

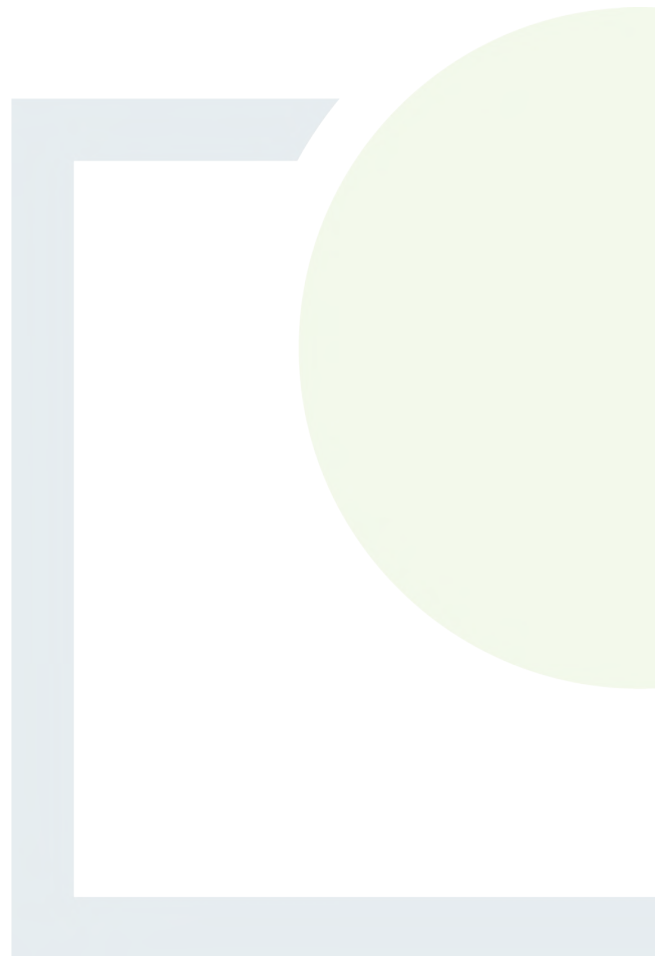


**FEHILY  
TIMONEY**

CONSULTANTS IN ENGINEERING,  
ENVIRONMENTAL SCIENCE & PLANNING

## **APPENDIX 2**

Causeway Geotechnical  
Reports





**CAUSEWAY**  
— GEOTECH

## Historical Landfills in North Kerry - Listowel

Client: Kerry County Council

Client's Representative: Feehily Timoney

Report No.: 18-1068c

Date: September 2019

Status: Final for Issue

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Document Control Sheet




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## Document Control Sheet

<b>Report No.:</b>		18-1068b			
<b>Project Title:</b>		Historical Landfills in North Kerry - Listowel			
<b>Client:</b>		Kerry County Council			
<b>Client's Representative:</b>		Fehily Timoney			
<b>Revision:</b>	A00	<b>Status:</b>	Final for Issue	<b>Issue Date:</b>	23 September 2019
<b>Prepared by:</b>		<b>Reviewed by:</b>		<b>Approved by:</b>	
 Sean Ross BSc MSc		 Colm Hurley BSc FGS		 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. The length achieved is stated (mm) for any test increment less than 75mm
N=X	SPT blow count 'N' given by the summation of the blows 'X' required to drive the full test length (300mm)
N=X/Z	Incomplete standard penetration test where the full test length was not achieved. The blows 'X' represent the total blows for the given test length 'Z' (mm)
V VR	Shear vane test (borehole)      Hand vane test (trial pit)      Shear strength stated in kPa V: undisturbed vane shear strength      VR: remoulded vane shear strength
dd/mm/yy: 1.0 dd/mm/yy: dry	Date & water level at the borehole depth at the end of shift and the start of the following shift
▽	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).

## Historical Landfills in North Kerry - Listowel

### 1 AUTHORITY

On the instructions of Fehily Timoney Consulting Engineers, (“the Client’s Representative”), acting on the behalf of Kerry County Council (“the Client”), a ground investigation was undertaken at the above location to allow the geotechnical and environmental assessment of the historical landfill present on site. The information will input into the Tier 2 and 3 reports being compiled by the Client’s Representative.

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 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, soil sampling, environmental sampling, 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 in the Garden of Europe public park 200m south east of Listowel, Co.Kerry. the site is bounded to the north east and west by agricultural lands and to the south by the River Feale. There is a large drop in topography across the site from north to south towards the River Feale.

## 4 SITE OPERATIONS

### 4.1 Summary of site works

Site operations, which were conducted between 13<sup>th</sup> and 15<sup>th</sup> August 2019, comprised:

- two boreholes by rotary drilling methods;
- two standpipe installations; and
- eight boreholes by dynamic (windowless) sampling methods.

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

A total of ten boreholes were put down in a minimum diameter of 150mm through soil strata to their completion depths by a combination of methods, including light percussion boring using a Dando Terrier rig and rotary drilling by a Comacchio 205 tracked rotary drilling rig.

The borehole logs state the methodology and plant used for each location, as well as the appropriate depth ranges.

A summary of the boreholes, subdivided by category in accordance with the methods employed for their completion, is presented in the following sub-sections.

#### 4.2.1 Dynamic sampled boreholes

Eight boreholes (WS01-WS08) were put down to completion by light percussion boring techniques using a Dando Terrier dynamic sampling rig. The boreholes were put down initially in 150mm diameter, reducing in diameter with depth as required, down to 50mm by use of the smallest sampler.

Hand dug inspection pits were carried out between ground level and 1.20m depth to ensure boreholes were put down clear of services or subsurface obstructions. The boreholes were taken to depths ranging between 3.30m and 6.00m where they were terminated at their scheduled depths, or else they were terminated on encountering virtual refusal on obstructions above this depth.

Disturbed (bulk bag) samples were taken within the encountered strata. Environmental samples were taken at various intervals within the strata encountered.

Groundwater was not encountered during drilling of any of the boreholes.

Appendix C presents the borehole logs.

