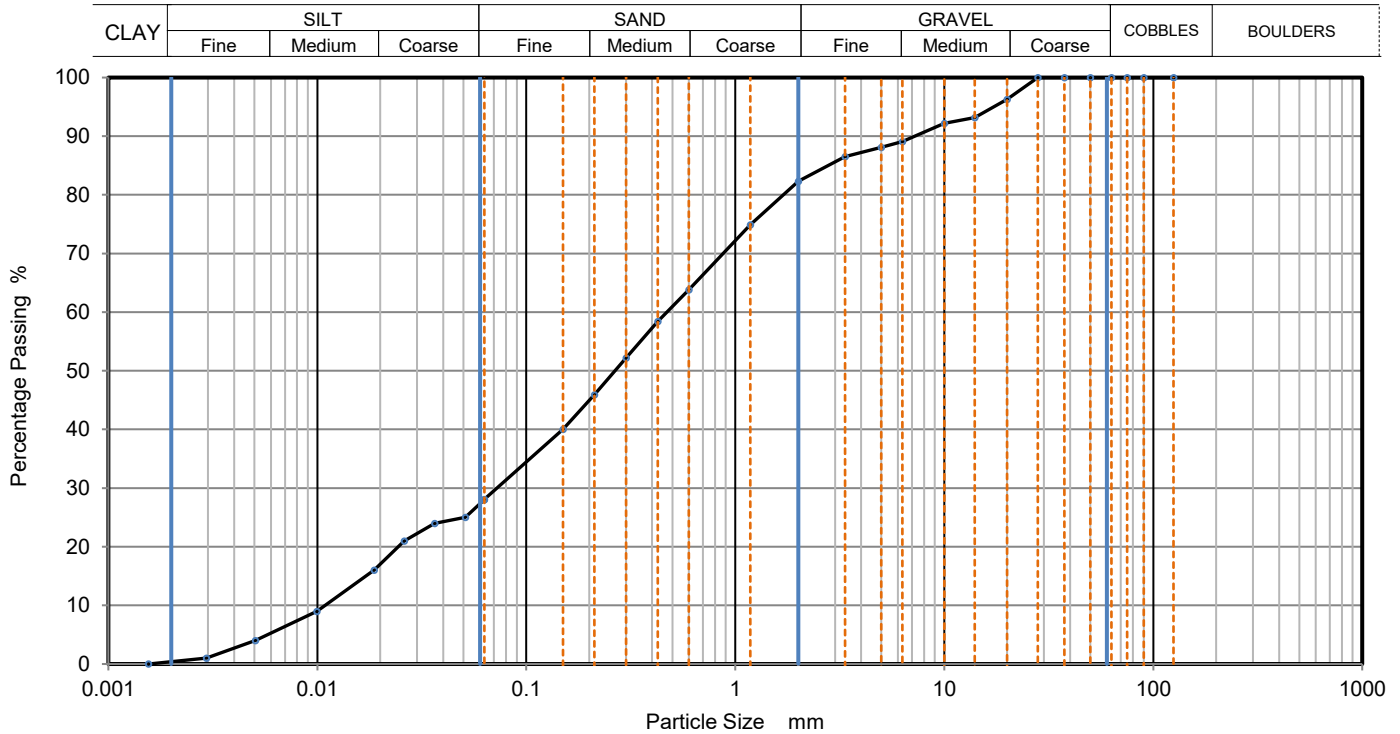
Depth, m **0.10**

Specimen Reference **8** Specimen Depth **0.1** m

Sample Type **B**

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

KeyLAB ID **Caus2020071695**



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	28
90	100	0.05114	25
75	100	0.03638	24
63	100	0.02603	21
50	100	0.01872	16
37.5	100	0.00994	9
28	100	0.00505	4
20	96	0.00294	1
14	93	0.00156	0
10	92		
6.3	89		
5	88		
3.35	87		
2	82		
1.18	75		
0.6	64		
0.425	58	Particle density (assumed)	
0.3	52	2.65 Mg/m3	
0.212	46		
0.15	40		
0.063	28		

Dry Mass of sample, g **2130**

Sample Proportions	% dry mass
Cobbles	0
Gravel	18
Sand	54
Silt	28
Clay	1

Grading Analysis	
D100	mm
D60	mm
D30	mm
D10	mm
Uniformity Coefficient	43
Curvature Coefficient	1

Remarks
Preparation and testing in accordance with BS1377-2 :1990 unless noted below

Approved

Stephen.Watson





PARTICLE SIZE DISTRIBUTION

Job Ref **19-1465A**

Borehole/Pit No. **TP02**

Site Name **Galway Historic Landfills - Tuam**

Sample No. **1**

Soil Description **Brown sandy slightly gravelly clayey SILT.**

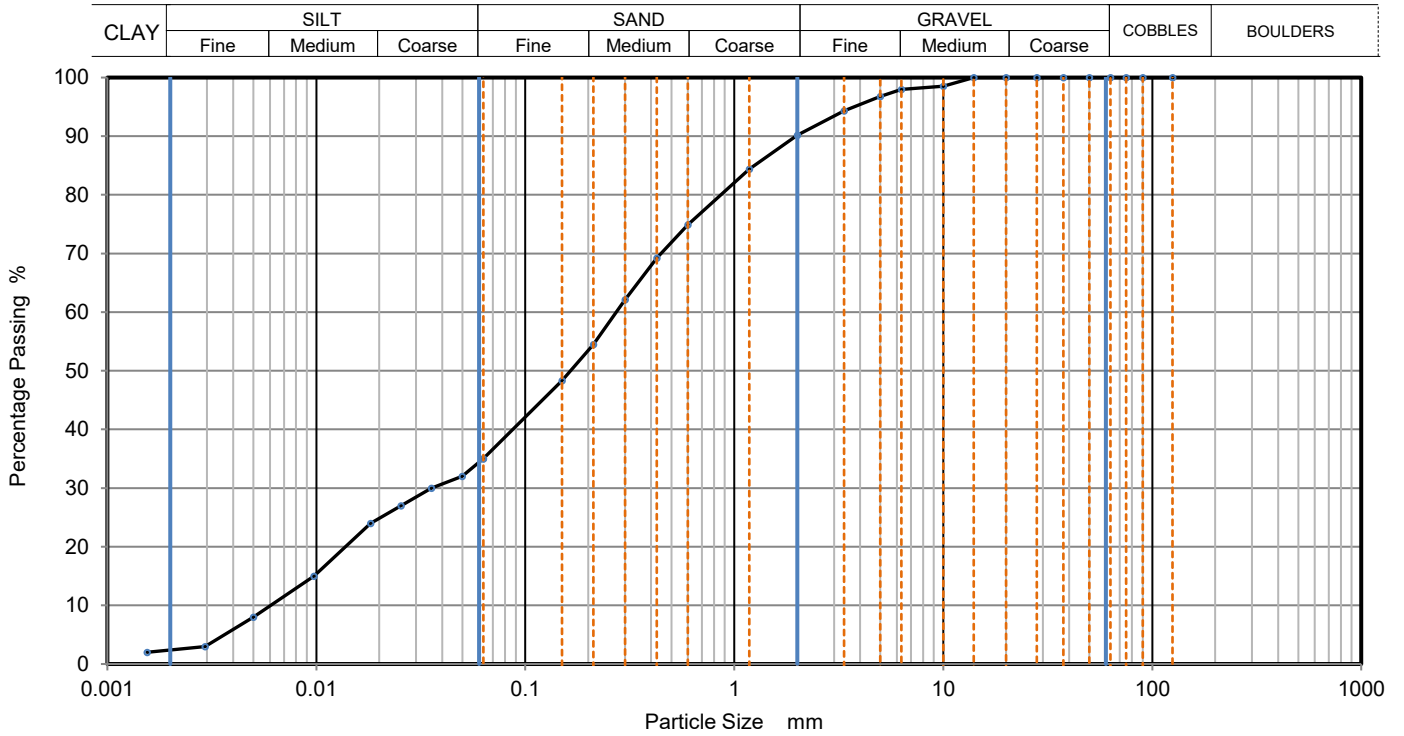
Depth, m **0.00**

Specimen Reference **8** Specimen Depth **0** m

Sample Type **B**

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

KeyLAB ID **Caus2020071696**



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	35
90	100	0.04990	32
75	100	0.03551	30
63	100	0.02542	27
50	100	0.01819	24
37.5	100	0.00972	15
28	100	0.00499	8
20	100	0.00293	3
14	100	0.00155	2
10	99		
6.3	98		
5	97		
3.35	94		
2	90		
1.18	84		
0.6	75		
0.425	69	Particle density (assumed)	
0.3	62	2.65	Mg/m3
0.212	55		
0.15	48		
0.063	35		

Dry Mass of sample, g **232**

Sample Proportions	% dry mass
Cobbles	0
Gravel	10
Sand	55
Silt	33
Clay	2

Grading Analysis	
D100	mm
D60	mm
D30	mm
D10	mm
Uniformity Coefficient	44
Curvature Coefficient	0.68

Remarks

Preparation and testing in accordance with BS1377-2 :1990 unless noted below

Approved

Stephen.Watson





Moisture Condition Value / Moisture Content Relationship

Job Ref	19-1465A
Borehole/Pit No.	TP01
Sample No.	1
Depth	0.1
Sample Type	B
KeyLAB ID	Caus2020071695
Date started	23/07/2020

Site Name	Galway Historic Landfills - Tuam		
Soil Description	Brown sandy slightly gravelly clayey SILT.		
Specimen Reference	9	Specimen Depth	0.1 m
Specimen Description	Brown sandy slightly gravelly clayey SILT.		
Test Method	BS1377:Part4:1990:clause 5.5		

Sample preparation

Amount of material larger than 20mm sieve removed 3 %

Natural Moisture Content of sample 26.5 %

Initial Moisture Content of test sample below 20mm 27.4 %

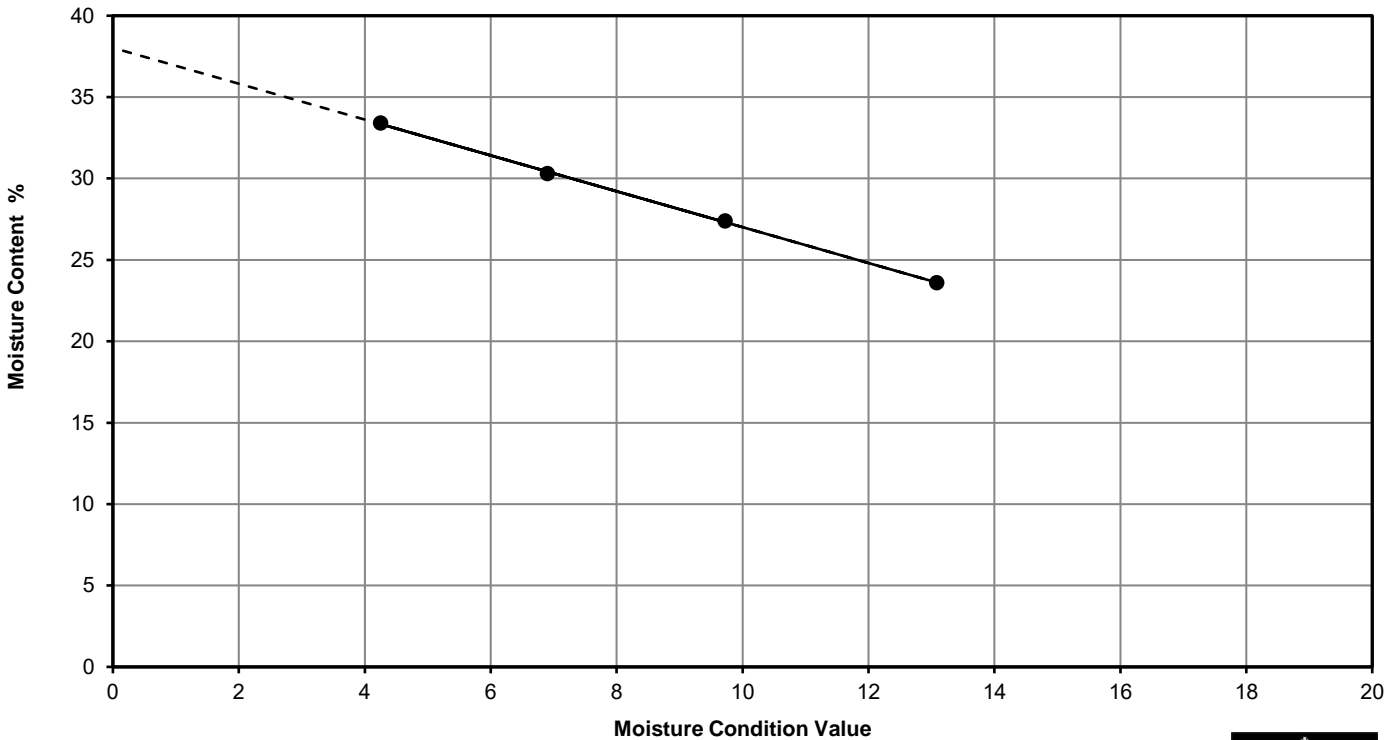
Separate specimens tested

General remarks

Table of results

MCV Test Number	1	2	3	4	
Moisture Content, %	27.4	30.3	33.4	23.6	
Moisture Condition Value	9.7	6.9	4.2	13.1	
MCV report	9.7	6.9	4.2	13.1	
Effective / Valid data point	YES	YES	YES	YES	
Specimen remarks					

● valid points × invalid points - - - - extended regression — linear regression



Approved

Stephen.Watson

LAB 11R Version 4





Moisture Condition Value / Moisture Content Relationship

Job Ref	19-1465A
Borehole/Pit No.	TP02
Sample No.	1
Depth	0
Sample Type	B
KeyLAB ID	Caus2020071696
Date started	01/08/2020

Site Name	Galway Historic Landfills - Tuam	
Soil Description	Brown sandy slightly gravelly clayey SILT.	
Specimen Reference	9	Specimen Depth m
Specimen Description	Brown sandy slightly gravelly clayey SILT.	
Test Method	BS1377:Part4:1990:clause 5.5	

Sample preparation

Amount of material larger than 20mm sieve removed 5 %

Natural Moisture Content of sample 25.3 %

Initial Moisture Content of test sample below 20mm 26.9 %

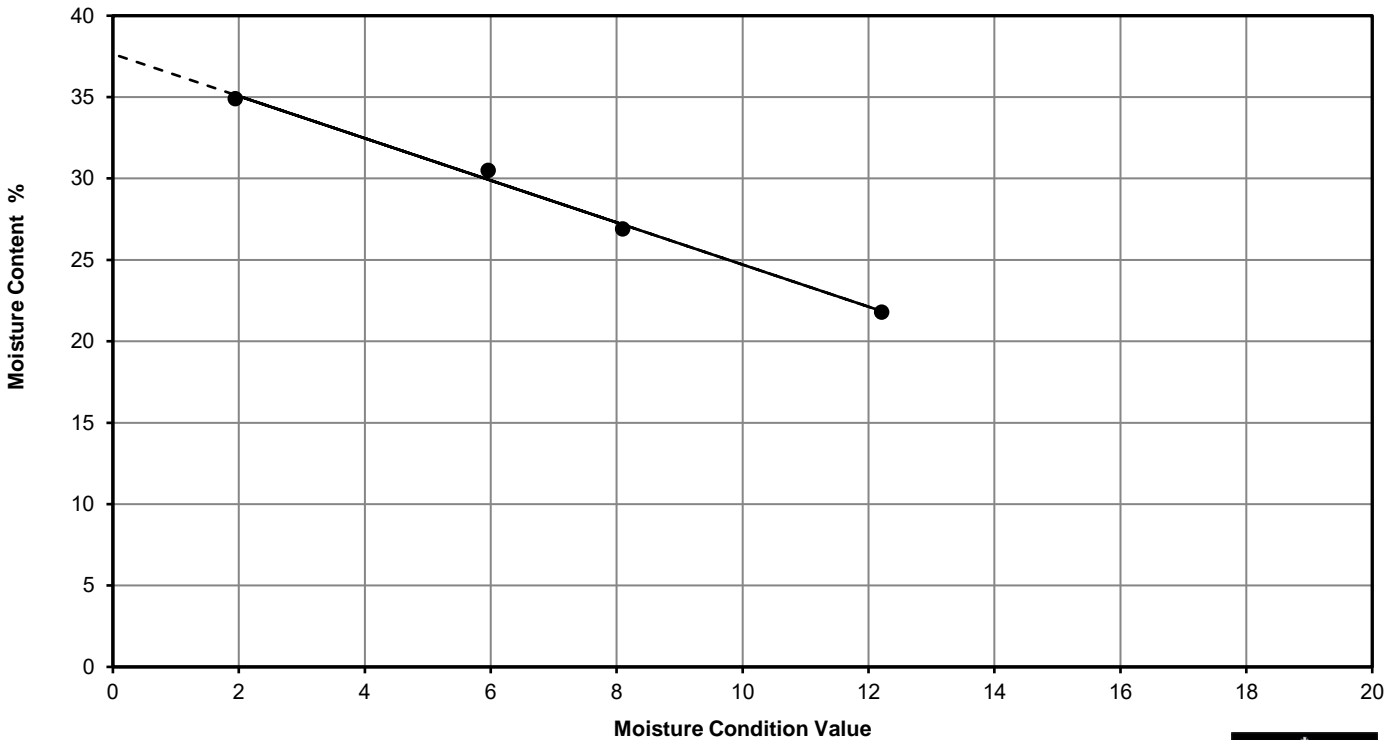
Separate specimens tested

General remarks

Table of results

MCV Test Number	1	2	3	4	
Moisture Content, %	26.9	30.5	34.9	21.8	
Moisture Condition Value	8.1	6.0	1.9	12.2	
MCV report	8.1	6	1.9	12.2	
Effective / Valid data point	YES	YES	YES	YES	
Specimen remarks					

● valid points × invalid points - - - - extended regression — linear regression



Approved

Stephen.Watson

LAB 11R Version 4





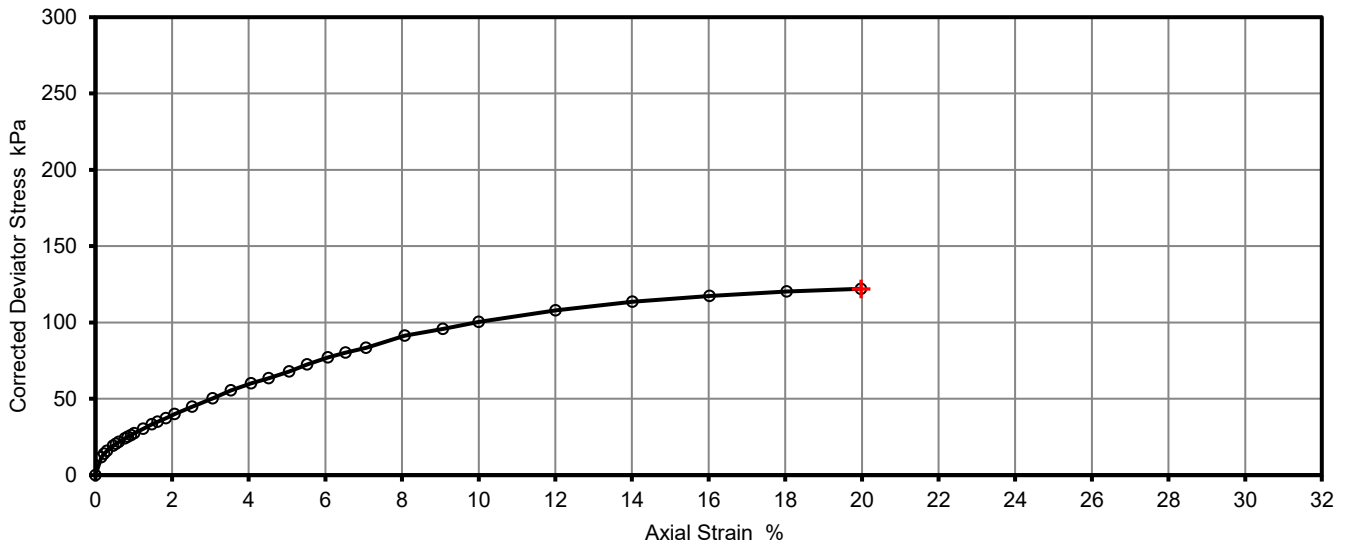
**Unconsolidated Undrained Triaxial
Compression Test without measurement
of pore pressure - single specimen**

Job Ref	19-1465A
Borehole/Pit No.	TP01
Sample No.	1
Depth	0.10
Sample Type	B
KeyLAB ID	Caus2020071695
Date of test	11/04/2020

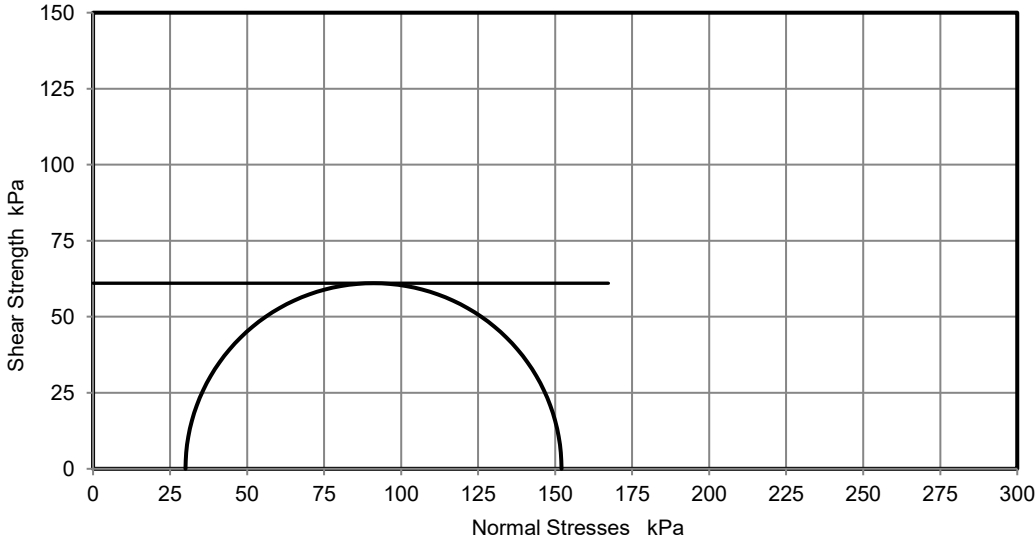
Site Name	Galway Historic Landfills - Tuam		
Soil Description	Brown sandy slightly gravelly clayey SILT.		
Specimen Reference	10	Specimen Depth	0.10 m
Specimen Description	Firm brown sandy slightly gravelly clayey SILT.		
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen		

Test Number	1	
Length	210.9	mm
Diameter	105.4	mm
Bulk Density	1.82	Mg/m ³
Moisture Content	28.5	%
Dry Density	1.42	Mg/m ³
Rate of Strain	1.0	%/min
Cell Pressure	30	kPa
At failure	20.0	%
Axial Strain	122	kPa
Deviator Stress, ($\sigma_1 - \sigma_3$) _f	61	kPa $\frac{1}{2}(\sigma_1 - \sigma_3)$
Undrained Shear Strength, c_u		
Mode of Failure		

Deviator Stress v Axial Strain



Mohr Circles



Deviator stress corrected for area change and membrane effects based on Fig 11 BS1377-7:1990

Mohr circles and their interpretation is not covered by BS1377-7. This is provided for information only.

Remarks

Recompacted from bulk sample using 4.5kg rammer. Testing terminated at 20% axial strain.

Approved

Stephen.Watson

Printed

13/08/2020 08:48





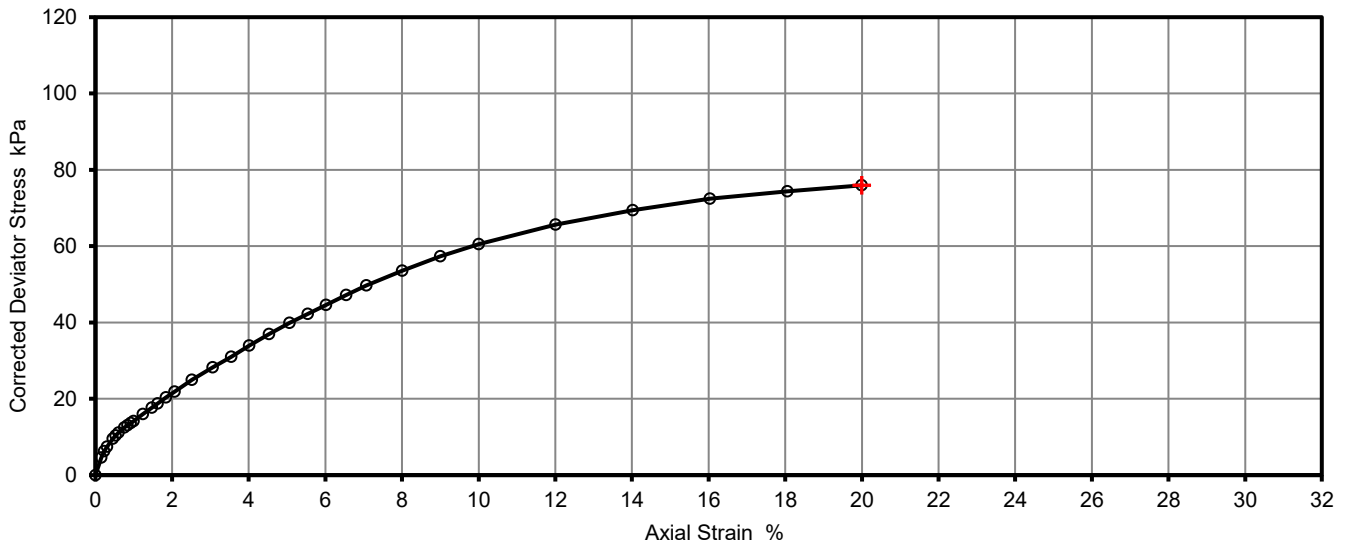
**Unconsolidated Undrained Triaxial
Compression Test without measurement
of pore pressure - single specimen**

Job Ref	19-1465A
Borehole/Pit No.	TP02
Sample No.	1
Depth	0.00
Sample Type	B
KeyLAB ID	Caus2020071696
Date of test	11/08/2020

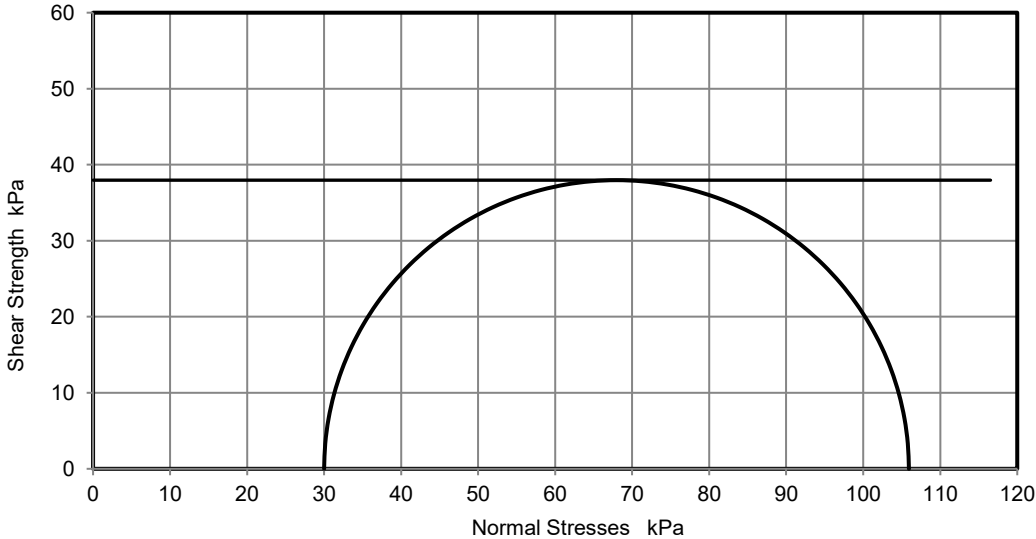
Site Name	Galway Historic Landfills - Tuam		
Soil Description	Brown sandy slightly gravelly clayey SILT.		
Specimen Reference	10	Specimen Depth	0.00 m
Specimen Description	Soft brown sandy slightly gravelly clayey SILT.		
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen		

Test Number	1	
Length	210.8	mm
Diameter	105.6	mm
Bulk Density	1.87	Mg/m ³
Moisture Content	25.0	%
Dry Density	1.50	Mg/m ³
Rate of Strain	1.0	%/min
Cell Pressure	30	kPa
At failure	20.0	%
Axial Strain	76	kPa
Deviator Stress, (σ ₁ - σ ₃) _f	38	kPa
Undrained Shear Strength, c _u		½(σ ₁ - σ ₃) _f
Mode of Failure		

Deviator Stress v Axial Strain



Mohr Circles



Deviator stress corrected for area change and membrane effects based on Fig 11 BS1377-7:1990

Mohr circles and their interpretation is not covered by BS1377-7. This is provided for information only.

Remarks

Recompacted from bulk sample using 4.5kg rammer. Testing terminated at 20% axial strain.

Approved

Stephen.Watson

Printed

13/08/2020 08:48

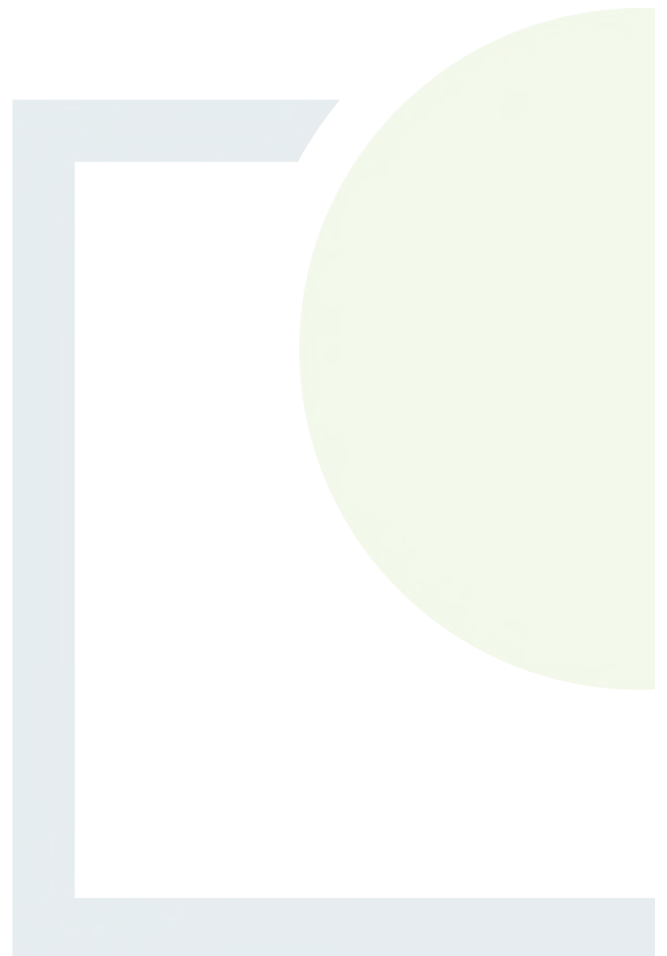




CONSULTANTS IN ENGINEERING,
ENVIRONMENTAL SCIENCE
& PLANNING

APPENDIX 5

Civic Amenity Waste
Collection Permit



WASTE COLLECTION PERMIT

Waste Management (Collection Permit) Regulations, 2007 as amended

Offaly County Council as the National Waste Collection Permit Office being a nominated authority under Section 34(1)(aa) of the Waste Management Act 1996, has granted a waste collection permit to:

Applicant Name:	Bruscar Bhearna Teo (herein called the permit holder)
Trading As:	Barna Recycling
Permit Number:	NWCPO-08-03604-08
Trading Address:	Carrowbrowne Headford Rd Co. Galway
Registered Company Address:	Carrowbrowne Headford Rd Co. Galway
Permit Holder Phone Number:	091771619
Valid From:	22/04/2021
Valid to and Expires on	21/04/2026

This permit, issued to the aforementioned permit holder, is subject to the attached schedule of conditions.

Any non-compliance with the conditions of this permit is an offence under the Waste Management (Collection Permit) Regulations, 2007 as amended and Section 34(1) of the Waste Management Act 1996.

