FEHILY TIMONEY

CONSULTANTS IN ENGINEERING,
ENVIRONMENTAL SCIENCE & PLANNING

APPENDIX 6

Causeway Geotechnical Reports 2020 and 2022

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

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APPENDICES

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:**	23rd 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 Nx5=Cu 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

CAUSEWAY GEOTECH

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:	**Scale:**
15/08/2022	1:10000

CAUSEWAY GEOTECH

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:	**Scale:**
15/08/2022	1:1000

CAUSEWAY GEOTECH

APPENDIX B

BOREHOLE LOGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
22-0418	Tuam Landfill	BH01
	Client: Galway County Council	
	Client's Rep: Fehily Timoney and Company	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Cable Percussion	Dando 2000	0.00	8.20	543771.91 E 749901.87 N

Final Depth:	Start Date:	Driller:	Sheet 1 of 2
8.20 m	19/07/2022	BM	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
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.
					40.72	3.00		MADE GROUND: Landfill
6.00	ES3							

Water

Backfill

0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)

Casing Details

To (m)	Diameter

Water Added

From (m)	To (m)

Chiselling Details

From (m)	To (m)	Time (hh:mm)

Remarks

Termination Reason

Terminated at scheduled depth.

Last Updated

23/08/2022

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
22-0418	Tuam Landfill	BH01
	Client: Galway County Council	
	Client's Rep: Fehily Timoney and Company	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Cable Percussion	Dando 2000	0.00	8.20	543771.91 E 749901.87 N

Final Depth:	Start Date:	Driller:	Sheet 2 of 2
8.20 m	19/07/2022	BM	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
								MADE GROUND: Landfill		
8.00	ES4				35.72	8.00		PEAT		
					35.52	8.20		End of Borehole at 8.20m		

7.5 8.0 8.5 9.0 9.5 10.0 10.5 11.0 11.5 12.0 12.5 13.0 13.5 14.0 14.5

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)

Casing Details

To (m)	Diameter

Water Added

From (m)	To (m)

Chiselling Details

From (m)	To (m)	Time (hh:mm)

Remarks

Termination Reason

Terminated at scheduled depth.

Last Updated

23/08/2022

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CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
22-0418	Tuam Landfill	BH02
	Client: Galway County Council	
	Client's Rep: Fehily Timoney and Company	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Cable Percussion	Dando 2000	0.00	9.40	543831.98 E 749987.50 N

Final Depth:	Start Date:	Driller:	Sheet 1 of 2
9.40 m	19/07/2022	BM	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
0.40 - 0.80	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							
					44.99	0.90		MADE GROUND: Landfill
2.00	ES2							
		Slow seepage at 3.40m						
					40.89	5.00		MADE GROUND: Soft greyish sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.
5.50	ES3							

Water

Backfill

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
3.40	3.40		

Casing Details

To (m)	Diameter

Water Added

From (m)	To (m)

Chiselling Details

From (m)	To (m)	Time (hh:mm)

Remarks

Termination Reason

Terminated at scheduled depth.

Last Updated

23/08/2022

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
22-0418	Tuam Landfill	BH02
	Client: Galway County Council	
	Client's Rep: Fehily Timoney and Company	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Cable Percussion	Dando 2000	0.00	9.40	543831.98 E 749987.50 N

Final Depth:	Start Date:	Driller:	Sheet 2 of 2
9.40 m	19/07/2022	BM	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				36.89	9.00		MADE GROUND: Soft greyish sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.		
					36.59	9.30		MADE GROUND: Landfill		
					36.49	9.40		PEAT		
								End of Borehole at 9.40m		

Water Strikes			
Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
3.40	3.40		

Casing Details		Water Added	
To (m)	Diameter	From (m)	To (m)

Chiselling Details		
From (m)	To (m)	Time (hh:mm)

Remarks

Termination Reason	Last Updated
Terminated at scheduled depth.	23/08/2022

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
22-0418	Tuam Landfill	BH03
	Client: Galway County Council	
	Client's Rep: Fehily Timoney and Company	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Cable Percussi	Dando 200	0.00	8.20	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
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		MADE GROUND: Landfill
3.00	ES2							
5.00	ES3							

Water

Backfill

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
8.00	8.00	20	7.80

Casing Details

To (m)	Diameter

Water Added

From (m)	To (m)

Chiselling Details

From (m)	To (m)	Time (hh:mm)

Remarks

Termination Reason

Terminated at scheduled depth.

Last Updated

23/08/2022

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CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
22-0418	Tuam Landfill	BH03
	Client: Galway County Council	
	Client's Rep: Fehily Timoney and Company	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Cable Percussi	Dando 200	0.00	8.20	543793.33 E 750038.31 N

Final Depth:	Start Date:	Driller:	Sheet 2 of 2
8.20 m	18/07/2022	BM	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
					36.53	8.00		MADE GROUND: Landfill		
8.00	ES4	Slow seepage at 8.00m			36.33	8.20		PEAT End of Borehole at 8.20m		

7.5 8.0 8.5 9.0 9.5 10.0 10.5 11.0 11.5 12.0 12.5 13.0 13.5 14.0 14.5

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
8.00	8.00	20	7.80

Casing Details

To (m)	Diameter

Water Added

From (m)	To (m)

Chiselling Details

From (m)	To (m)	Time (hh:mm)

Remarks

Termination Reason

Terminated at scheduled depth.