#### **4.2.2 Rotary drilled boreholes**

Two boreholes (BH01-BH02) were put to their completion by rotary drilling techniques only. The boreholes were completed using a Hanjin 8D tracked rotary drilling rig.

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

Appendix B presents the borehole logs.

#### **4.3 Standpipe installations**

A groundwater monitoring standpipe was installed in BH01 and BH02.

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 R6 GPS system employing VRS and real time kinetic (RTK) techniques.

The plan coordinates (Irish National Grid) 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:

- **permeability testing:** permeability by triaxial compression

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 D.

## 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 out according to Engineer's Ireland Suite E which comprises a single stage waste acceptance criteria (WAC) test.

Results of environmental laboratory testing are presented in Appendix E.

## 6 GROUND CONDITIONS

### 6.1 General geology of the area

Published geological mapping indicate the superficial deposits underlying the site comprise made ground, alluvium and glacial till. These deposits are underlain by Visean Limestones and mudstones of the Clare Shale 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:** BH01 encountered 200mm of concrete surfacing.
- **Topsoil:** encountered at all locations except BH01 with a thickness range of 100 – 300mm.
- **Made Ground (fill):** landfill material comprising various amounts of plastic bags, plastic, timber, glass, cotton, rubber, ceramic and wool encountered in WS02, WS03, WS05, WS07, WS08 and BH01, to a maximum depth of 6.00m in WS02, WS05 and WS08. A very strong hydrocarbon odour was noted within the made ground in WS02, WS03, WS05 and WS07. Note, recovery of this material was poor across the site, with the driller's log describing the material as "liquid" or "sludge" coming out of the sampler.
- **Alluvium deposits:** typically, medium dense sands and gravels interspersed with layers of sandy gravelly clay encountered in WS01 and BH01 to a depth of 7.00m.
- **Glacial Till:** sandy gravelly clay, frequently with low cobble content, typically firm or stiff in upper

horizons, becoming very stiff with increasing depth.

### 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 drilling as water strikes as shown in Table 1 below.

**Table 1 Groundwater strikes encountered during the ground investigation**

GI Ref.	Water level (mbgl)	Comments
BH01	0.20	Seepage
BH01	5.20	Seepage

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 at other depths should not be ruled out.

Groundwater was not noted during drilling of any of the window sample boreholes.

## 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.

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

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

BS EN 1997-2: 2007: Eurocode 7 - Geotechnical design - Part 2 Ground investigation and testing. 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 EN ISO 14689-1:2018: Geotechnical investigation and testing. Identification and classification of rock. Identification and description

BS EN ISO 22282-2: 2012: Geotechnical investigation and testing. Geohydraulic testing – Part 2: Water permeability tests in a borehole using open systems.



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**APPENDIX A**  
**SITE AND EXPLORATORY HOLE LOCATION PLANS**





**Project No.:** 18-1068c

**Client:** Kerry County Council

**Project Name:** Historical Landfills in North Kerry - Listowel

**Client's Representative:** Fehily Timoney

Legend Key



**Title:**  
Site Location Plan

**Last Revised:**  
16/08/2019

**Scale:**  
1:10000

bing  
Microsoft product screen shots reproduced with permission from Microsoft Corporation

500 Metres  
1500 Feet



**Project No.:** 18-1068c

**Client:** Kerry County Council

**Project Name:** Historical Landfills in North Kerry - Listowel

**Client's Representative:** Fehily Timoney

**Legend Key**

- Locations By Type - RO
- Locations By Type - WS



**Title:**  
Exploratory Hole Location Plan

**Last Revised:**  
16/08/2019

**Scale:**  
1:2000



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**APPENDIX B**  
**BOREHOLE LOGS**





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<b>Project No.:</b> 18-1068c	<b>Project Name:</b> Historical Landfills in North Kerry - Listowel	<b>Borehole No.:</b> BH01
<b>Coordinates:</b> 99721.28 E	<b>Client:</b> Kerry County Council	Sheet 1 of 1
<b>Method</b> Rotary Drilling	<b>Plant Used</b> Comacchio 205	<b>Top</b> 0.00
<b>Base</b> 7.00	<b>Client's Representative:</b> Fehily Timoney	<b>Scale:</b> 1:50
<b>Ground Level:</b> 18.16 mOD	<b>Dates:</b> 15/08/2019 - 15/08/2019	<b>Driller:</b> RS
		<b>Logger:</b> PF

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill
				Slight seepage	17.96	(0.20) 0.20		MADE GROUND: Concrete		
						(5.00)		MADE GROUND: Black WASTE with a clay matrix. (Driller's description)		
				Large water strike	12.96	5.20		Dark brown clayey GRAVEL. (Driller's description)		
						(1.80)				
					11.16	7.00		End of Borehole at 7.00m		

Remarks  Terminated on instruction of engineer.	Water Strikes				Chiselling Details		
	Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	From (m)	To (m)	Time (hrs:mins)
	0.20						
	5.20						
	Water Added		Casing Details				
	From (m)	To (m)	To (m)	Diam (mm)			
			7.00	200			



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<b>Project No.:</b> 18-1068c	<b>Project Name:</b> Historical Landfills in North Kerry - Listowel	<b>Borehole No.:</b> BH02
<b>Coordinates:</b> 99687.20 E	<b>Client:</b> Kerry County Council	Sheet 1 of 2
<b>Method</b> Rotary Drilling	<b>Plant Used</b> Comacchio 205	<b>Top</b> 0.00
<b>Base</b> 11.50	<b>Client's Representative:</b> Fehily Timoney	<b>Scale:</b> 1:50
<b>Ground Level:</b> 27.21 mOD	<b>Dates:</b> 14/08/2019 - 15/08/2019	<b>Driller:</b> RS
		<b>Logger:</b> PF

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill
						(0.60)		Brown CLAY. (Driller's description)		
					26.61	0.60		Light brown gravelly SILT. (Driller's description)		
						(3.30)				
					23.31	3.90		BOULDER. (Driller's description)		
						(0.50)				
					22.81	4.40		Light brown gravelly clayey SILT. (Driller's description)		
						(7.10)				