Signed: _____


 Programme Manager

Date: _____

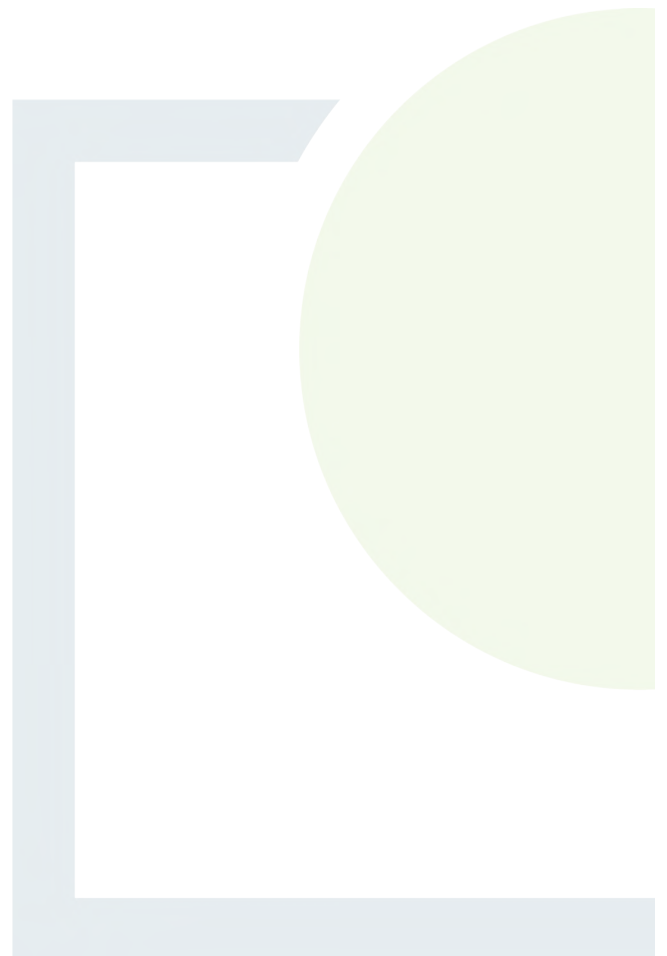
22/4/2021



CONSULTANTS IN ENGINEERING,
ENVIRONMENTAL SCIENCE
& PLANNING

APPENDIX 6

Civic Amenity Waste
Acceptance 2021



Date	Collector	Waste Type	EWG Code	Tonnes	Destination	License No
Jul-21	Enva	Aerosols	160504*	0.1	Enva	W0184-01
Aug-21	Enva	Aerosols	160504*	0.1	Enva	W0184-01
Sep-21	Enva	Aerosols	160504*	0.1	Enva	W0184-01
Nov-21	Enva	Aerosols	160504*	0.1	Enva	W0184-01
Feb-21	Glassco Recycling	Aluminium Cans	150104	0.12	Glassco Recycling	W0279-01
Mar-21	Glassco Recycling	Aluminium Cans	150104	0.13	Glassco Recycling	W0279-01
Apr-21	Glassco Recycling	Aluminium Cans	150104	0.18	Glassco Recycling	W0279-01
May-21	Glassco Recycling	Aluminium Cans	150104	0.265	Glassco Recycling	W0279-01
Jun-21	Glassco Recycling	Aluminium Cans	150104	0.172	Glassco Recycling	W0279-01
Aug-21	Glassco Recycling	Aluminium Cans	150104	0.242	Glassco Recycling	W0279-01
Oct-21	Glassco Recycling	Aluminium Cans	150104	0.277	Glassco Recycling	W0279-01
Nov-21	Glassco Recycling	Aluminium Cans	150104	0.268	Glassco Recycling	W0279-01
Dec-21	Glassco Recycling	Aluminium Cans	150104	0.131	Glassco Recycling	W0279-01
Jan-21	KMK Metals	Batteries(Fence)	160601	0.1	KMK Metals	W0113-04
May-21	KMK Metals	Batteries(Fence)	160601	0.08	KMK Metals	W0113-04
Jul-21	KMK Metals	Batteries(Fence)	160601	0.08	KMK Metals	W0113-04
Sep-21	KMK Metals	Batteries(Fence)	160601	0.394	KMK Metals	W0113-04
Jan-21	KMK Metals	Batteries(Portable)	160601	0.28	KMK Metals	W0113-04
Apr-21	KMK Metals	Batteries(Portable)	160601	0.69	KMK Metals	W0113-04
May-21	KMK Metals	Batteries(Portable)	160601	0.46	KMK Metals	W0113-04
Jun-21	KMK Metals	Batteries(Portable)	160601	0.44	KMK Metals	W0113-04
Jul-21	KMK Metals	Batteries(Portable)	160601	0.312	KMK Metals	W0113-04
Sep-21	KMK Metals	Batteries(Portable)	160601	0.183	KMK Metals	W0113-04
Jan-21	Glassco Recycling	Bottled Glass	150107	2.72	Glassco Recycling	W0279-01
Feb-21	Glassco Recycling	Bottled Glass	150107	6.81	Glassco Recycling	W0279-01
Mar-21	Glassco Recycling	Bottled Glass	150107	5.13	Glassco Recycling	W0279-01
Apr-21	Glassco Recycling	Bottled Glass	150107	5.39	Glassco Recycling	W0279-01
May-21	Glassco Recycling	Bottled Glass	150107	5.89	Glassco Recycling	W0279-01
Jun-21	Glassco Recycling	Bottled Glass	150107	5.09	Glassco Recycling	W0279-01
Jul-21	Glassco Recycling	Bottled Glass	150107	3.347	Glassco Recycling	W0279-01
Aug-21	Glassco Recycling	Bottled Glass	150107	5.48	Glassco Recycling	W0279-01
Oct-21	Glassco Recycling	Bottled Glass	150107	9.494	Glassco Recycling	W0279-01
Nov-21	Glassco Recycling	Bottled Glass	150107	8.1	Glassco Recycling	W0279-01
Dec-21	Glassco Recycling	Bottled Glass	150107	7.011	Glassco Recycling	W0279-01
Jul-21	Barna Recycling	Bulky Waste	200307	9.64	Barna Recycling Carrowbrown Headford Rd Galway	W0106-02
Aug-21	Barna Recycling	Bulky Waste	200307	32.3	Barna Recycling Carrowbrown Headford Rd Galway	W0106-02
Dec-21	Barna Recycling	Bulky Waste	200307	1.18	Barna Recycling Carrowbrown Headford Rd Galway	W0106-02
Jan-21	Barna Recycling	Cardboard	150101	11.74	Barna Recycling Carrowbrown Headford Rd Galway	W0106-02
Feb-21	Barna Recycling	Cardboard	150101	15.28	Barna Recycling Carrowbrown Headford Rd Galway	W0106-02
Mar-21	Barna Recycling	Cardboard	150101	12.86	Barna Recycling Carrowbrown Headford Rd Galway	W0106-02
Apr-21	Barna Recycling	Cardboard	150101	11.76	Barna Recycling Carrowbrown Headford Rd Galway	W0106-02
May-21	Barna Recycling	Cardboard	150101	11.12	Barna Recycling Carrowbrown Headford Rd Galway	W0106-02
Jun-21	Barna Recycling	Cardboard	150101	19.24	Barna Recycling Carrowbrown Headford Rd Galway	W0106-02
Jul-21	Barna Recycling	Cardboard	150101	12.22	Barna Recycling Carrowbrown Headford Rd Galway	W0106-02
Aug-21	Barna Recycling	Cardboard	150101	19.08	Barna Recycling Carrowbrown Headford Rd Galway	W0106-02
Sep-21	Barna Recycling	Cardboard	150101	15.46	Barna Recycling Carrowbrown Headford Rd Galway	W0106-02
Oct-21	Barna Recycling	Cardboard	150101	10.86	Barna Recycling Carrowbrown Headford Rd Galway	W0106-02
Nov-21	Barna Recycling	Cardboard	150101	18.08	Barna Recycling Carrowbrown Headford Rd Galway	W0106-02
Dec-21	Barna Recycling	Cardboard	150101	8.3	Barna Recycling Carrowbrown Headford Rd Galway	W0106-02
Jan-21	Textile Recycling	Clothes	200110	1	Textile Recycling	
Feb-21	Textile Recycling	Clothes	200110	1.05	Textile Recycling	
Mar-21	Textile Recycling	Clothes	200110	1.28	Textile Recycling	
Apr-21	Textile Recycling	Clothes	200110	1.93	Textile Recycling	
May-21	Textile Recycling	Clothes	200110	1.13	Textile Recycling	
Jun-21	Textile Recycling	Clothes	200110	1.1	Textile Recycling	
Jul-21	Textile Recycling	Clothes	200110	0.73	Textile Recycling	
Aug-21	Textile Recycling	Clothes	200110	0.6	Textile Recycling	
Sep-21	Textile Recycling	Clothes	200110	1.56	Textile Recycling	
Oct-21	Textile Recycling	Clothes	200110	0.97	Textile Recycling	
Nov-21	Textile Recycling	Clothes	200110	1.03	Textile Recycling	
Dec-21	Textile Recycling	Clothes	200110	0.75	Textile Recycling	
Mar-21	Frylite	Cooking Oil	200125	100 Litres	Frylite	WFP-G-10-0007
May-21	Frylite	Cooking Oil	200125	120 litres	Frylite	WFP-G-10-0007
Aug-21	Frylite	Cooking Oil	200125	100 litres	Frylite	WFP-G-10-0007
Feb-21	Barna Recycling	Flat Glass	200102	1.8	Barna Recycling Carrowbrown Headford Rd Galway	W0106-02
Apr-21	Barna Recycling	Flat Glass	200102	6.34	Barna Recycling Carrowbrown Headford Rd Galway	W0106-02
Jun-21	Barna Recycling	Flat Glass	200102	2.84	Barna Recycling Carrowbrown Headford Rd Galway	W0106-02
Aug-21	Barna Recycling	Flat Glass	200102	1.88	Barna Recycling Carrowbrown Headford Rd Galway	W0106-02
Oct-21	Barna Recycling	Flat Glass	200102	2.64	Barna Recycling Carrowbrown Headford Rd Galway	W0106-02
Apr-21	KMK Metals	Flourescent Tubes	200123	0.153	KMK Metals	W0113-04
May-21	KMK Metals	Flourescent Tubes	200123	0.075	KMK Metals	W0113-04
Jul-21	KMK Metals	Flourescent Tubes	200123	0.224	KMK Metals	W0113-04
Dec-21	KMK Metals	Flourescent Tubes	200123	0.306	KMK Metals	W0113-04
Jan-21	KMK Metals	Fridges	200135	1.77	KMK Metals	W0113-04
Feb-21	KMK Metals	Fridges	200135	1.75	KMK Metals	W0113-04
Mar-21	KMK Metals	Fridges	200135	2.91	KMK Metals	W0113-04
Apr-21	KMK Metals	Fridges	200135	2.09	KMK Metals	W0113-04
May-21	KMK Metals	Fridges	200135	1.67	KMK Metals	W0113-04
Jun-21	KMK Metals	Fridges	200135	2.98	KMK Metals	W0113-04
Jul-21	KMK Metals	Fridges	200135	1.502	KMK Metals	W0113-04
Aug-21	KMK Metals	Fridges	200135	2.982	KMK Metals	W0113-04
Sep-21	KMK Metals	Fridges	200135	2.358	KMK Metals	W0113-04
Oct-21	KMK Metals	Fridges	200135	2.358	KMK Metals	W0113-04
Nov-21	KMK Metals	Fridges	200135	1.672	KMK Metals	W0113-04
Dec-21	KMK Metals	Fridges	200135	0.702	KMK Metals	W0113-04
Jan-21	Barna Recycling	Hard Plastic	200139	5.96	Barna Recycling Carrowbrown Headford Rd Galway	W0106-02
Feb-21	Barna Recycling	Hard Plastic	200139	5.32	Barna Recycling Carrowbrown Headford Rd Galway	W0106-02
Mar-21	Barna Recycling	Hard Plastic	200139	4.8	Barna Recycling Carrowbrown Headford Rd Galway	W0106-02
Apr-21	Barna Recycling	Hard Plastic	200139	5.88	Barna Recycling Carrowbrown Headford Rd Galway	W0106-02
May-21	Barna Recycling	Hard Plastic	200139	4.2	Barna Recycling Carrowbrown Headford Rd Galway	W0106-02
Jun-21	Barna Recycling	Hard Plastic	200139	5	Barna Recycling Carrowbrown Headford Rd Galway	W0106-02
Jul-21	Barna Recycling	Hard Plastic	200139	4.16	Barna Recycling Carrowbrown Headford Rd Galway	W0106-02
Aug-21	Barna Recycling	Hard Plastic	200139	4.82	Barna Recycling Carrowbrown Headford Rd Galway	W0106-02
Sep-21	Barna Recycling	Hard Plastic	200139	5.41	Barna Recycling Carrowbrown Headford Rd Galway	W0106-02
Oct-21	Barna Recycling	Hard Plastic	200139	3.16	Barna Recycling Carrowbrown Headford Rd Galway	W0106-02
Nov-21	Barna Recycling	Hard Plastic	200139	3.06	Barna Recycling Carrowbrown Headford Rd Galway	W0106-02
Dec-21	Barna Recycling	Hard Plastic	200139	2.58	Barna Recycling Carrowbrown Headford Rd Galway	W0106-02
Oct-21	Bounce Back Recycling	Mattresses-Bulky	200307	0.45		
Nov-21	Bounce Back Recycling	Mattresses-Bulky	200307	1		
Jan-21	Clearcircle	Metal	200140	6.73	Galway Metal	P1006-02
Feb-21	Clearcircle	Metal	200140	4.8	Galway Metal	P1006-02
Mar-21	Clearcircle	Metal	200140	8.22	Galway Metal	P1006-02
Apr-21	Clearcircle	Metal	200140	9.49	Galway Metal	P1006-02
May-21	Clearcircle	Metal	200140	7.82	Galway Metal	P1006-02
Jun-21	Clearcircle	Metal	200140	7.02	Galway Metal	P1006-02
Jul-21	Clearcircle	Metal	200140	7.1	Galway Metal	P1006-02
Aug-21	Clearcircle	Metal	200140	8.64	Galway Metal	P1006-02
Sep-21	Clearcircle	Metal	200140	6.03	Galway Metal	P1006-02
Oct-21	Clearcircle	Metal	200140	4.8	Galway Metal	P1006-02
Nov-21	Clearcircle	Metal	200140	3	Galway Metal	P1006-02
Dec-21	Clearcircle	Metal	200140	4.94	Galway Metal	P1006-02
Oct-21	Barna Recycling	Mixed Recycling	200301	0.9	Barna Recycling Carrowbrown Headford Rd Galway	W0106-02

Bulky Waste Collection

Bulky Waste Collection

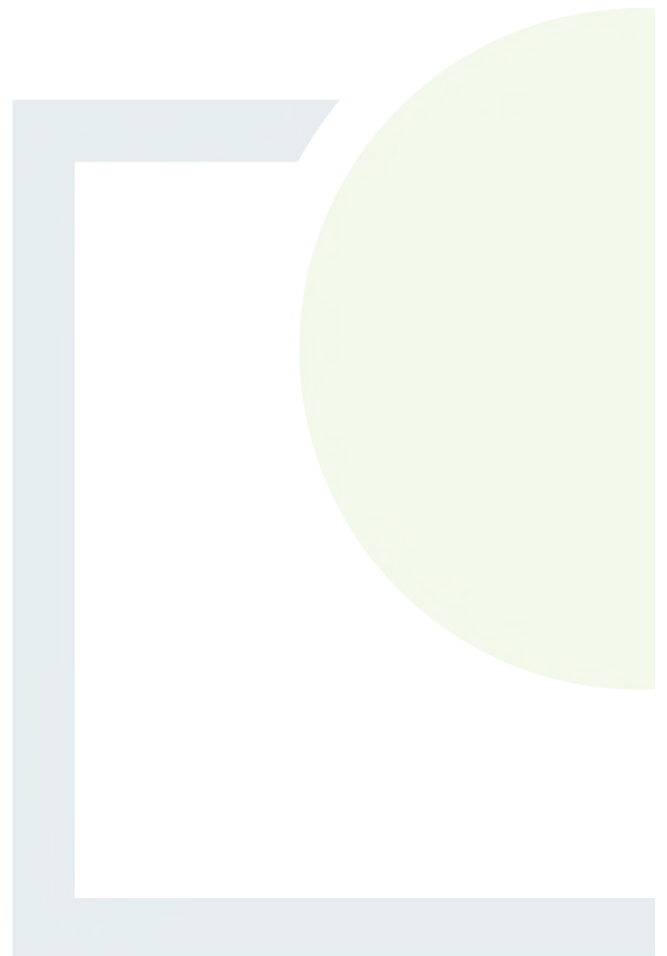
Dec-21	Barna Recycling	Mixed Recycling	200301	5.92	Barna Recycling Carrowbrowne Headford Rd Galway	W0106-02
Aug-21	Enva	Oil Filters	16 01 07*	0.12	Enva	W0184-01
Jan-21	Enva	Paints	200127	3.56	Enva	W0184-01
Feb-21	Enva	Paints	200127	4.04	Enva	W0184-01
Apr-21	Enva	Paints	200127	10.24	Enva	W0184-01
May-21	Enva	Paints	200127	3.72	Enva	W0184-01
Jun-21	Enva	Paints	200127	3.58	Enva	W0184-01
Jul-21	Enva	Paints	200127	5.2	Enva	W0184-01
Aug-21	Enva	Paints	200127	2.88	Enva	W0184-01
Sep-21	Enva	Paints	200127	7.32	Enva	W0184-01
Oct-21	Enva	Paints	200127	3.24	Enva	W0184-01
Nov-21	Enva	Paints	200127	2.9	Enva	W0184-01
Jan-21	Barna Recycling	Plastic	200139	5	Barna Recycling Carrowbrowne Headford Rd Galway	W0106-02
Feb-21	Barna Recycling	Plastic	200139	3.96	Barna Recycling Carrowbrowne Headford Rd Galway	W0106-02
Mar-21	Barna Recycling	Plastic	200139	10.04	Barna Recycling Carrowbrowne Headford Rd Galway	W0106-02
Apr-21	Barna Recycling	Plastic	200139	5.94	Barna Recycling Carrowbrowne Headford Rd Galway	W0106-02
May-21	Barna Recycling	Plastic	200139	5.86	Barna Recycling Carrowbrowne Headford Rd Galway	W0106-02
Jun-21	Barna Recycling	Plastic	200139	7.22	Barna Recycling Carrowbrowne Headford Rd Galway	W0106-02
Jul-21	Barna Recycling	Plastic	200139	5.24	Barna Recycling Carrowbrowne Headford Rd Galway	W0106-02
Aug-21	Barna Recycling	Plastic	200139	7.9	Barna Recycling Carrowbrowne Headford Rd Galway	W0106-02
Sep-21	Barna Recycling	Plastic	200139	5.92	Barna Recycling Carrowbrowne Headford Rd Galway	W0106-02
Oct-21	Barna Recycling	Plastic	200139	6.38	Barna Recycling Carrowbrowne Headford Rd Galway	W0106-02
Nov-21	Barna Recycling	Plastic	200139	5.88	Barna Recycling Carrowbrowne Headford Rd Galway	W0106-02
Dec-21	Barna Recycling	Plastic	200139	7.1	Barna Recycling Carrowbrowne Headford Rd Galway	W0106-02
May-21	Enva	Waste Oil	130208*	1800L	Enva	W0184-01
Jul-21	Enva	Waste Oil	13 02 08*	1164 Litres	Enva	W0184-01
Sep-21	Enva	Waste Oil	13 02 08*	1425 Litres	Enva	W0184-01
Nov-21	Enva	Waste Oil	13 02 08*	1116 Litres	Enva	W0184-01
Jan-21	KMK Metals	WEEE	200136	12.15	KMK Metals	W0113-04
Feb-21	KMK Metals	WEEE	200136	11.63	KMK Metals	W0113-04
Mar-21	KMK Metals	WEEE	200136	16.08	KMK Metals	W0113-04
Apr-21	KMK Metals	WEEE	200136	14.05	KMK Metals	W0113-04
May-21	KMK Metals	WEEE	200136	11.88	KMK Metals	W0113-04
Jun-21	KMK Metals	WEEE	200136	15.41	KMK Metals	W0113-04
Jul-21	KMK Metals	WEEE	200136	12.787	KMK Metals	W0113-04
Aug-21	KMK Metals	WEEE	200136	16.354	KMK Metals	W0113-04
Sep-21	KMK Metals	WEEE	200136	13.197	KMK Metals	W0113-04
Oct-21	KMK Metals	WEEE	200136	13.197	KMK Metals	W0113-04
Nov-21	KMK Metals	WEEE	200136	13.247	KMK Metals	W0113-04
Dec-21	KMK Metals	WEEE	200136	7.408	KMK Metals	W0113-04
Dec-21	Barna Recycling	Wood	200138	1.7	Barna Recycling Carrowbrowne Headford Rd Galway	W0106-02





CONSULTANTS IN ENGINEERING,
ENVIRONMENTAL SCIENCE
& PLANNING

APPENDIX 7

Civic Amenity within Site
Boundary Figure





-  Site Boundary
-  Civic Amenity Boundary

TITLE:	Civic Amenity Boundary	
PROJECT:	Tuam Historic Landfill ERA	
FIGURE NO:		
CLIENT:	Galway County Council	
SCALE:	1:1,500	REVISION: 0
DATE:	26/10/2022	PAGE SIZE: A3

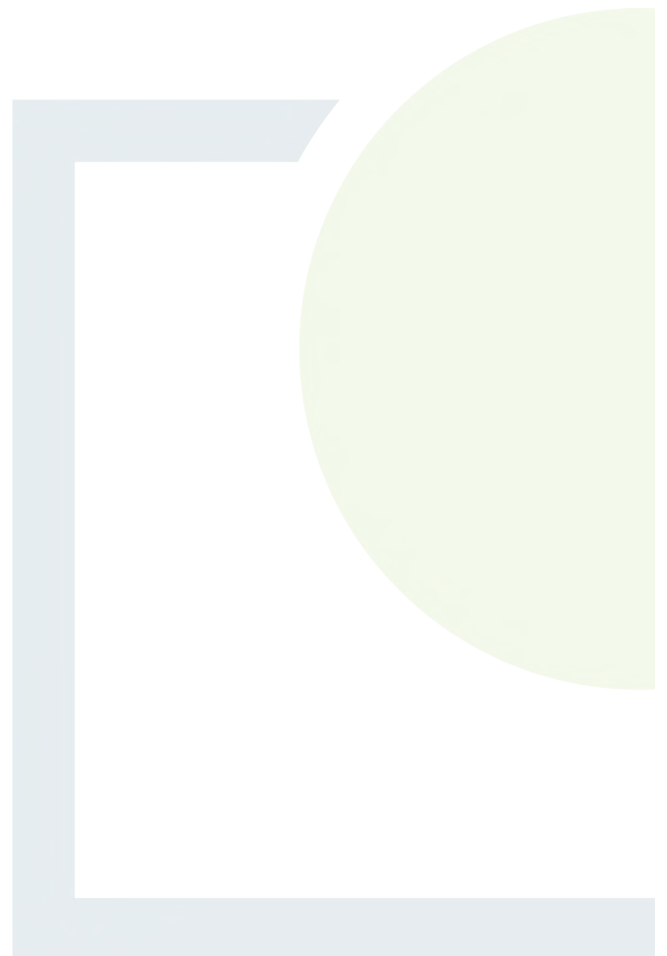




CONSULTANTS IN ENGINEERING,
ENVIRONMENTAL SCIENCE
& PLANNING

APPENDIX 8

Geotechnical Report – August
2022





CAUSEWAY
—
GEOTECH

Tuam Landfill – Ground Investigation

Client: Galway County Council

Client's Representative: Fehily Timoney and Company

Report No.: 22-0418

Date: August 2022

Status: Final for Issue



CONTENTS

Document Control Sheet




Note on: Methods of describing soils and rocks & abbreviations used on exploratory hole logs

1	AUTHORITY	4
2	SCOPE	4
3	DESCRIPTION OF SITE	4
4	SITE OPERATIONS.....	5
	4.1 Summary of site works.....	5
	4.2 Boreholes.....	5
	4.3 Standpipe installations.....	5
	4.4 Surveying.....	6
	4.5 Permeameter testing.....	6
5	LABORATORY WORK.....	6
	5.1 Geotechnical laboratory testing of soils.....	6
	5.2 Environmental laboratory testing of soils	7
6	GROUND CONDITIONS	7
	6.1 General geology of the area	7
	6.2 Ground types encountered during investigation of the site	7
	6.3 Groundwater.....	8
7	REFERENCES	9

APPENDICES

Appendix A	Site and exploratory hole location plans
Appendix B	Borehole logs
Appendix C	Geotechnical laboratory test results
Appendix D	Environmental laboratory test results

Document Control Sheet

Report No.:		22-0418			
Project Title:		Tuam Landfill			
Client:		Galway County Council			
Client's Representative:		Fehily Timoney and Company			
Revision:	A00	Status:	Final for Issue	Issue Date:	23 rd August 2022
Prepared by:		Reviewed by:		Approved by:	
 Rachel White BA (Mod.) Geoscience		 Sean Ross BSc MSc MIEI PGeo		 Darren O'Mahony BSc MSc MIEI EurGeol PGeo	

The works were conducted in accordance with:

British Standards Institute (2015) BS 5930:2015+A1:2020, Code of practice for ground investigations.

BS EN 1997-2: 2007: Eurocode 7 - Geotechnical design - Part 2 Ground investigation and testing.

Geotechnical Society of Ireland (2016), Specification & Related Documents for Ground Investigation in Ireland

Laboratory testing was conducted in accordance with:

British Standards Institute BS 1377:1990 parts 2, 4, 5, 7 and 9

METHODS OF DESCRIBING SOILS AND ROCKS

Soil and rock descriptions are based on the guidance in BS5930:2015+A1:2020, The Code of Practice for Ground Investigation.

Abbreviations used on exploratory hole logs	
U	Nominal 100mm diameter undisturbed open tube sample (thick walled sampler).
UT	Nominal 100mm diameter undisturbed open tube sample (thin walled sampler).
P	Nominal 100mm diameter undisturbed piston sample.
B	Bulk disturbed sample.
LB	Large bulk disturbed sample.
D	Small disturbed sample.
C	Core sub-sample (displayed in the Field Records column on the logs).
L	Liner sample from dynamic sampled borehole.
W	Water sample.
ES / EW	Soil sample for environmental testing / Water sample for environmental testing.
SPT (s)	Standard penetration test using a split spoon sampler (small disturbed sample obtained).
SPT (c)	Standard penetration test using 60 degree solid cone.
(x,x/x,x,x,x)	Blows per increment during the standard penetration test. The initial two values relate to the seating drive (150mm) and the remaining four to the 75mm increments of the test length.
(Y for Z/ Y for Z)	Incomplete standard penetration test where the full test length was not achieved. The blows 'X' represent the total blows for the given seating or test length 'Z' (mm).
N=X	SPT blow count 'N' given by the summation of the blows 'X' required to drive the full test length (300mm).
HVP / HVR	In situ hand vane test result (HVP) and vane test residual result (HVR). Results presented in kPa.
V VR	Shear vane test (borehole). Shear strength stated in kPa. V: undisturbed vane shear strength VR: remoulded vane shear strength
Soil consistency description	In cohesive soils, where samples are disturbed and there are no suitable laboratory tests, N values may be used to indicate consistency on borehole logs – a median relationship of $N \times 5 = C_u$ is used (as set out in Stroud & Butler 1975).
dd-mm-yyyy	Date at the end and start of shifts, shown at the relevant borehole depth. Corresponding casing and water depths shown in the adjacent columns.
▽	Water strike: initial depth of strike.
▼	Water strike: depth water rose to.
Abbreviations relating to rock core – reference Clause 36.4.4 of BS 5930: 2015+A1:2020	
TCR (%)	Total Core Recovery: Ratio of rock/soil core recovered (both solid and non-intact) to the total length of core run.
SCR (%)	Solid Core Recovery: Ratio of solid core to the total length of core run. Solid core has a full diameter, uninterrupted by natural discontinuities, but not necessarily a full circumference and is measured along the core axis between natural fractures.
RQD (%)	Rock Quality Designation: Ratio of total length of solid core pieces greater than 100mm to the total length of core run.
FI	Fracture Index: Number of natural discontinuities per metre over an indicated length of core of similar intensity of fracturing.
NI	Non Intact: Used where the rock material was recovered fragmented, for example as fine to coarse gravel size particles.
AZCL	Assessed zone of core loss: The estimated depth range where core was not recovered.
DIF	Drilling induced fracture: A fracture of non-geological origin brought about by the rock coring.
(xxx/xxx/xxx)	Spacing between discontinuities (minimum/average/maximum) measured in millimetres.

Tuam Landfill

1 AUTHORITY

On the instructions of Fehily Timoney and Company (“the Client’s Representative”), acting on the behalf of Galway County Council (“the Client”), a ground investigation was undertaken at the above location to provide geotechnical and environmental information to determine the existing state of the current landfill.

This report details the work carried out both on site and in the geotechnical and chemical testing laboratories; it contains a description of the site and the works undertaken, the exploratory hole logs and the laboratory test results.

All information given in this report is based upon the ground conditions encountered during the ground investigation works, and on the results of the laboratory and field tests performed. However, there may be conditions at the site that have not been taken into account, such as unpredictable soil strata, contaminant concentrations, and water conditions between or below exploratory holes. It should be noted that groundwater levels usually vary due to seasonal and/or other effects and may at times differ to those recorded during the investigation. No responsibility can be taken for conditions not encountered through the scope of work commissioned, for example between exploratory hole points, or beneath the termination depths achieved.

This report was prepared by Causeway Geotech Ltd for the use of the Client and the Client’s Representative in response to a particular set of instructions. Any other parties using the information contained in this report do so at their own risk and any duty of care to those parties is excluded.

2 SCOPE

The extent of the investigation, as instructed by the Client’s Representative, included boreholes, soil sampling, in-situ and laboratory testing, and the preparation of a factual report on the findings.

3 DESCRIPTION OF SITE

As shown on the site location plan in Appendix A, the works were conducted on the site of Tuam Landfill, located in Tuam, County Galway. The site is bordered by Agricultural Land to the west and south, Hynes Plant & Tool Hire to the north, and the Athenry Road to the east.

The site is relatively flat, with a slight loss in elevation sloping downwards to the south.

4 SITE OPERATIONS

4.1 Summary of site works

Site operations, which were conducted between the 18th to the 20th of July 2022, comprised:

- four boreholes by light cable percussion
- a standpipe installation in four boreholes; and
- a permeameter test at two boreholes

The exploratory holes and in-situ tests were located as instructed by the Client's Representative, as shown on the exploratory hole location plan in Appendix A.

4.2 Boreholes

Four boreholes (BH01-BH03 and BHLFG1) were put down to completion in minimum 200mm diameter using a Dando 2000 light cable percussion boring rig. All boreholes were terminated at their scheduled completion depths.

Disturbed (bulk and small bag) samples were taken within the encountered strata. Undisturbed (U100) samples were taken within the clay capping material encountered above the landfill. Environmental samples were taken at standard intervals within the waste body, as directed by the Client's Representative.

Any water strikes encountered during boring were recorded along with any changes in their levels as the borehole proceeded.

Appendix B presents the borehole logs.

4.3 Standpipe installations

A groundwater monitoring standpipe was installed all boreholes. Waterra tubing was installed in each borehole to allow for future groundwater/leachate sampling. Timber fencing was also installed around each headworks to prevent damage from cattle.

Details of the installations, including the depth range of the response zone, are provided in Appendix B on the individual borehole logs.

4.4 Surveying

The as-built exploratory hole positions were surveyed following completion of site operations by a Site Engineer from Causeway Geotech. Surveying was carried out using a Trimble R10 GPS system employing VRS and real time kinetic (RTK) techniques.

The plan coordinates (Irish Transverse Mercator) and ground elevation (mOD Malin) at each location are recorded on the individual exploratory hole logs. The exploratory hole location plan presented in Appendix A shows these as-built positions.

4.5 Permeameter testing

Permeameter tests were carried out at two locations BH01 and BH03 at the interface of the topsoil/geocomposite clay liner (GCL) interface. The tests, which were carried out in accordance with BS EN 12697-40: 2012, involved recording the time taken for four litres of water to drain into the test surface.

The results of the testing are presented below where:

- t is the average outflow time expressed in seconds, (s);
- r is the series resistance outflow time expressed in seconds, (s).
- HC is the relative hydraulic conductivity expressed in s^{-1}

Table 1 Permeameter test results

Location	Depth of test (mbgl)	r (s)	t (mins:secs)	t (s)	HC (s^{-1})
BH01	0.37	1.92	12:35	755	0.0013279
BH03	0.40	1.92	14:42	882	0.0011363

5 LABORATORY WORK

Upon their receipt in the laboratory, all disturbed samples were carefully examined and accurately described, and their descriptions incorporated into the borehole logs.

5.1 Geotechnical laboratory testing of soils

Laboratory testing of soils comprised:

- **permeability:** triaxial permeability tests

Laboratory testing of soils samples was carried out in accordance with British Standards Institute: *BS 1377, Methods of test for soils for civil engineering purposes; Part 1 (2016), and Parts 2-9 (1990).*

The test results are presented in Appendix C.

5.2 Environmental laboratory testing of soils

Environmental testing, as specified by the Client's Representative was conducted on selected environmental soil samples by Chemtest at its laboratory in Newmarket, Suffolk.

Testing was carried according to Engineer's Ireland Suite I, testing for a range of determinants, including:

- Metals
- Speciated total petroleum hydrocarbons (TPH)
- Speciated polycyclic aromatic hydrocarbons (PAH)
- BTEX compounds
- Volatile Organic Compounds (VOCs)
- Polychlorinated biphenyls (PCBs)
- Phenols
- Organic matter
- Total Organic Carbon (TOC)
- Cyanides
- Asbestos screen
- Sulphate
- Phosphate
- pH
- Waste acceptance criteria (WAC)

Results of environmental laboratory testing are presented in Appendix D.

6 GROUND CONDITIONS

6.1 General geology of the area

Published geological mapping indicate the superficial deposits underlying the site comprise peat. These deposits are underlain by limestones of the Visean Limestones Formation.

6.2 Ground types encountered during investigation of the site

A summary of the ground types encountered in the exploratory holes is listed below, in approximate stratigraphic order:

- **Paved surface:** BHLFG1 encountered 50mm of bitmac surfacing.
- **Made Ground (sub-base):** approximately 350mm of aggregate fill beneath the paved surface in BHLFG1.
- **Made Ground (fill):** reworked sandy gravelly clay fill extending to depths between 0.90-2.80m.
- **Made Ground (landfill):** landfill comprising domestic waste was encountered across the site to depths ranging from 2.10m in BHLFG1 to 9.30m in BH02.
- **Recent deposits (peat):** encountered in all boreholes beneath the waste body.

6.3 Groundwater

Details of the individual groundwater strikes, along with any relative changes in levels as works proceeded, are presented on the exploratory hole logs for each location.

Groundwater was encountered during percussion boring through soil as water strikes shown in Table 1 below.

Table 2: Groundwater strikes encountered during ground investigations.

Location	Depth (mbgl)	Comments
BH02	3.40	
BH03	8.00	Rose from 8.00 to 7.80m after 20 minutes

Groundwater was not noted during drilling at two of the borehole locations. However, it should be noted that the casing used in supporting the borehole walls during drilling may have sealed out additional groundwater strikes and the possibility of encountering groundwater during excavation works should not be ruled out.

Subsequent groundwater monitoring of the standpipe installations recorded water levels as shown in Table 2.

Table 3: Groundwater monitoring

Date	Water level (mbgl)/Installation Depth (mbgl)			
	BH01	BH02	BH03	BHLGF1
28/07/2022	7.72/8.40	8.48/8.80	7.14/8.15	2.28/2.31

7 REFERENCES

Geotechnical Society of Ireland (2016), Specification & Related Documents for Ground Investigation in Ireland.

IS EN 1997-2: 2007: Eurocode 7 - Geotechnical design - Part 2 Ground investigation and testing. National Standards Authority of Ireland.

BS 5930: 2015+A1:2020: Code of practice for ground investigations. British Standards Institution.

BS EN ISO 14688-1:2018: Geotechnical investigation and testing. Identification and classification of soil. Part 1 Identification and description.