Last Updated

23/08/2022

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CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
22-0418	Tuam Landfill	BHLFG1
	Client: Galway County Council	
	Client's Rep: Fehily Timoney and Company	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Cable Percussio	Dando 2000	0.00	3.00	543884.79 E 749916.52 N

Final Depth:	Start Date:	Driller:	Sheet 1 of 1
3.00 m	20/07/2022	BM	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
					41.16	0.05		BITMAC
								MADE GROUND: Grey slightly sandy angular to subangular fine to coarse GRAVEL with low cobble content. Sand is fine to coarse. Cobbles are angular.
					40.81	0.40		MADE GROUND: Soft brownish black sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.
0.50 - 1.50	B1							
					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 | Backfill

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)

Casing Details

To (m)	Diameter

Water Added

From (m)	To (m)

Chiselling Details

From (m)	To (m)	Time (hh:mm)

Remarks

Termination Reason

Terminated at scheduled depth.

Last Updated

23/08/2022

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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

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)

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awatkins@prosoils.co.uk

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

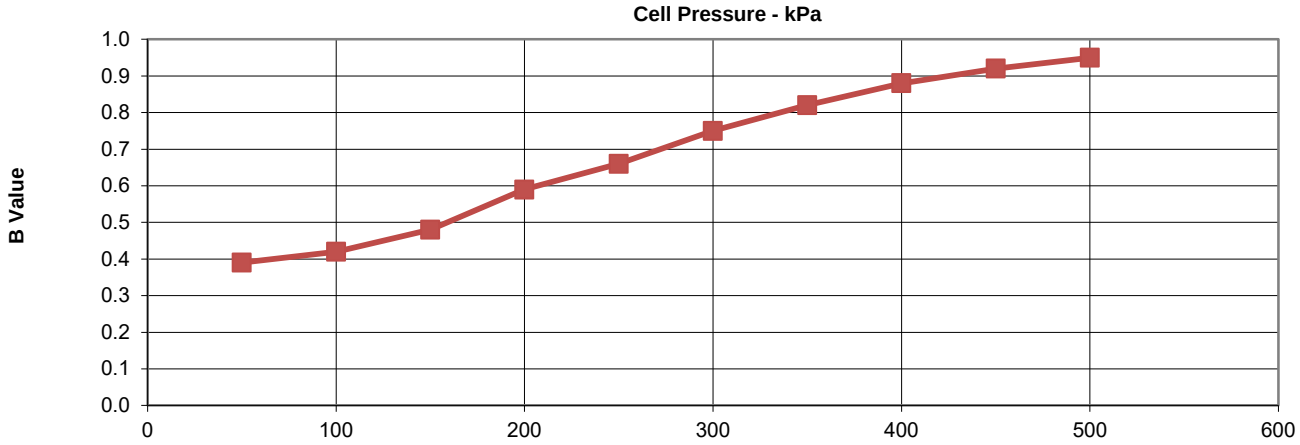
Final Specimen Conditions		
Moisture Content	%	21
Bulk Density	Mg/m^3	2.11
Dry Density	Mg/m^3	1.75