<b>Remarks</b> No groundwater encountered.  Terminated on instruction of engineer.	<b>Water Strikes</b>				<b>Chiselling Details</b>		
	Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	From (m)	To (m)	Time (hrs:min)
	<b>Water Added</b>		<b>Casing Details</b>				
From (m)	To (m)	To (m)	Diam (mm)				
		11.50	200				





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<b>Project No.:</b> 18-1068c	<b>Project Name:</b> Historical Landfills in North Kerry - Listowel	<b>Borehole No.:</b> BH02
<b>Coordinates:</b> 99687.20 E	<b>Client:</b> Kerry County Council	Sheet 2 of 2
<b>Method</b> Rotary Drilling	<b>Plant Used</b> Comacchio 205	<b>Top</b> 0.00
<b>Base</b> 11.50	<b>Client's Representative:</b> Fehily Timoney	<b>Scale:</b> 1:50
<b>Ground Level:</b> 27.21 mOD	<b>Dates:</b> 14/08/2019 - 15/08/2019	<b>Driller:</b> RS
		<b>Logger:</b> PF

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill
					15.71	11.50		Light brown gravelly clayey SILT. (Driller's description)		
								End of Borehole at 11.50m		

<b>Remarks</b> No groundwater encountered.  Terminated on instruction of engineer.	<b>Water Strikes</b>				<b>Chiselling Details</b>		
	Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	From (m)	To (m)	Time (hrs:min)
	<b>Water Added</b>		<b>Casing Details</b>				
	From (m)	To (m)	To (m)	Diam (mm)			
			11.50	200			



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**APPENDIX C**

**WINDOW SAMPLE LOGS**





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**Project No.:**  
18-1068c

**Project Name:**  
Historical Landfills in North Kerry - Listowel

**Borehole No.:**  
WS01

**Coordinates:**  
99698.91 E  
133378.46 N

**Client:**  
Kerry County Council

Sheet 1 of 1

Method	Plant Used	Top	Base
Light Percussion	Dando Terrier	0.00	4.20

**Client's Representative:**  
Fehily Timoney

**Scale:** 1:50

**Ground Level:**  
18.61 mOD

**Dates:**  
13/08/2019 - 13/08/2019

**Driller:** PL

**Logger:** SR

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill
0.15 - 0.60	B4				18.46	(0.15) 0.15	TOPSOIL			
0.60 - 1.20	B5				18.01	(0.45) 0.60	MADE GROUND: Light grey sandy silty subangular fine to coarse GRAVEL of mixed lithologies. Sand is fine to coarse.			
						(0.60) 17.41		Very soft dark brown slightly gravelly sandy CLAY with rootlets. Sand is fine to medium. Gravel is subangular to rounded of mixed lithologies.		
						(0.80) 16.61		Orangish brown sandy subrounded fine to coarse GRAVEL of mixed lithologies. Sand is fine to coarse.		
2.00	ES1				16.61	(1.00) 15.61		Brown slightly sandy silty subangular fine to coarse GRAVEL of mixed lithologies. Sand is fine to coarse.		
3.00	ES2				15.61	(1.20) 14.41		Orangish brown sandy silty rounded coarse GRAVEL of mixed lithologies. Sand is fine to coarse.		
4.20	ES3				14.41	4.20		End of Borehole at 4.20m		

**Remarks**  
No visible signs of landfill material present.

Terminated on very dense gravel.

Water Strikes				Chiselling Details		
Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	From (m)	To (m)	Time (hrs:min)
Water Added		Casing Details				
From (m)	To (m)	To (m)	Diam (mm)			



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<b>Project No.:</b> 18-1068c	<b>Project Name:</b> Historical Landfills in North Kerry - Listowel	<b>Borehole No.:</b> WS02
<b>Coordinates:</b> 99727.57 E	<b>Client:</b> Kerry County Council	Sheet 1 of 1
<b>Method</b> Light Percussion	<b>Plant Used</b> Dando Terrier	<b>Top</b> 0.00
<b>Base</b> 6.00	<b>Client's Representative:</b> Fehily Timoney	<b>Scale:</b> 1:50
<b>Ground Level:</b> 23.58 mOD	<b>Dates:</b> 15/08/2019 - 15/08/2019	<b>Driller:</b> PL
		<b>Logger:</b> SR

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill
0.10 - 1.00	B3 ES1				23.48	(0.10)	TOPSOIL	MADE GROUND: Very soft orangish brown sandy gravelly CLAY with fragments of timber, plastic and glass. Sand is fine to coarse. Gravel is subangular fine to medium.		
1.00 - 3.00	B4				22.58	1.00		MADE GROUND: Plastic, cotton, rubber and ceramic with bands of silt. (No recovery) Very strong hydrocarbon odour present.		
3.00 - 6.00	B5 ES2				20.58	3.00		MADE GROUND: Soft locally firm brownish black sandy gravelly SILT with fragments of concrete, plastic, glass and rope.. Sand is fine to coarse. Gravel is subangular fine to medium of mixed lithologies.		
					17.58	6.00		End of Borehole at 6.00m		

<b>Remarks</b> Very poor recovery of landfill material.  Terminated at scheduled depth.	<b>Water Strikes</b>				<b>Chiselling Details</b>		
	Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	From (m)	To (m)	Time (hrs:min)
	<b>Water Added</b>		<b>Casing Details</b>				
	From (m)	To (m)	To (m)	Diam (mm)			



**CAUSEWAY**  
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<b>Project No.:</b> 18-1068c	<b>Project Name:</b> Historical Landfills in North Kerry - Listowel	<b>Borehole No.:</b> WS03
<b>Coordinates:</b> 99721.48 E	<b>Client:</b> Kerry County Council	Sheet 1 of 1
<b>Method</b> Light Percussion	<b>Plant Used</b> Dando Terrier	<b>Top</b> 0.00
<b>Base</b> 5.00	<b>Client's Representative:</b> Fehily Timoney	<b>Scale:</b> 1:50
<b>Ground Level:</b> 22.38 mOD	<b>Dates:</b> 15/08/2019 - 15/08/2019	<b>Driller:</b> PL
		<b>Logger:</b> SR