BS EN ISO 14688-2:2018: Geotechnical investigation and testing. Identification and classification of soil. Part 2 Principles for a classification.

BS 1377: 1990: Methods of test for soils for civil engineering purposes. British Standards Institution.



CAUSEWAY
— GEOTECH

APPENDIX A
SITE AND EXPLORATORY HOLE LOCATION PLANS





Project No.: 22-0418

Client: Galway County Council

Project Name: Tuam Landfill

Client's Representative: Fehily Timoney and Company

Legend Key



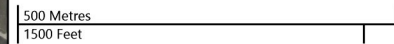
Title:
Site Location Plan

Last Revised:
15/08/2022

Scale:
1:10000



Microsoft product screen shot(s) reprinted with permission from Microsoft Corporation






Project No.: 22-0418

Client: Galway County Council

Project Name: Tuam Landfill

Client's Representative: Fehily Timoney and Company

Legend Key

 Locations By Type - CP



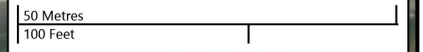
Title:
Exploratory Hole Location Plan

Last Revised:
15/08/2022

Scale:
1:1000



Microsoft product screen shot(s) reprinted with permission from Microsoft Corporation





CAUSEWAY
— GEOTECH

APPENDIX B
BOREHOLE LOGS





CAUSEWAY
GEOTECH

Project No.
22-0418

Project Name: Tuam Landfill
Client: Galway County Council
Client's Rep: Fehily Timoney and Company

Borehole ID
BH01

Method Cable Percussion	Plant Used Dando 2000	Top (m) 0.00	Base (m) 8.20	Coordinates 543771.91 E 749901.87 N	Final Depth: 8.20 m	Start Date: 19/07/2022	Driller: BM	Sheet 1 of 2 Scale: 1:40
					Elevation: 43.72 mOD	End Date: 19/07/2022	Logger: SR	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
0.30 - 0.70	U5	Ublow=30 90%						MADE GROUND: Soft to firm brownish grey sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.		
0.50	ES1				42.82	0.90		MADE GROUND: Landfill		
2.50	ES2				41.22	2.50		MADE GROUND: Soft brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.		
6.00	ES3				40.72	3.00		MADE GROUND: Landfill		

Water Strikes				Chiselling Details			Remarks
Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	From (m)	To (m)	Time (hh:mm)	
Casing Details		Water Added					
To (m)	Diameter	From (m)	To (m)				
Termination Reason Terminated at scheduled depth.							Last Updated 23/08/2022





Project No.
22-0418

Project Name: Tuam Landfill
Client: Galway County Council
Client's Rep: Fehily Timoney and Company

Borehole ID
BH01

Method Cable Percussion	Plant Used Dando 2000	Top (m) 0.00	Base (m) 8.20	Coordinates 543771.91 E 749901.87 N	Final Depth: 8.20 m	Start Date: 19/07/2022	Driller: BM	Sheet 2 of 2 Scale: 1:40
					Elevation: 43.72 mOD	End Date: 19/07/2022	Logger: SR	

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
8.00	ES4				35.72	8.00		MADE GROUND: Landfill		
					35.52	8.20		PEAT		
								End of Borehole at 8.20m		

Water Strikes				Chiselling Details			Remarks
Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	From (m)	To (m)	Time (hh:mm)	
Casing Details		Water Added					
To (m)	Diameter	From (m)	To (m)				
Termination Reason Terminated at scheduled depth.							Last Updated 23/08/2022





Project No.
22-0418

Project Name: Tuam Landfill
Client: Galway County Council
Client's Rep: Fehily Timoney and Company

Borehole ID
BH02

Method Cable Percussion	Plant Used Dando 2000	Top (m) 0.00	Base (m) 9.40	Coordinates 543831.98 E 749987.50 N	Final Depth: 9.40 m	Start Date: 19/07/2022	Driller: BM	Sheet 1 of 2 Scale: 1:40
					Elevation: 45.89 mOD	End Date: 19/07/2022	Logger: SR	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
0.40 - 0.80 0.50	U5 ES1	Ublow=30 90%			44.99	0.90	[Cross-hatch pattern]	MADE GROUND: Soft to firm brownish grey sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.		
2.00	ES2						[Cross-hatch pattern]	MADE GROUND: Landfill		
5.50	ES3	Slow seepage at 3.40m			40.89	5.00	[Cross-hatch pattern]	MADE GROUND: Soft greyish sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.	▼	

Water Strikes				Chiselling Details			Remarks	
Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	From (m)	To (m)	Time (hh:mm)		
3.40	3.40							
Casing Details		Water Added					Termination Reason	
To (m)	Diameter	From (m)	To (m)					
							Last Updated	
Terminated at scheduled depth.							23/08/2022	



Project No.
22-0418

Project Name: Tuam Landfill
Client: Galway County Council
Client's Rep: Fehily Timoney and Company

Borehole ID
BH02

Method Cable Percussion	Plant Used Dando 2000	Top (m) 0.00	Base (m) 9.40	Coordinates 543831.98 E 749987.50 N	Final Depth: 9.40 m	Start Date: 19/07/2022	Driller: BM	Sheet 2 of 2 Scale: 1:40
					Elevation: 45.89 mOD	End Date: 19/07/2022	Logger: SR	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
8.50	ES4							MADE GROUND: Soft greyish sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.		
					36.89	9.00		MADE GROUND: Landfill		
					36.59	9.30		PEAT		
					36.49	9.40		End of Borehole at 9.40m		

Water Strikes				Chiselling Details			Remarks
Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	From (m)	To (m)	Time (hh:mm)	
3.40	3.40						
Casing Details		Water Added					
To (m)	Diameter	From (m)	To (m)				
Termination Reason							Last Updated
Terminated at scheduled depth.							23/08/2022





Project No.
22-0418

Project Name: Tuam Landfill
Client: Galway County Council
Client's Rep: Fehily Timoney and Company

Borehole ID
BH03

Method Cable Percussi	Plant Used Dando 200	Top (m) 0.00	Base (m) 8.20	Coordinates 543793.33 E 750038.31 N	Final Depth: 8.20 m	Start Date: 18/07/2022	Driller: BM	Sheet 1 of 2 Scale: 1:40
					Elevation: 44.53 mOD	End Date: 18/07/2022	Logger: SR	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
0.30 - 0.70	U5	Ublow=30 70%						MADE GROUND: Soft brownish grey sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.		
0.50	ES1				43.53	1.00				
3.00	ES2							MADE GROUND: Landfill		
5.00	ES3									

Water Strikes				Chiselling Details			Remarks
Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	From (m)	To (m)	Time (hh:mm)	
8.00	8.00	20	7.80				
Casing Details		Water Added					
To (m)	Diameter	From (m)	To (m)				
Termination Reason							Last Updated
Terminated at scheduled depth.							23/08/2022





Project No.
22-0418

Project Name: Tuam Landfill
Client: Galway County Council
Client's Rep: Fehily Timoney and Company

Borehole ID
BH03

Method Cable Percussi	Plant Used Dando 200	Top (m) 0.00	Base (m) 8.20	Coordinates 543793.33 E 750038.31 N	Final Depth: 8.20 m	Start Date: 18/07/2022	Driller: BM	Sheet 2 of 2 Scale: 1:40
					Elevation: 44.53 mOD	End Date: 18/07/2022	Logger: SR	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
8.00	ES4	Slow seepage at 8.00m			36.53	8.00		MADE GROUND: Landfill		
					36.33	8.20		PEAT		
								End of Borehole at 8.20m		

Water Strikes				Chiselling Details			Remarks	
Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	From (m)	To (m)	Time (hh:mm)		
8.00	8.00	20	7.80					
Casing Details		Water Added						
To (m)	Diameter	From (m)	To (m)					
							Termination Reason	Last Updated
							Terminated at scheduled depth.	23/08/2022





Project No.
22-0418

Project Name: Tuam Landfill

Borehole ID
BHLFG1

Client: Galway County Council

Client's Rep: Fehily Timoney and Company

Method Cable Percussio	Plant Used Dando 2000	Top (m) 0.00	Base (m) 3.00	Coordinates 543884.79 E 749916.52 N	Final Depth: 3.00 m	Start Date: 20/07/2022	Driller: BM	Sheet 1 of 1 Scale: 1:40
					Elevation: 41.21 mOD	End Date: 20/07/2022	Logger: SR	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
0.50 - 1.50	B1				41.16	0.05		BITMAC		
						40.81		MADE GROUND: Grey slightly sandy angular to subangular fine to coarse GRAVEL with low cobble content. Sand is fine to coarse. Cobbles are angular.		
								MADE GROUND: Soft brownish black sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.		
					39.11	2.10		MADE GROUND: Dense grey subangular fine to coarse GRAVEL		
2.50 - 3.00	B2				38.71	2.50		PEAT		
					38.21	3.00		End of Borehole at 3.00m		

Water Strikes				Chiselling Details			Remarks
Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	From (m)	To (m)	Time (hh:mm)	
Casing Details		Water Added					
To (m)	Diameter	From (m)	To (m)				

Termination Reason
Terminated at scheduled depth.

Last Updated
23/08/2022





CAUSEWAY
— GEOTECH

APPENDIX C

GEOTECHNICAL LABORATORY TEST RESULTS





LABORATORY REPORT



4043

Contract Number: PSL22/5053

Report Date: 19 August 2022
Client's Reference: 22-0418
Client Name: Causeway Geotech
8 Drumahiskey Road
Ballymoney
Co. Antrim
BT53 7QL

For the attention of: Stephen Watson

Contract Title: Tuam Landfill
Date Received: 2/8/2022
Date Commenced: 2/8/2022
Date Completed: 19/8/2022

Notes: Opinions and Interpretations are outside the UKAS Accreditation

A copy of the Laboratory Schedule of accredited tests as issued by UKAS is attached to this report. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced other than in full, without the prior written approval of the laboratory.

Checked and Approved Signatories:

A Watkins
(Director)

R Berriman
(Quality Manager)


S Royle
(Laboratory Manager)

L Knight
(Assistant Laboratory Manager)

S Eyre
(Senior Technician)

T Watkins
(Senior Technician)

5 – 7 Hexthorpe Road, Hexthorpe,
Doncaster DN4 0AR
tel: +44 (0)844 815 6641
fax: +44 (0)844 815 6642
e-mail: rberriman@prosoils.co.uk
awatkins@prosoils.co.uk

Page 1 of

PERMEABILITY IN A TRIAXIAL CELL

BS 1377 : Part 6 : 1990: Clause 6

Hole Number: BH01 Top Depth (m) : 0.30

Sample Number: 5 Base Depth (m) : 0.70

Sample Type: U Lift Number:

Date Grid Reference:

Description of Specimen	
Brown gravelly sandy CLAY.	
Remarks	
Undisturbed	

Initial Specimen Conditions		
Height	mm	101.06
Diameter	mm	101.12
Area	mm ²	8030.90
Volume	cm ³	811.60
Mass	g	1650
Dry Mass	g	1418
Bulk Density	Mg/m ³	2.03
Dry Density	Mg/m ³	1.75
Moisture Content	%	16
Voids Ratio	-	0.516
Specific Gravity	Mg/m ³	2.65
(assumed/measured)	-	assumed

Final Specimen Conditions		
Moisture Content	%	21
Bulk Density	Mg/m ³	2.11
Dry Density	Mg/m ³	1.75

Test Setup		
Date Started		14/08/2022
Date Finished		17/08/2022
Top Drain Used		Y
Base Drain Used		Y
Method of Saturation		By back pressure
Direction Of Flow		Vertically Downwards
Saturation Time	Days	1
Consolidation Time	Days	1
Permeability Time	Days	1



PSL
Professional Soils Laboratory

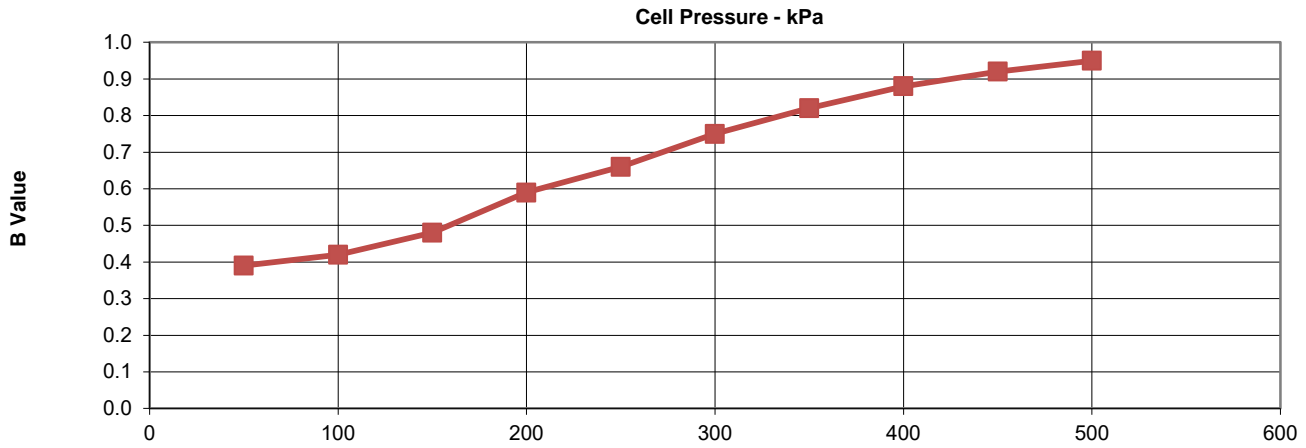
Tuam Landfill

Contract No.
PSL22/5053
Client Ref
22-0418

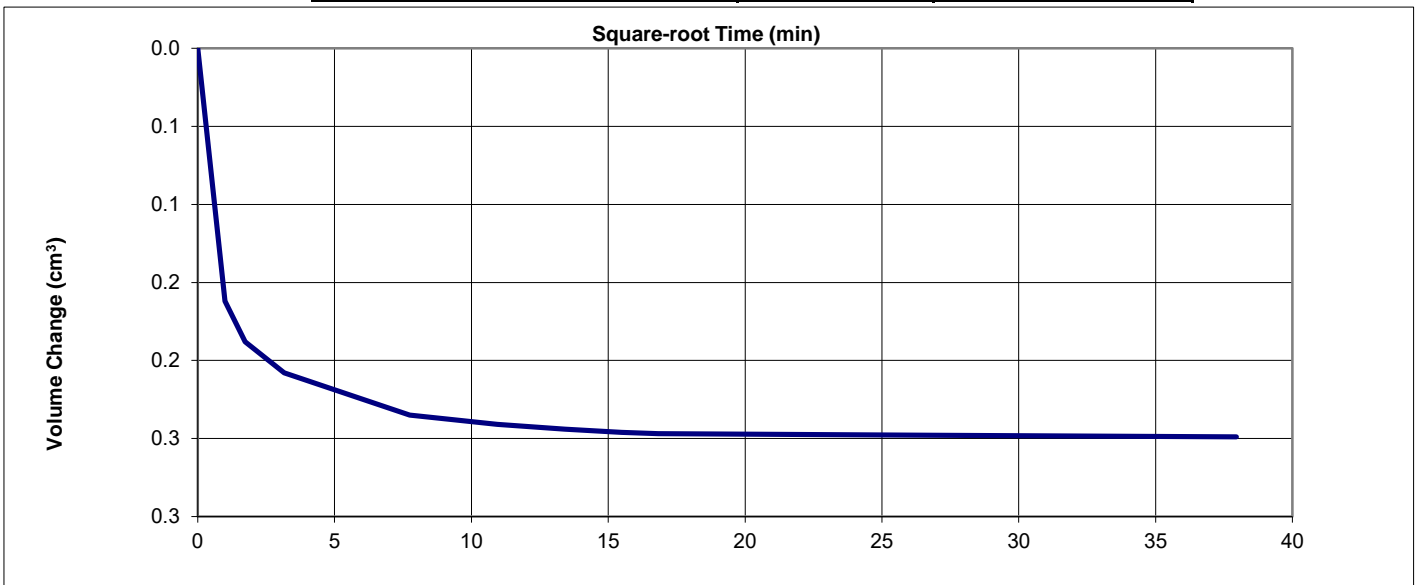
PERMEABILITY IN A TRIAXIAL CELL

BS 1377 : Part 6 : 1990 Clause 6

Specimen Details		
Hole Number		BH01
Sample Depth	m	0.30
Sample No,		5
Grid Reference		
Lift Number		
Saturation		
Cell Pressure Incr.	kPa	50
Back Pressure Incr.	kPa	50
Differential Pressure	kPa	10
Final Cell Pressure	kPa	500
Final B Value	-	0.95



Consolidation		
Effective Pressure	kPa	20
Cell Pressure	kPa	520
Back Pressure	kPa	500
Final PWP	kPa	500
PWP dissipation	%	100



Tuam Landfill

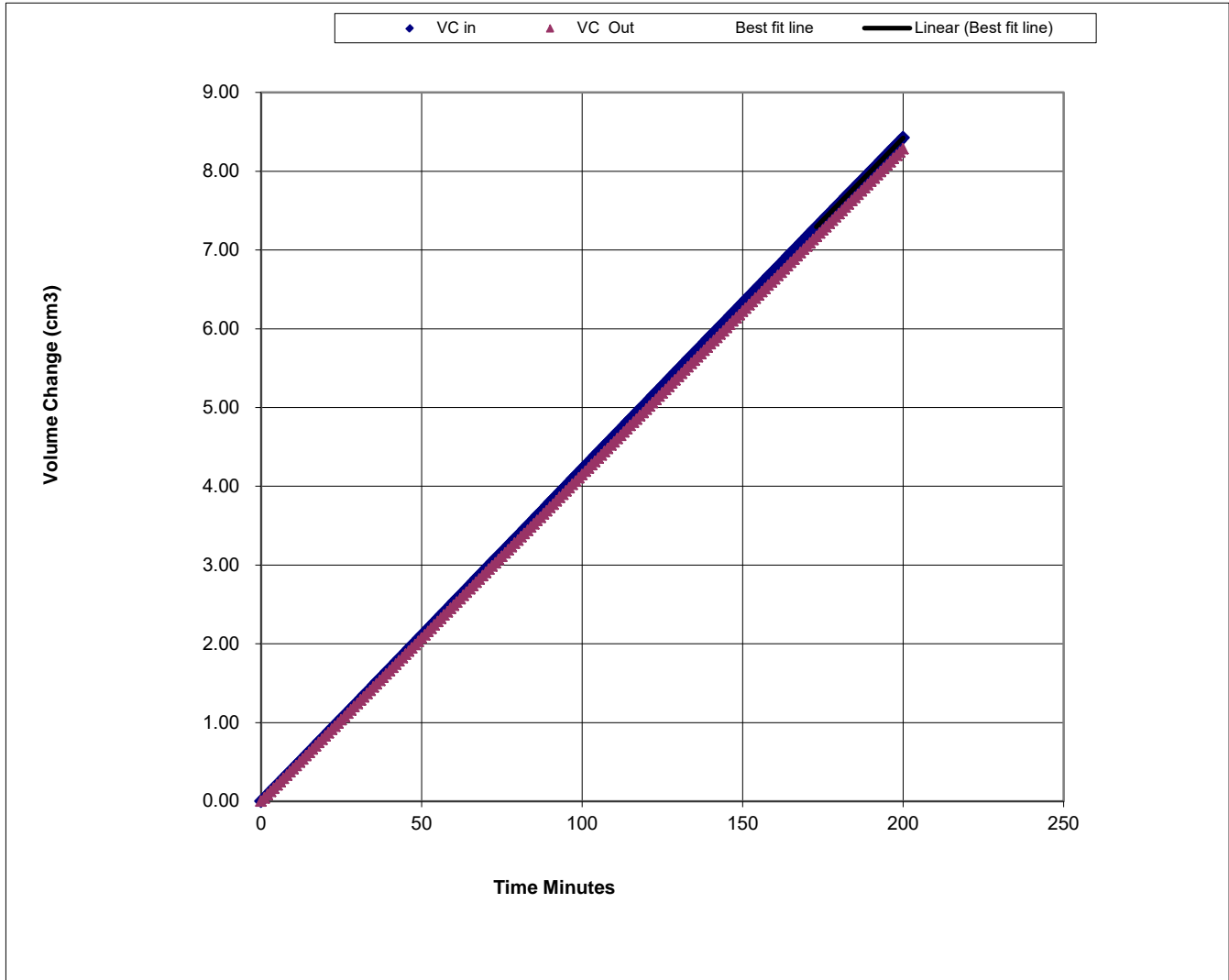
Contract No.
PSL22/5053
Client Ref
22-0418

PERMEABILITY IN A TRIAXIAL CELL

BS 1377 : Part 6 : 1990 Clause 6

Specimen Details		
Hole Number		BH01
Sample Depth	m	0.30
Sample No.		5
Grid Reference		
Lift Number		

Permeability Stage



Permeability Stage		
Cell Pressure	kPa	520
Mean Effective Stress	kPa	20
Back Pressure Diff.	kPa	10
Mean Rate of Flow	ml/min	0.0418
Average Temperature	'C	20
Vertical Permeability K_v	m/s	8.6E-09



PSL
Professional Soils Laboratory

Tuam Landfill

Contract No.
PSL22/5053
Client Ref
22-0418

PERMEABILITY IN A TRIAXIAL CELL

BS 1377 : Part 6 : 1990: Clause 6

Hole Number: BH03 Top Depth (m) : 0.30

Sample Number: 5 Base Depth (m) : 0.70

Sample Type: U Lift Number:

Date Grid Reference:

Description of Specimen	
Brown gravelly sandy CLAY.	
Remarks	
Undisturbed	

Initial Specimen Conditions		
Height	mm	101.64
Diameter	mm	102.95
Area	mm ²	8324.20
Volume	cm ³	846.07
Mass	g	1765
Dry Mass	g	1528
Bulk Density	Mg/m ³	2.09
Dry Density	Mg/m ³	1.81
Moisture Content	%	16
Voids Ratio	-	0.467
Specific Gravity	Mg/m ³	2.65
(assumed/measured)	-	assumed

Final Specimen Conditions		
Moisture Content	%	17
Bulk Density	Mg/m ³	2.12
Dry Density	Mg/m ³	1.81

Test Setup		
Date Started		14/08/2022
Date Finished		17/08/2022
Top Drain Used		Y
Base Drain Used		Y
Method of Saturation		By back pressure
Direction Of Flow		Vertically Downwards
Saturation Time	Days	1
Consolidation Time	Days	1
Permeability Time	Days	2



PSL
Professional Soils Laboratory

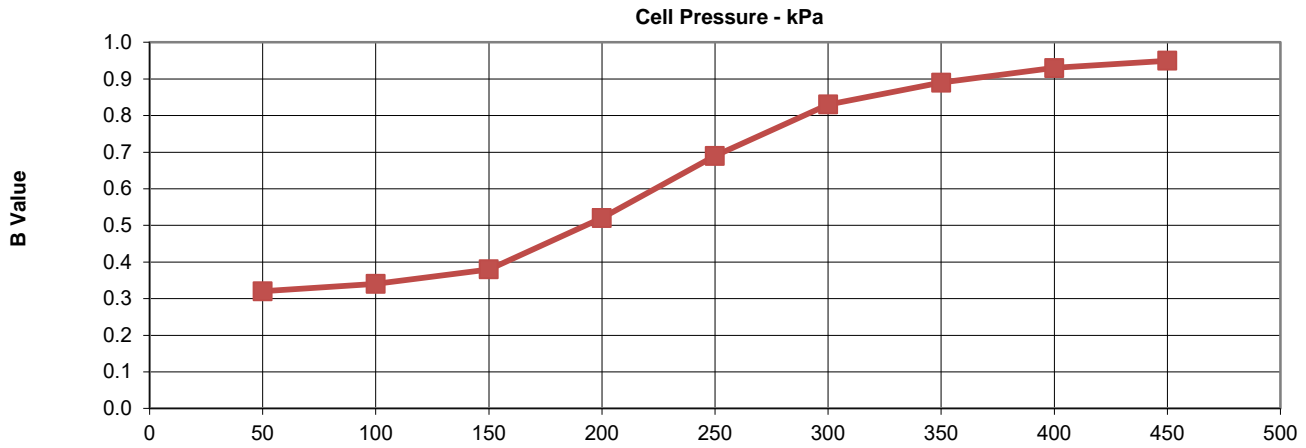
Tuam Landfill

Contract No.
PSL22/5053
Client Ref
22-0418

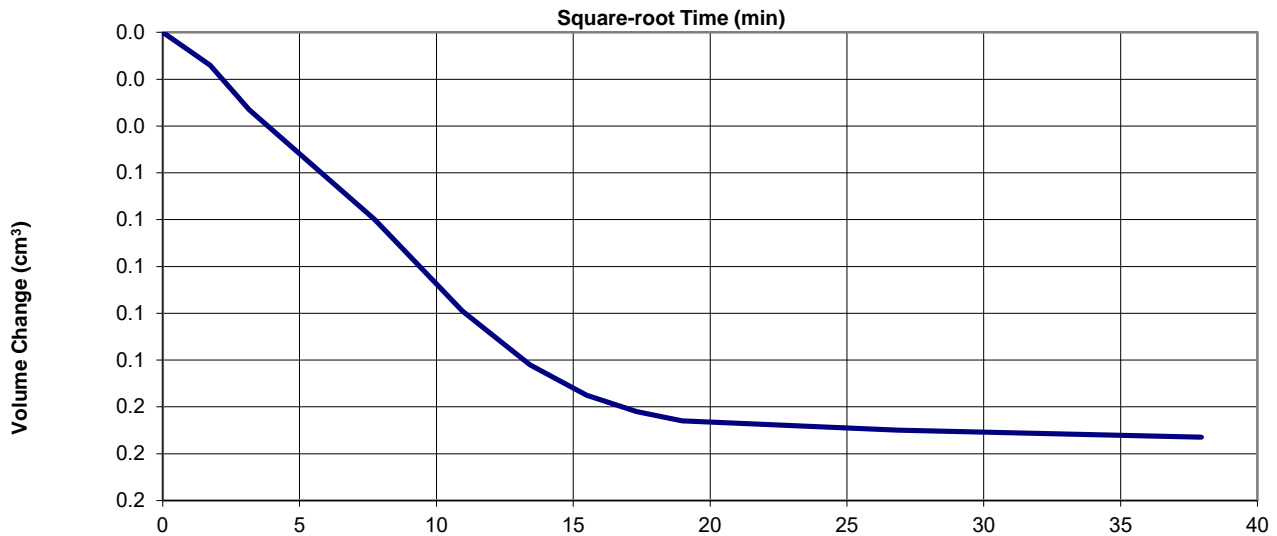
PERMEABILITY IN A TRIAXIAL CELL

BS 1377 : Part 6 : 1990 Clause 6

Specimen Details		
Hole Number		BH03
Sample Depth	m	0.30
Sample No,		5
Grid Reference		
Lift Number		
Saturation		
Cell Pressure Incr.	kPa	50
Back Pressure Incr.	kPa	50
Differential Pressure	kPa	10
Final Cell Pressure	kPa	450
Final B Value	-	0.95



Consolidation		
Effective Pressure	kPa	20
Cell Pressure	kPa	470
Back Pressure	kPa	450
Final PWP	kPa	450
PWP dissipation	%	100



Tuam Landfill

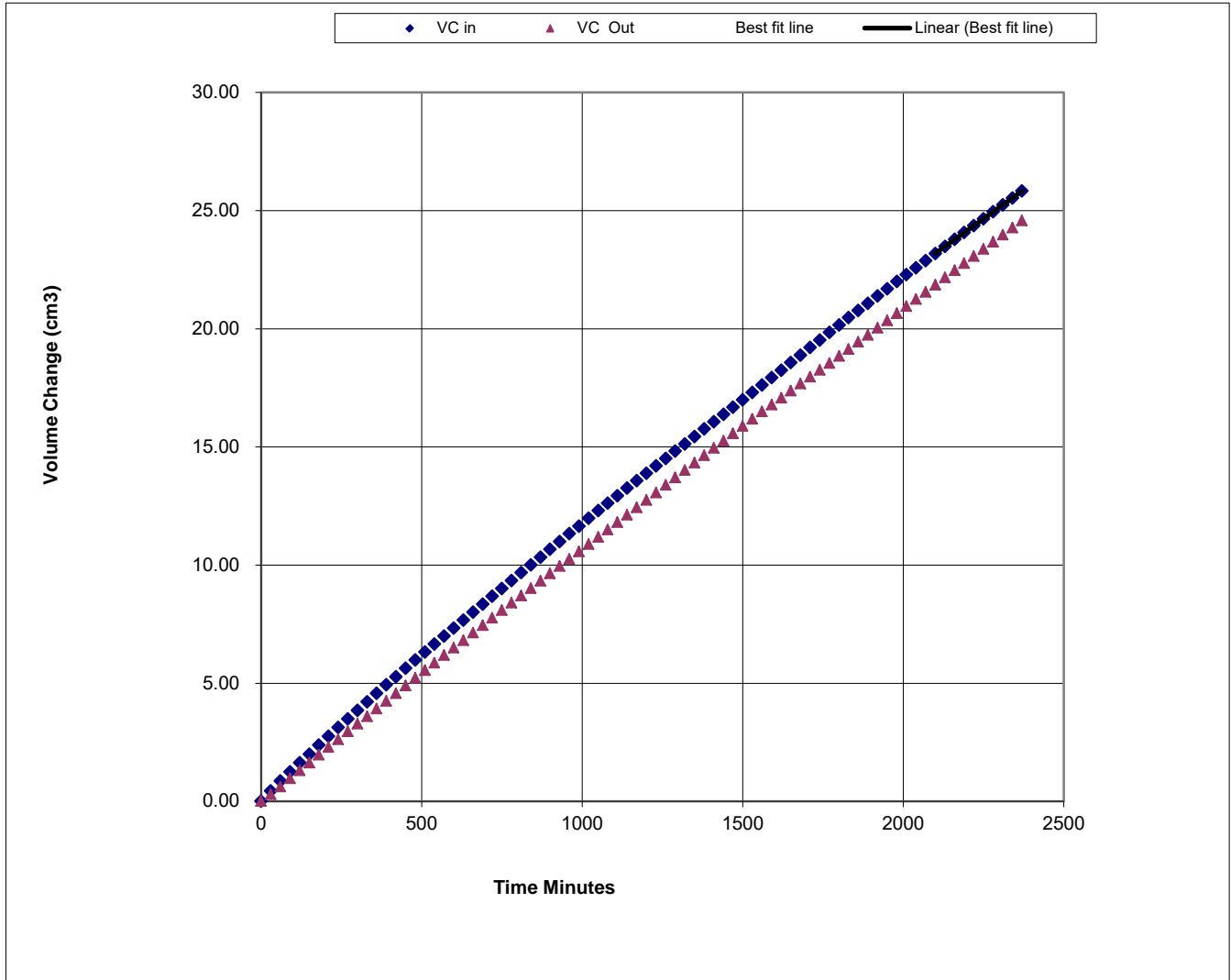
Contract No.
PSL22/5053
Client Ref
22-0418

PERMEABILITY IN A TRIAXIAL CELL

BS 1377 : Part 6 : 1990 Clause 6

Specimen Details		
Hole Number		BH03
Sample Depth	m	0.30
Sample No.		5
Grid Reference		
Lift Number		

Permeability Stage



Permeability Stage		
Cell Pressure	kPa	470
Mean Effective Stress	kPa	20
Back Pressure Diff.	kPa	10
Mean Rate of Flow	ml/min	0.0098
Average Temperature	'C	20
Vertical Permeability Kv	m/s	2.0E-09



Tuam Landfill

Contract No.
PSL22/5053
Client Ref
22-0418



CAUSEWAY
— GEOTECH

APPENDIX D
ENVIRONMENTAL LABORATORY TEST RESULTS





Amended Report

Report No.:	22-28066-4	Date of Re-Issue:	16-Aug-2022
Initial Date of Issue:	16-Aug-2022		
Client	Causeway Geotech Ltd		
Client Address:	8 Drumahiskey Road Balnamore Ballymoney County Antrim BT53 7QL		
Contact(s):	Colm Hurley Darren O'Mahony Gabriella Horan John Cameron Matthew Gilbert Neil Haggan Paul Dunlop Sean Ross Stephen Franey Stuart Abraham		
Project	22-0418 Tuam Landfill		
Quotation No.:	Q22-28148	Date Received:	25-Jul-2022
Order No.:		Date Instructed:	28-Jul-2022
No. of Samples:	3		
Turnaround (Wkdays):	7	Results Due:	05-Aug-2022
Date Approved:	15-Aug-2022	Subcon Results Due:	18-Aug-2022

Approved By:

Details: Stuart Henderson, Technical Manager

Results - Soil

Project: 22-0418 Tuam Landfill

Client: Causeway Geotech Ltd		Chemtest Job No.:			22-28066	22-28066	22-28066
Quotation No.: Q22-28148		Chemtest Sample ID.:			1474290	1474293	1474298
Order No.:		Client Sample Ref.:			3	2	3
		Sample Location:			BH01	BH02	BH03
		Sample Type:			SOIL	SOIL	SOIL
		Top Depth (m):			6.0	2.5	5.0
		Date Sampled:			22-Jul-2022	22-Jul-2022	22-Jul-2022
		Asbestos Lab:			DURHAM	DURHAM	DURHAM
Determinand	Accred.	SOP	Units	LOD			
Benzo(j)fluoranthene	SN		mg/kg	1	< 1	< 1	< 1
ACM Type	U	2192		N/A	-	-	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
Moisture	N	2030	%	0.020	37	30	19
Boron (Hot Water Soluble)	M	2120	mg/kg	0.40	19	7.2	2.7
Sulphate (2:1 Water Soluble) as SO4	M	2120	g/l	0.010	1.5	0.11	0.40
Cyanide (Free)	M	2300	mg/kg	0.50	< 0.50	< 0.50	< 0.50
Cyanide (Total)	M	2300	mg/kg	0.50	0.80	< 0.50	< 0.50
Arsenic	M	2455	mg/kg	0.5	6.1	4.8	2.7
Barium	M	2455	mg/kg	0	160	53	14
Cadmium	M	2455	mg/kg	0.10	1.5	0.78	0.38
Chromium	M	2455	mg/kg	0.5	22	17	4.8
Molybdenum	M	2455	mg/kg	0.5	2.9	1.1	< 0.5
Antimony	N	2455	mg/kg	2.0	4.7	2.1	< 2.0
Copper	M	2455	mg/kg	0.50	54	70	15
Mercury	M	2455	mg/kg	0.05	0.16	0.12	< 0.05
Nickel	M	2455	mg/kg	0.50	24	19	8.9
Lead	M	2455	mg/kg	0.50	420	83	17
Selenium	M	2455	mg/kg	0.25	1.2	2.4	< 0.25
Zinc	M	2455	mg/kg	0.50	220	170	260
Chromium (Trivalent)	N	2490	mg/kg	1.0	22	17	4.7
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50
Organic Matter	M	2625	%	0.40	19	10	0.90
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0	210	< 1.0	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	210	< 5.0	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0