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

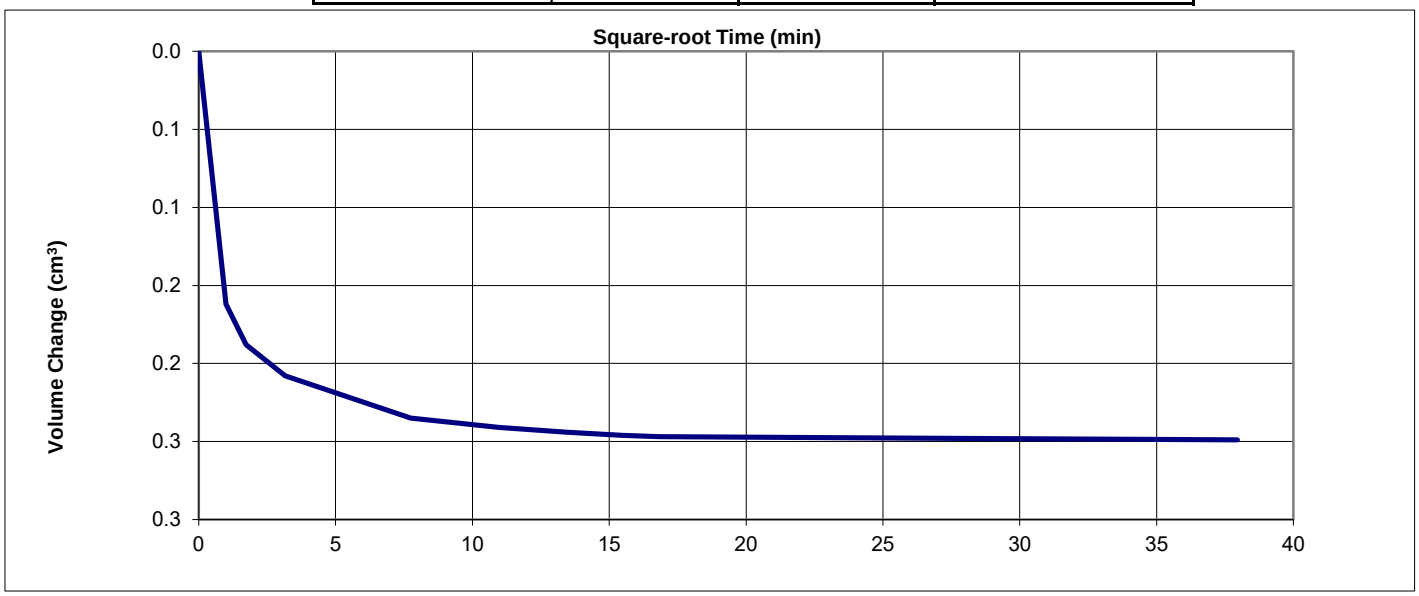
PERMEABILITY IN A TRIAXIAL CELL

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



UKAS TESTING 4043

PSL Professional Soils Laboratory

Tuam Landfill

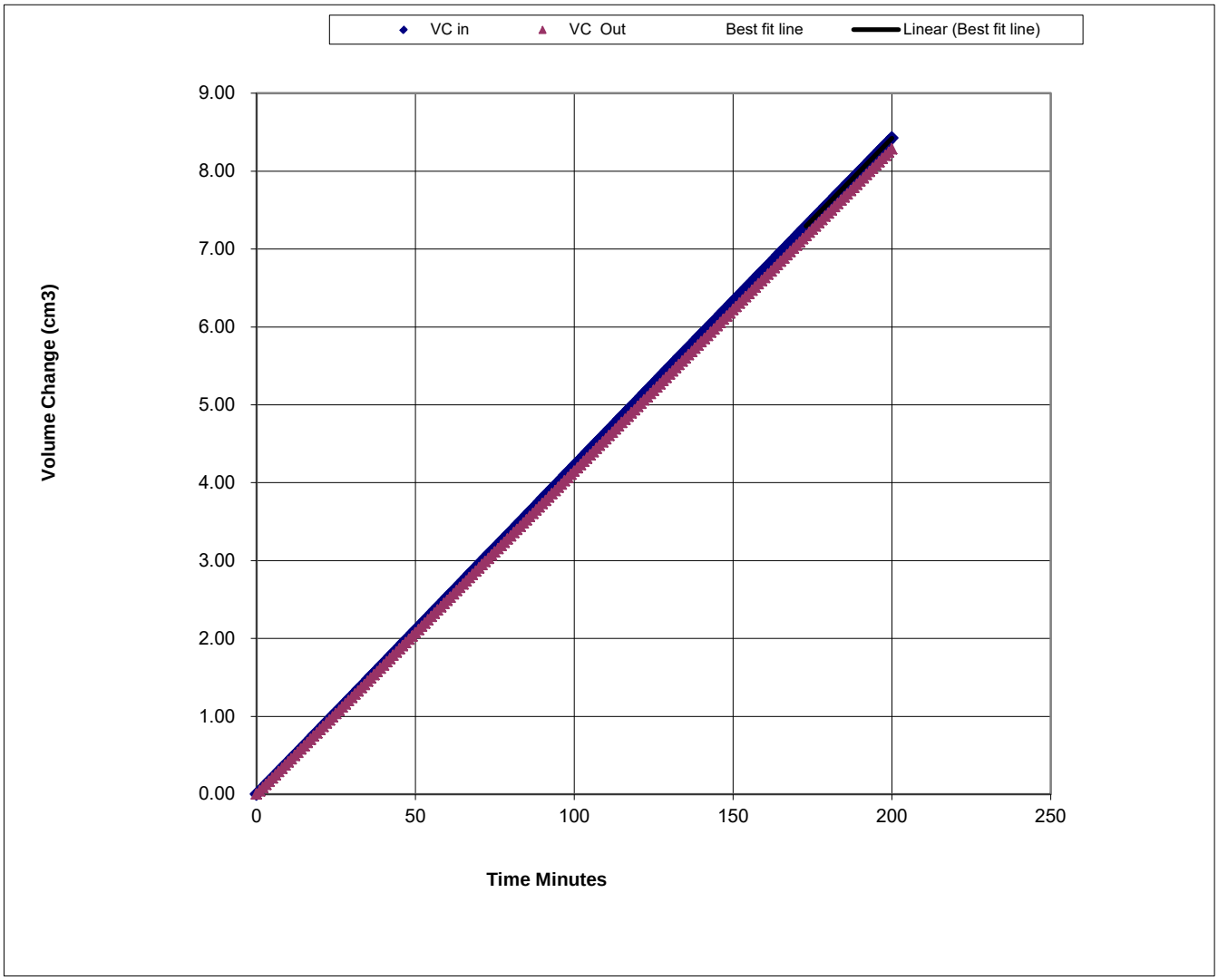
Contract No.
PSL22/5053
Client Ref
22-0418