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill
0.10 - 1.20	B3 ES1				22.28	(0.10)	[Pattern]	TOPSOIL		
1.20 - 2.50	B4				21.18	1.20	[Pattern]	MADE GROUND: Plastic, glass, rope, wire with bands of SILT. (Poor recovery) Strong hydrocarbon odour present.		
2.50 - 5.00	B5 ES2				19.88	2.50	[Pattern]	MADE GROUND: Soft bluish brown sandy gravelly SILT with fragments of plastic and glass. Sand is fine to coarse. Gravel is subangular fine to medium of mixed lithologies.		
					17.38	5.00	[Pattern]	End of Borehole at 5.00m		

<b>Remarks</b> Very poor recovery of landfill material.  Terminated on obstruction.	<b>Water Strikes</b>				<b>Chiselling Details</b>		
	Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	From (m)	To (m)	Time (hrs:min)
	<b>Water Added</b>		<b>Casing Details</b>				
	From (m)	To (m)	To (m)	Diam (mm)			



**CAUSEWAY**  
GEOTECH

<b>Project No.:</b> 18-1068c	<b>Project Name:</b> Historical Landfills in North Kerry - Listowel	<b>Borehole No.:</b> WS04
<b>Coordinates:</b> 99669.12 E 133492.27 N	<b>Client:</b> Kerry County Council	Sheet 1 of 1
<b>Method</b> Light Percussion	<b>Plant Used</b> Dando Terrier	<b>Scale:</b> 1:50
<b>Top</b> 0.00	<b>Base</b> 3.80	<b>Driller:</b> PL
<b>Ground Level:</b> 22.56 mOD	<b>Dates:</b> 14/08/2019 - 14/08/2019	<b>Logger:</b> SR

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill
0.20 - 1.20	B3				22.36	(0.20) 0.20	TOPSOIL			
1.00	ES1				21.36	(1.00) 1.20		Firm orangish brown slightly gravelly sandy SILT. Sand is fine to medium. Gravel is rounded fine to coarse of mixed lithologies.		
2.00	ES2				20.56	(0.80) 2.00		Stiff light brown sandy gravelly SILT. Sand is fine to coarse. Gravel is subangular coarse of mixed lithologies.		
					19.56	(1.00) 3.00		Stiff to very stiff light grey slightly gravelly sandy SILT. Sand is fine to medium. Gravel is subrounded fine to medium of mixed lithologies.		
					18.76	(0.80) 3.80		Very stiff orangish light brown sandy gravelly SILT. Sand is fine to medium. Gravel is subrounded fine to medium of mixed lithologies.		
								End of Borehole at 3.80m		

**Remarks**  
No visible signs of landfill material present.

Terminated on obstruction.

Water Strikes				Chiselling Details		
Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	From (m)	To (m)	Time (hrs:min)
Water Added		Casing Details				
From (m)	To (m)	To (m)	Diam (mm)			



**CAUSEWAY**  
GEOTECH

<b>Project No.:</b> 18-1068c	<b>Project Name:</b> Historical Landfills in North Kerry - Listowel	<b>Borehole No.:</b> WS05
<b>Coordinates:</b> 99743.16 E	<b>Client:</b> Kerry County Council	Sheet 1 of 1
<b>Method</b> Light Percussion	<b>Plant Used</b> Dando Terrier	<b>Top</b> 0.00
<b>Base</b> 6.00	<b>Client's Representative:</b> Fehily Timoney	<b>Scale:</b> 1:50
<b>Ground Level:</b> 22.79 mOD	<b>Dates:</b> 15/08/2019 - 15/08/2019	<b>Driller:</b> PL
		<b>Logger:</b> SR

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill
0.10 - 1.00	B3 ES1				22.69	0.10	TOPSOIL	MADE GROUND: Soft blackish brown sandy gravelly CLAY with fragments of plastic and glass. Sand is fine to coarse. Gravel is subangular fine to medium of mixed lithologies. Very strong hydrocarbon odour present.		
1.00 - 6.00	B4 ES2				21.79	1.00		MADE GROUND: Plastic, glass, metal and heavy hydrocarbon with a SILT matrix. (Very poor recovery)		
					16.79	6.00		End of Borehole at 6.00m		

<b>Remarks</b> Very poor recovery of landfill material.  Terminated at scheduled depth.	<b>Water Strikes</b>				<b>Chiselling Details</b>		
	Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	From (m)	To (m)	Time (hr:min)
	<b>Water Added</b>		<b>Casing Details</b>				
	From (m)	To (m)	To (m)	Diam (mm)			



**CAUSEWAY**  
GEOTECH

**Project No.:**  
18-1068c

**Project Name:**  
Historical Landfills in North Kerry - Listowel

**Borehole No.:**  
WS06

**Coordinates:**  
99670.29 E  
133531.56 N

**Client:**  
Kerry County Council

Sheet 1 of 1

Method	Plant Used	Top	Base
Light Percussion	Dando Terrier	0.00	3.30

**Client's Representative:**  
Fehily Timoney

**Scale:** 1:50

**Ground Level:**  
25.17 mOD

**Dates:**  
14/08/2019 - 14/08/2019

**Driller:** PL

**Logger:** SR

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill
0.20 - 0.70	B1				24.97	(0.20) 0.20	[Pattern]	TOPSOIL		
						(0.50)	[Pattern]	Orangish brown gravelly silty fine to medium SAND. Gravel is subrounded fine to coarse of mixed lithologies.		
1.00	ES2				24.47	0.70 (0.50)	[Pattern]	Stiff orangish brown sandy gravelly SILT. Sand is fine to coarse. Gravel is subangular fine to medium of mixed lithologies.		
					23.97	1.20 (0.80)	[Pattern]	Stiff greyish brown sandy gravelly SILT. Sand is fine to coarse. Gravel is subrounded fine to medium of mixed lithologies.		
2.00	ES3				23.17	2.00 (1.30)	[Pattern]	Very stiff light brown slightly gravelly sandy SILT. Sand is fine to coarse. Gravel is subrounded fine to medium of mixed lithologies.		
					21.87	3.30		End of Borehole at 3.30m		

**Remarks**  
No visible signs of landfill material present.

Terminated on obstruction.