Results - Soil

Project: 22-0418 Tuam Landfill

Client: Causeway Geotech Ltd		Chemtest Job No.:		22-28066	22-28066	22-28066	
Quotation No.: Q22-28148		Chemtest Sample ID.:		1474290	1474293	1474298	
Order No.:		Client Sample Ref.:		3	2	3	
		Sample Location:		BH01	BH02	BH03	
		Sample Type:		SOIL	SOIL	SOIL	
		Top Depth (m):		6.0	2.5	5.0	
		Date Sampled:		22-Jul-2022	22-Jul-2022	22-Jul-2022	
		Asbestos Lab:		DURHAM	DURHAM	DURHAM	
Determinand	Accred.	SOP	Units	LOD			
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	15	< 1.0	< 1.0
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0	77	< 1.0	< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	92	< 5.0	< 5.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	300	< 10	< 10
Naphthalene	N	2800	mg/kg	0.010	< 0.010	< 0.010	< 0.010
Acenaphthylene	N	2800	mg/kg	0.010	< 0.010	< 0.010	< 0.010
Acenaphthene	N	2800	mg/kg	0.010	< 0.010	< 0.010	< 0.010
Fluorene	N	2800	mg/kg	0.010	< 0.010	< 0.010	< 0.010
Phenanthrene	N	2800	mg/kg	0.010	< 0.010	< 0.010	< 0.010
Anthracene	N	2800	mg/kg	0.010	< 0.010	< 0.010	< 0.010
Fluoranthene	N	2800	mg/kg	0.010	< 0.010	< 0.010	< 0.010
Pyrene	N	2800	mg/kg	0.010	< 0.010	< 0.010	< 0.010
Benzo[a]anthracene	N	2800	mg/kg	0.010	< 0.010	< 0.010	< 0.010
Chrysene	N	2800	mg/kg	0.010	< 0.010	< 0.010	< 0.010
Benzo[b]fluoranthene	N	2800	mg/kg	0.010	< 0.010	< 0.010	< 0.010
Benzo[k]fluoranthene	N	2800	mg/kg	0.010	< 0.010	< 0.010	< 0.010
Benzo[a]pyrene	N	2800	mg/kg	0.010	< 0.010	< 0.010	< 0.010
Indeno(1,2,3-c,d)Pyrene	N	2800	mg/kg	0.010	< 0.010	< 0.010	< 0.010
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.010	< 0.010	< 0.010	< 0.010
Benzo[g,h,i]perylene	N	2800	mg/kg	0.010	< 0.010	< 0.010	< 0.010
Coronene	N	2800	mg/kg	0.010	< 0.010	< 0.010	< 0.010
Total Of 16 PAH's	N	2800	mg/kg	0.20	< 0.20	< 0.20	< 0.20
Total Of 17 PAH's	N	2800	mg/kg	0.20	< 0.20	< 0.20	< 0.20
PCB 28	U	2815	mg/kg	0.010	< 0.010	< 0.010	< 0.010
PCB 52	U	2815	mg/kg	0.010	< 0.010	< 0.010	< 0.010
PCB 90+101	U	2815	mg/kg	0.010	< 0.010	< 0.010	< 0.010
PCB 118	U	2815	mg/kg	0.010	< 0.010	< 0.010	< 0.010
PCB 153	U	2815	mg/kg	0.010	< 0.010	< 0.010	< 0.010
PCB 138	U	2815	mg/kg	0.010	< 0.010	< 0.010	< 0.010
PCB 180	U	2815	mg/kg	0.010	< 0.010	< 0.010	< 0.010
Total PCBs (7 Congeners)	U	2815	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Total Phenols	M	2920	mg/kg	0.10	< 0.10	< 0.10	< 0.10

Results - Single Stage WAC

Project: 22-0418 Tuam Landfill

Chemtest Job No: 22-28066 Chemtest Sample ID: 1474290 Sample Ref: 3 Sample ID: Sample Location: BH01 Top Depth(m): 6.0 Bottom Depth(m): Sampling Date: 22-Jul-2022				Landfill Waste Acceptance Criteria			
				Limits			
				Inert Waste Landfill	Stable, Non-reactive hazardous waste in non-hazardous Landfill	Hazardous Waste Landfill	
Determinand	SOP	Accred.	Units				
Total Organic Carbon	2625	M	%	11	3	5	6
Loss On Ignition	2610	M	%	29	--	--	10
Total BTEX	2760	M	mg/kg	< 0.010	6	--	--
Total PCBs (7 congeners)					1	--	--
TPH Total WAC	2670	M	mg/kg	300	500	--	--
Total (of 17) PAHs					100	--	--
pH	2010	M		8.1	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg	0.013	--	To evaluate	To evaluate
Eluate Analysis			10:1 Eluate mg/l	10:1 Eluate mg/kg	Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg		
Arsenic	1455	U	0.013	0.13	0.5	2	25
Barium	1455	U	0.022	0.22	20	100	300
Cadmium	1455	U	0.00053	0.0053	0.04	1	5
Chromium	1455	U	0.0098	0.098	0.5	10	70
Copper	1455	U	0.039	0.39	2	50	100
Mercury	1455	U	0.00009	0.00094	0.01	0.2	2
Molybdenum	1455	U	0.026	0.26	0.5	10	30
Nickel	1455	U	0.021	0.21	0.4	10	40
Lead	1455	U	0.030	0.30	0.5	10	50
Antimony	1455	U	0.019	0.19	0.06	0.7	5
Selenium	1455	U	0.0025	0.025	0.1	0.5	7
Zinc	1455	U	0.082	0.82	4	50	200
Chloride	1220	U	13	130	800	15000	25000
Fluoride	1220	U	0.94	9.4	10	150	500
Sulphate	1220	U	140	1400	1000	20000	50000
Total Dissolved Solids	1020	N	860	8400	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	52	520	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	37

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Results - Single Stage WAC

Project: 22-0418 Tuam Landfill

Chemtest Job No: 22-28066					Landfill Waste Acceptance Criteria Limits		
Chemtest Sample ID: 1474293							
Sample Ref: 2							
Sample ID:							
Sample Location: BH02							
Top Depth(m): 2.5							
Bottom Depth(m):				Inert Waste Landfill	Stable, Non-reactive hazardous waste in non-hazardous Landfill	Hazardous Waste Landfill	
Sampling Date: 22-Jul-2022							
Determinand	SOP	Accred.	Units				
Total Organic Carbon	2625	M	%	5.8	3	5	6
Loss On Ignition	2610	M	%	11	--	--	10
Total BTEX	2760	M	mg/kg	< 0.010	6	--	--
Total PCBs (7 congeners)					1	--	--
TPH Total WAC	2670	M	mg/kg	< 10	500	--	--
Total (of 17) PAHs					100	--	--
pH	2010	M		8.1	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg	0.032	--	To evaluate	To evaluate
Eluate Analysis			10:1 Eluate mg/l	10:1 Eluate mg/kg	Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg		
Arsenic	1455	U	0.0036	0.036	0.5	2	25
Barium	1455	U	0.043	0.43	20	100	300
Cadmium	1455	U	< 0.00011	< 0.0011	0.04	1	5
Chromium	1455	U	< 0.0005	< 0.0050	0.5	10	70
Copper	1455	U	0.0010	0.010	2	50	100
Mercury	1455	U	< 0.00005	< 0.00050	0.01	0.2	2
Molybdenum	1455	U	0.018	0.18	0.5	10	30
Nickel	1455	U	0.0084	0.084	0.4	10	40
Lead	1455	U	< 0.0005	< 0.0050	0.5	10	50
Antimony	1455	U	0.0039	0.039	0.06	0.7	5
Selenium	1455	U	0.0015	0.015	0.1	0.5	7
Zinc	1455	U	0.007	0.067	4	50	200
Chloride	1220	U	67	670	800	15000	25000
Fluoride	1220	U	0.13	1.3	10	150	500
Sulphate	1220	U	480	4800	1000	20000	50000
Total Dissolved Solids	1020	N	870	8600	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	31	310	500	800	1000

Solid Information

Dry mass of test portion/kg	0.090
Moisture (%)	30

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Results - Single Stage WAC

Project: 22-0418 Tuam Landfill

Chemtest Job No: 22-28066					Landfill Waste Acceptance Criteria Limits		
Chemtest Sample ID: 1474298					Inert Waste Landfill	Stable, Non-reactive hazardous waste in non-hazardous Landfill	Hazardous Waste Landfill
Sample Ref: 3							
Sample ID:							
Sample Location: BH03							
Top Depth(m): 5.0							
Bottom Depth(m):							
Sampling Date: 22-Jul-2022							
Determinand	SOP	Accred.	Units				
Total Organic Carbon	2625	M	%	0.52	3	5	6
Loss On Ignition	2610	M	%	10	--	--	10
Total BTEX	2760	M	mg/kg	< 0.010	6	--	--
Total PCBs (7 congeners)					1	--	--
TPH Total WAC	2670	M	mg/kg	< 10	500	--	--
Total (of 17) PAHs					100	--	--
pH	2010	M		8.3	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg	0.020	--	To evaluate	To evaluate
Eluate Analysis			10:1 Eluate mg/l	10:1 Eluate mg/kg	Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg		
Arsenic	1455	U	0.0028	0.028	0.5	2	25
Barium	1455	U	0.032	0.32	20	100	300
Cadmium	1455	U	< 0.00011	< 0.0011	0.04	1	5
Chromium	1455	U	0.0010	0.010	0.5	10	70
Copper	1455	U	0.0041	0.041	2	50	100
Mercury	1455	U	< 0.00005	< 0.00050	0.01	0.2	2
Molybdenum	1455	U	0.012	0.12	0.5	10	30
Nickel	1455	U	0.013	0.13	0.4	10	40
Lead	1455	U	0.010	0.10	0.5	10	50
Antimony	1455	U	0.015	0.15	0.06	0.7	5
Selenium	1455	U	0.0013	0.013	0.1	0.5	7
Zinc	1455	U	0.030	0.30	4	50	200
Chloride	1220	U	79	790	800	15000	25000
Fluoride	1220	U	0.21	2.1	10	150	500
Sulphate	1220	U	180	1800	1000	20000	50000
Total Dissolved Solids	1020	N	580	5800	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	73	730	500	800	1000

Solid Information

Dry mass of test portion/kg	0.090
Moisture (%)	19

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Test Methods

SOP	Title	Parameters included	Method summary
1020	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Conductivity Meter
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1455	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1610	Total/Dissolved Organic Carbon in Waters	Organic Carbon	TOC Analyser using Catalytic Oxidation
1920	Phenols in Waters by HPLC	Phenolic compounds including: Phenol, Cresols, Xylenols, Trimethylphenols Note: Chlorophenols are excluded.	Determination by High Performance Liquid Chromatography (HPLC) using electrochemical detection.
2010	pH Value of Soils	pH	pH Meter
2015	Acid Neutralisation Capacity	Acid Reserve	Titration
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
2300	Cyanides & Thiocyanate in Soils	Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Alkaline extraction followed by colorimetric determination using Automated Flow Injection Analyser.
2490	Hexavalent Chromium in Soils	Chromium [VI]	Soil extracts are prepared by extracting dried and ground soil samples into boiling water. Chromium [VI] is determined by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazide.
2610	Loss on Ignition	loss on ignition (LOI)	Determination of the proportion by mass that is lost from a soil by ignition at 550°C.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2670	Total Petroleum Hydrocarbons (TPH) in Soils by GC-FID	TPH (C6–C40); optional carbon banding, e.g. 3-band – GRO, DRO & LRO*TPH C8–C40	Dichloromethane extraction / GC-FID
2680	TPH A/A Split	Aliphatics: >C5–C6, >C6–C8,>C8–C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35– C44Aromatics: >C5–C7, >C7–C8, >C8– C10, >C10–C12, >C12–C16, >C16– C21, >C21– C35, >C35– C44	Dichloromethane extraction / GCxGC FID detection
2760	Volatile Organic Compounds (VOCs) in Soils by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics.(cf. USEPA Method 8260)*please refer to UKAS schedule	Automated headspace gas chromatographic (GC) analysis of a soil sample, as received, with mass spectrometric (MS) detection of volatile organic compounds.
2800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-MS	Acenaphthene*; Acenaphthylene; Anthracene*; Benzo[a]Anthracene*; Benzo[a]Pyrene*; Benzo[b]Fluoranthene*; Benzo[ghi]Perylene*; Benzo[k]Fluoranthene; Chrysene*; Dibenz[ah]Anthracene; Fluoranthene*; Fluorene*; Indeno[123cd]Pyrene*; Naphthalene*; Phenanthrene*; Pyrene*	Dichloromethane extraction / GC-MS

Test Methods

SOP	Title	Parameters included	Method summary
2815	Polychlorinated Biphenyls (PCB) ICES7Congeners in Soils by GC-MS	ICES7 PCB congeners	Acetone/Hexane extraction / GC-MS
2920	Phenols in Soils by HPLC	Phenolic compounds including Resorcinol, Phenol, Methylphenols, Dimethylphenols, 1-Naphthol and TrimethylphenolsNote: chlorophenols are excluded.	60:40 methanol/water mixture extraction, followed by HPLC determination using electrochemical detection.
640	Characterisation of Waste (Leaching C10)	Waste material including soil, sludges and granular waste	ComplianceTest for Leaching of Granular Waste Material and Sludge

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"
SOP	Standard operating procedure
LOD	Limit of detection

Comments or interpretations are beyond the scope of UKAS accreditation

The results relate only to the items tested

Uncertainty of measurement for the determinands tested are available upon request

None of the results in this report have been recovery corrected

All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis

All Asbestos testing is performed at the indicated laboratory

Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

- A - Date of sampling not supplied
- B - Sample age exceeds stability time (sampling to extraction)
- C - Sample not received in appropriate containers
- D - Broken Container
- E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 30 days from the date of receipt

All water samples will be retained for 14 days from the date of receipt

Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:

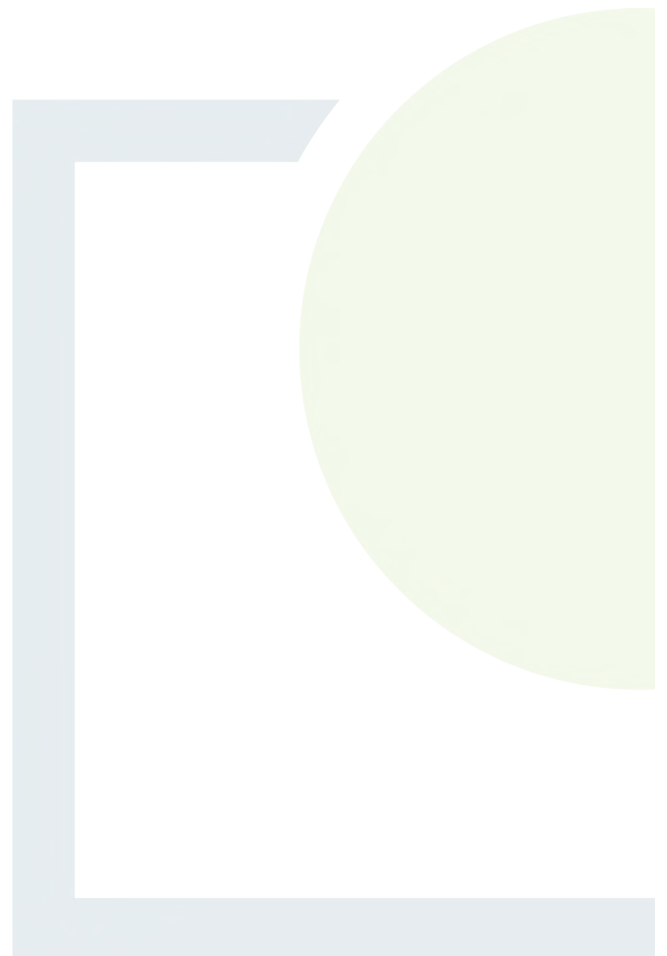
customerservices@chemtest.com



CONSULTANTS IN ENGINEERING,
ENVIRONMENTAL SCIENCE
& PLANNING

APPENDIX 9

Updated Geophysical Survey
Report



Tuam Historic Landfill
Tuam Co. Galway
Geophysical Survey

Report Status: Final

MGX Project Number: 6499

MGX File Ref: 6499f_Tuam-005.doc

4th October 2022

Confidential Report To:

Fehily Timoney & Co.

J5 Plaza
North Park Business Park
North Road
Dublin 11

**Report submitted by:
Minerex Geophysics Limited**

Unit F4, Maynooth Business Campus
Maynooth, Co. Kildare, W23X7Y5
Ireland
Tel.: 01-6510030
Email: info@mgx.ie

Issued by:



Author: John Connaughton (Geophysicist)



Reviewer: Hartmut Krahn (Senior Geophysicist)



Subsurface Geophysical Investigations

EXECUTIVE SUMMARY

1. Minorex Geophysics Ltd. (MGX) carried out a geophysical survey consisting of EM31 ground conductivity, 2D-Resistivity and seismic refraction (p-wave) surveying for the ground investigation of the Tuam Historic landfill, County Galway.
2. The main objectives of this survey were to identify the extent and depth of the former landfill site, quantify the volume of the waste, provide information on nature of the waste body, waste type and composition, look for evidence of leachate migration from the site and provide information on the underlying subsoil and bedrock.
3. The online geological map of Ireland (GSI, 2019) indicates the bedrock under the site is Visean Limestones, described as undifferentiated limestone. Visean Limestone is karstifiable.
4. The EM31 Ground Conductivity survey shows high conductivities throughout the site which indicates mainly domestic or commercial & industrial (C&I) waste material. The conductivities decrease towards the periphery of the site which indicates a reduction in the thickness of waste material. The extent of the waste material on the site covers an area of 23,300m². The extent of the site to the surrounding drain is 27,700 m².
5. The depth of the waste layer extends to the level of the surrounding land which is around 35 – 39 mOD. The total average depth of waste material is approx. 8 m.
6. Total volume of waste material is calculated as 186,400 m³.
7. The layer below the landfill may consist of clay or peat overburden or overburden with leachate.
8. Fresh rock below this layer minimises migration of leachate but there may be possible leachate migration into the rock near the west of the site.

CONTENTS

1. INTRODUCTION	1
1.1 Background.....	1
1.2 Objectives	1
1.3 Site Description.....	1
1.4 Geology	2
1.5 Report.....	2
2. GEOPHYSICAL SURVEY	3
2.1 Methodology.....	3
2.2 EM31 Ground Conductivity	3
2.3 2D-Resistivity	4
2.4 Seismic Refraction.....	4
2.5 Site Work.....	4
3. RESULTS AND INTERPRETATION	5
3.1 EM31 Ground Conductivity	5
3.2 2D-Resistivity	6
3.3 Seismic Refraction.....	6
3.4 Interpretation of Resistivity and Seismic Refraction	7
4. CONCLUSIONS AND RECOMMENDATIONS.....	8
5. REFERENCES.....	9

List of Tables, Maps and Figures:

Title	Pages	Document Reference
Table 1: Geophysical Survey Locations and Acquisition Parameters	In text	In text
Table 2: Summary of Interpretation	In text	In text
Map 1: Geophysical Survey Location Map	1 x A3	6499f_Tuam_MapsFigs.dwg
Map 2: EM31 Ground Conductivity Contour Map	1 x A3	6499f_Tuam_MapsFigs.dwg
Map 3: Geophysical Survey Interpretation Map	1 x A3	6499f_Tuam_MapsFigs.dwg
Figure 1: Models of Geophysical Survey	1 x A3	6499f_Tuam_MapsFigs.dwg
Figure 2: Interpretation of Geophysical Survey	1 x A3	6499f_Tuam_MapsFigs.dwg

1. INTRODUCTION

1.1 Background

Minerex Geophysics Ltd. (MGX) carried out a geophysical survey at an historic landfill in Tuam, Co. Galway. The survey consisted of EM31 ground conductivity, 2D-Resistivity and seismic refraction (p-wave) measurements. The survey was commissioned by Fehily Timoney & Co.

The survey employed various geophysical methods that complement each other and improve the interpretation. The role of geophysics as a non-destructive fast method is to allow later targeted direct investigations. Those results can be used to improve the initial results and interpretation.

A geophysical survey is a fast and effective way to investigate the waste size, extent and possible leachate from the landfill in a non-invasive manner. The geological background is also investigated a part of the survey. This survey is part of the Tier 2 site investigation and test report.

1.2 Objectives

The main objectives of the geophysical survey were:

- Identify the extent and depth of the former landfill
- Quantify the volume of the waste
- Provide information on the nature of the waste body, waste type and composition
- Look for evidence of leachate migration from the site
- Provide information on the underlying subsoil and bedrock

1.3 Site Description

The site is located off the R347 south of the town of Tuam. The Barna Waste Recycling Centre is located in the SE corner of the site. The site has a dome shaped topography with the highest elevations in the middle of the site and steep drops in elevations around the edges. The survey area consists of a capped historic landfill, grassed across its extents, surrounded by a wire fence. The site is accessed via the adjoining recycling centre/civic amenity site.

1.4 Geology

The online bedrock geological map of Ireland (GSI, 2019) describes the quaternary sediments as cut over raised peat. The survey area is underlain mostly by Visean Limestone, described as undifferentiated limestone.

Two Rotary Core holes carried out in the adjacent field show peat overlain by silt and clay overburden. GW02 noted limestone at 6.4 m below ground level.

Visean Limestone is karstifiable but the nearest karst features are over 1.7 km NE of the site.

1.5 Report

This report includes the results and interpretation of the geophysical survey. Maps, figures and tables are included to illustrate the results of the survey. More detailed descriptions of geophysical methods and measurements can be found in GSEG (2002), Milsom (1989) and Reynolds (1997).

The client provided maps of the site and the digital version was used as the background map in this report. Elevations were surveyed on site and are used in the vertical sections.

The interpretative nature and the non-invasive survey methods must be taken into account when considering the results of this survey and Minerex Geophysics Limited, while using appropriate practice to execute, interpret and present the data, give no guarantees in relation to the existing subsurface.

2. GEOPHYSICAL SURVEY

2.1 Methodology

The methodology is outlined in the tender documents and consisted of EM31 Ground Conductivity measurements across the site to map and determine targets for additional geophysical methods including 2D-Resistivity and Seismic Refraction Profiling. These profiles were carried out in different directions through the middle of the waste body as identified through the EM31 ground conductivity survey.

The survey locations are indicated on Map 1. The profiles and parameters are tabulated in Table 1 below.

All geophysical surveys are acquired, processed and reported in accordance with British Standards BS 5930:1999 +A2:2010 'Code of Practice for Site Investigations'.

Table 1: Geophysical Survey Locations and Acquisition Parameters

Profile Name	Electrode/Geophone Spacing/m	Number of Electrodes/Geophones	Profile Length/m
R1	3	54	159
R2	3	72	213
SUM			372
S1	3	54	159
S2	3	72	213
SUM			372

2.2 EM31 Ground Conductivity

The EM31 ground conductivity survey was carried out over the area indicated in Map 1 on lines nominally 10 m apart. Along each line a reading of ground conductivity was taken every second while walking along, thereby resulting in a survey grid of nominally 10 x 2 m. The locations were measured with a sub-meter accuracy SERES DGPS system attached to the EM31 and all data was jointly stored in a data logger. The conductivity meter was a GEONICS EM31 with Allegro data logger and NAV31 data acquisition software. The instrument was checked at a base station, the readings were stable and no drift occurred.

EM31 ground conductivity determines the bulk conductivity of the subsurface over a typical depth between 0 and 6 m below ground level (bgl). and over a radius of approx. 5 m around the instrument.

2.3 2D-Resistivity

2D-Resistivity profiles were surveyed with electrode spacing of 3 m, up to 64 electrodes per set-up and a maximum length of 189 m per profile. The readings were taken with a Tigre Resistivity Meter, Imager Cables, stainless steel electrodes, laptop and ImagerPro acquisition software. Profile R2 was acquired in roll-along mode to achieve continuous depth across the profile.

During 2D-Resistivity surveying data is acquired in the form of linear profiles using a suite of metal electrodes. A current is injected into the ground via a pair of electrodes while a potential difference is measured across a second pair of electrodes. This allows for the recording of the apparent resistivity in a two-dimensional arrangement below the profile. The data is inverted after the survey to obtain a model of subsurface resistivities. The generated model resistivity values and their spatial distribution can then be related to typical values for different geological and manmade materials.

The penetration depth of a resistivity profile increases towards the centre where it reaches an approx. value of $1/6^{\text{th}}$ of the layout length.

2.4 Seismic Refraction

Seismic refraction profiles were surveyed with geophone spacing of 3 m and 24 geophones per set-up resulting in a 69 m length per set-up. The recording equipment consisted of a 24 Channel GEOMETRICS ES-3000 engineering seismograph with 4.5 Hz vertical geophones. The seismic energy source consisted of a hammer and plate. A zero-delay trigger was used to start the recording. Normally 7 shot points per p-wave profile were used.

Set-ups were acquired in longer continuous profiles using common shot points between set-ups and concatenating into longer profiles at the processing stage.

In the seismic refraction survey method, a p-wave is generated by a source at the surface resulting in energy travelling through surface layers directly and along boundaries between layers of differing seismic wave velocities. Processing of the seismic data allows geological layer thicknesses and boundaries to be established.

Seismic Refraction generally determines the depth to horizontal or near horizontal layers where the compaction/strength/rock quality changes with an accuracy of 10 – 20% of depth to that layer. Where low velocity layers or shadow zones are present (e.g. below solid ground surface) or where layers dip with more than 20 degrees angle the accuracy becomes much less.

2.5 Site Work

The data acquisition was carried out on the 21st May and 9th of June 2020. The weather conditions were variable throughout the acquisition period. Health and safety standards were adhered to at all times. The locations and elevations were surveyed with a Carlson NR3 RTK-GPS to accuracy < 0.05 m.

3. RESULTS AND INTERPRETATION

The interpretation of geophysical data was carried out utilising the known response of geophysical measurements, typical physical parameters for subsurface features that may underlay the site, and the experience of the authors.

Direct ground investigations were provided after the survey. Five trial pits were carried out over the identified landfill area. Four of these were terminated at the geo-composite clay liner overlying the landfill at a depth of 0.2 – 0.4 m. TP04 was carried out in a corner of the landfill and identified waste to a depth of 2 m below ground level before being terminated.

3.1 EM31 Ground Conductivity

The EM31 ground conductivity values were merged into one data file for the survey area and contoured and gridded with the SURFER contouring package. The contours are created by gridding and interpolation and care must be taken when using the data. The contour map is overlaid over the location and base map (Map 2) and the values in milliSiemens/metre (mS/m) are indicated on the colour scale bar.

Within the top 6 m bgl, the conductivities are characteristic for certain overburden and rock types. If there is a high content of clay minerals (which are electrically conductive) then the overburden conductivity will be higher than as if there is a high content of clastic grains like sand or gravel. The purer the clay and the lower the sand/gravel content the higher the conductivity. The water content in the overburden also influences the conductivity but generally the clay content has a larger effect.

Non-natural material like waste or leachate will generally have a high conductivity or increase the conductivity of the natural geological material. Many waste materials decompose or dissolve in the ground and enrich the ground and water with ions, which increase the conductivity and decrease the resistivity. Waste material from domestic or commercial and industrial (C&I) sources generally contain more decomposable or dissolvable material than waste from construction or demolition (C&D). Therefore domestic or C&I Waste will have lower resistivities and higher conductivities than C&D waste.

The scale used on this site represents the very high conductivity results surveyed throughout the site. The highest conductivities are found in the centre of the site where conductivities are typically above 60 mS/m. Very high conductivities indicate deep domestic or C&I waste material. Around the edge of the site the conductivities begin to decrease. Conductivities between 20 – 30 mS/m would indicate some waste material, while conductivities of less than 20 mS/m which are only found on the periphery of the site would usually indicate soil and rock fill, natural material or C&D waste.

3.2 2D-Resistivity

The 2D-Resistivity data was positioned and inverted with the RES2DINV inversion package. The programme uses a smoothness constrained least-squares inversion method to produce a 2D model of the subsurface model resistivities from the recorded apparent resistivity values. Three variations of the least squares method are available and for this project the Jacobian Matrix was recalculated for the first three iterations, then a Quasi-Newton approximation was used for subsequent iterations. Each dataset was inverted using seven iterations resulting in a typical RMS error of <3.0%. The resulting models were colour contoured with the same resistivity scale for all profiles and they are displayed as cross sections (Figure 1). A vertical exaggeration of 4 is used for the sections.

The resistivities are the inverse value of the conductivities therefore remarks made above for the conductivity are also valid for the resistivity. It has to be considered that the conductivity is determined as a single bulk value for a depth range from 0 - 6 m bgl while the 2D-Resistivity method determines the values based on depth levels.

Both profiles show a rapid change with depth from low resistivities to high resistivities at approx. 30 mOD. Low resistivities (<62.5 Ohm) indicate mainly domestic or C&I waste material or leachate but may also indicate clay-rich or peat overburden. High resistivities (>500 Ohmm) at depth indicate fresh limestone. Both profiles are laterally consistent which indicates domestic or C&I waste throughout the site.

Profile R1 has low – medium conductivities at depth. This may indicate a karst feature or leachate penetrating into the rock layer. It may also be an artificial effect of the very low resistivities above it and sharp topography along the surface.

3.3 Seismic Refraction

The p-wave seismic velocity is closely linked to the density of subsurface materials and to parameters like compaction, stiffness, strength and rock quality. The higher the density of the subsurface materials the higher the seismic velocity. Similarly, for the other parameters it is generally valid that a more compacted, stiffer and stronger material will have a higher seismic velocity. For rock, the seismic velocity is higher when the rock is stronger, less weathered and has a higher quality. If the rock is more weathered, broken, fractured, fissured or karstified then the seismic velocity will be reduced compared to that of intact fresh rock.

The seismic refraction data was positioned and processed with the SEISIMAGER software package. The data shows very low seismic velocities near the surface but did not identify any higher velocity layers within the parameters of the survey. This occurs typically when the waste material is generally greater than 5 m thick. Velocities were determined for the ground below the surface and these are annotated on the sections on Figure 1.

3.4 Interpretation of Resistivity and Seismic Refraction

The seismic refraction and 2D-Resistivity provide information on two physical parameters of the waste material, however as discussed above the waste material may share some of these physical parameters with other material. Therefore, by using both methods together a clearer picture of the waste body is obtained.

Waste material generally consists of low velocity, low resistivity material. The 2D-Resistivity data and the seismic refraction data shows low velocities and resistivities near the surface across the survey area. Historic maps do not show any development on the site previous to it being a landfill and it is assumed the waste was dumped on the surface rather than in an excavation. The surrounding elevations are around 35 – 39 mOD which is the assumed depth of the landfill. This gives a waste layer which is up to 10 m thick near the middle of the site but becomes very thin near the edges where the topography drops off.

Where low resistivities continue below this, it is an indication of leachate in the natural ground below the landfill. The low resistivities below the landfill may also be due to clay-rich or peat overburden.

High resistivities beginning at between 25 and 30 mOD along both profiles give an indication of rock depth as the seismic refraction model do not penetrate to this depth. The high resistivities are interpreted as good limestone with no leachate.

Along Profile R1, low – medium resistivities at depth may indicate leachate in the rock layer, karstified rock or it may be an artificial effect from the strong topographical gradient on the surface and the fact that the profile does not reach the natural ground around the landfill.

Table 2 summarises the interpretation. Interpreted cross sections are shown in Figure 2. The interpretation has been made from all available information. The resistivity models have been used to delineate between waste and natural material and the depth to rock. Resistivity data is better suited to show rock types and features within the rock while seismic refraction velocities are indicating the change of compaction, stiffness or rock quality with depth.

Table 2: Summary of Interpretation

Layer	General Seismic Velocity Range (m/sec)	General Resistivity Range (Ohmm)	Interpretation
1	200	<62.5	Waste (Mainly Domestic or C&I Waste)
2	700	>62.5	Overburden with Leachate
3a	N/A	>500 (At Depth)	Fresh Limestone
3b	N/A	<500 (At Depth)	Karstified Limestone, Leachate within Limestone or Artificial Effect

4. CONCLUSIONS AND RECOMMENDATIONS

Geological Background

The geophysical survey indicates the landfill is underlain by overburden over fresh limestone. The overburden material below the waste material is approx. 9 m thick and could contain any material like peat, clay or sand and gravel. The fresh limestone should restrict the movement of leachate below the waste and overburden however low resistivities along profile R1 may indicate leachate penetration towards the west of the site.

Lateral extent of waste and landfill boundary

The area outlined in orange on Map 3 shows the interpreted extent of the landfill using all the information available. The interpreted landfill extent covers an area of approx. 23,300 m². The extent of the site to the surrounding drain covers an area of 27,700m².

Vertical extent (depth) of waste

The thickness/depth has been estimated from the seismic refraction and 2D-Resistivity data. Considering the thickness of the interpreted Layer 1, an average thickness of 8 m has been calculated for the waste material. This estimate includes any capping or natural fill material on top of the main waste body.

Including the layer of overburden below the landfill containing leachate (Layer 2), the total depth of waste and leachate reaches an average of 17 m bgl.

Volume of waste

Considering the areas and average thickness above, the volume of the waste body is estimated at 186,400 m³.

Nature of waste

Low resistivities and seismic velocities measured are consistent with domestic or commercial & industrial (C&I) waste throughout of the landfill.