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		

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 Kv	m/s	8.6E-09

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

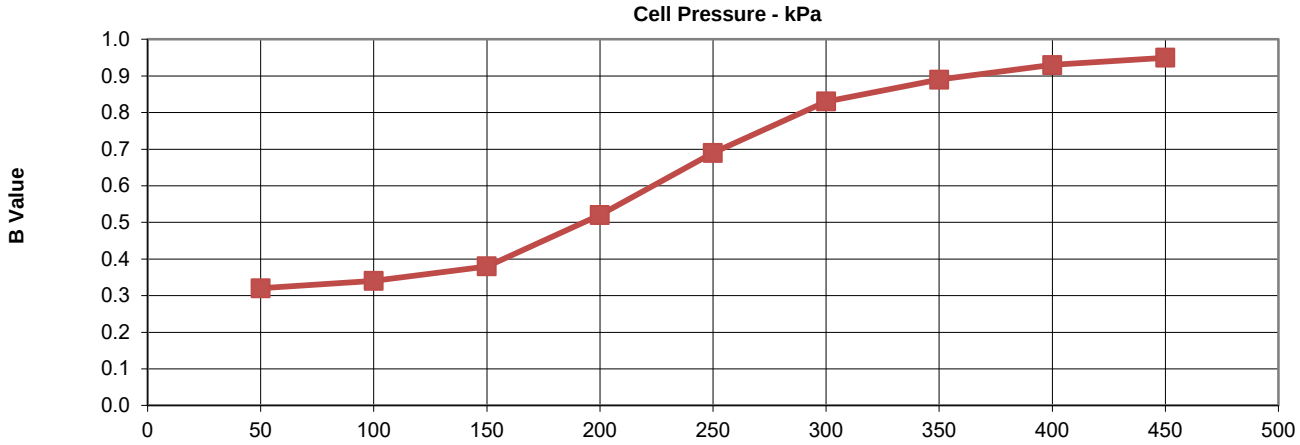
Final Specimen Conditions		
Moisture Content	%	17
Bulk Density	Mg/m^3	2.12
Dry Density	Mg/m^3	1.81

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

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

UKAS TESTING 4043

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		

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

CAUSEWAY GEOTECH

APPENDIX D

ENVIRONMENTAL LABORATORY TEST RESULTS

eurofins | Chemtest
Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Amended Report

Report No.:	22-28066-4		
Initial Date of Issue:	16-Aug-2022	**Date of Re-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

					Landfill Waste Acceptance Criteria Limits		
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						
Determinand	**SOP**	**Accred.**	**Units**		**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
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):							
Sampling Date:	22-Jul-2022						
Determinand	**SOP**	**Accred.**	**Units**		**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
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

					Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	22-28066						
Chemtest Sample ID:	1474298						
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**		**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
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	Allkaline 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

Galway Historic Landfills – Tuam Ground Investigation

Client:	Galway County Council
Client's Representative:	Feehily Timoney
Report No.:	19-1465A
Date:	September 2020
Status:	Final for Issue

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Approved: ISO 9001 • ISO 14001 • OHSAS 18001

CONTENTS

APPENDICES

Document Control Sheet

Report No.:		19-1465A			
Project Title:		Galway Historic Landfills –Tuam			
Client:		Galway County Council			
Client's Representative:		Feehily Timoney			
Revision:	A00	**Status:**	Final for Issue	**Issue Date:**	21 September 2020
Prepared by:		**Reviewed by:**		**Approved by:**	
 Sean Ross BSc MSc MIEI		 Colm Hurley BSc FGS PGeo		 Darren O'Mahony BSc MSc MIEI EurGeol PGeo	

The works were conducted in accordance with:

British Standards Institute (2015) BS 5930:2015, Code of practice for site 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, The Code of Practice for Site 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 Nx5=Cu 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	
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.

Galway Historic Landfills – Tuam

1 AUTHORITY

On the instructions of Feehily Timoney Consulting Engineers, ("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 for input to the remediation of an historic landfill site in Galway.

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. A discussion on the recommendations for construction is also provided.

All information given in this report is based upon the ground conditions encountered during the site 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, trial pits, 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 a site located 1km south east of Tuam town centre. The site is accessed off he R347 and is bounded by the R347 and the Tuam Civic Amenity Site to the east, and by agricultural lands to the north, south and west. Works were undertaken in an old landfill site immediately adjacent to the Civic Amenity Site and in the field to the south.

4 SITE OPERATIONS

4.1 Summary of site works

Site operations, which were conducted between 26th June and 18th September 2020, comprised:

- two boreholes by rotary drilling methods
- a standpipe installation in each borehole; and
- five machine dug trial pits

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

Two boreholes (GW01 and GW02) were put to their completion by rotary drilling techniques only. The boreholes were completed using a Hanjin 8D tracked drilling rig.

Symmetrix-cased full hole rotary percussive drilling techniques were employed to advance the boreholes to scheduled depth.

Appendix B presents the borehole logs.

4.3 Standpipe installations

A groundwater monitoring standpipe was installed in each borehole. Each borehole was also installed with waterra tubing and foot valve to allow future groundwater sampling.

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

4.4 Trial Pits

Five trial pits (TP01–TP05) were excavated using a 13t tracked excavator fitted with a 600mm wide bucket, to a maximum depth of 2.00m. TP01-TP03 and TP05 were undertaken to prove the depth to the existing clay liner.

Bulk samples were taken at depths specified by the Client's Representative.

Any water strikes encountered during excavation were recorded along with any changes in their levels as the excavation proceeded. The stability of the trial pit walls was noted on completion.

Appendix C presents the trial pit logs with photographs of the pits and arising provided in Appendix D.

4.5 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 R6 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 plan presented in Appendix A shows these as-built positions.