Water Strikes				Chiselling Details		
Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	From (m)	To (m)	Time (hrs:min)
Water Added		Casing Details				
From (m)	To (m)	To (m)	Diam (mm)			





**CAUSEWAY**  
GEOTECH

<b>Project No.:</b> 18-1068c	<b>Project Name:</b> Historical Landfills in North Kerry - Listowel	<b>Borehole No.:</b> WS07
<b>Coordinates:</b> 99745.73 E	<b>Client:</b> Kerry County Council	Sheet 1 of 1
<b>Method</b> Light Percussion	<b>Plant Used</b> Dando Terrier	<b>Top</b> 0.00
<b>Base</b> 6.00	<b>Client's Representative:</b> Fehily Timoney	<b>Scale:</b> 1:50
<b>Ground Level:</b> 25.87 mOD	<b>Dates:</b> 14/08/2019 - 14/08/2019	<b>Driller:</b> PL
		<b>Logger:</b> SR

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill
0.15 - 1.00	B1 ES3				25.72	(0.15) 0.15	TOPSOIL			
						(0.85)		MADE GROUND: Very soft blueish brown sandy gravelly CLAY with fragments of plastic and glass. Sand is fine to coarse. Gravel is subangular fine to medium of mixed lithologies.		
								Very strong hydrocarbon odour present.		
1.00 - 6.00	B2 ES4				24.87	1.00		MADE GROUND: Plastic, glass, copper and wire in a SILT matrix. (Very poor recovery)		
						(5.00)				
					19.87	6.00		End of Borehole at 6.00m		

<b>Remarks</b> Very poor recovery of landfill material.  Terminated at scheduled depth.	<b>Water Strikes</b>				<b>Chiselling Details</b>		
	Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	From (m)	To (m)	Time (hrs:min)
	<b>Water Added</b>		<b>Casing Details</b>				
	From (m)	To (m)	To (m)	Diam (mm)			



**CAUSEWAY**  
GEOTECH

**Project No.:**  
18-1068c

**Project Name:**  
Historical Landfills in North Kerry - Listowel

**Borehole No.:**  
WS08

**Coordinates:**  
99746.39 E

**Client:**  
Kerry County Council

Sheet 1 of 1

133574.69 N

**Client's Representative:**  
Fehily Timoney

**Scale:** 1:50

Method	Plant Used	Top	Base
Light Percussion	Dando Terrier	0.00	6.00

**Ground Level:**  
26.92 mOD

**Dates:**  
14/08/2019 - 14/08/2019

**Driller:** PL

**Logger:** SR

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill
0.10 - 1.00	B1 ES3				26.82	(0.10)	TOPSOIL	MADE GROUND: Very soft greyish brown sandy gravelly CLAY with fragments of bitmac, red brick, glass and plastic. Sand is fine to coarse. Gravel is subangular fine to coarse of mixed lithologies.		
1.00 - 3.80	B2				25.92	1.00		MADE GROUND: Timber, plastic, wool and glass in a SILT matrix. (Very poor recovery)		
						(2.80)				
3.80	ES4				23.12	3.80		Very soft greyish brown slightly sandy slightly gravelly SILT. Sand is fine to coarse. Gravel is subangular fine to medium.		
						(1.20)				
					21.92	5.00		Soft to firm brown slightly gravelly very sandy SILT. Sand is fine to coarse. Gravel is subangular fine to coarse.		
						(1.00)				
					20.92	6.00		End of Borehole at 6.00m		

**Remarks**  
Very poor recovery of landfill material.  
  
Terminated at scheduled depth.

Water Strikes				Chiselling Details		
Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	From (m)	To (m)	Time (hrs:min)

Water Added		Casing Details	
From (m)	To (m)	To (m)	Diam (mm)



**CAUSEWAY**  
— GEOTECH

**APPENDIX D**  
**GEOTECHNICAL LABORATORY TEST RESULTS**





# LABORATORY REPORT



4043

**Contract Number: PSL19/5162**

Report Date: 18 September 2019  
Client's Reference: 18-1068c  
Client Name: Causeway Geotech  
8 Drumahiskey Road  
Ballymoney  
Co. Antrim  
BT53 7QL

**For the attention of: Stephen Watson**

Contract Title: Historical Landfills in North Kerry - Listowel  
Date Received: 28/8/2019  
Date Commenced: 28/8/2019  
Date Completed: 18/9/2019

**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:

R Gunson  
(Director)

S Royle  
(Laboratory Manager)

A Watkins  
(Director)

S Eyre  
(Senior Technician)

R Berriman  
(Quality Manager)

L Knight  
(Senior Technician)

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

Page 1 of

# PERMEABILITY IN A TRIAXIAL CELL

BS 1377 : Part 6 : 1990: Clause 6

Hole Number: **WS08** Top Depth (m) : **0.10**  
Sample Number: **1** Base Depth (m) : **1.00**  
Sample Type: **B** Lift Number:  
Date Grid Reference:

Description of Specimen	
Dark brown slightly gravelly slightly sandy CLAY	
Remarks	
Remoulded with 2.5kg rammer	

Initial Specimen Conditions		
Height	mm	102.44
Diameter	mm	102.05
Area	mm <sup>2</sup>	8179.30
Volume	cm <sup>3</sup>	837.89
Mass	g	1623
Dry Mass	g	1299
Bulk Density	Mg/m <sup>3</sup>	1.94
Dry Density	Mg/m <sup>3</sup>	1.55
Moisture Content	%	25
Voids Ratio	-	0.709
Specific Gravity	Mg/m <sup>3</sup>	2.65
(assumed/measured)	-	assumed