Capping layer

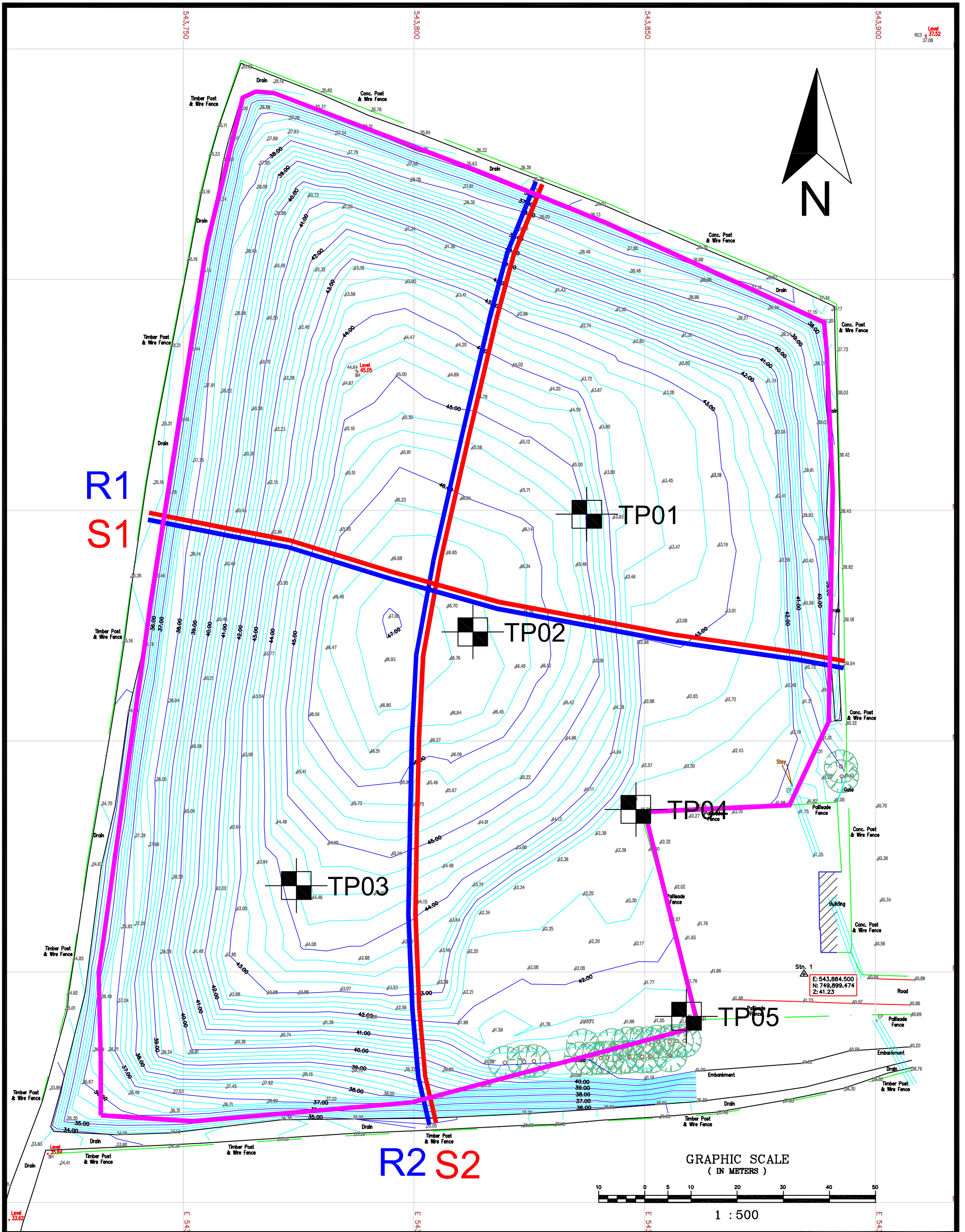
The geophysical survey does not show any significant natural material over the landfill. Trial pits have determined there is a geo-composite clay liner overlying the landfill at a depth of 0.2 – 0.4 m.

Leachate

Low resistivities below the waste body is interpreted as likely leachate. The fresh limestone below this layer should generally restrict the leachate movement but there may be leachate penetration into the rock along profile R1.

5. REFERENCES

1. **GSEG 2002.** Geophysics in Engineering Investigations. Geological Society Engineering Geology Special Publication 19, London, 2002.
2. **GSI, 2019.** Online Bedrock Geological Map of Ireland. Geological Survey of Ireland 2019.
3. **Milsom, 1989.** Field Geophysics. John Wiley and Sons.
4. **Reynolds, 1997.** An Introduction to Applied and Environmental Geophysics. John Wiley and Son.



Minerex
Geophysics Limited

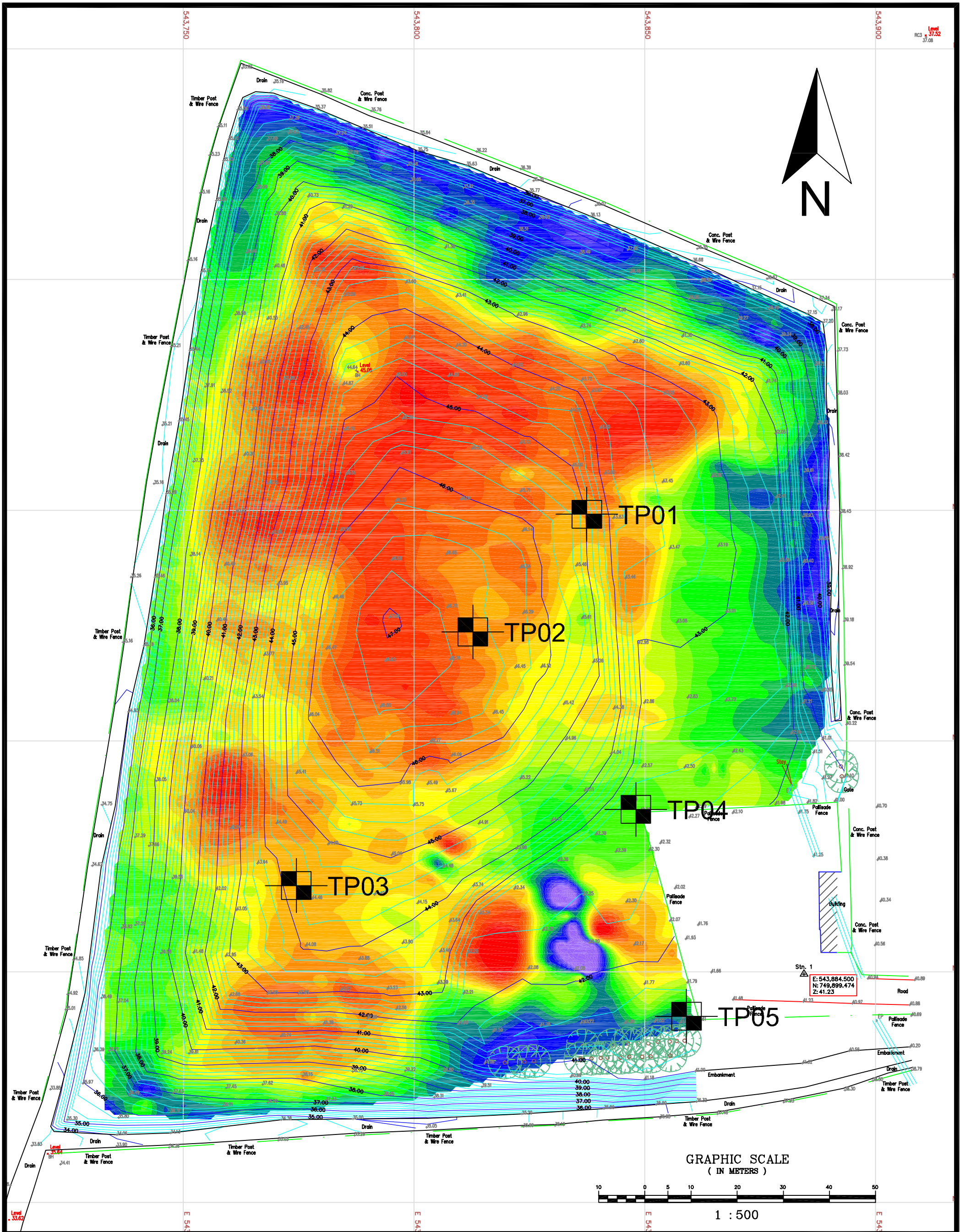
Unit F4, Maynooth Business Campus
Maynooth, Co. Kildare
Tel. (01) 6510030
Email: info@mgx.ie
Web: www.mgx.ie

CLIENT	FTCO
PROJECT	Tuam Historic Landfill Geophysical Survey
TITLE	Map 1: Geophysical Survey Location Map

SCALE:	1:750 @ A3
PROJECT:	6499
DRAWN:	JC
DATE:	22/05/2020
MGX FILE:	6499f_Tuam_MapsFigs.dwg
STATUS:	Final

LEGEND: Geophysical Survey Locations:

	R2	2D-Resistivity Profile
	S1	Seismic Refraction Profile
		EM31 Survey Area



Minerex
Geophysics Limited

Unit F4, Maynooth Business Campus
Maynooth, Co. Kildare
Tel. (01) 6510030
Email: info@mgx.ie
Web: www.mgx.ie

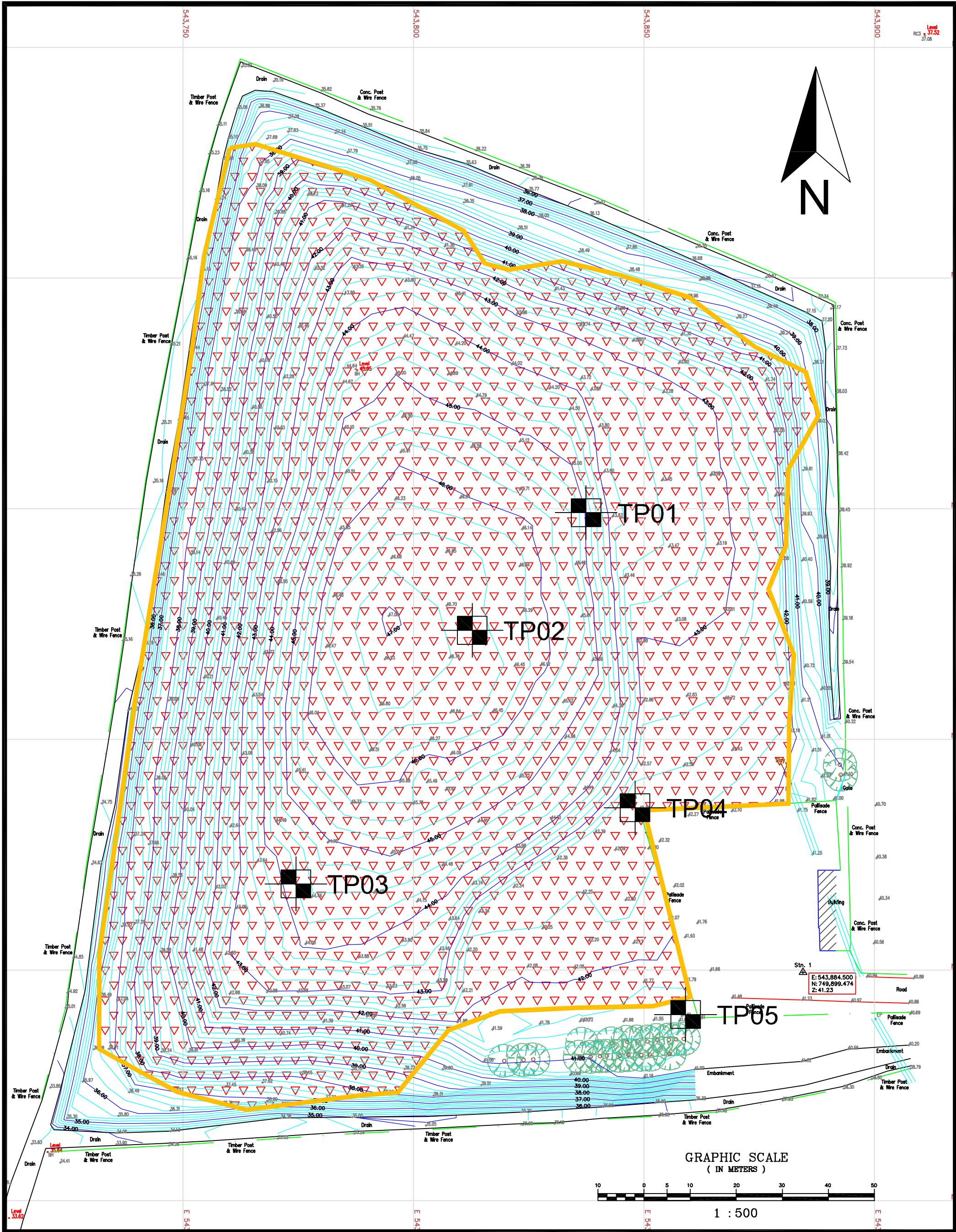
CLIENT	FTCO
PROJECT	Tuam Historic Landfill Geophysical Survey
TITLE	Map 2: EM31 Ground Conductivity Contour Map

SCALE:	1:750 @ A3
PROJECT:	6499
DRAWN:	JC
DATE:	22/05/2020
MGX FILE:	6499f_Tuam_MapsFigs.dwg
STATUS:	Final

LEGEND: EM31 Ground Conductivity Values:

0 10 20 30 40 50 60 70 80 90 100

The map shows the EM31 ground conductivity contours mS/m. The low (blue) conductivities indicate the no waste material. The middle range (green) values indicates some waste material. The high (red) values indicates the deepest waste area.



Minerex
Geophysics Limited

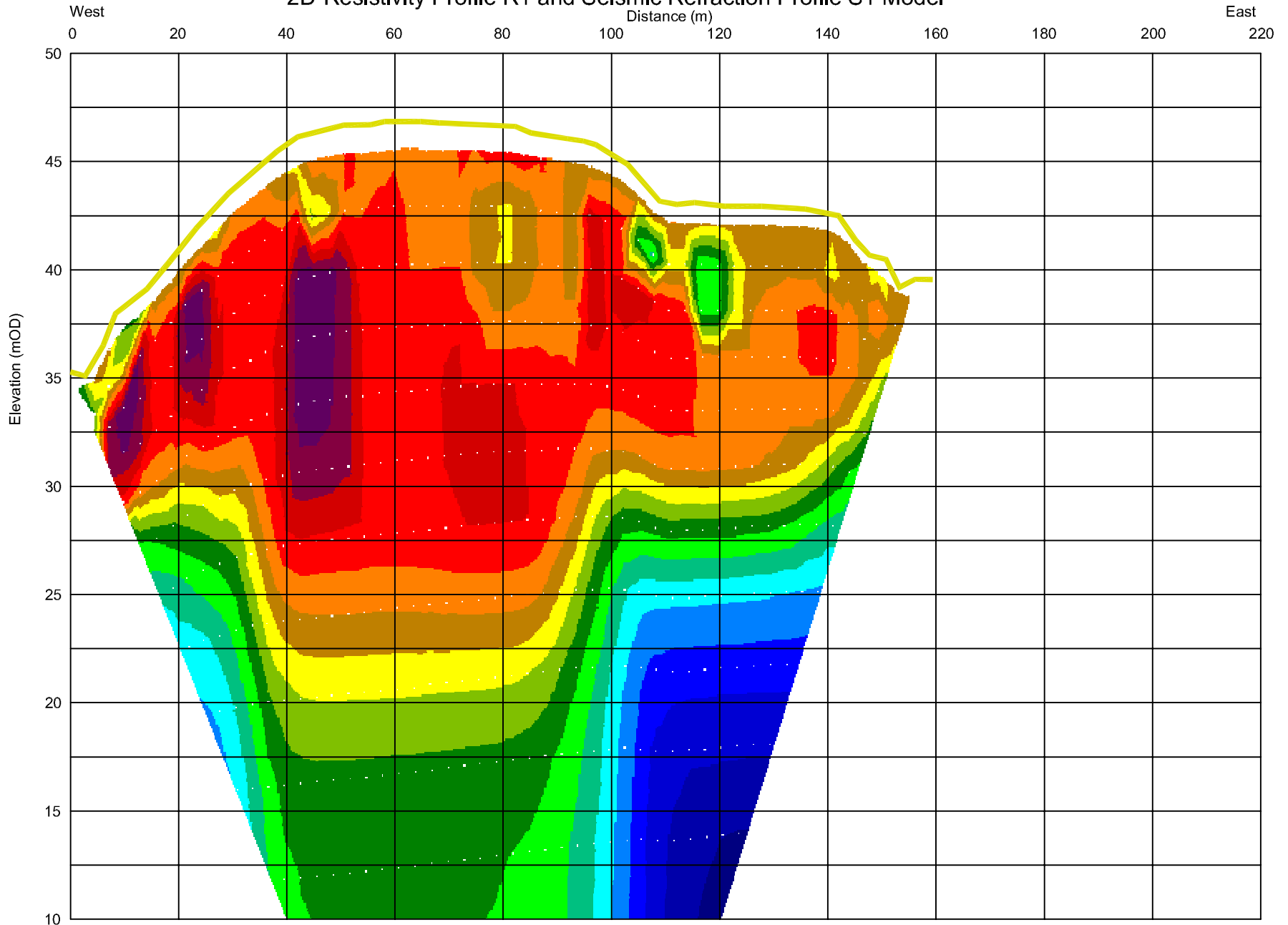
Unit F4, Maynooth Business Campus
Maynooth, Co. Kildare
Tel. (01) 6510030
Email: info@mgx.ie
Web: www.mgx.ie

CLIENT	FTCO
PROJECT	Tuam Historic Landfill Geophysical Survey
TITLE	Map 3: Geophysical Survey Interpretation Map

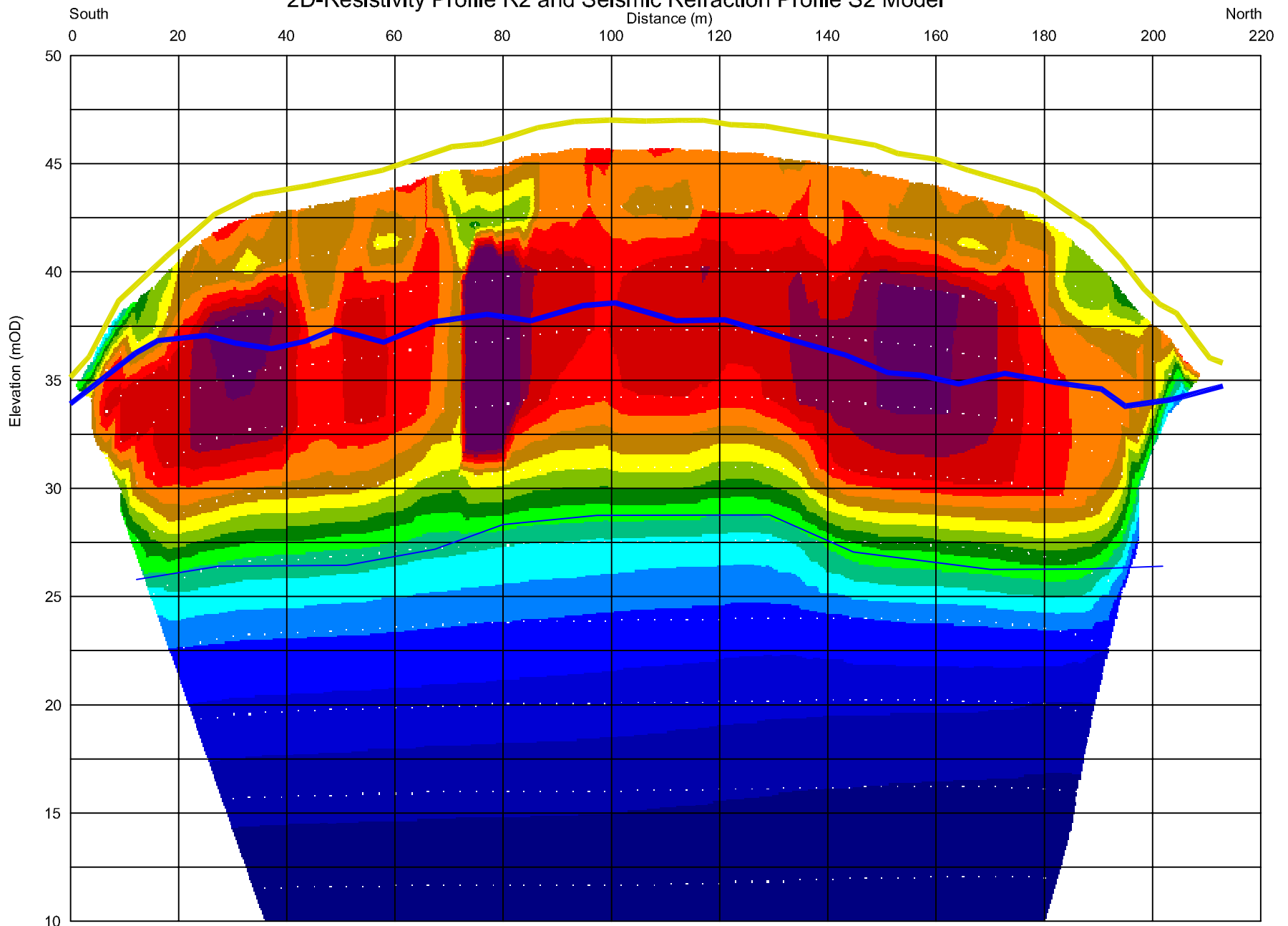
SCALE:	1:750 @ A3
PROJECT:	6499
DRAWN:	JC
DATE:	22/05/2020
MGX FILE:	6499f_Tuam_MapsFigs.dwg
STATUS:	Final

LEGEND:	Geophysical Interpretation:
	Extent of domestic or C&I Waste

2D-Resistivity Profile R1 and Seismic Refraction Profile S1 Model



2D-Resistivity Profile R2 and Seismic Refraction Profile S2 Model



Minerex
Geophysics Limited
Unit F4, Maynooth Business Campus
Maynooth, Co. Kildare
Tel. (01) 6510030
Email: info@mgx.ie
Web: www.mgx.ie

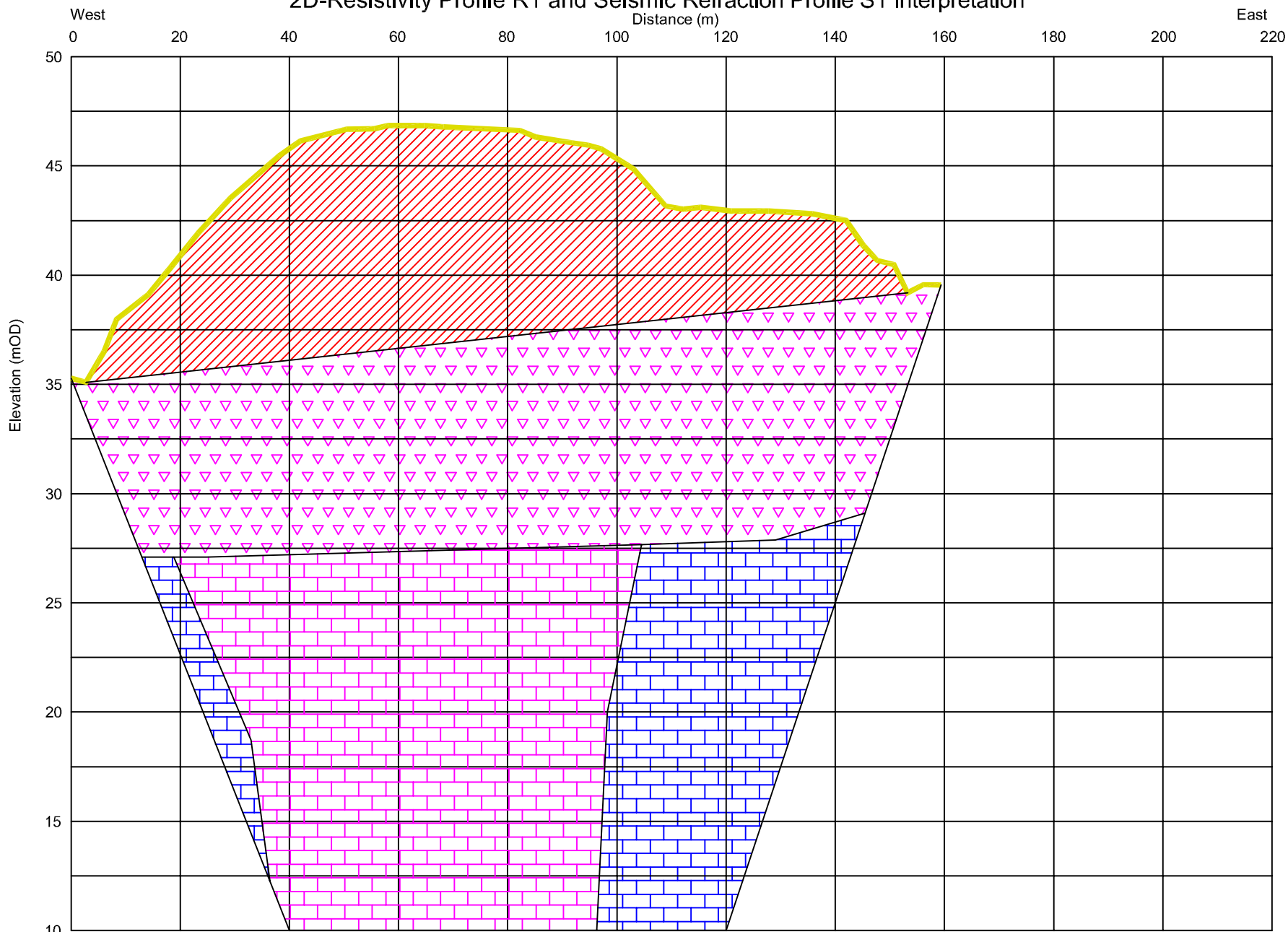
CLIENT FTCO
PROJECT Tuam Historic Landfill
Geophysical Survey
TITLE Figure 1: Models of
Geophysical Survey

SCALE: 1:1000 @ A3
PROJECT: 6499
DRAWN: JC
DATE: 22/06/2020
MGX FILE: 6499f_Tuam_MapsFigs.dwg
STATUS: Final

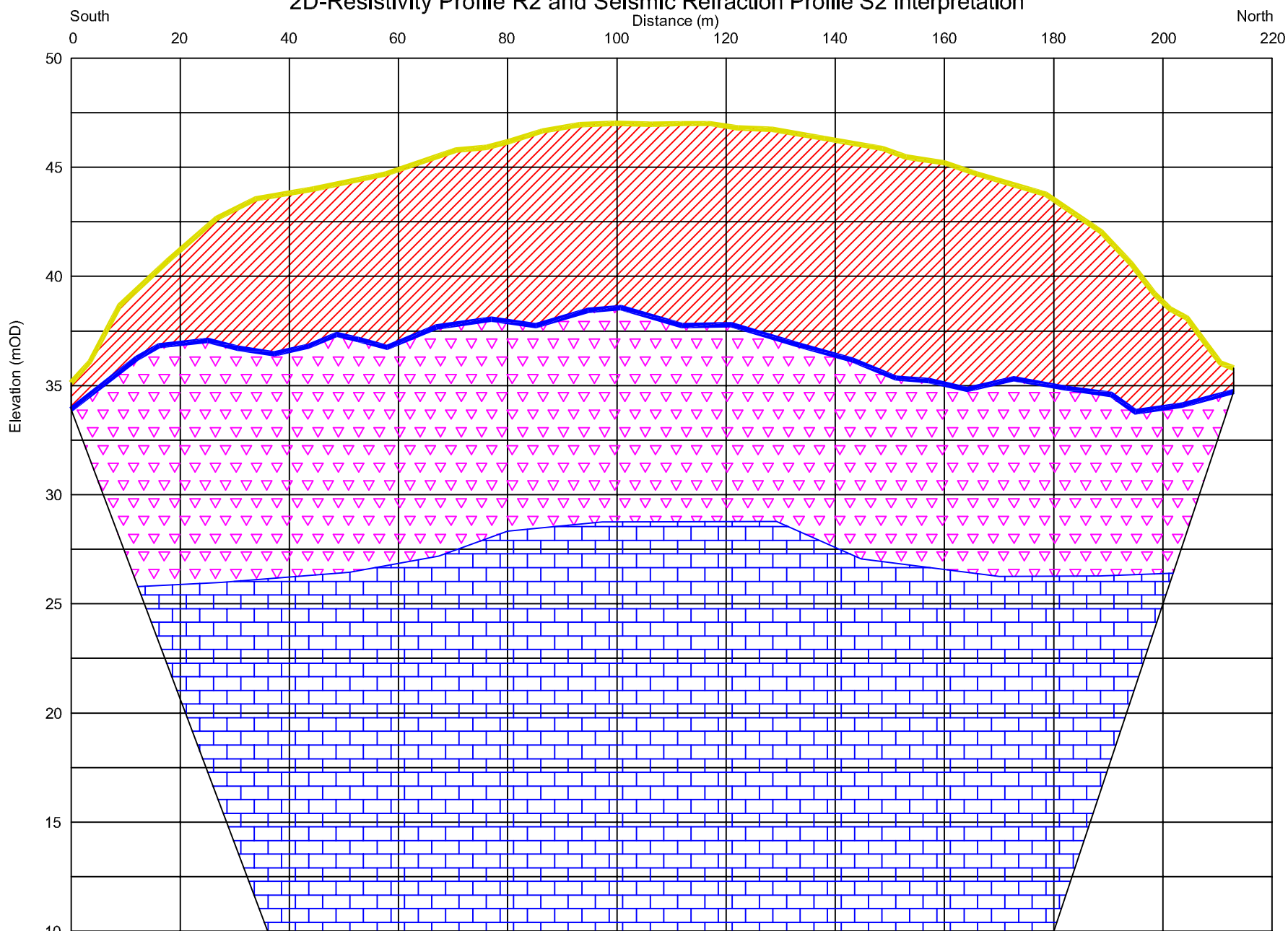
LEGEND: Layers from Seismic Refraction Model:
— Ground Surface/Top of Layer 1 (200 m/s)
— Top of Layer 2 (700 m/s)

2D-Resistivity Model Values:
7.82 15.6 31.3 62.5 125 250 500 1000

2D-Resistivity Profile R1 and Seismic Refraction Profile S1 Interpretation



2D-Resistivity Profile R2 and Seismic Refraction Profile S2 Interpretation



Minerex
Geophysics Limited
Unit F4, Maynooth Business Campus
Maynooth, Co. Kildare
Tel. (01) 6510030
Email: info@mgx.ie
Web: www.mgx.ie

CLIENT FTCO
PROJECT Tuam Historic Landfill
Geophysical Survey
TITLE Figure 2: Interpretation of
Geophysical Survey

SCALE: 1:1000 @ A3
PROJECT: 6499
DRAWN: JC
DATE: 22/06/2020
MGX FILE: 6499f_Tuam_MapsFigs.dwg
STATUS: Final

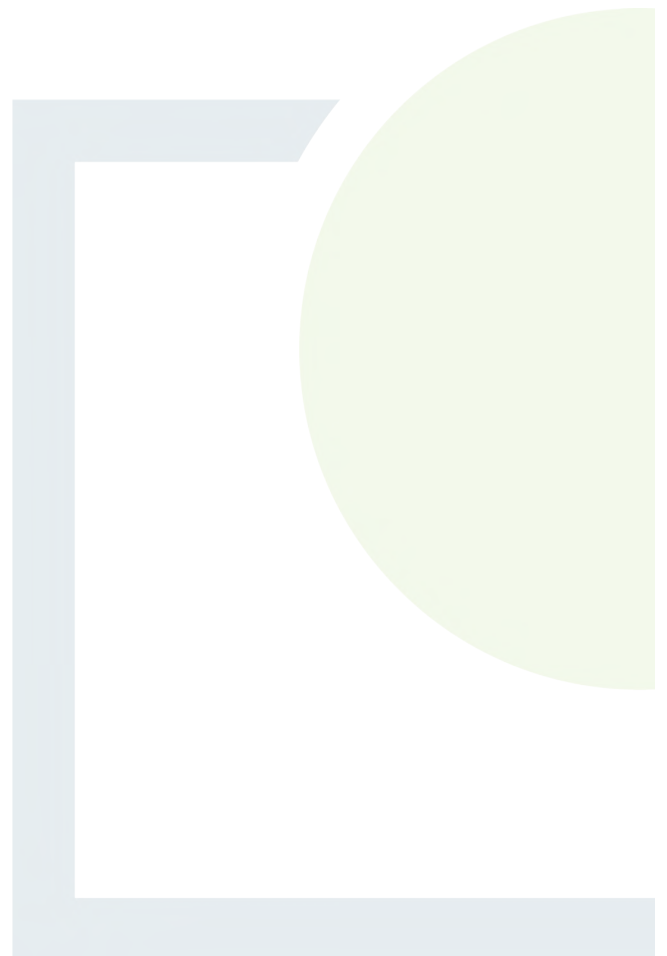
LEGEND:
Interpretation:
1 Waste (Mainly domestic or C&I Waste)
2 Overburden with Leachate
3a Fresh Limestone
3b Karstified Limestone, Leachate within Limestone or Artificial Effect



CONSULTANTS IN ENGINEERING,
ENVIRONMENTAL SCIENCE
& PLANNING

APPENDIX 10

Updated Figure 4.2 'Surface
Water Sampling Locations'

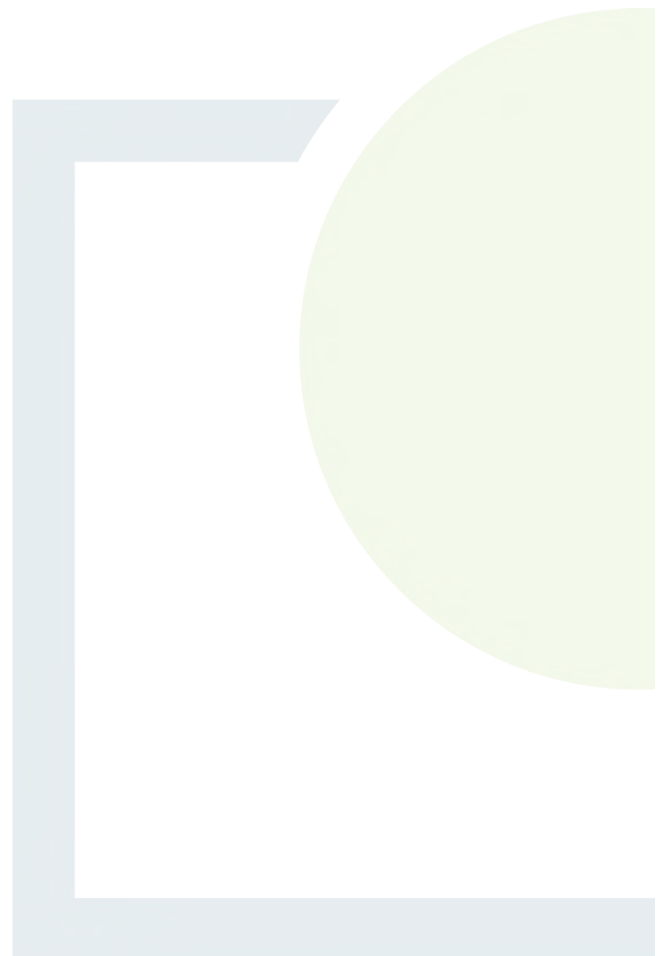




CONSULTANTS IN ENGINEERING,
ENVIRONMENTAL SCIENCE
& PLANNING

APPENDIX 11

Certificate of Analysis –
Surface Water Monitoring





Unit 7-8 Hawarden Business Park
Manor Road (off Manor Lane)
Hawarden
Deeside
CH5 3US

Tel: (01244) 528777

email: hawardencustomerservices@alsglobal.com

Website: www.alsenvironmental.co.uk

Fehily Timoney
3rd Floor
North Park Offices
North Park Business Park
North Road
Dublin
Dublin 11

Attention: Daniel Hayden

CERTIFICATE OF ANALYSIS

Date of report Generation:	17 June 2022
Customer:	Fehily Timoney
Sample Delivery Group (SDG):	220606-22
Your Reference:	Galway Historic Landfills P22-040
Location:	Tuam Landfill
Report No:	651143
Order Number:	Z3385

We received 4 samples on Monday June 06, 2022 and 4 of these samples were scheduled for analysis which was completed on Friday June 17, 2022. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

Should this report require incorporation into client reports, it must be used in its entirety and not simply with the data sections alone.