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:

- **soil classification:** moisture content measurement, Atterberg Limit tests and particle size distribution analysis.
- **shear strength** (total stress): unconsolidated undrained triaxial tests
- **compaction related:** Moisture Condition Value/moisture content relationship

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 F.

6 GROUND CONDITIONS

6.1 General geology of the area

Published geological mapping indicate the superficial deposits underlying the site comprise peat and glacial till. These deposits are underlain by undifferentiated Visean Limestones.

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:

- **Topsoil:** encountered across the site with a thickness range of 50-400mm.
- **Paved surface:** 50mm of bitmac was encountered at a depth of 0.25mbgl in TP04.
- **Clay liner**: a geo-composite clay liner was encountered in all trial pits at depths of 0.20-0.40m.
- **Made Ground (fill):** sandy gravel or gravelly silty sand fill encountered beneath topsoil in TP04 and TP05.
- **Made Ground (landfill)**: reworked sandy gravel or gravelly silty sand or sandy gravelly silty clay encountered in TP04 to a depth of 2.00m. It should be noted that the trial pit was terminated at 2.00m and this stratum may extend beyond this. Fragments of timber, plastic, glass, steel, wire, clothing, brick and timber were encountered throughout the trial pit.
- **Recent deposits (peat):** peat was encountered in GW01 and GW02 to depths of 1.00m.
- **Glacial till:** sandy gravelly clay/silt with granular pockets were encountered in both boreholes to a depth of 6.40m in GW02. Extent was not proven in GW01 as the borehole terminated at 5.00m.
- **Bedrock (Limestone):** Limestone bedrock was encountered at a depth of 6.40m in GW02.

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 rotary drilling in GW02 at a depth of 5.00m. Groundwater was noted during drilling of GW01; however, groundwater was present at the bottom of the hole upon termination of the borehole.

It should be noted that the casing used in supporting the borehole walls during drilling may have sealed out any/additional groundwater strikes and the possibility of encountering groundwater at other depths should not be ruled out.

Groundwater was not noted during excavation of any of the trial pits.

Subsequent groundwater monitoring of the standpipe installations recorded water levels as shown in Table 1.

Table 1: Groundwater monitoring

Date	Water level (mbgl)	
	GW01	GW02
21/09/20	0.30	0.22

Seasonal variation in groundwater levels should also be factored into design considerations and continued monitoring of the installed standpipes will give an indication of the seasonal variation.

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

BS 5930: 2015: 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.

BS EN ISO 14689-1:2018: Geotechnical investigation and testing. Identification and classification of rock. Identification and description.