Final Specimen Conditions		
Moisture Content	%	21
Bulk Density	Mg/m <sup>3</sup>	1.87
Dry Density	Mg/m <sup>3</sup>	1.55

Test Setup		
Date Started		07/09/2019
Date Finished		12/09/2019
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	2
Permeability Time	Days	1



**PSL**  
Professional Soils Laboratory

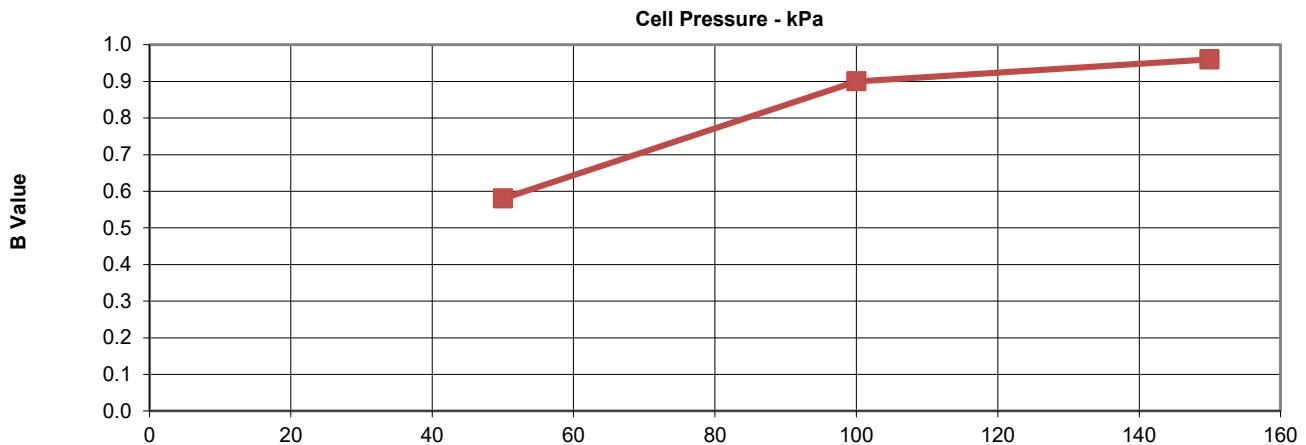
Historical Landfills in North Kerry- Listowel

Contract No.  
**PSL19/5162**  
Client Ref  
**18-1068c**

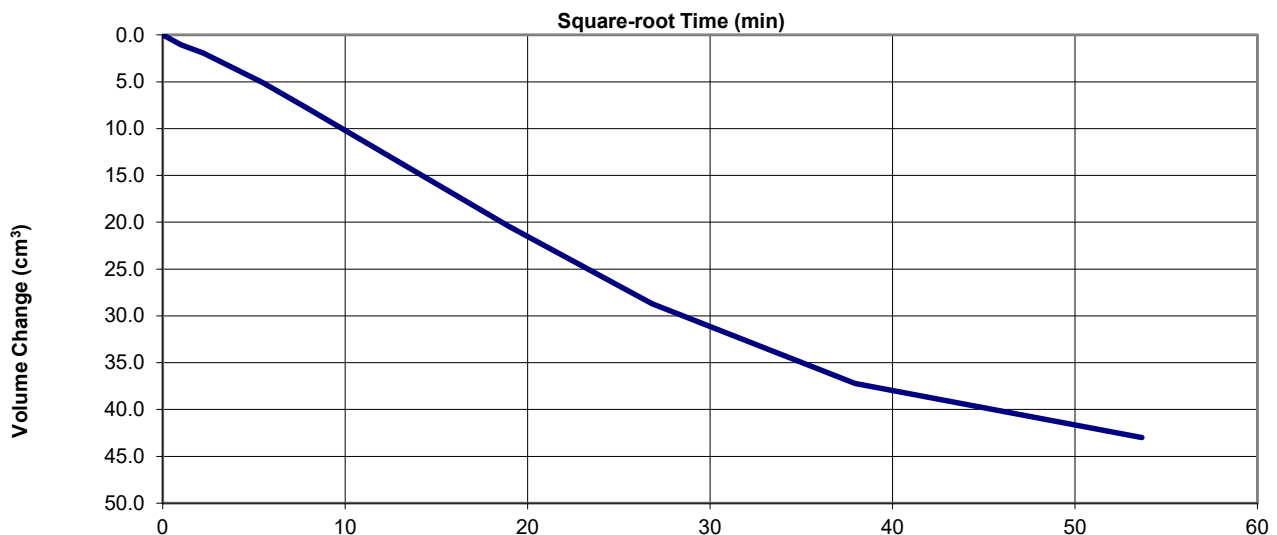
# PERMEABILITY IN A TRIAXIAL CELL

BS 1377 : Part 6 : 1990 Clause 6

Specimen Details		
Hole Number		WS08
Sample Depth	m	0.10
Sample No,		1
Grid Reference		
Lift Number		
Saturation		
Cell Pressure Incr.	kPa	50
Back Pressure Incr.	kPa	50
Differential Pressure	kPa	10
Final Cell Pressure	kPa	150
Final B Value	-	0.96



Consolidation		
Effective Pressure	kPa	100
Cell Pressure	kPa	400
Back Pressure	kPa	300
Final PWP	kPa	300
PWP dissipation	%	100