Chemical testing (unless subcontracted) performed at ALS Life Sciences Ltd Hawarden.

All sample data is provided by the customer. The reported results relate to the sample supplied, and on the basis that this data is correct.

Incorrect sampling dates and/or sample information will affect the validity of results.

The customer is not permitted to reproduce this report except in full without the approval of the laboratory.

Approved By:

Sonia McWhan

Operations Manager





CERTIFICATE OF ANALYSIS

Validated

SDG: 220606-22

Report Number: 651143

Superseded Report:

Client Ref.: Galway Historic Landfills P22-040

Location: Tuam Landfill

Received Sample Overview

Lab Sample No(s)	Customer Sample Ref.	AGS Ref.	Depth (m)	Sampled Date
26388595	SW1		0.00 - 0.00	31/05/2022
26388621	SW2		0.00 - 0.00	31/05/2022
26388645	SW3		0.00 - 0.00	31/05/2022
26388663	SW4		0.00 - 0.00	31/05/2022

Only received samples which have had analysis scheduled will be shown on the following pages.



CERTIFICATE OF ANALYSIS

Validated

SDG: 220606-22
 Client Ref.: Galway Historic Landfills P22-040

Report Number: 651143
 Location: Tuam Landfill

Superseded Report:

Results Legend

- X Test
- N No Determination Possible

Sample Types -

- S - Soil/Solid
- UNS - Unspecified Solid
- GW - Ground Water
- SW - Surface Water
- LE - Land Leachate
- PL - Prepared Leachate
- PR - Process Water
- SA - Saline Water
- TE - Trade Effluent
- TS - Treated Sewage
- US - Untreated Sewage
- RE - Recreational Water
- DW - Drinking Water Non-regulatory
- UNL - Unspecified Liquid
- SL - Sludge
- G - Gas
- OTH - Other

Lab Sample No(s)	Customer Sample Reference	AGS Reference	Depth (m)	Container											Sample Type			
				0.5l glass bottle (ALE227)	250ml BOD (ALE212)	500ml Plastic (ALE208)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)	NaOH (ALE245)	Vial (ALE297)	0.5l glass bottle (ALE227)	250ml BOD (ALE212)	500ml Plastic (ALE208)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)	NaOH (ALE245)	Vial (ALE297)	SW
26388595	SW1		0.00 - 0.00															
26388621	SW2		0.00 - 0.00															
26388645	SW3		0.00 - 0.00															

Acid Herbicides by GCMS	All	NDPs: 0 Tests: 4	X					X					X				
Alkalinity as CaCO3	All	NDPs: 0 Tests: 4	X					X					X				
Ammonium Low	All	NDPs: 0 Tests: 4			X					X						X	
Anions by Kone (w)	All	NDPs: 0 Tests: 4			X					X						X	
BOD True Total	All	NDPs: 0 Tests: 4		X					X					X			
COD Unfiltered	All	NDPs: 0 Tests: 4		X					X					X			
Cyanide Comp/Free/Total/Thiocyanate	All	NDPs: 0 Tests: 4						X					X				
Dissolved Metals by ICP-MS	All	NDPs: 0 Tests: 4						X					X				X
Dissolved Oxygen by Probe	All	NDPs: 0 Tests: 4			X					X					X		
Fluoride	All	NDPs: 0 Tests: 4			X					X					X		
Mercury Dissolved	All	NDPs: 0 Tests: 4						X					X				X
PCB Congeners - Aqueous (W)	All	NDPs: 0 Tests: 4			X					X					X		
Pesticides (Suite I) by GCMS	All	NDPs: 0 Tests: 4	X							X					X		
Pesticides (Suite II) by GCMS	All	NDPs: 0 Tests: 4	X							X					X		
Pesticides (Suite III) by GCMS	All	NDPs: 0 Tests: 4	X							X					X		

26388663	SW4	0.00 - 0.00	Vial (ALE297)	SW																					
			NaOH (ALE245)	SW								X													
			HNO3 Filtered (ALE204)	SW									X												
			H2SO4 (ALE244)	SW				X																	
			500ml Plastic (ALE208)	SW					X																
			250ml BOD (ALE12)	SW						X															
26388645	SW3	0.00 - 0.00	0.5l glass bottle (ALE227)	SW								X													
			Vial (ALE297)	SW									X												
			NaOH (ALE245)	SW													X								



CERTIFICATE OF ANALYSIS

Validated

SDG: 220606-22
Client Ref.: Galway Historic Landfills P22-040

Report Number: 651143
Location: Tuam Landfill

Superseded Report:

Results Legend

- X Test
- N No Determination Possible

Sample Types -

- S - Soil/Solid
- UNS - Unspecified Solid
- GW - Ground Water
- SW - Surface Water
- LE - Land Leachate
- PL - Prepared Leachate
- PR - Process Water
- SA - Saline Water
- TE - Trade Effluent
- TS - Treated Sewage
- US - Untreated Sewage
- RE - Recreational Water
- DW - Drinking Water Non-regulatory
- UNL - Unspecified Liquid
- SL - Sludge
- G - Gas
- OTH - Other

Results Legend	Lab Sample No(s)		Customer Sample Reference		AGS Reference		Depth (m)		Container												Sample Type			
	263886995	263886921	263886445	SW1	SW2	SW3	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00	HNO3 Filtered (ALE204)	H2SO4 (ALE244)	500ml Plastic (ALE208)	250ml BOD (ALE212)	0.5l glass bottle (ALE227)	Vial (ALE297)	NaOH (ALE245)	HNO3 Filtered (ALE204)	H2SO4 (ALE244)	500ml Plastic (ALE208)	250ml BOD (ALE212)	0.5l glass bottle (ALE227)	SW		
pH Value	All																							
SVOC MS (W) - Aqueous	All																							
Total Organic and Inorganic Carbon	All																							
VOC MS (W)	All																							

26388663	SW4	0.00 - 0.00	Vial (ALE297)	SW						X
			NaOH (ALE245)	SW						
			HNO3 Filtered (ALE204)	SW						
			H2SO4 (ALE244)	SW						
			500ml Plastic (ALE208)	SW	X					
			250ml BOD (ALE212)	SW						
			0.5l glass bottle (ALE227)	SW		X				
26388645	SW3	0.00 - 0.00	Vial (ALE297)	SW						X
			NaOH (ALE245)	SW						



CERTIFICATE OF ANALYSIS

Validated

SDG: 220606-22
Client Ref.: Galway Historic Landfills P22-040

Report Number: 651143
Location: Tuam Landfill

Superseded Report:

Results Legend		Customer Sample Ref.	SW1	SW2	SW3	SW4		
# ISO17025 accredited. M mCERTS accredited. aq Aqueous / settled sample. diss.filt Dissolved / filtered sample. tot.unfilt Total / unfiltered sample. * Subcontracted - refer to subcontractor report for accreditation status. ** % recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery (F) Trigger breach confirmed 1-4*\$@ Sample deviation (see appendix)		Depth (m) Sample Type Date Sampled Sample Time Date Received SDG Ref Lab Sample No.(s) AGS Reference	0.00 - 0.00 Surface Water (SW) 31/05/2022	0.00 - 0.00 Surface Water (SW) 31/05/2022	0.00 - 0.00 Surface Water (SW) 31/05/2022	0.00 - 0.00 Surface Water (SW) 31/05/2022		
Component	LOD/Units	Method						
Alkalinity, Total as HCO3	<2 mg/l	TM043	492	422	434	425		
BOD, unfiltered	<1 mg/l	TM045	<1	<1	<1	<1	@ #	@ #
Oxygen, dissolved	<0.3 mg/l	TM046	10.1	6.07	6.81	11.4		
Organic Carbon, Total	<3 mg/l	TM090	9.75	11.2	11.3	11.7	@ #	@ #
Ammoniacal Nitrogen as N (low level)	<0.01 mg/l	TM099	0.0537	0.139	0.0285	0.0297	#	#
Fluoride	<0.5 mg/l	TM104	<0.5	<0.5	<0.5	<0.5		
COD, unfiltered	<7 mg/l	TM107	17.9	35.5	25.1	29	#	#
Arsenic (diss.filt)	<0.5 µg/l	TM152	0.863	1.12	1.04	1.15	#	#
Barium (diss.filt)	<0.2 µg/l	TM152	17.7	20.7	24.4	25.4	#	#
Boron (diss.filt)	<10 µg/l	TM152	<10	<10	17.5	14.9	#	#
Cadmium (diss.filt)	<0.08 µg/l	TM152	<0.08	<0.08	<0.08	<0.08	#	#
Chromium (diss.filt)	<1 µg/l	TM152	<1	<1	<1	<1	#	#
Copper (diss.filt)	<0.3 µg/l	TM152	6.16	0.4	0.442	0.731	#	#
Lead (diss.filt)	<0.2 µg/l	TM152	<0.2	<0.2	<0.2	<0.2	#	#
Manganese (diss.filt)	<3 µg/l	TM152	49.6	50.3	35.3	12.5	#	#
Nickel (diss.filt)	<0.4 µg/l	TM152	3.95	2.71	2.89	2.78	#	#
Phosphorus (diss.filt)	<10 µg/l	TM152	66.4	14.3	13.3	13.8	#	#
Selenium (diss.filt)	<1 µg/l	TM152	<1	<1	<1	<1	#	#
Thallium (diss.filt)	<2 µg/l	TM152	<2	<2	<2	<2	#	#
Zinc (diss.filt)	<1 µg/l	TM152	3.55	2.1	4.06	2.72	#	#
Sodium (Dis.Filt)	<0.076 mg/l	TM152	9.73	11.1	13.9	13.9	#	#
Magnesium (Dis.Filt)	<0.036 mg/l	TM152	7.88	7.13	8.07	7.92	#	#
Potassium (Dis.Filt)	<0.2 mg/l	TM152	2.64	0.547	1.37	0.93	#	#
Calcium (Dis.Filt)	<0.2 mg/l	TM152	159	132	132	132	#	#
Iron (Dis.Filt)	<0.019 mg/l	TM152	0.19	0.198	0.212	0.21	#	#
Mercury (diss.filt)	<0.01 µg/l	TM183	<0.01	<0.01	<0.01	<0.01		
Sulphate	<2 mg/l	TM184	9.9	<2	<2	<2	#	#
Chloride	<2 mg/l	TM184	20.3	20.1	24.6	23	#	#
Total Oxidised Nitrogen as N	<0.1 mg/l	TM184	0.265	0.126	0.22	<0.1	#	#
PCB congener 28	<0.015 µg/l	TM197	<0.015	<0.015	<0.015	<0.015		
PCB congener 52	<0.015 µg/l	TM197	<0.015	<0.015	<0.015	<0.015		
PCB congener 101	<0.015 µg/l	TM197	<0.015	<0.015	<0.015	<0.015		
PCB congener 118	<0.015 µg/l	TM197	<0.015	<0.015	<0.015	<0.015		



CERTIFICATE OF ANALYSIS

Validated

SDG: 220606-22
Client Ref.: Galway Historic Landfills P22-040

Report Number: 651143
Location: Tuam Landfill

Superseded Report:

Results Legend		Customer Sample Ref.	SW1	SW2	SW3	SW4		
# ISO17025 accredited. M mCERTS accredited. aq Aqueous / settled sample. dis.filt Dissolved / filtered sample. tot.unfilt Total / unfiltered sample. * Subcontracted - refer to subcontractor report for accreditation status. ** % recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery. (F) Trigger breach confirmed 1-4* Sample deviation (see appendix)		Depth (m) Sample Type Date Sampled Sample Time Date Received SDG Ref Lab Sample No.(s) AGS Reference	0.00 - 0.00 Surface Water (SW) 31/05/2022	0.00 - 0.00 Surface Water (SW) 31/05/2022	0.00 - 0.00 Surface Water (SW) 31/05/2022	0.00 - 0.00 Surface Water (SW) 31/05/2022		
Component	LOD/Units	Method						
PCB congener 138	<0.015 µg/l	TM197	<0.015	<0.015	<0.015	<0.015		
PCB congener 153	<0.015 µg/l	TM197	<0.015	<0.015	<0.015	<0.015		
PCB congener 180	<0.015 µg/l	TM197	<0.015	<0.015	<0.015	<0.015		
Sum of detected EC7 PCB's	<0.105 µg/l	TM197	<0.105	<0.105	<0.105	<0.105		
Cyanide, Total	<0.05 mg/l	TM227	<0.05	<0.05	<0.05	<0.05		
pH	<1 pH Units	TM256	7.79	7.84	7.88	8.07	#	#
Conductivity @ 20 deg.C	<0.02 mS/cm	TM256	0.693	0.608	0.627	0.615	#	#
Trifluralin	<0.01 µg/l	TM343	<0.01	<0.01	<0.01	<0.015		
alpha-HCH	<0.01 µg/l	TM343	<0.01	<0.01	<0.01	<0.015		
gamma-HCH (Lindane)	<0.01 µg/l	TM343	<0.01	<0.02	<0.03	<0.015		
Heptachlor	<0.01 µg/l	TM343	<0.01	<0.01	<0.01	<0.015		
Aldrin	<0.01 µg/l	TM343	<0.01	<0.01	<0.01	<0.015		
beta-HCH	<0.01 µg/l	TM343	<0.01	<0.01	<0.01	<0.015		
Isodrin	<0.01 µg/l	TM343	<0.01	<0.01	<0.01	<0.015		
delta-HCH	<0.01 µg/l	TM343	<0.01	<0.01	<0.01	<0.015		
Heptachlor epoxide	<0.01 µg/l	TM343	<0.01	<0.02	<0.02	<0.015		
o,p'-DDE	<0.01 µg/l	TM343	<0.01	<0.02	<0.02	<0.015		
Endosulphan I	<0.01 µg/l	TM343	<0.01	<0.02	<0.02	<0.015		
trans-Chlordane	<0.01 µg/l	TM343	<0.02	<0.01	<0.01	<0.03		
cis-Chlordane	<0.01 µg/l	TM343	<0.01	<0.01	<0.01	<0.015		
p,p'-DDE	<0.01 µg/l	TM343	<0.01	<0.02	<0.02	<0.015		
Dieldrin	<0.01 µg/l	TM343	<0.01	<0.01	0.0386	<0.015		
o,p'-DDD (TDE)	<0.01 µg/l	TM343	<0.01	<0.01	<0.01	<0.015		
Endrin	<0.01 µg/l	TM343	<0.02	<0.02	<0.02	<0.03		
o,p'-DDT	<0.01 µg/l	TM343	<0.02	<0.02	<0.02	<0.03		
p,p'-DDD (TDE)	<0.01 µg/l	TM343	<0.02	<0.02	<0.02	<0.03		
Endosulphan II	<0.02 µg/l	TM343	<0.02	<0.02	<0.02	<0.03		
p,p'-DDT	<0.01 µg/l	TM343	<0.02	<0.02	<0.02	<0.03		
o,p'-Methoxychlor	<0.01 µg/l	TM343	<0.02	<0.02	<0.02	<0.03		
p,p'-Methoxychlor	<0.01 µg/l	TM343	<0.02	<0.02	<0.02	<0.03		
Endosulphan Sulphate	<0.02 µg/l	TM343	<0.12	<0.02	<0.02	<0.18		
Permethrin I	<0.01 µg/l	TM343	<0.01	<0.01	<0.01	<0.015		
Permethrin II	<0.01 µg/l	TM343	<0.01	<0.01	<0.01	<0.015		



CERTIFICATE OF ANALYSIS

Validated

SDG: 220606-22
Client Ref.: Galway Historic Landfills P22-040

Report Number: 651143
Location: Tuam Landfill

Superseded Report:

Results Legend			Customer Sample Ref.	SW1	SW2	SW3	SW4		
# ISO17025 accredited. M mCERTS accredited. sq Aqueous / settled sample. dis.filt Dissolved / filtered sample. tot.unfilt Total / unfiltered sample. * Subcontracted - refer to subcontractor report for accreditation status. ** % recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery. (F) Trigger breach confirmed 1-4* Sample deviation (see appendix)	Depth (m)		0.00 - 0.00	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00			
	Sample Type		Surface Water (SW)	Surface Water (SW)	Surface Water (SW)	Surface Water (SW)			
	Date Sampled		31/05/2022	31/05/2022	31/05/2022	31/05/2022			
	Sample Time								
	Date Received		06/06/2022	06/06/2022	06/06/2022	06/06/2022			
	SDG Ref		220606-22	220606-22	220606-22	220606-22			
	Lab Sample No.(s)		26388595	26388621	26388645	26388663			
	AGS Reference								
Component	LOD/Units	Method							
1,3,5-Trichlorobenzene	<0.01 µg/l	TM344	<0.02	<0.02	<0.02	<0.02			
Hexachlorobutadiene	<0.01 µg/l	TM344	<0.01	<0.01	<0.01	<0.01			
1,2,4-Trichlorobenzene	<0.01 µg/l	TM344	<0.01	<0.01	<0.01	<0.01			
1,2,3-Trichlorobenzene	<0.01 µg/l	TM344	<0.01	<0.01	<0.01	<0.01			
Dichlorvos	<0.01 µg/l	TM344	<0.01	<0.01	<0.01	<0.01			
Dichlobenil	<0.01 µg/l	TM344	<0.01	<0.01	<0.01	<0.01			
Mevinphos	<0.01 µg/l	TM344	<0.01	<0.01	<0.01	<0.01			
Tecnazene	<0.01 µg/l	TM344	<0.01	<0.01	<0.01	<0.01			
Hexachlorobenzene	<0.01 µg/l	TM344	<0.01	<0.01	<0.01	<0.01			
Demeton-S-methyl	<0.01 µg/l	TM344	<0.01	<0.01	<0.01	<0.01			
Phorate	<0.01 µg/l	TM344	<0.01	<0.02	<0.02	<0.01			
Diazinon	<0.01 µg/l	TM344	<0.01	<0.01	<0.01	<0.01			
Triallate	<0.01 µg/l	TM344	<0.01	<0.01	<0.01	<0.01			
Atrazine	<0.01 µg/l	TM344	<0.01	0.0133	0.013	<0.01			
Simazine	<0.01 µg/l	TM344	<0.01	<0.01	<0.01	<0.01			
Disulfoton	<0.01 µg/l	TM344	<0.01	<0.01	<0.01	<0.01			
Propetamphos	<0.01 µg/l	TM344	<0.01	<0.01	<0.01	<0.01			
Chlorpyrifos-methyl	<0.01 µg/l	TM344	<0.01	<0.01	<0.01	<0.01			
Dimethoate	<0.01 µg/l	TM344	<0.01	<0.01	<0.01	<0.01			
Pirimiphos-methyl	<0.01 µg/l	TM344	<0.01	<0.01	<0.01	<0.01			
Chlorpyrifos	<0.01 µg/l	TM344	<0.01	<0.01	<0.01	<0.01			
Methyl Parathion	<0.01 µg/l	TM344	<0.01	<0.01	<0.01	<0.01			
Malathion	<0.01 µg/l	TM344	<0.01	<0.01	<0.01	<0.01			
Fenthion	<0.01 µg/l	TM344	<0.01	<0.01	<0.01	<0.01			
Fenitrothion	<0.01 µg/l	TM344	<0.01	<0.01	<0.01	<0.01			
Triadimefon	<0.01 µg/l	TM344	<0.01	<0.01	<0.01	<0.01			
Pendimethalin	<0.01 µg/l	TM344	<0.01	<0.01	<0.01	<0.01			
Parathion	<0.01 µg/l	TM344	<0.01	<0.01	<0.01	<0.01			
Chlorfenvinphos	<0.01 µg/l	TM344	<0.01	<0.01	<0.01	<0.01			
trans-Chlordane	<0.01 µg/l	TM344	<0.01	<0.01	<0.01	<0.01			
cis-Chlordane	<0.01 µg/l	TM344	<0.01	<0.01	<0.01	<0.01			
Ethion	<0.01 µg/l	TM344	<0.01	<0.01	<0.01	<0.01			
Carbophenothion	<0.01 µg/l	TM344	<0.01	<0.02	<0.02	<0.01			



CERTIFICATE OF ANALYSIS

Validated

SDG: 220606-22
Client Ref.: Galway Historic Landfills P22-040

Report Number: 651143
Location: Tuam Landfill

Superseded Report:

Results Legend			Customer Sample Ref.	SW1	SW2	SW3	SW4		
# ISO17025 accredited. M mCERTS accredited. sq Aqueous / settled sample. dis.filt Dissolved / filtered sample. tot.unfilt Total / unfiltered sample. * Subcontracted - refer to subcontractor report for accreditation status. ** % recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery. (F) Trigger breach confirmed 1-4*# Sample deviation (see appendix)			Depth (m) Sample Type Date Sampled Sample Time Date Received SDG Ref Lab Sample No.(s) AGS Reference	0.00 - 0.00 Surface Water (SW) 31/05/2022	0.00 - 0.00 Surface Water (SW) 31/05/2022	0.00 - 0.00 Surface Water (SW) 31/05/2022	0.00 - 0.00 Surface Water (SW) 31/05/2022		
Component	LOD/Units	Method							
Triazophos	<0.01 µg/l	TM344	<0.01	<0.02	<1.53	<0.01			
Phosalone	<0.01 µg/l	TM344	<0.01	<0.02	<0.02	<0.01			
Azinphos methyl	<0.02 µg/l	TM344	<0.04	<0.02	<0.02	<0.04			
Azinphos ethyl	<0.02 µg/l	TM344	<0.02	<0.02	<0.02	<0.02			
Etridiazole	<0.01 µg/l	TM345	<0.02	<0.02	<0.02	<0.02			
Pentachlorobenzene	<0.01 µg/l	TM345	<0.01	<0.01	<0.01	<0.01			
Propachlor	<0.01 µg/l	TM345	<0.01	<0.01	<0.01	<0.01			
Quintozene (PCNB)	<0.01 µg/l	TM345	<0.01	<0.01	<0.01	<0.01			
Omethoate	<0.01 µg/l	TM345	<0.02	<0.02	<0.02	<0.02			
Propazine	<0.01 µg/l	TM345	<0.01	<0.01	<0.01	<0.01			
Propyzamide	<0.01 µg/l	TM345	<0.01	<0.01	<0.01	<0.01			
Alachlor	<0.01 µg/l	TM345	<0.01	<0.01	<0.01	<0.01			
Prometryn	<0.01 µg/l	TM345	<0.01	<0.01	<0.01	<0.01			
Telodrin	<0.01 µg/l	TM345	<0.01	<0.01	<0.01	<0.01			
Terbutryn	<0.01 µg/l	TM345	<0.01	<0.01	<0.01	<0.01			
Chlorothalonil	<0.01 µg/l	TM345	<0.01	<0.01	<0.01	<0.01			
Etrimpfos	<0.01 µg/l	TM345	<0.01	<0.01	<0.01	<0.01			
Metazachlor	<0.01 µg/l	TM345	<0.01	<0.01	<0.01	<0.01			
Cyanazine	<0.01 µg/l	TM345	<0.01	<0.01	<0.01	<0.01			
Trietazine	<0.01 µg/l	TM345	<0.01	<0.01	<0.01	<0.01			
Coumaphos	<0.01 µg/l	TM345	<0.01	<0.01	<0.01	<0.01			
Phosphamidon I	<0.01 µg/l	TM345	<0.02	<0.02	<0.02	<0.02			
Phosphamidon II	<0.01 µg/l	TM345	<0.01	<0.01	<0.01	<0.01			
Dinitro-o-cresol	<0.1 µg/l	TM411	<0.1	<0.1	<0.1	<0.1			
Clopyralid	<0.04 µg/l	TM411	<0.04	<0.04	<0.04	<0.04			
MCPA	<0.05 µg/l	TM411	<0.05	<0.05	<0.05	<0.05			
Mecoprop	<0.04 µg/l	TM411	<0.04	<0.04	<0.04	<0.04			
Dicamba	<0.04 µg/l	TM411	<0.04	<0.04	<0.04	<0.04			
MCPB	<0.05 µg/l	TM411	<0.05	<0.05	<0.05	<0.05			
2,4-DB	<0.1 µg/l	TM411	<0.1	<0.1	<0.1	<0.1			
2,3,6-Trichlorobenzoic acid	<0.05 µg/l	TM411	<0.05	<0.05	<0.05	<0.05			
Dichlorprop	<0.1 µg/l	TM411	<0.1	<0.1	<0.1	<0.1			
Triclopyr	<0.05 µg/l	TM411	<0.05	<0.05	<0.05	<0.05			



CERTIFICATE OF ANALYSIS

Validated

SDG: 220606-22
Client Ref.: Galway Historic Landfills P22-040

Report Number: 651143
Location: Tuam Landfill

Superseded Report:

Table with columns for Results Legend, Customer Sample Ref., Depth (m), Sample Type, Date Sampled, Sample Time, Date Received, SDG Ref, Lab Sample No.(s), AGS Reference, Component, LOD/Units, Method, and SW1-SW4. Includes rows for various pesticides like Fenoprop (Silvex), 2,4-Dichlorophenoxyacetic acid, etc.



CERTIFICATE OF ANALYSIS

Validated

SDG: 220606-22
Client Ref.: Galway Historic Landfills P22-040

Report Number: 651143
Location: Tuam Landfill

Superseded Report:

SVOC MS (W) - Aqueous

Results Legend		Customer Sample Ref.	SW1	SW2	SW3	SW4		
#	ISO17025 accredited.	Depth (m) Sample Type Date Sampled Sample Time Date Received SDG Ref Lab Sample No.(s) AGS Reference	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00		
M	mCERTS accredited.		Surface Water (SW)	Surface Water (SW)	Surface Water (SW)	Surface Water (SW)		
aq	Aqueous / settled sample.		31/05/2022	31/05/2022	31/05/2022	31/05/2022		
diss.filt	Dissolved / filtered sample.		06/06/2022	06/06/2022	06/06/2022	06/06/2022		
tot.unfilt	Total / unfiltered sample.		220606-22	220606-22	220606-22	220606-22		
*	Subcontracted - refer to subcontractor report for accreditation status.		26388595	26388621	26388645	26388663		
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery							
(F)	Trigger breach confirmed							
1-4*§	Sample deviation (see appendix)							
Component	LOD/Units		Method					
1,2,4-Trichlorobenzene (aq)	<1 µg/l	TM176	<1	<1	<1	<1	#	#
1,2-Dichlorobenzene (aq)	<1 µg/l	TM176	<1	<1	<1	<1	#	#
1,3-Dichlorobenzene (aq)	<1 µg/l	TM176	<1	<1	<1	<1	#	#
1,4-Dichlorobenzene (aq)	<1 µg/l	TM176	<1	<1	<1	<1	#	#
2,4,5-Trichlorophenol (aq)	<1 µg/l	TM176	<1	<1	<1	<1	#	#
2,4,6-Trichlorophenol (aq)	<1 µg/l	TM176	<1	<1	<1	<1	#	#
2,4-Dichlorophenol (aq)	<1 µg/l	TM176	<1	<1	<1	<1	#	#
2,4-Dimethylphenol (aq)	<1 µg/l	TM176	<1	<1	<1	<1	#	#
2,4-Dinitrotoluene (aq)	<1 µg/l	TM176	<1	<1	<1	<1	#	#
2,6-Dinitrotoluene (aq)	<1 µg/l	TM176	<1	<1	<1	<1	#	#
2-Chloronaphthalene (aq)	<1 µg/l	TM176	<1	<1	<1	<1	#	#
2-Chlorophenol (aq)	<1 µg/l	TM176	<1	<1	<1	<1	#	#
2-Methylnaphthalene (aq)	<1 µg/l	TM176	<1	<1	<1	<1	#	#
2-Methylphenol (aq)	<1 µg/l	TM176	<1	<1	<1	<1	#	#
2-Nitroaniline (aq)	<1 µg/l	TM176	<1	<1	<1	<1	#	#
2-Nitrophenol (aq)	<1 µg/l	TM176	<1	<1	<1	<1	#	#
3-Nitroaniline (aq)	<1 µg/l	TM176	<1	<1	<1	<1	#	#
4-Bromophenylphenylether (aq)	<1 µg/l	TM176	<1	<1	<1	<1	#	#
4-Chloro-3-methylphenol (aq)	<1 µg/l	TM176	<1	<1	<1	<1	#	#
4-Chloroaniline (aq)	<1 µg/l	TM176	<1	<1	<1	<1	#	#
4-Chlorophenylphenylether (aq)	<1 µg/l	TM176	<1	<1	<1	<1	#	#
4-Methylphenol (aq)	<1 µg/l	TM176	<1	<1	<1	<1	#	#
4-Nitroaniline (aq)	<1 µg/l	TM176	<1	<1	<1	<1	#	#
4-Nitrophenol (aq)	<1 µg/l	TM176	<1	<1	<1	<1	#	#
Azobenzene (aq)	<1 µg/l	TM176	<1	<1	<1	<1	#	#
Acenaphthylene (aq)	<1 µg/l	TM176	<1	<1	<1	<1	#	#
Acenaphthene (aq)	<1 µg/l	TM176	<1	<1	<1	<1	#	#
Anthracene (aq)	<1 µg/l	TM176	<1	<1	<1	<1	#	#
bis(2-Chloroethyl)ether (aq)	<1 µg/l	TM176	<1	<1	<1	<1	#	#
bis(2-Chloroethoxy)methane (aq)	<1 µg/l	TM176	<1	<1	<1	<1	#	#
bis(2-Ethylhexyl) phthalate (aq)	<2 µg/l	TM176	<2	<2	<2	<2	#	#
Butylbenzyl phthalate (aq)	<1 µg/l	TM176	<1	<1	<1	<1	#	#
Benzo(a)anthracene (aq)	<1 µg/l	TM176	<1	<1	<1	<1	#	#



CERTIFICATE OF ANALYSIS

Validated

SDG: 220606-22
Client Ref.: Galway Historic Landfills P22-040

Report Number: 651143
Location: Tuam Landfill

Superseded Report:

SVOC MS (W) - Aqueous

Table with columns for Component, LOD/Units, Method, and sample locations SW1-SW4. Includes a Results Legend section with accreditation details and a list of SVOCs such as Benzo(a)fluoranthene, Pyrene, and Fluorene.