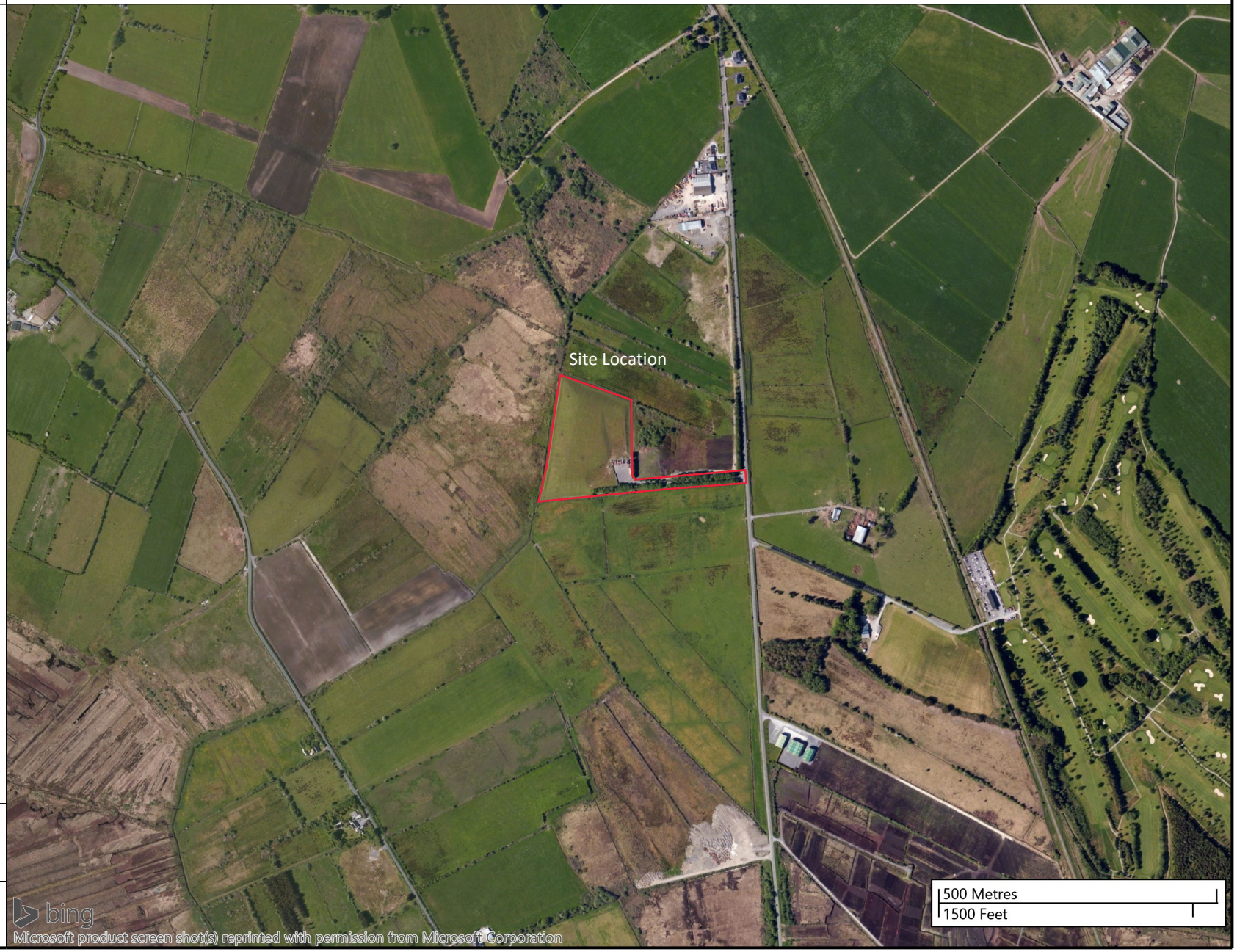
CAUSEWAY GEOTECH

APPENDIX A

SITE AND EXPLORATORY HOLE LOCATION PLAN

Project No.:	19-1465A	**Client:**	Galway County Council
Project Name:	Galway Historic Landfills - Tuam	**Client's Representative:**	Feehily Timoney

Legend Key



Title:

Site Location Plan

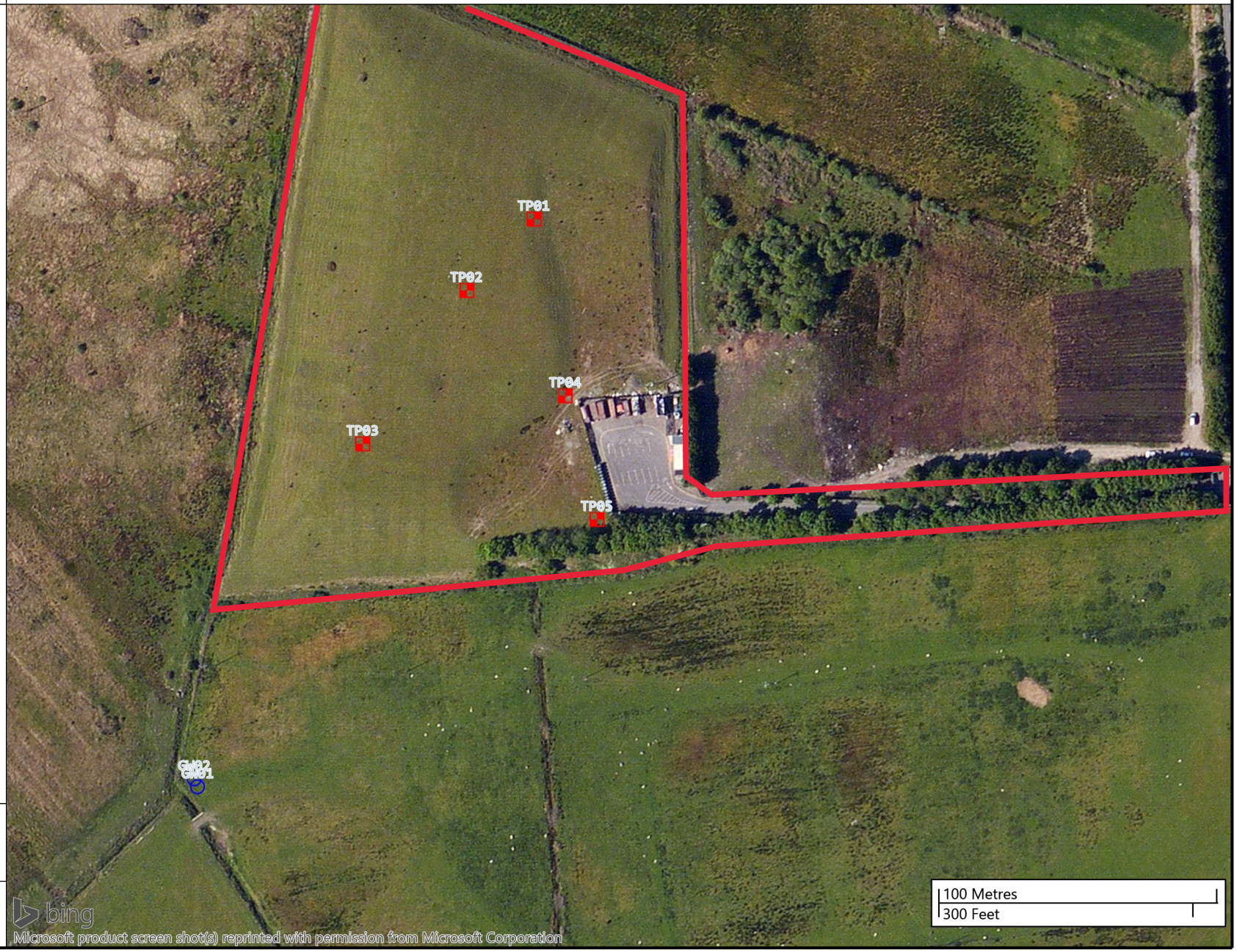
Last Revised:	**Scale:**
21/09/2020	1:10000