**PSL**  
Professional Soils Laboratory

Historical Landfills in North Kerry- Listowel

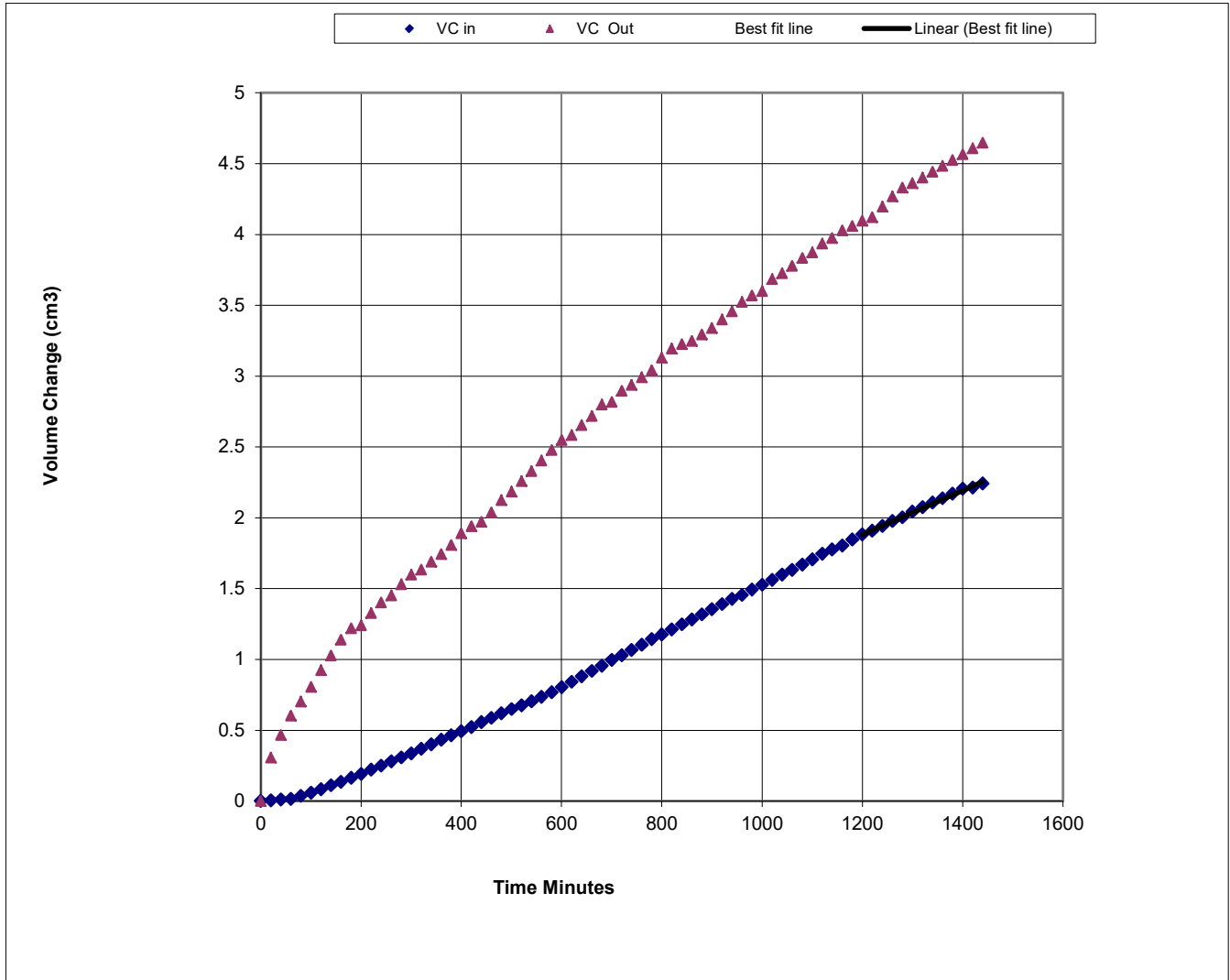
<b>Contract No.</b>
<b>PSL19/5162</b>
<b>Client Ref</b>
<b>18-1068c</b>

# PERMEABILITY IN A TRIAXIAL CELL

BS 1377 : Part 6 : 1990 Clause 6

Specimen Details		
Hole Number		WS08
Sample Depth	m	0.10
Sample No.		1
Grid Reference		
Lift Number		

## Permeability Stage



Permeability Stage		
Cell Pressure	kPa	400
Mean Effective Stress	kPa	100
Back Pressure Diff.	kPa	20
Mean Rate of Flow	ml/min	0.0015
Average Temperature	'C	20
Vertical Permeability Kv	m/s	1.5E-10



**PSL**  
Professional Soils Laboratory

Historical Landfills in North Kerry- Listowel

Contract No.  
PSL19/5162  
Client Ref  
18-1068c



# TEST AMENDMENT NOTICE

(Please tick boxes as appropriate)

From: *David Burton*

To: *Causeway Geotech*

Date: *6 / 9 / 2019*

Laboratory Ref:

Contract Number: *PSH19/5162*

Location: *Historical Landfills in North Kerry - Listowel*

BH     TP    Sample Number

Depth (m): *0.1 - 1.00*

*W505*

Sample Type:     U

*B3*

D

W

P

C

Test/s: *permeability*

The above sample cannot be tested for the following reasons:

- The Sample has not been received
- There is insufficient material for BS1377: 1990 testing
  - Maximum Grain Size (Minimum 10%):     Fine     Medium     Coarse
  - Sample Mass (kg): .....
  - Required Mass (kg): .....

- The Sample has been previously tested.
- The Sample has been misplaced in the Laboratory.
- The Sample is unsuitable for testing because:
 

*unsuitable material - high percentage of wood fragments/chipboard*

Please advise action required:

- Perform original test on the following alternative Sample:
  - BH     TP    Sample Number:    Depth (m):
  - Sample Type:     U     B     D     W     P     C
- Combine original Sample with the following sample:
  - BH     TP    Sample Number:    Depth (m):
  - Sample Type:     U     B     D     W     P     C
- Perform the following alternative test/s on the original Sample
- Perform non-standard test on material available
- Take no further action.

Signed .....  
(Project Engineer)

Date .....