CERTIFICATE OF ANALYSIS

Validated

SDG: 220606-22

Report Number: 651143

Superseded Report:

Client Ref.: Galway Historic Landfills P22-040

Location: Tuam Landfill

VOC MS (W)

Results Legend		Customer Sample Ref.	SW1	SW2	SW3	SW4		
#	ISO17025 accredited.	Depth (m) Sample Type Date Sampled Sample Time Date Received SDG Ref Lab Sample No.(s) AGS Reference	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00		
M	mCERTS accredited.		Surface Water (SW)	Surface Water (SW)	Surface Water (SW)	Surface Water (SW)		
aq	Aqueous / settled sample.		31/05/2022	31/05/2022	31/05/2022	31/05/2022		
diss.filt	Dissolved / filtered sample.		06/06/2022	06/06/2022	06/06/2022	06/06/2022		
tot.unfilt	Total / unfiltered sample.		220606-22	220606-22	220606-22	220606-22		
*	Subcontracted - refer to subcontractor report for accreditation status.		26388595	26388621	26388645	26388663		
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery							
(F)	Trigger breach confirmed							
1-4*§	Sample deviation (see appendix)							
Component	LOD/Units		Method					
Dibromofluoromethane**	%	TM208	111	107	113	99.4		
Toluene-d8**	%	TM208	99.2	102	97.5	103		
4-Bromofluorobenzene**	%	TM208	99.8	104	102	104		
Dichlorodifluoromethane	<1 µg/l	TM208	<1	<1	<1	<1	#	#
Chloromethane	<1 µg/l	TM208	<1	<1	<1	<1	#	#
Vinyl chloride	<1 µg/l	TM208	<1	<1	<1	<1	#	#
Bromomethane	<1 µg/l	TM208	<1	<1	<1	<1	#	#
Chloroethane	<1 µg/l	TM208	<1	<1	<1	<1	#	#
Trichlorofluoromethane	<1 µg/l	TM208	<1	<1	<1	<1	#	#
1,1-Dichloroethene	<1 µg/l	TM208	<1	<1	<1	<1	#	#
Carbon disulphide	<1 µg/l	TM208	<1	<1	<1	<1	#	#
Dichloromethane	<3 µg/l	TM208	<5.5	<4	<5.5	<3	#	#
Methyl tertiary butyl ether (MTBE)	<1 µg/l	TM208	<1	<1	<1	<1	#	#
trans-1,2-Dichloroethene	<1 µg/l	TM208	<1	<1	<1	<1	#	#
1,1-Dichloroethane	<1 µg/l	TM208	<1	<1	<1	<1	#	#
cis-1,2-Dichloroethene	<1 µg/l	TM208	<1	<1	<1	<1	#	#
2,2-Dichloropropane	<1 µg/l	TM208	<1	<1	<1	<1	#	#
Bromochloromethane	<1 µg/l	TM208	<1	<1	<1	<1	#	#
Chloroform	<1 µg/l	TM208	<1	<1	<1	<1	#	#
1,1,1-Trichloroethane	<1 µg/l	TM208	<1	<1	<1	<1	#	#
1,1-Dichloropropene	<1 µg/l	TM208	<1	<1	<1	<1	#	#
Carbontetrachloride	<1 µg/l	TM208	<1	<1	<1	<1	#	#
1,2-Dichloroethane	<1 µg/l	TM208	<1	<1	<1	<1	#	#
Benzene	<1 µg/l	TM208	<1	<1	<1	<1	#	#
Trichloroethene	<1 µg/l	TM208	<1	<1	<1	<1	#	#
1,2-Dichloropropane	<1 µg/l	TM208	<1	<1	<1	<1	#	#
Dibromomethane	<1 µg/l	TM208	<1	<1	<1	<1	#	#
Bromodichloromethane	<1 µg/l	TM208	<1	<1	<1	<1	#	#
cis-1,3-Dichloropropene	<1 µg/l	TM208	<1	<1	<1	<1	#	#
Toluene	<1 µg/l	TM208	<1	<1	<1	<1	#	#
trans-1,3-Dichloropropene	<1 µg/l	TM208	<1	<1	<1	<1	#	#
1,1,2-Trichloroethane	<1 µg/l	TM208	<1	<1	<1	<1	#	#
1,3-Dichloropropane	<1 µg/l	TM208	<1	<1	<1	<1	#	#



CERTIFICATE OF ANALYSIS

Validated

SDG: 220606-22
Client Ref.: Galway Historic Landfills P22-040

Report Number: 651143
Location: Tuam Landfill

Superseded Report:

VOC MS (W)

Results Legend			Customer Sample Ref.	SW1	SW2	SW3	SW4		
#	ISO17025 accredited.								
M	mCERTS accredited.								
aq	Aqueous / settled sample.								
dis.filt	Dissolved / filtered sample.								
tot.unfilt	Total / unfiltered sample.								
*	Subcontracted - refer to subcontractor report for accreditation status.								
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery.								
(F)	Trigger breach confirmed								
1-4*#	Sample deviation (see appendix)								
Component	LOD/Units	Method	Depth (m) Sample Type Date Sampled Sample Time Date Received SDG Ref Lab Sample No.(s) AGS Reference	0.00 - 0.00 Surface Water (SW) 31/05/2022	0.00 - 0.00 Surface Water (SW) 31/05/2022	0.00 - 0.00 Surface Water (SW) 31/05/2022	0.00 - 0.00 Surface Water (SW) 31/05/2022		
Tetrachloroethene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
Dibromochloromethane	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
1,2-Dibromoethane	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
Chlorobenzene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
1,1,1,2-Tetrachloroethane	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
Ethylbenzene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
m,p-Xylene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
o-Xylene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
Styrene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
Bromoform	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
Isopropylbenzene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
1,1,2,2-Tetrachloroethane	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
1,2,3-Trichloropropane	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
Bromobenzene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
Propylbenzene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
2-Chlorotoluene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
1,3,5-Trimethylbenzene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
4-Chlorotoluene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
tert-Butylbenzene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
1,2,4-Trimethylbenzene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
sec-Butylbenzene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
4-iso-Propyltoluene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
1,3-Dichlorobenzene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
1,4-Dichlorobenzene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
n-Butylbenzene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
1,2-Dichlorobenzene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
1,2-Dibromo-3-chloropropane	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
1,2,4-Trichlorobenzene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
Hexachlorobutadiene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
tert-Amyl methyl ether (TAME)	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
Naphthalene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
1,2,3-Trichlorobenzene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		
1,3,5-Trichlorobenzene	<1 µg/l	TM208		<1 #	<1 #	<1 #	<1 #		



CERTIFICATE OF ANALYSIS

Validated

SDG: 220606-22
Client Ref.: Galway Historic Landfills P22-040

Report Number: 651143
Location: Tuam Landfill

Superseded Report:

Table of Results - Appendix

Method No	Reference	Description
TM043	Method 2320B, AWWA/APHA, 20th Ed., 1999 / BS 2690: Part109 1984	Determination of alkalinity in aqueous samples
TM045	MEWAM BOD5 2nd Ed.HMSO 1988 / Method 5210B, AWWA/APHA, 20th Ed., 1999; SCA Blue Book 130	Determination of BOD5 (ATU) Filtered by Oxygen Meter on liquids
TM046	Method 4500G, AWWA/APHA, 20th Ed., 1999	Measurement of Dissolved Oxygen by Oxygen Meter
TM090	Method 5310, AWWA/APHA, 20th Ed., 1999 / Modified: US EPA Method 415.1 & 9060	Determination of Total Organic Carbon/Total Inorganic Carbon in Water and Waste Water
TM099	BS 2690: Part 7:1968 / BS 6068: Part2.11:1984	Determination of Ammonium in Water Samples using the Kone Analyser
TM104	Method 4500F, AWWA/APHA, 20th Ed., 1999	Determination of Fluoride using the Kone Analyser
TM107	ISO 6060-1989	Determination of Chemical Oxygen Demand using COD Dr Lange Kit
TM152	ISO 17294-2:2016 Water quality - Application of inductively coupled plasma mass spectrometry (ICP-MS)	Analysis of Aqueous Samples by ICP-MS
TM176	EPA 8270D Semi-Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)	Determination of SVOCs in Water by GCMS
TM183	BS EN 23506:2002, (BS 6068-2.74:2002) ISBN 0 580 38924 3	Determination of Trace Level Mercury in Waters and Leachates by PSA Cold Vapour Atomic Fluorescence Spectrometry
TM184	EPA Methods 325.1 & 325.2,	The Determination of Anions in Aqueous Matrices using the Kone Spectrophotometric Analysers
TM197	Modified: US EPA Method 8082.EA Method 174 and 5109631	Determination of WHO12 and EC7 Polychlorinated Biphenyl Congeners by GC-MS in Waters
TM208	Modified: US EPA Method 8260b & 624	Determination of Volatile Organic Compounds by Headspace / GC-MS in Waters
TM227	Standard methods for the examination of waters and wastewaters 20th Edition, AWWA/APHA Method 4500.	Determination of Total Cyanide, Free (Easily Liberatable) Cyanide and Thiocyanate
TM256	The measurement of Electrical Conductivity and the Laboratory determination of pH Value of Natural, Treated and Wastewaters. HMSO, 1978. ISBN 011 751428 4, Standard Methods for the examination of waters and wastewaters 20th Edition, PHA, Washington DC, USA. ISBN 0-87553-235-7 and The Determination of Alkalinity and Acidity in water HMSO, 1981, ISBN 0 11 751601 5.	Determination of pH, EC, TDS and Alkalinity in Aqueous samples
TM343	EPA 8270D - Semi-Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)	Determination of Selected Pesticides (Suite I) in Liquids by GCMS
TM344	EPA 8270D - Semi-Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)	Determination of selected pesticides (Suite II) by GCMS
TM345	EPA 8270D - Semi-Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)	Determination of selected pesticides (Suite III) by GCMS
TM411	Acid_Herbs_GCMS	Acid Herbs in Water by GCMS

NA = not applicable.

Chemical testing (unless subcontracted) performed at ALS Life Sciences Ltd Hawarden.



CERTIFICATE OF ANALYSIS

Validated

SDG: 220606-22
Client Ref.: Galway Historic Landfills P22-040

Report Number: 651143
Location: Tuam Landfill

Superseded Report:

Test Completion Dates

Lab Sample No(s)	26388595	26388621	26388645	26388663
Customer Sample Ref.	SW1	SW2	SW3	SW4
AGS Ref.				
Depth	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00
Type	Surface Water	Surface Water	Surface Water	Surface Water

	26388595	26388621	26388645	26388663
Acid Herbicides by GCMS	15-Jun-2022	13-Jun-2022	13-Jun-2022	17-Jun-2022
Alkalinity as CaCO3	09-Jun-2022	09-Jun-2022	09-Jun-2022	09-Jun-2022
Ammonium Low	09-Jun-2022	10-Jun-2022	09-Jun-2022	09-Jun-2022
Anions by Kone (w)	10-Jun-2022	09-Jun-2022	09-Jun-2022	10-Jun-2022
BOD True Total	11-Jun-2022	11-Jun-2022	11-Jun-2022	11-Jun-2022
COD Unfiltered	10-Jun-2022	10-Jun-2022	10-Jun-2022	10-Jun-2022
Cyanide Comp/Free/Total/Thiocyanate	09-Jun-2022	09-Jun-2022	09-Jun-2022	09-Jun-2022
Dissolved Metals by ICP-MS	10-Jun-2022	10-Jun-2022	10-Jun-2022	10-Jun-2022
Dissolved Oxygen by Probe	07-Jun-2022	07-Jun-2022	07-Jun-2022	07-Jun-2022
Fluoride	10-Jun-2022	10-Jun-2022	09-Jun-2022	10-Jun-2022
Mercury Dissolved	10-Jun-2022	10-Jun-2022	10-Jun-2022	10-Jun-2022
PCB Congeners - Aqueous (W)	13-Jun-2022	13-Jun-2022	13-Jun-2022	13-Jun-2022
Pesticides (Suite I) by GCMS	09-Jun-2022	10-Jun-2022	10-Jun-2022	09-Jun-2022
Pesticides (Suite II) by GCMS	08-Jun-2022	09-Jun-2022	09-Jun-2022	08-Jun-2022
Pesticides (Suite III) by GCMS	10-Jun-2022	10-Jun-2022	10-Jun-2022	10-Jun-2022
pH Value	07-Jun-2022	08-Jun-2022	08-Jun-2022	07-Jun-2022
SVOC MS (W) - Aqueous	08-Jun-2022	09-Jun-2022	09-Jun-2022	08-Jun-2022
Total Organic and Inorganic Carbon	08-Jun-2022	07-Jun-2022	07-Jun-2022	07-Jun-2022
VOC MS (W)	13-Jun-2022	14-Jun-2022	13-Jun-2022	14-Jun-2022



CERTIFICATE OF ANALYSIS

SDG: 220606-22
Client Ref: Galway Historic Landfills P22-(

Report Number: 651143
Location: Tuam Landfill

Superseded Report:

Appendix

1. Results are expressed on a dry weight basis (dried at 35°C) for all soil analyses except for the following: NRA and CEN Leach tests, flash point LOI, pH, ammonium as NH4 by the BRE method, VOC TICs and SVOC TICs.

2. If sufficient sample is received a sub sample will be retained free of charge for 30 days after analysis is completed (e-mailed) for all sample types unless the sample is destroyed on testing. The prepared soil sub sample that is analysed for asbestos will be retained for a period of 6 months after the analysis date. All bulk samples will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of one month after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALS reserve the right to charge for samples received and stored but not analysed.

3. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.

4. We take responsibility for any test performed by sub-contractors (marked with an asterisk). We endeavour to use UKAS/MCERTS Accredited Laboratories, who either complete a quality questionnaire or are audited by ourselves. For some determinands there are no UKAS/MCERTS Accredited Laboratories, in this instance a laboratory with a known track record will be utilised.

5. If no separate volatile sample is supplied by the client, or if a headspace or sediment is present in the volatile sample, the integrity of the data may be compromised. This will be flagged up as an invalid VOC on the test schedule and the result marked as deviating on the test certificate.

6. NDP - No determination possible due to insufficient/unsuitable sample.

7. Results relate only to the items tested.

8. LoDs (Limit of Detection) for wet tests reported on a dry weight basis are not corrected for moisture content.

9. **Surrogate recoveries** - Surrogates are added to your sample to monitor recovery of the test requested. A % recovery is reported, results are not corrected for the recovery measured. Typical recoveries for organics tests are 70-130%. Recoveries in soils are affected by organic rich or clay rich matrices. Waters can be affected by remediation fluids or high amounts of sediment. Test results are only ever reported if all of the associated quality checks pass; it is assumed that all recoveries outside of the values above are due to matrix affect.

10. Stones/debris are not routinely removed. We always endeavour to take a representative sub sample from the received sample.

11. In certain circumstances the method detection limit may be elevated due to the sample being outside the calibration range. Other factors that may contribute to this include possible interferences. In both cases the sample would be diluted which would cause the method detection limit to be raised.

12. For dried and crushed preparations of soils volatile loss may occur e.g volatile mercury.

13. For leachate preparations other than Zero Headspace Extraction (ZHE) volatile loss may occur.

14. For the BSEN 12457-3 two batch process to allow the cumulative release to be calculated, the volume of the leachate produced is measured and filtered for all tests. We therefore cannot carry out any unfiltered analysis. The tests affected include volatiles GCFID/GCMS and all subcontracted analysis.

15. Analysis and identification of specific compounds using GCFID is by retention time only, and we routinely calibrate and quantify for benzene, toluene, ethylbenzenes and xylenes (BTEX). For total volatiles in the C5-C12 range, the total area of the chromatogram is integrated and expressed as ug/kg or ug/l. Although this analysis is commonly used for the quantification of gasoline range organics (GRO), the system will also detect other compounds such as chlorinated solvents, and this may lead to a falsely high result with respect to hydrocarbons only. It is not possible to specifically identify these non-hydrocarbons, as standards are not routinely run for any other compounds, and for more definitive identification, volatiles by GCMS should be utilised.

16. We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample. Other coarse granular material such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

17 Data retention. All records, communications and reports pertaining to the analysis are archived for seven years from the date of issue of the final report.

General

18. **Tentatively Identified Compounds (TICs)** are non-target peaks in VOC and SVOC analysis. All non-target peaks detected with a concentration above the LoD are subjected to a mass spectral library search. Non-target peaks with a library search confidence of >75% are reported based on the best mass spectral library match. When a non-target peak with a library search confidence of <75% is detected it is reported as "mixed hydrocarbons". Non-target compounds identified from the scan data are semi-quantified relative to one of the deuterated internal standards, under the same chromatographic conditions as the target compounds. This result is reported as a semi-quantitative value and reported as Tentatively Identified Compounds (TICs). TICs are outside the scope of UKAS accreditation and are not moisture corrected.

19. Sample Deviations

If a sample is classed as deviated then the associated results may be compromised.

1	Container with Headspace provided for volatiles analysis
2	Incorrect container received
3	Deviation from method
4	Matrix interference
♦	Sample holding time exceeded in laboratory
@	Sample holding time exceeded due to late arrival of instructions or samples
§	Sampled on date not provided

20. Asbestos

When requested, the individual sub sample scheduled will be analysed in house for the presence of asbestos fibres and asbestos containing material by our documented in house method TM048 based on HSG 248 (2021), which is accredited to ISO17025. If a specific asbestos fibre type is not found this will be reported as "Not detected". If no asbestos fibre types are found all will be reported as "Not detected" and the sub sample analysed deemed to be clear of asbestos. If an asbestos fibre type is found it will be reported as detected (for each fibre type found). Testing can be carried out on asbestos positive samples, but, due to Health and Safety considerations, may be replaced by alternative tests or reported as No Determination Possible (NDP). The quantity of asbestos present is not determined unless specifically requested.

Identification of Asbestos in Bulk Materials & Soils

The results for identification of asbestos in bulk materials and soils are obtained from supplied bulk materials and soils which have been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2021).

The results for identification of asbestos in soils are obtained from a homogenised sub sample which has been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining.

Asbestos Type	Common Name
Chrysotile	White Asbestos
Amosite	Brown Asbestos
Crocidolite	Blue Asbestos
Fibrous Actinolite	-
Fibrous Anthophyllite	-
Fibrous Tremolite	-

Visual Estimation Of Fibre Content

Estimation of fibre content is not permitted as part of our UKAS accredited test other than: - Trace - Where only one or two asbestos fibres were identified.

Respirable Fibres

Respirable fibres are defined as fibres of <3 µm diameter, longer than 5 µm and with aspect ratios of at least 3:1 that can be inhaled into the lower regions of the lung and are generally acknowledged to be most important predictor of hazard and risk for cancers of the lung.

Further guidance on typical asbestos fibre content of manufactured products can be found in HSG 264.

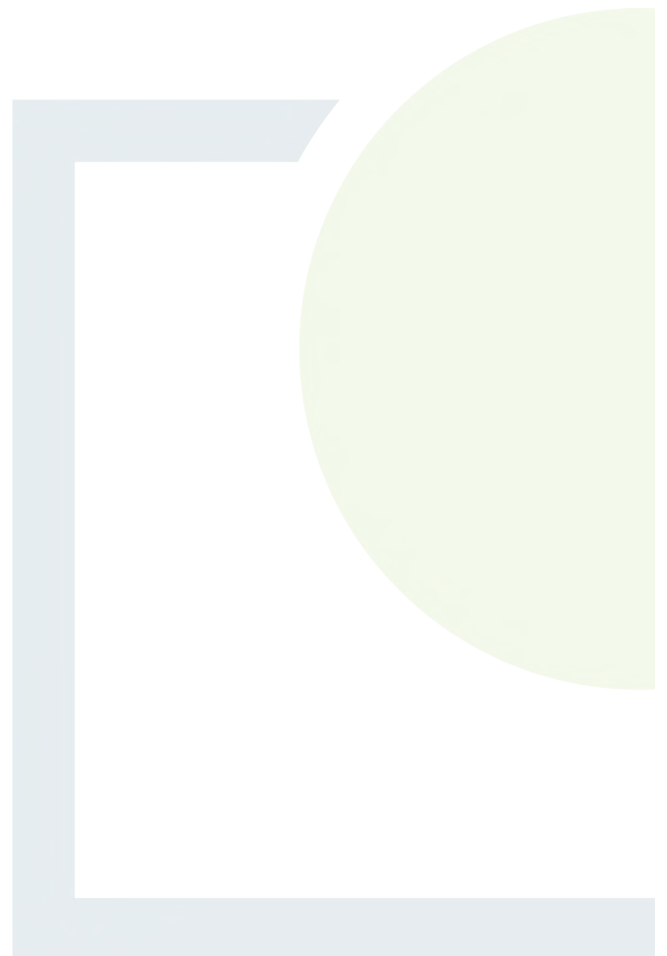
The identification of asbestos containing materials and soils falls within our schedule of tests for which we hold UKAS accreditation, however opinions, interpretations and all other information contained in the report are outside the scope of UKAS accreditation.



CONSULTANTS IN ENGINEERING,
ENVIRONMENTAL SCIENCE
& PLANNING

APPENDIX 12

Certificate of Analysis –
Leachate Monitoring





Unit 7-8 Hawarden Business Park
Manor Road (off Manor Lane)
Hawarden
Deeside
CH5 3US

Tel: (01244) 528777

email: hawardencustomerservices@alsglobal.com

Website: www.alsenvironmental.co.uk

Fehily Timoney
3rd Floor
North Park Offices
North Park Business Park
North Road
Dublin
Dublin 11

Attention: Daniel Hayden

CERTIFICATE OF ANALYSIS

Date of report Generation: 26 August 2022
Customer: Fehily Timoney
Sample Delivery Group (SDG): 220811-71
Your Reference: Galway Historic Landfills P22-040
Location: Tuam Landfill
Report No: 659148
Order Number:

We received 3 samples on Thursday August 11, 2022 and 3 of these samples were scheduled for analysis which was completed on Friday August 26, 2022. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

Should this report require incorporation into client reports, it must be used in its entirety and not simply with the data sections alone.

Chemical testing (unless subcontracted) performed at ALS Life Sciences Ltd Hawarden.

All sample data is provided by the customer. The reported results relate to the sample supplied, and on the basis that this data is correct.

Incorrect sampling dates and/or sample information will affect the validity of results.

The customer is not permitted to reproduce this report except in full without the approval of the laboratory.

Approved By:

Sonia McWhan

Operations Manager





CERTIFICATE OF ANALYSIS

Validated

SDG: 220811-71
Client Ref.: Galway Historic Landfills P22-040

Report Number: 659148
Location: Tuam Landfill

Superseded Report:

Received Sample Overview

Lab Sample No(s)	Customer Sample Ref.	AGS Ref.	Depth (m)	Sampled Date
26714539	BH1		0.00 - 0.00	10/08/2022
26714550	BH2		0.00 - 0.00	10/08/2022
26714561	BH3		0.00 - 0.00	10/08/2022

Only received samples which have had analysis scheduled will be shown on the following pages.



CERTIFICATE OF ANALYSIS

Validated

SDG: 220811-71
Client Ref.: Galway Historic Landfills P22-040

Report Number: 659148
Location: Tuam Landfill

Superseded Report:

Results Legend	Lab Sample No(s)		Customer Sample Reference		AGS Reference		Depth (m)		Container										Sample Type									
	X Test	N No Determination Possible	26714539	26714550	26714561	BH1	BH2	BH3	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00	NaOH (ALE245)	HNO3 Filtered (ALE204)	H2SO4 (ALE244)	500ml Plastic (ALE208)	250ml BOD (ALE212)	0.5l glass bottle (ALE227)	Vial (ALE297)	NaOH (ALE245)	HNO3 Filtered (ALE204)	H2SO4 (ALE244)	500ml Plastic (ALE208)	250ml BOD (ALE212)	0.5l glass bottle (ALE227)	Vial (ALE297)	LE		
Acid Herbicides by GCMS	All	NDPs: 0 Tests: 3	X					X																				
Alkalinity as CaCO3	All	NDPs: 0 Tests: 3	X					X																				
Ammonium Low	All	NDPs: 0 Tests: 3								X												X						
Anions by Kone (w)	All	NDPs: 0 Tests: 3	X											X										X				
BOD True Total	All	NDPs: 0 Tests: 3						X						X										X				
COD Unfiltered	All	NDPs: 0 Tests: 3						X						X										X				
Cyanide Comp/Free/Total/Thiocyanate	All	NDPs: 0 Tests: 3									X										X							X
Dissolved Metals by ICP-MS	All	NDPs: 0 Tests: 3										X										X						X
Dissolved Oxygen by Probe	All	NDPs: 0 Tests: 3	X											X										X				
Fluoride	All	NDPs: 0 Tests: 3	X											X										X				
Mercury Dissolved	All	NDPs: 0 Tests: 3										X										X						X
PCB Congeners - Aqueous (W)	All	NDPs: 0 Tests: 3	X											X										X				
Pesticides (Suite I) by GCMS	All	NDPs: 0 Tests: 3																									X	
Pesticides (Suite II) by GCMS	All	NDPs: 0 Tests: 3	X											X										X				
Pesticides (Suite III) by GCMS	All	NDPs: 0 Tests: 3	X											X										X				



CERTIFICATE OF ANALYSIS

SDG: 220811-71
Client Ref.: Galway Historic Landfills P22-040

Report Number: 659148
Location: Tuam Landfill

Superseded Report:

Results Legend

- X Test
- N No Determination Possible

Sample Types -

- S - Soil/Solid
- UNS - Unspecified Solid
- GW - Ground Water
- SW - Surface Water
- LE - Land Leachate
- PL - Prepared Leachate
- PR - Process Water
- SA - Saline Water
- TE - Trade Effluent
- TS - Treated Sewage
- US - Untreated Sewage
- RE - Recreational Water
- DW - Drinking Water Non-regulatory
- UNL - Unspecified Liquid
- SL - Sludge
- G - Gas
- OTH - Other

	Lab Sample No(s)	Customer Sample Reference	AGS Reference	Depth (m)	Container												Sample Type	
					NaOH (ALE245)	HNO3 Filtered (ALE204)	H2SO4 (ALE244)	500ml Plastic (ALE208)	250ml BOD (ALE212)	0.5l glass bottle (ALE227)	Vial (ALE297)	NaOH (ALE245)	HNO3 Filtered (ALE204)	H2SO4 (ALE244)	500ml Plastic (ALE208)	250ml BOD (ALE212)		0.5l glass bottle (ALE227)
	26714539	BH1		0.00 - 0.00														
	26714550	BH2		0.00 - 0.00														
	26714561	BH3		0.00 - 0.00														
pH Value	All	NDPs: 0 Tests: 3																
SVOC MS (W) - Aqueous	All	NDPs: 0 Tests: 3																
Total Organic and Inorganic Carbon	All	NDPs: 0 Tests: 3																
VOC MS (W)	All	NDPs: 0 Tests: 3																

26714561	BH3		0.00 - 0.00	Via (ALE297)	LE								X
----------	-----	--	-------------	--------------	----	--	--	--	--	--	--	--	---



CERTIFICATE OF ANALYSIS

Validated

SDG: 220811-71
Client Ref.: Galway Historic Landfills P22-040

Report Number: 659148
Location: Tuam Landfill

Superseded Report:

Results Legend		Customer Sample Ref.	BH1	BH2	BH3		
#	ISO17025 accredited.						
M	mCERTS accredited.						
aq	Aqueous / settled sample.						
diss.filt	Dissolved / filtered sample.						
tot.unfilt	Total / unfiltered sample.						
*	Subcontracted - refer to subcontractor report for accreditation status.						
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery						
(F)	Trigger breach confirmed						
1-4*\$@	Sample deviation (see appendix)						
		Depth (m)	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00		
		Sample Type	Land Leachate (LE)	Land Leachate (LE)	Land Leachate (LE)		
		Date Sampled	10/08/2022	10/08/2022	10/08/2022		
		Sample Time					
		Date Received	11/08/2022	11/08/2022	11/08/2022		
		SDG Ref	220811-71	220811-71	220811-71		
		Lab Sample No.(s)	26714539	26714550	26714561		
		AGS Reference					
Component	LOD/Units	Method					
Alkalinity, Total as HCO3	<2 mg/l	TM043	7130	2340	3310		
BOD, unfiltered	<1 mg/l	TM045	60.5	42.8	166		
Oxygen, dissolved	<0.3 mg/l	TM046	1.87	7.99	<0.3		
Organic Carbon, Total	<3 mg/l	TM090	91.8	47.2	233		
Ammoniacal Nitrogen as N (low level)	<0.01 mg/l	TM099	68	96.2	255		
Fluoride	<0.5 mg/l	TM104	<0.5	<0.5	<0.5		
COD, unfiltered	<7 mg/l	TM107	2380	1420	1860		
			#	#	#		
Arsenic (diss.filt)	<0.5 µg/l	TM152	3.01	2.54	6.35		
			#	#	#		
Barium (diss.filt)	<0.2 µg/l	TM152	261	215	233		
			#	#	#		
Boron (diss.filt)	<10 µg/l	TM152	904	456	1470		
			#	#	#		
Cadmium (diss.filt)	<0.08 µg/l	TM152	<0.08	0.163	<0.08		
			#	#	#		
Chromium (diss.filt)	<1 µg/l	TM152	3.22	3.03	27.1		
			#	#	#		
Copper (diss.filt)	<0.3 µg/l	TM152	<0.3	8.49	<0.3		
			#	#	#		
Lead (diss.filt)	<0.2 µg/l	TM152	0.644	14.6	0.224		
			#	#	#		
Manganese (diss.filt)	<3 µg/l	TM152	141	1790	3390		
			#	#	#		
Nickel (diss.filt)	<0.4 µg/l	TM152	13.2	10.7	57.5		
			#	#	#		
Phosphorus (diss.filt)	<10 µg/l	TM152	290	118	320		
			#	#	#		
Selenium (diss.filt)	<1 µg/l	TM152	8.45	1.88	3.99		
			#	#	#		
Thallium (diss.filt)	<2 µg/l	TM152	<2	<2	<2		
			#	#	#		
Zinc (diss.filt)	<1 µg/l	TM152	4.25	149	4.47		
			#	#	#		
Sodium (Dis.Filt)	<0.076 mg/l	TM152	1090	87.5	740		
			#	#	#		
Magnesium (Dis.Filt)	<0.036 mg/l	TM152	64.9	55.6	184		
			#	#	#		
Potassium (Dis.Filt)	<0.2 mg/l	TM152	120	59.4	227		
			#	#	#		
Calcium (Dis.Filt)	<0.2 mg/l	TM152	56.7	210	165		
			#	#	#		
Iron (Dis.Filt)	<0.019 mg/l	TM152	3.3	2.01	6.48		
			#	#	#		
Mercury (diss.filt)	<0.01 µg/l	TM183	<0.01	0.0531	<0.01		
			#	#	#		
Sulphate	<2 mg/l	TM184	176	133	513		
Chloride	<2 mg/l	TM184	440	70.2	739		
Total Oxidised Nitrogen as N	<0.1 mg/l	TM184	<0.1	<0.1	<0.1		
PCB congener 28	<0.015 µg/l	TM197	<0.075	<0.03	<0.075		
PCB congener 52	<0.015 µg/l	TM197	<0.075	<0.03	<0.075		
PCB congener 101	<0.015 µg/l	TM197	<0.075	<0.03	<0.075		
PCB congener 118	<0.015 µg/l	TM197	<0.075	<0.03	<0.075		



CERTIFICATE OF ANALYSIS

Validated

SDG: 220811-71
Client Ref.: Galway Historic Landfills P22-040

Report Number: 659148
Location: Tuam Landfill

Superseded Report:

Results Legend		Customer Sample Ref.	BH1	BH2	BH3			
# ISO17025 accredited. M mCERTS accredited. sq Aqueous / settled sample. dis.filt Dissolved / filtered sample. tot.unfilt Total / unfiltered sample. * Subcontracted - refer to subcontractor report for accreditation status. ** % recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery. (F) Trigger breach confirmed 1-4*# Sample deviation (see appendix)		Depth (m) Sample Type Date Sampled Sample Time Date Received SDG Ref Lab Sample No.(s) AGS Reference	0.00 - 0.00 Land Leachate (LE) 10/08/2022	0.00 - 0.00 Land Leachate (LE) 10/08/2022	0.00 - 0.00 Land Leachate (LE) 10/08/2022			
Component	LOD/Units	Method						
PCB congener 138	<0.015 µg/l	TM197	<0.075	<0.03	<0.075			
PCB congener 153	<0.015 µg/l	TM197	<0.075	<0.03	<0.075			
PCB congener 180	<0.015 µg/l	TM197	<0.075	<0.03	<0.075			
Sum of detected EC7 PCB's	<0.105 µg/l	TM197	<0.525	<0.21	<0.525			
Cyanide, Total	<0.05 mg/l	TM227	<0.05	<0.05	<0.05	#	#	#
pH	<1 pH Units	TM256	8.06	7.79	7.56	#	#	#
Conductivity @ 20 deg.C	<0.02 mS/cm	TM256	3.12	1.98	6.33	#	#	#
Trifluralin	<0.01 µg/l	TM343	<0.01	<0.01	<0.01			
alpha-HCH	<0.01 µg/l	TM343	<0.01	<0.01	0.121			
gamma-HCH (Lindane)	<0.01 µg/l	TM343	<0.01	<0.01	<0.01			
Heptachlor	<0.01 µg/l	TM343	<0.01	<0.01	<0.01			
Aldrin	<0.01 µg/l	TM343	<0.01	<0.01	<0.01			
beta-HCH	<0.01 µg/l	TM343	<0.01	<0.01	<0.01			
Isodrin	<0.01 µg/l	TM343	<0.01	<0.01	<0.01			
delta-HCH	<0.01 µg/l	TM343	<0.01	<0.01	<0.01			
Heptachlor epoxide	<0.01 µg/l	TM343	<0.01	<0.01	<0.01			
o,p'-DDE	<0.01 µg/l	TM343	<0.01	<0.01	<0.01			
Endosulphan I	<0.01 µg/l	TM343	<0.01	<0.01	<0.01			
trans-Chlordane	<0.01 µg/l	TM343	<0.01	<0.01	<0.01			
cis-Chlordane	<0.01 µg/l	TM343	<0.01	<0.01	<0.01			
p,p'-DDE	<0.01 µg/l	TM343	<0.4	<0.02	<0.4			
Dieldrin	<0.01 µg/l	TM343	<0.01	<0.01	<0.01			
o,p'-DDD (TDE)	<0.01 µg/l	TM343	<0.01	<0.01	<0.01			
Endrin	<0.01 µg/l	TM343	<0.4	<0.02	<0.4			
o,p'-DDT	<0.01 µg/l	TM343	<1	<0.05	<1			
p,p'-DDD (TDE)	<0.01 µg/l	TM343	<0.01	<0.01	<0.01			
Endosulphan II	<0.02 µg/l	TM343	<0.02	<0.02	<0.02			
p,p'-DDT	<0.01 µg/l	TM343	<2	<0.1	<2			
o,p'-Methoxychlor	<0.01 µg/l	TM343	<1	<0.05	<1			
p,p'-Methoxychlor	<0.01 µg/l	TM343	<2	<0.1	<2			
Endosulphan Sulphate	<0.02 µg/l	TM343	<0.8	<0.04	<0.8			
Permethrin I	<0.01 µg/l	TM343	<0.01	<0.01	<0.01			
Permethrin II	<0.01 µg/l	TM343	<0.01	<0.01	<0.01			



CERTIFICATE OF ANALYSIS

Validated

SDG: 220811-71
Client Ref.: Galway Historic Landfills P22-040

Report Number: 659148
Location: Tuam Landfill

Superseded Report:

Results Legend			Customer Sample Ref.	BH1	BH2	BH3			
# ISO17025 accredited. M mCERTS accredited. sq Aqueous / settled sample. dis.filt Dissolved / filtered sample. tot.unfilt Total / unfiltered sample. * Subcontracted - refer to subcontractor report for accreditation status. ** % recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery. (F) Trigger breach confirmed 1-4*#@ Sample deviation (see appendix)			Depth (m) Sample Type Date Sampled Sample Time Date Received SDG Ref Lab Sample No.(s) AGS Reference	0.00 - 0.00 Land Leachate (LE) 10/08/2022	0.00 - 0.00 Land Leachate (LE) 10/08/2022	0.00 - 0.00 Land Leachate (LE) 10/08/2022			
Component	LOD/Units	Method							
1,3,5-Trichlorobenzene	<0.01 µg/l	TM344	<0.01	<0.01	<0.01				
Hexachlorobutadiene	<0.01 µg/l	TM344	<0.01	<0.01	<0.01				
1,2,4-Trichlorobenzene	<0.01 µg/l	TM344	<0.01	<0.01	<0.01				
1,2,3-Trichlorobenzene	<0.01 µg/l	TM344	<0.01	<0.01	<0.01				
Dichlorvos	<0.01 µg/l	TM344	<0.01	<0.01	<0.01				
Dichlobenil	<0.01 µg/l	TM344	<0.01	<0.01	<0.01				
Mevinphos	<0.01 µg/l	TM344	<0.01	<0.01	<0.01				
Tecnazene	<0.01 µg/l	TM344	<0.01	<0.01	<0.01				
Hexachlorobenzene	<0.01 µg/l	TM344	<0.01	<0.01	<0.01				
Demeton-S-methyl	<0.01 µg/l	TM344	<0.01	<0.01	<0.01				
Phorate	<0.01 µg/l	TM344	<0.01	<0.01	<0.01				
Diazinon	<0.01 µg/l	TM344	<0.01	<0.01	<0.01				
Triallate	<0.01 µg/l	TM344	<0.01	<0.01	<0.01				
Atrazine	<0.01 µg/l	TM344	<0.01	<0.01	<0.01				
Simazine	<0.01 µg/l	TM344	<0.01	<0.01	<0.01				
Disulfoton	<0.01 µg/l	TM344	<0.01	<0.01	<0.01				
Propetamphos	<0.01 µg/l	TM344	<0.01	<0.01	<0.01				
Chlorpyrifos-methyl	<0.01 µg/l	TM344	<0.01	<0.01	<0.01				
Dimethoate	<0.01 µg/l	TM344	<0.01	<0.01	<0.01				
Pirimiphos-methyl	<0.01 µg/l	TM344	<0.01	<0.01	<0.01				
Chlorpyrifos	<0.01 µg/l	TM344	<0.01	<0.01	<0.01				
Methyl Parathion	<0.01 µg/l	TM344	<0.01	<0.01	<0.01				
Malathion	<0.01 µg/l	TM344	<0.01	<0.01	<0.01				
Fenthion	<0.01 µg/l	TM344	<0.01	<0.01	<0.01				
Fenitrothion	<0.01 µg/l	TM344	<0.01	<0.01	<0.01				
Triadimefon	<0.01 µg/l	TM344	<0.01	<0.01	<0.01				
Pendimethalin	<0.01 µg/l	TM344	<0.01	<0.01	<0.01				
Parathion	<0.01 µg/l	TM344	<0.01	<0.01	<0.01				
Chlorfenvinphos	<0.01 µg/l	TM344	<0.01	<0.01	<0.01				
trans-Chlordane	<0.01 µg/l	TM344	<0.01	<0.01	<0.01				
cis-Chlordane	<0.01 µg/l	TM344	<0.01	<0.01	<0.01				
Ethion	<0.01 µg/l	TM344	<0.01	<0.01	<0.01				
Carbophenothion	<0.01 µg/l	TM344	<0.01	<0.01	<0.01				



CERTIFICATE OF ANALYSIS

Validated

SDG: 220811-71
Client Ref.: Galway Historic Landfills P22-040

Report Number: 659148
Location: Tuam Landfill

Superseded Report:

Results Legend		Customer Sample Ref.	BH1	BH2	BH3			
#	ISO17025 accredited.							
M	mCERTS accredited.							
aq	Aqueous / settled sample.							
dis.filt	Dissolved / filtered sample.							
tot.unfilt	Total / unfiltered sample.							
*	Subcontracted - refer to subcontractor report for accreditation status.							
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery.							
(F)	Trigger breach confirmed							
1-4*#	Sample deviation (see appendix)							
Component	LOD/Units	Method						
Triazophos	<0.01 µg/l	TM344	<0.01	<0.01	<0.01			
Phosalone	<0.01 µg/l	TM344	<0.01	<0.01	<0.01			
Azinphos methyl	<0.02 µg/l	TM344	<0.02	<0.02	<0.02			
Azinphos ethyl	<0.02 µg/l	TM344	<0.02	<0.02	<0.02			
Etridiazole	<0.01 µg/l	TM345	<0.01	<0.01	<0.01			
Pentachlorobenzene	<0.01 µg/l	TM345	<0.01	<0.01	<0.01			
Propachlor	<0.01 µg/l	TM345	<0.01	<0.01	<0.01			
Quintozene (PCNB)	<0.01 µg/l	TM345	<0.01	<0.01	<0.01			
Omethoate	<0.01 µg/l	TM345	<0.01	<0.01	<0.01			
Propazine	<0.01 µg/l	TM345	<0.01	<0.01	<0.01			
Propyzamide	<0.01 µg/l	TM345	<0.01	<0.01	<0.01			
Alachlor	<0.01 µg/l	TM345	<0.01	<0.01	<0.01			
Prometryn	<0.01 µg/l	TM345	<0.01	<0.01	<0.01			
Telodrin	<0.01 µg/l	TM345	<0.01	<0.01	<0.01			
Terbutryn	<0.01 µg/l	TM345	<0.01	<0.01	<0.01			
Chlorothalonil	<0.01 µg/l	TM345	<0.01	<0.01	<0.01			
Etrimpfos	<0.01 µg/l	TM345	<0.01	<0.01	<0.01			
Metazachlor	<0.01 µg/l	TM345	<0.01	<0.01	<0.01			
Cyanazine	<0.01 µg/l	TM345	<0.01	<0.01	<0.01			
Trietazine	<0.01 µg/l	TM345	<0.01	<0.01	<0.01			
Coumaphos	<0.01 µg/l	TM345	<0.01	<0.01	<0.01			
Phosphamidon I	<0.01 µg/l	TM345	<0.01	<0.01	<0.01			
Phosphamidon II	<0.01 µg/l	TM345	<0.01	<0.01	<0.01			
Dinitro-o-cresol	<0.1 µg/l	TM411	<10	<10	<10			
Clopyralid	<0.04 µg/l	TM411	<4	<4	<4			
MCPA	<0.05 µg/l	TM411	<5	<5	<5			
Mecoprop	<0.04 µg/l	TM411	<4	<4	<4			
Dicamba	<0.04 µg/l	TM411	<4	<4	<4			
MCPB	<0.05 µg/l	TM411	<5	<5	<5			
2,4-DB	<0.1 µg/l	TM411	<10	<10	<10			
2,3,6-Trichlorobenzoic acid	<0.05 µg/l	TM411	<5	<5	<5			
Dichlorprop	<0.1 µg/l	TM411	<10	<10	<10			
Triclopyr	<0.05 µg/l	TM411	<5	<5	<5			



CERTIFICATE OF ANALYSIS

Validated

SDG: 220811-71
Client Ref.: Galway Historic Landfills P22-040

Report Number: 659148
Location: Tuam Landfill

Superseded Report:

SVOC MS (W) - Aqueous

Results Legend		Customer Sample Ref.	BH1	BH2	BH3		
#	ISO17025 accredited.						
M	mCERTS accredited.						
aq	Aqueous / settled sample.						
dis.s.filt	Dissolved / filtered sample.						
tot.unfilt	Total / unfiltered sample.						
*	Subcontracted - refer to subcontractor report for accreditation status.						
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery						
(F)	Trigger breach confirmed						
1-4*§@	Sample deviation (see appendix)						
Component	LOD/Units	Method	Depth (m)	Sample Type	Date Sampled	Sample Time	Date Received
			0.00 - 0.00	Land Leachate (LE)	10/08/2022		11/08/2022
							220811-71
							26714539
							AGS Reference
							SDG Ref
							220811-71
							26714550
							26714561
1,2,4-Trichlorobenzene (aq)	<1 µg/l	TM176	<20	<10	<10		
1,2-Dichlorobenzene (aq)	<1 µg/l	TM176	<20	<10	<10		
1,3-Dichlorobenzene (aq)	<1 µg/l	TM176	<20	<10	<10		
1,4-Dichlorobenzene (aq)	<1 µg/l	TM176	<20	<10	<10		
2,4,5-Trichlorophenol (aq)	<1 µg/l	TM176	<20	<10	<10		
2,4,6-Trichlorophenol (aq)	<1 µg/l	TM176	<20	<10	<10		
2,4-Dichlorophenol (aq)	<1 µg/l	TM176	<20	<10	<10		
2,4-Dimethylphenol (aq)	<1 µg/l	TM176	<20	<10	<10		
2,4-Dinitrotoluene (aq)	<1 µg/l	TM176	<20	<10	<10		
2,6-Dinitrotoluene (aq)	<1 µg/l	TM176	<20	<10	<10		
2-Chloronaphthalene (aq)	<1 µg/l	TM176	<20	<10	<10		
2-Chlorophenol (aq)	<1 µg/l	TM176	<20	<10	<10		
2-Methylnaphthalene (aq)	<1 µg/l	TM176	<20	<10	<10		
2-Methylphenol (aq)	<1 µg/l	TM176	<20	<10	<10		
2-Nitroaniline (aq)	<1 µg/l	TM176	<20	<10	<10		
2-Nitrophenol (aq)	<1 µg/l	TM176	<20	<10	<10		
3-Nitroaniline (aq)	<1 µg/l	TM176	<20	<10	<10		
4-Bromophenylphenylether (aq)	<1 µg/l	TM176	<20	<10	<10		
4-Chloro-3-methylphenol (aq)	<1 µg/l	TM176	<20	<10	<10		
4-Chloroaniline (aq)	<1 µg/l	TM176	<20	<10	<10		
4-Chlorophenylphenylether (aq)	<1 µg/l	TM176	<20	<10	<10		
4-Methylphenol (aq)	<1 µg/l	TM176	<20	<10	<10		
4-Nitroaniline (aq)	<1 µg/l	TM176	<20	<10	<10		
4-Nitrophenol (aq)	<1 µg/l	TM176	<20	<10	<10		
Azobenzene (aq)	<1 µg/l	TM176	<20	<10	<10		
Acenaphthylene (aq)	<1 µg/l	TM176	<20	<10	<10		
Acenaphthene (aq)	<1 µg/l	TM176	<20	<10	<10		
Anthracene (aq)	<1 µg/l	TM176	<20	<10	<10		
bis(2-Chloroethyl)ether (aq)	<1 µg/l	TM176	<20	<10	<10		
bis(2-Chloroethoxy)methane (aq)	<1 µg/l	TM176	<20	<10	<10		
bis(2-Ethylhexyl) phthalate (aq)	<2 µg/l	TM176	541	86.2	31		
Butylbenzyl phthalate (aq)	<1 µg/l	TM176	59.7	<10	<10		
Benzo(a)anthracene (aq)	<1 µg/l	TM176	<20	<10	<10		



CERTIFICATE OF ANALYSIS

Validated

SDG: 220811-71

Report Number: 659148

Superseded Report:

Client Ref.: Galway Historic Landfills P22-040

Location: Tuam Landfill

VOC MS (W)

Results Legend		Customer Sample Ref.	BH1	BH2	BH3		
# ISO17025 accredited. M mCERTS accredited. aq Aqueous / settled sample. diss.filt Dissolved / filtered sample. tot.unfilt Total / unfiltered sample. * Subcontracted - refer to subcontractor report for accreditation status. ** % recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery (F) Trigger breach confirmed 1-4*§@ Sample deviation (see appendix)		Depth (m) Sample Type Date Sampled Sample Time Date Received SDG Ref Lab Sample No.(s) AGS Reference	0.00 - 0.00 Land Leachate (LE) 10/08/2022	0.00 - 0.00 Land Leachate (LE) 10/08/2022	0.00 - 0.00 Land Leachate (LE) 10/08/2022		
Component	LOD/Units	Method					
Dibromofluoromethane**	%	TM208	107	108	103		
Toluene-d8**	%	TM208	95.8	95.2	97.4		
4-Bromofluorobenzene**	%	TM208	85.3	89.5	95.6		
Dichlorodifluoromethane	<1 µg/l	TM208	<1 #	<1 #	<1 #		
Chloromethane	<1 µg/l	TM208	<1 #	<1 #	<1 #		
Vinyl chloride	<1 µg/l	TM208	<1 #	<1 #	<1 #		
Bromomethane	<1 µg/l	TM208	<1 #	<1 #	<1 #		
Chloroethane	<1 µg/l	TM208	<1 #	<1 #	<1 #		
Trichlorofluoromethane	<1 µg/l	TM208	<1 #	<1 #	<1 #		
1,1-Dichloroethene	<1 µg/l	TM208	<1 #	<1 #	<1 #		
Carbon disulphide	<1 µg/l	TM208	1.48 #	<1 #	1.67 #		
Dichloromethane	<3 µg/l	TM208	<7 #	<7.5 #	<7 #		
Methyl tertiary butyl ether (MTBE)	<1 µg/l	TM208	<1 #	<1 #	<1 #		
trans-1,2-Dichloroethene	<1 µg/l	TM208	<1 #	<1 #	<1 #		
1,1-Dichloroethane	<1 µg/l	TM208	<1 #	<1 #	<1 #		
cis-1,2-Dichloroethene	<1 µg/l	TM208	<1 #	<1 #	<1 #		
2,2-Dichloropropane	<1 µg/l	TM208	<1 #	<1 #	<1 #		
Bromochloromethane	<1 µg/l	TM208	<1 #	<1 #	<1 #		
Chloroform	<1 µg/l	TM208	<1 #	<1 #	<1 #		
1,1,1-Trichloroethane	<1 µg/l	TM208	<1 #	<1 #	<1 #		
1,1-Dichloropropene	<1 µg/l	TM208	<1 #	<1 #	<1 #		
Carbontetrachloride	<1 µg/l	TM208	<1 #	<1 #	<1 #		
1,2-Dichloroethane	<1 µg/l	TM208	<1 #	<1 #	<1 #		
Benzene	<1 µg/l	TM208	1.84 #	<1 #	3.39 #		
Trichloroethene	<1 µg/l	TM208	<1 #	<1 #	<1 #		
1,2-Dichloropropane	<1 µg/l	TM208	<1 #	<1 #	<1 #		
Dibromomethane	<1 µg/l	TM208	<1 #	<1 #	<1 #		
Bromodichloromethane	<1 µg/l	TM208	<1 #	<1 #	<1 #		
cis-1,3-Dichloropropene	<1 µg/l	TM208	<1 #	<1 #	<1 #		
Toluene	<1 µg/l	TM208	1.11 #	<1 #	1.8 #		
trans-1,3-Dichloropropene	<1 µg/l	TM208	<1 #	<1 #	<1 #		
1,1,2-Trichloroethane	<1 µg/l	TM208	<1 #	<1 #	<1 #		
1,3-Dichloropropane	<1 µg/l	TM208	<1 #	<1 #	<1 #		



CERTIFICATE OF ANALYSIS

Validated

SDG: 220811-71
Client Ref.: Galway Historic Landfills P22-040

Report Number: 659148
Location: Tuam Landfill

Superseded Report:

VOC MS (W)

Results Legend			Customer Sample Ref.	BH1	BH2	BH3			
#	ISO17025 accredited.								
M	mCERTS accredited.								
sq	Aqueous / settled sample.								
dis.filt	Dissolved / filtered sample.								
tot.unfilt	Total / unfiltered sample.								
*	Subcontracted - refer to subcontractor report for accreditation status.								
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery.								
(F)	Trigger breach confirmed								
1-4*§@	Sample deviation (see appendix)								
Component	LOD/Units	Method	Depth (m) Sample Type Date Sampled Sample Time Date Received SDG Ref Lab Sample No.(s) AGS Reference						
Tetrachloroethene	<1 µg/l	TM208	0.00 - 0.00 Land Leachate (LE) 10/08/2022	<1 #	<1 #	<1 #			
Dibromochloromethane	<1 µg/l	TM208	0.00 - 0.00 Land Leachate (LE) 10/08/2022	<1 #	<1 #	<1 #			
1,2-Dibromoethane	<1 µg/l	TM208	0.00 - 0.00 Land Leachate (LE) 10/08/2022	<1 #	<1 #	<1 #			
Chlorobenzene	<1 µg/l	TM208	11/08/2022 220811-71 26714539	<1 #	<1 #	<1 #			
1,1,1,2-Tetrachloroethane	<1 µg/l	TM208	11/08/2022 220811-71 26714539	<1 #	5.23 #	<1 #			
Ethylbenzene	<1 µg/l	TM208	11/08/2022 220811-71 26714539	<1 #	5 #	2.51 #			
m,p-Xylene	<1 µg/l	TM208	11/08/2022 220811-71 26714539	<1 #	51 #	1.77 #			
o-Xylene	<1 µg/l	TM208	11/08/2022 220811-71 26714539	<1 #	1.42 #	1.09 #			
Styrene	<1 µg/l	TM208	11/08/2022 220811-71 26714539	<1 #	<1 #	<1 #			
Bromoform	<1 µg/l	TM208	11/08/2022 220811-71 26714539	<1 #	<1 #	<1 #			
Isopropylbenzene	<1 µg/l	TM208	11/08/2022 220811-71 26714539	<1 #	<1 #	<1 #			
1,1,2,2-Tetrachloroethane	<1 µg/l	TM208	11/08/2022 220811-71 26714539	<1 #	<1 #	<1 #			
1,2,3-Trichloropropane	<1 µg/l	TM208	11/08/2022 220811-71 26714539	<1 #	<1 #	<1 #			
Bromobenzene	<1 µg/l	TM208	11/08/2022 220811-71 26714539	<1 #	<1 #	<1 #			
Propylbenzene	<1 µg/l	TM208	11/08/2022 220811-71 26714539	<1 #	<1 #	<1 #			
2-Chlorotoluene	<1 µg/l	TM208	11/08/2022 220811-71 26714539	<1 #	<1 #	<1 #			
1,3,5-Trimethylbenzene	<1 µg/l	TM208	11/08/2022 220811-71 26714539	<1 #	1.52 #	<1 #			
4-Chlorotoluene	<1 µg/l	TM208	11/08/2022 220811-71 26714539	<1 #	<1 #	<1 #			
tert-Butylbenzene	<1 µg/l	TM208	11/08/2022 220811-71 26714539	<1 #	<1 #	<1 #			
1,2,4-Trimethylbenzene	<1 µg/l	TM208	11/08/2022 220811-71 26714539	<1 #	1.89 #	<1 #			
sec-Butylbenzene	<1 µg/l	TM208	11/08/2022 220811-71 26714539	<1 #	<1 #	<1 #			
4-iso-Propyltoluene	<1 µg/l	TM208	11/08/2022 220811-71 26714539	<1 #	<1 #	1.21 #			
1,3-Dichlorobenzene	<1 µg/l	TM208	11/08/2022 220811-71 26714539	<1 #	<1 #	<1 #			
1,4-Dichlorobenzene	<1 µg/l	TM208	11/08/2022 220811-71 26714539	<1 #	<1 #	<1 #			
n-Butylbenzene	<1 µg/l	TM208	11/08/2022 220811-71 26714539	<1 #	<1 #	<1 #			
1,2-Dichlorobenzene	<1 µg/l	TM208	11/08/2022 220811-71 26714539	<1 #	<1 #	<1 #			
1,2-Dibromo-3-chloropropane	<1 µg/l	TM208	11/08/2022 220811-71 26714539	<1 #	<1 #	<1 #			
1,2,4-Trichlorobenzene	<1 µg/l	TM208	11/08/2022 220811-71 26714539	<1 #	<1 #	<1 #			
Hexachlorobutadiene	<1 µg/l	TM208	11/08/2022 220811-71 26714539	<1 #	<1 #	<1 #			
tert-Amyl methyl ether (TAME)	<1 µg/l	TM208	11/08/2022 220811-71 26714539	<1 #	<1 #	<1 #			
Naphthalene	<1 µg/l	TM208	11/08/2022 220811-71 26714539	<1 #	<1 #	<1 #			
1,2,3-Trichlorobenzene	<1 µg/l	TM208	11/08/2022 220811-71 26714539	<1 #	<1 #	<1 #			
1,3,5-Trichlorobenzene	<1 µg/l	TM208	11/08/2022 220811-71 26714539	<1 #	<1 #	<1 #			



CERTIFICATE OF ANALYSIS

Validated

SDG: 220811-71
Client Ref.: Galway Historic Landfills P22-040

Report Number: 659148
Location: Tuam Landfill

Superseded Report:

Table of Results - Appendix

Method No	Reference	Description
TM043	Method 2320B, AWWA/APHA, 20th Ed., 1999 / BS 2690: Part109 1984	Determination of alkalinity in aqueous samples
TM045	MEWAM BOD5 2nd Ed.HMSO 1988 / Method 5210B, AWWA/APHA, 20th Ed., 1999; SCA Blue Book 130	Determination of BOD5 (ATU) Filtered by Oxygen Meter on liquids
TM046	Method 4500G, AWWA/APHA, 20th Ed., 1999	Measurement of Dissolved Oxygen by Oxygen Meter
TM090	Method 5310, AWWA/APHA, 20th Ed., 1999 / Modified: US EPA Method 415.1 & 9060	Determination of Total Organic Carbon/Total Inorganic Carbon in Water and Waste Water
TM099	BS 2690: Part 7:1968 / BS 6068: Part2.11:1984	Determination of Ammonium in Water Samples using the Kone Analyser
TM104	Method 4500F, AWWA/APHA, 20th Ed., 1999	Determination of Fluoride using the Kone Analyser
TM107	ISO 6060-1989	Determination of Chemical Oxygen Demand using COD Dr Lange Kit
TM152	ISO 17294-2:2016 Water quality - Application of inductively coupled plasma mass spectrometry (ICP-MS)	Analysis of Aqueous Samples by ICP-MS
TM176	EPA 8270D Semi-Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)	Determination of SVOCs in Water by GCMS
TM183	BS EN 23506:2002, (BS 6068-2.74:2002) ISBN 0 580 38924 3	Determination of Trace Level Mercury in Waters and Leachates by PSA Cold Vapour Atomic Fluorescence Spectrometry
TM184	EPA Methods 325.1 & 325.2,	The Determination of Anions in Aqueous Matrices using the Kone Spectrophotometric Analysers
TM197	Modified: US EPA Method 8082.EA Method 174 and 5109631	Determination of WHO12 and EC7 Polychlorinated Biphenyl Congeners by GC-MS in Waters
TM208	Modified: US EPA Method 8260b & 624	Determination of Volatile Organic Compounds by Headspace / GC-MS in Waters
TM227	Standard methods for the examination of waters and wastewaters 20th Edition, AWWA/APHA Method 4500.	Determination of Total Cyanide, Free (Easily Liberatable) Cyanide and Thiocyanate
TM256	The measurement of Electrical Conductivity and the Laboratory determination of pH Value of Natural, Treated and Wastewaters. HMSO, 1978. ISBN 011 751428 4, Standard Methods for the examination of waters and wastewaters 20th Edition, PHA, Washington DC, USA. ISBN 0-87553-235-7 and The Determination of Alkalinity and Acidity in water HMSO, 1981, ISBN 0 11 751601 5.	Determination of pH, EC, TDS and Alkalinity in Aqueous samples
TM343	EPA 8270D - Semi-Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)	Determination of Selected Pesticides (Suite I) in Liquids by GCMS
TM344	EPA 8270D - Semi-Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)	Determination of selected pesticides (Suite II) by GCMS
TM345	EPA 8270D - Semi-Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)	Determination of selected pesticides (Suite III) by GCMS
TM411	Acid_Herbs_GCMS	Acid Herbs in Water by GCMS

NA = not applicable.

Chemical testing (unless subcontracted) performed at ALS Life Sciences Ltd Hawarden (Method codes TM).



CERTIFICATE OF ANALYSIS

Validated

SDG: 220811-71
Client Ref.: Galway Historic Landfills P22-040

Report Number: 659148
Location: Tuam Landfill

Superseded Report:

Test Completion Dates

Lab Sample No(s)	26714539	26714550	26714561
Customer Sample Ref.	BH1	BH2	BH3
AGS Ref.			
Depth	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00
Type	Land Leachate	Land Leachate	Land Leachate

	26714539	26714550	26714561
Acid Herbicides by GCMS	26-Aug-2022	26-Aug-2022	26-Aug-2022
Alkalinity as CaCO3	16-Aug-2022	16-Aug-2022	16-Aug-2022
Ammonium Low	12-Aug-2022	16-Aug-2022	12-Aug-2022
Anions by Kone (w)	12-Aug-2022	12-Aug-2022	12-Aug-2022
BOD True Total	19-Aug-2022	19-Aug-2022	19-Aug-2022
COD Unfiltered	18-Aug-2022	18-Aug-2022	18-Aug-2022
Cyanide Comp/Free/Total/Thiocyanate	15-Aug-2022	15-Aug-2022	15-Aug-2022
Dissolved Metals by ICP-MS	15-Aug-2022	15-Aug-2022	15-Aug-2022
Dissolved Oxygen by Probe	16-Aug-2022	16-Aug-2022	16-Aug-2022
Fluoride	13-Aug-2022	13-Aug-2022	13-Aug-2022
Mercury Dissolved	16-Aug-2022	16-Aug-2022	16-Aug-2022
PCB Congeners - Aqueous (W)	16-Aug-2022	16-Aug-2022	16-Aug-2022
Pesticides (Suite I) by GCMS	19-Aug-2022	20-Aug-2022	19-Aug-2022
Pesticides (Suite II) by GCMS	22-Aug-2022	22-Aug-2022	22-Aug-2022
Pesticides (Suite III) by GCMS	22-Aug-2022	22-Aug-2022	22-Aug-2022
pH Value	15-Aug-2022	15-Aug-2022	15-Aug-2022
SVOC MS (W) - Aqueous	17-Aug-2022	17-Aug-2022	17-Aug-2022
Total Organic and Inorganic Carbon	13-Aug-2022	13-Aug-2022	17-Aug-2022
VOC MS (W)	12-Aug-2022	12-Aug-2022	12-Aug-2022



CERTIFICATE OF ANALYSIS

SDG: 220811-71
Client Ref: Galway Historic Landfills P22-(

Report Number: 659148
Location: Tuam Landfill

Superseded Report:

Appendix

1. Results are expressed on a dry weight basis (dried at 35°C) for all soil analyses except for the following: NRA and CEN Leach tests, flash point LOI, pH, ammonium as NH4 by the BRE method, VOC TICs and SVOC TICs.

2. If sufficient sample is received a sub sample will be retained free of charge for 30 days after analysis is completed (e-mailed) for all sample types unless the sample is destroyed on testing. The prepared soil sub sample that is analysed for asbestos will be retained for a period of 6 months after the analysis date. All bulk samples will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of one month after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALS reserve the right to charge for samples received and stored but not analysed.

3. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.

4. We take responsibility for any test performed by sub-contractors (marked with an asterisk). We endeavour to use UKAS/MCERTS Accredited Laboratories, who either complete a quality questionnaire or are audited by ourselves. For some determinands there are no UKAS/MCERTS Accredited Laboratories, in this instance a laboratory with a known track record will be utilised.

5. If no separate volatile sample is supplied by the client, or if a headspace or sediment is present in the volatile sample, the integrity of the data may be compromised. This will be flagged up as an invalid VOC on the test schedule and the result marked as deviating on the test certificate.

6. NDP - No determination possible due to insufficient/unsuitable sample.

7. Results relate only to the items tested.

8. LoDs (Limit of Detection) for wet tests reported on a dry weight basis are not corrected for moisture content.

9. **Surrogate recoveries** - Surrogates are added to your sample to monitor recovery of the test requested. A % recovery is reported, results are not corrected for the recovery measured. Typical recoveries for organics tests are 70-130%. Recoveries in soils are affected by organic rich or clay rich matrices. Waters can be affected by remediation fluids or high amounts of sediment. Test results are only ever reported if all of the associated quality checks pass; it is assumed that all recoveries outside of the values above are due to matrix affect.

10. Stones/debris are not routinely removed. We always endeavour to take a representative sub sample from the received sample.

11. In certain circumstances the method detection limit may be elevated due to the sample being outside the calibration range. Other factors that may contribute to this include possible interferences. In both cases the sample would be diluted which would cause the method detection limit to be raised.

12. For dried and crushed preparations of soils volatile loss may occur e.g volatile mercury.

13. For leachate preparations other than Zero Headspace Extraction (ZHE) volatile loss may occur.

14. For the BSEN 12457-3 two batch process to allow the cumulative release to be calculated, the volume of the leachate produced is measured and filtered for all tests. We therefore cannot carry out any unfiltered analysis. The tests affected include volatiles GCFID/GCMS and all subcontracted analysis.

15. Analysis and identification of specific compounds using GCFID is by retention time only, and we routinely calibrate and quantify for benzene, toluene, ethylbenzenes and xylenes (BTEX). For total volatiles in the C5-C12 range, the total area of the chromatogram is integrated and expressed as ug/kg or ug/l. Although this analysis is commonly used for the quantification of gasoline range organics (GRO), the system will also detect other compounds such as chlorinated solvents, and this may lead to a falsely high result with respect to hydrocarbons only. It is not possible to specifically identify these non-hydrocarbons, as standards are not routinely run for any other compounds, and for more definitive identification, volatiles by GCMS should be utilised.

16. We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample. Other coarse granular material such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

17 Data retention. All records, communications and reports pertaining to the analysis are archived for seven years from the date of issue of the final report.

General

18. **Tentatively Identified Compounds (TICs)** are non-target peaks in VOC and SVOC analysis. All non-target peaks detected with a concentration above the LoD are subjected to a mass spectral library search. Non-target peaks with a library search confidence of >75% are reported based on the best mass spectral library match. When a non-target peak with a library search confidence of <75% is detected it is reported as "mixed hydrocarbons". Non-target compounds identified from the scan data are semi-quantified relative to one of the deuterated internal standards, under the same chromatographic conditions as the target compounds. This result is reported as a semi-quantitative value and reported as Tentatively Identified Compounds (TICs). TICs are outside the scope of UKAS accreditation and are not moisture corrected.

19. Sample Deviations

If a sample is classed as deviated then the associated results may be compromised.

1	Container with Headspace provided for volatiles analysis
2	Incorrect container received
3	Deviation from method
4	Matrix interference
♦	Sample holding time exceeded in laboratory
@	Sample holding time exceeded due to late arrival of instructions or samples
§	Sampled on date not provided

20. Asbestos

When requested, the individual sub sample scheduled will be analysed in house for the presence of asbestos fibres and asbestos containing material by our documented in house method TM048 based on HSG 248 (2021), which is accredited to ISO17025. If a specific asbestos fibre type is not found this will be reported as "Not detected". If no asbestos fibre types are found all will be reported as "Not detected" and the sub sample analysed deemed to be clear of asbestos. If an asbestos fibre type is found it will be reported as detected (for each fibre type found). Testing can be carried out on asbestos positive samples, but, due to Health and Safety considerations, may be replaced by alternative tests or reported as No Determination Possible (NDP). The quantity of asbestos present is not determined unless specifically requested.

Identification of Asbestos in Bulk Materials & Soils

The results for identification of asbestos in bulk materials and soils are obtained from supplied bulk materials and soils which have been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2021).

The results for identification of asbestos in soils are obtained from a homogenised sub sample which has been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining.

Asbestos Type	Common Name
Chrysotile	White Asbestos
Amosite	Brown Asbestos
Crocidolite	Blue Asbestos
Fibrous Actinolite	-
Fibrous Anthophyllite	-
Fibrous Tremolite	-

Visual Estimation Of Fibre Content

Estimation of fibre content is not permitted as part of our UKAS accredited test other than: - Trace - Where only one or two asbestos fibres were identified.

Respirable Fibres

Respirable fibres are defined as fibres of <3 µm diameter, longer than 5 µm and with aspect ratios of at least 3:1 that can be inhaled into the lower regions of the lung and are generally acknowledged to be most important predictor of hazard and risk for cancers of the lung.

Further guidance on typical asbestos fibre content of manufactured products can be found in HSG 264.

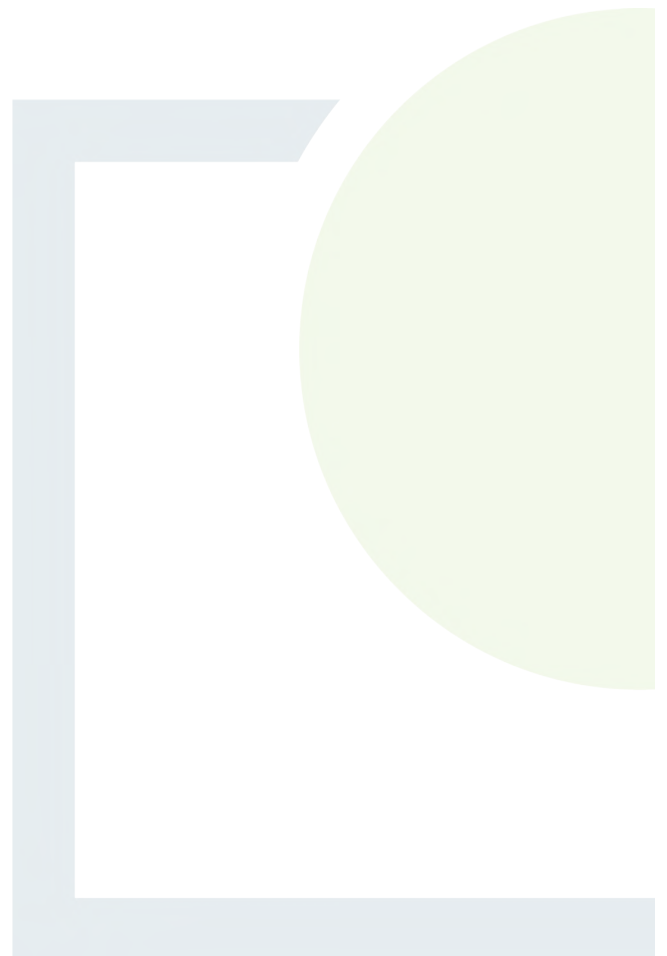
The identification of asbestos containing materials and soils falls within our schedule of tests for which we hold UKAS accreditation, however opinions, interpretations and all other information contained in the report are outside the scope of UKAS accreditation.



CONSULTANTS IN ENGINEERING,
ENVIRONMENTAL SCIENCE
& PLANNING

APPENDIX 13

Drawing Requested under
Point 18





**CONSULTANTS IN ENGINEERING,
ENVIRONMENTAL SCIENCE
& PLANNING**

www.fehilytimoney.ie

📍 Cork Office

Core House
Pouladuff Road,
Cork, T12 D773,
Ireland
+353 21 496 4133

📍 Dublin Office

J5 Plaza,
North Park Business Park,
North Road, Dublin 11, D11 PXT0,
Ireland
+353 1 658 3500

📍 Carlow Office

Unit 6, Bagenalstown Industrial
Park, Royal Oak Road,
Muine Bheag,
Co. Carlow, R21 XW81,
Ireland
+353 59 972 3800