CAUSEWAY GEOTECH

Project No.:	19-1465A	**Client:**	Galway County Council
Project Name:	Galway Historic Landfills - Tuam	**Client's Representative:**	Feehily Timoney

Legend Key

- Locations By Type - RO
- Locations By Type - TP



Title:
Exploratory Hole Location Plan

Last Revised:	**Scale:**
21/09/2020	1:2000

CAUSEWAY GEOTECH

APPENDIX B

BOREHOLE LOGS

CAUSEWAY GEOTECH

Project No.	Project Name: Galway Historic Landfills - Tuam	Borehole ID
19-1465A	Client: Galway County Council	GW01
	Client's Rep: Feehily Timoney	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Rotary Drilling	Hanjin 8D	0.00	5.00	543727.49 E 749783.09 N

Final Depth:	5.00 m	Start Date:	18/09/2020	Driller:	KW	Sheet 1 of 1 Scale: 1:40
Elevation:	34.24 mOD	End Date:	18/09/2020	Logger:	SR	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description
					34.14	0.10		TOPSOIL Brown PEAT. (Driller's description)
					33.24	1.00		Brown sandy gravelly SILT. (Driller's description)
					31.24	3.00		Grey sandy gravelly CLAY with low cobble content. (Driller's description)
					29.24	5.00		End of Borehole at 5.00m

Water

Backfill

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)

Casing Details

To (m)	Diam (mm)
5.00	200

Water Added

From (m)	To (m)

Remarks

No noticeable groundwater strikes, but water present at the bottom of hole upon completion.

Core Barrel	Flush Type	Termination Reason	Last Updated
	Air	Terminated at scheduled depth.	21/09/2020

AGS

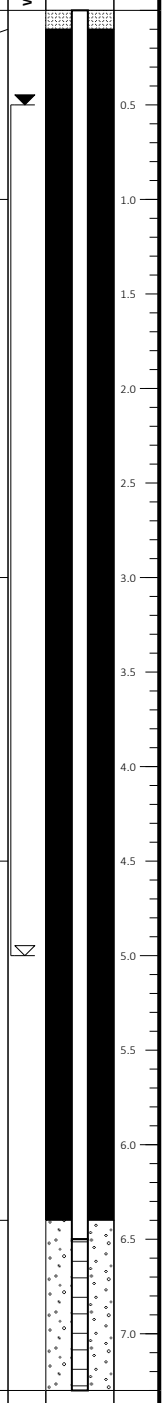
CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
19-1465A	Galway Historic Landfills - Tuam	GW02
	Client: Galway County Council	
	Client's Rep: Feehily Timoney	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Rotary Drilling	Hanjin 8D	0.00	12.00	543727.03 E 749785.25 N

Final Depth:	12.00 m	Start Date:	18/09/2020	Driller:	KW	Sheet 1 of 2 Scale: 1:40
Elevation:	34.35 mOD	End Date:	18/09/2020	Logger:	SR	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description
					34.25	0.10		TOPSOIL Brown PEAT. (Driller's description)
					33.35	1.00		Brown sandy gravelly SILT. (Driller's description)
					31.35	3.00		Grey sandy gravelly CLAY with low cobble content. (Driller's description)
		Strong water strike at 5.00m			29.85	4.50		Grey sandy fine to coarse GRAVEL. (Driller's description)
					27.95	6.40		Grey LIMESTONE. (Driller's description)



Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
5.00	5.00	20	0.50

Casing Details

To (m)	Diam (mm)
12.00	200

Water Added

From (m)	To (m)

Remarks

Core Barrel	Flush Type	Termination Reason	Last Updated
	Air	Terminated at scheduled depth.	21/09/2020

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
19-1465A	Galway Historic Landfills - Tuam	GW02
	Client: Galway County Council	
	Client's Rep: Feehily Timoney	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Rotary Drilling	Hanjin 8D	0.00	12.00	543727.03 E 749785.25 N

Final Depth:	12.00 m	Start Date:	18/09/2020	Driller:	KW
Elevation:	34.35 mOD	End Date:	18/09/2020	Logger:	SR

Sheet 2 of 2
Scale: 1:40
FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
								Grey LIMESTONE. (Driller's description)		
					22.35	12.00		End of Borehole at 12.00m		

7.5 8.0 8.5 9.0 9.5 10.0 10.5 11.0 11.5 12.0 12.5 13.0 13.5 14.0 14.5

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
5.00	5.00	20	0.50

Casing Details

To (m)	Diam (mm)
12.00	200

Water Added

From (m)	To (m)

Remarks

Core Barrel	Flush Type	Termination Reason	Last Updated
	Air	Terminated at scheduled depth.	21/09/2020

AGS

CAUSEWAY GEOTECH

APPENDIX C

TRIAL PIT LOGS

CAUSEWAY GEOTECH

Project No. 19-1465A	**Project Name:** Galway Historic Landfills - Tuam		**Trial Pit ID** TP01
Coordinates 543837.44 E 749999.13 N	**Client:** Galway County Council		
Method: Trial Pitting	**Client's Representative:** Feehily Timoney		Sheet 1 of 1 Scale: 1:25
Plant: 13t Tracked Excavator	**Elevation** 45.05 mOD	**Date:** 07/07/2020	**Logger:** JG	FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
0.10 - 0.40	B1					TOPSOIL	
			44.65	0.40		End of trial pit at 0.40m	

0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5

Water Strikes	
Struck at (m)	Remarks

Depth: 0.40
Width: 0.40
Length: 1.10

Remarks:
Geocomposite clay liner below topsoil at 0.40m.
No groundwater encountered.

Stability:	Termination Reason:	Last Updated
Stable	Geocomposite clay liner proven.	21/09/2020

AGS

CAUSEWAY GEOTECH

Project No. 19-1465A	**Project Name:** Galway Historic Landfills - Tuam		**Trial Pit ID** TP02
Coordinates 543812.74 E 749973.63 N	**Client:** Galway County Council		
Method: Trial Pitting	**Client's Representative:** Feehily Timoney		Sheet 1 of 1 Scale: 1:25
Plant: 13t Tracked Excavator	**Elevation** 46.74 mOD	**Date:** 07/07/2020	**Logger:** JG	FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
0.00 - 0.20	B1		46.54	0.20		TOPSOIL End of trial pit at 0.20m	

Water Strikes	
Struck at (m)	Remarks

Depth: 0.20
Width: 0.30
Length: 1.20

Remarks:
Geocomposite clay liner below topsoil at 0.20m.
No groundwater encountered.

Stability:	Termination Reason:	Last Updated
Stable	Geocomposite clay liner proven.	21/09/2020

AGS

CAUSEWAY GEOTECH

Project No. 19-1465A	**Project Name:** Galway Historic Landfills - Tuam		**Trial Pit ID** TP03
Coordinates 543774.50 E 749918.67 N	**Client:** Galway County Council		
Method: Trial Pitting	**Client's Representative:** Feehily Timoney		Sheet 1 of 1 Scale: 1:25
Plant: 13t Tracked Excavator	**Elevation** 44.26 mOD	**Date:** 07/07/2020	**Logger:** JG	FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
0.00 - 0.20	B1		44.06	0.20		TOPSOIL End of trial pit at 0.20m	

0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5

Water Strikes	
Struck at (m)	Remarks

Depth: 0.20
Width: 0.60
Length: 1.80

Remarks:
Geocomposite clay liner below topsoil at 0.20m.
No groundwater encountered.

Stability:	**Termination Reason:**	**Last Updated**
Stable	Geocomposite clay liner proven.	21/09/2020

AGS

CAUSEWAY GEOTECH

Project No. 19-1465A	**Project Name:** Galway Historic Landfills - Tuam		**Trial Pit ID** TP04
Coordinates 543848.05 E 749935.17 N	**Client:** Galway County Council		
Method: Trial Pitting	**Client's Representative:** Feehily Timoney		Sheet 1 of 1 Scale: 1:25
Plant: 13t Tracked Excavator	**Elevation** 42.38 mOD	**Date:** 07/07/2020	**Logger:** JG	FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
			42.33	0.05		TOPSOIL MADE GROUND: Light greyish brown sandy subangular to subrounded fine to coarse GRAVEL of mixed lithologies. Sand is fine to coarse.	
			42.13	0.25		BITMAC	
			42.08	0.30		MADE GROUND: Very soft to soft light greyish brown sandy gravelly silty CLAY with medium cobble content and fragments of timber, plastic, glass, steel, wire, brick and concrete. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies. Cobbles are subangular of mixed lithologies.	
			41.18	1.20		MADE GROUND: Soft dark grey and black sandy gravelly silty CLAY with medium cobble content and fragments of plastic, glass, clothing, timber, brick and concrete. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies. Cobbles are subangular of mixed lithologies.	
			40.38	2.00		End of trial pit at 2.00m	

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5

Water Strikes	
Struck at (m)	Remarks

Depth: 2.00
Width: 0.60
Length: 4.20

Remarks:
Geocomposite clay liner below topsoil at 0.25m.
No groundwater encountered.
Strong pungent odour present from 0.30-2.00m.
Moved into filed at the request of GCC engineer (Colin Ryder).

Stability:	**Termination Reason:**	**Last Updated**
Slightly unstable	Terminated at scheduled depth.	21/09/2020

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Trial Pit ID
19-1465A	Galway Historic Landfills - Tuam	TP05
Coordinates	**Client:**	
543859.01 E	Galway County Council	
749890.35 N	**Client's Representative:**	Sheet 1 of 1
	Feehily Timoney	Scale: 1:25
Elevation	**Date:** / **Logger:**	FINAL
41.73 mOD	07/07/2020 / JG	

Method: Trial Pitting

Plant: 13t Tracked Excavator

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
			41.68	0.05		TOPSOIL	
						MADE GROUND: Light grey slightly gravelly silty fine to coarse SAND. Gravel is subangular fine to coarse of mixed lithologies.	
			41.53	0.20		End of trial pit at 0.20m	

0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5

Water Strikes

Struck at (m)	Remarks

Depth: 0.20
Width: 0.30
Length: 3.20

Remarks:
Geocomposite clay liner below topsoil at 0.20m.
Moved to field side of Civic Area as per GCC engineer request.
No groundwater encountered.

Stability: Stable

Termination Reason: Geocomposite clay liner proven.

Last Updated 21/09/2020

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