**CAUSEWAY**  
— GEOTECH

**APPENDIX E**  
**ENVIRONMENTAL LABORATORY TEST RESULTS**





## Final Report

---

**Report No.:** 19-27965-1

**Initial Date of Issue:** 02-Sep-2019

**Client** Causeway Geotech Ltd

**Client Address:** 8 Drumahiskey Road  
Balnamore  
Ballymoney  
County Antrim  
BT53 7QL

**Contact(s):** Carin Cornwall  
Colm Hurley  
Darren O'Mahony  
Gabriella Horan  
Joe Gervin  
John Cameron  
Lucy Newland  
Matthew Gilbert  
Neil Haggan  
Paul Dunlop  
Paul McNamara  
Sean Ross  
Stephen Franey  
Stephen McCracken  
Stephen Watson  
Stuart Abraham  
Tom McIntyre

**Project** 18-1068C Listowel

**Quotation No.:** Q18-13245      **Date Received:** 20-Aug-2019

**Order No.:**      **Date Instructed:** 27-Aug-2019

**No. of Samples:** 2

**Turnaround (Wkdays):** 5      **Results Due:** 02-Sep-2019

**Date Approved:** 02-Sep-2019

**Approved By:**

**Details:**

Amy Parekh-Pross, Technical Projects  
Manager



The right chemistry to deliver results

**Chemtest Ltd.**

**Denot Road**

**Newmarket**

**CB8 0AL**

**Tel: 01638 606070**

**Email: [info@chemtest.com](mailto:info@chemtest.com)**

## Results - Single Stage WAC

**Project: 18-1068C Listowel**

<b>Chemtest Job No:</b> 19-27965 <b>Chemtest Sample ID:</b> 876202 <b>Sample Ref:</b> 2 <b>Sample ID:</b> <b>Sample Location:</b> WS03 <b>Top Depth(m):</b> 2.50 <b>Bottom Depth(m):</b> <b>Sampling Date:</b> 15-Aug-2019				<b>Landfill Waste Acceptance Criteria Limits</b>			
				<b>Inert Waste Landfill</b>	<b>Stable, Non-reactive hazardous waste in non-hazardous Landfill</b>	<b>Hazardous Waste Landfill</b>	
Determinand	SOP	Accred.	Units				
Total Organic Carbon	2625	U	%	15	3	5	
Loss On Ignition	2610	U	%	25	--	10	
Total BTEX	2760	U	mg/kg	< 0.010	6	--	
Total PCBs (7 Congeners)	2815	U	mg/kg	< 0.10	1	--	
TPH Total WAC (Mineral Oil)	2670	U	mg/kg	< 10	500	--	
Total (Of 17) PAH's	2700	N	mg/kg	< 2.0	100	--	
pH	2010	U		8.1	--	>6	
Acid Neutralisation Capacity	2015	N	mol/kg	0.010	--	To evaluate	
<b>Eluate Analysis</b>			<b>10:1 Eluate mg/l</b>	<b>10:1 Eluate mg/kg</b>	<b>Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg</b>		
Arsenic	1450	U	0.0022	< 0.050	0.5	2	
Barium	1450	U	0.14	1.4	20	100	
Cadmium	1450	U	< 0.00010	< 0.010	0.04	1	
Chromium	1450	U	0.0013	< 0.050	0.5	10	
Copper	1450	U	0.0015	< 0.050	2	50	
Mercury	1450	U	< 0.00050	< 0.0050	0.01	0.2	
Molybdenum	1450	U	0.031	0.31	0.5	10	
Nickel	1450	U	0.0057	0.057	0.4	10	
Lead	1450	U	< 0.0010	< 0.010	0.5	10	
Antimony	1450	U	0.0042	0.042	0.06	0.7	
Selenium	1450	U	0.0028	0.028	0.1	0.5	
Zinc	1450	U	0.020	< 0.50	4	50	
Chloride	1220	U	16	160	800	15000	
Fluoride	1220	U	0.23	2.3	10	150	
Sulphate	1220	U	440	4400	1000	20000	
Total Dissolved Solids	1020	N	780	7600	4000	60000	
Phenol Index	1920	U	< 0.030	< 0.30	1	-	
Dissolved Organic Carbon	1610	U	35	350	500	800	

<b>Solid Information</b>	
Dry mass of test portion/kg	0.090
Moisture (%)	38

### 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: 18-1068C Listowel**

<b>Chemtest Job No:</b> 19-27965 <b>Chemtest Sample ID:</b> 876212 <b>Sample Ref:</b> 2 <b>Sample ID:</b> <b>Sample Location:</b> WS08 <b>Top Depth(m):</b> 3.80 <b>Bottom Depth(m):</b> <b>Sampling Date:</b> 14-Aug-2019				<b>Landfill Waste Acceptance Criteria Limits</b>			
				<b>Inert Waste Landfill</b>	<b>Stable, Non-reactive hazardous waste in non-hazardous Landfill</b>	<b>Hazardous Waste Landfill</b>	
Determinand	SOP	Accred.	Units				
Total Organic Carbon	2625	U	%	0.23	3	5	
Loss On Ignition	2610	U	%	2.9	--	10	
Total BTEX	2760	U	mg/kg	< 0.010	6	--	
Total PCBs (7 Congeners)	2815	U	mg/kg	< 0.10	1	--	
TPH Total WAC (Mineral Oil)	2670	U	mg/kg	< 10	500	--	
Total (Of 17) PAH's	2700	N	mg/kg	< 2.0	100	--	
pH	2010	U		7.8	--	>6	
Acid Neutralisation Capacity	2015	N	mol/kg	0.0070	--	To evaluate	
<b>Eluate Analysis</b>			<b>10:1 Eluate mg/l</b>	<b>10:1 Eluate mg/kg</b>	<b>Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg</b>		
Arsenic	1450	U	< 0.0010	< 0.050	0.5	2	
Barium	1450	U	0.0065	< 0.50	20	100	
Cadmium	1450	U	< 0.00010	< 0.010	0.04	1	
Chromium	1450	U	< 0.0010	< 0.050	0.5	10	
Copper	1450	U	0.0027	< 0.050	2	50	
Mercury	1450	U	< 0.00050	< 0.0050	0.01	0.2	
Molybdenum	1450	U	0.0065	0.065	0.5	10	
Nickel	1450	U	0.0011	< 0.050	0.4	10	
Lead	1450	U	< 0.0010	< 0.010	0.5	10	
Antimony	1450	U	< 0.0010	< 0.010	0.06	0.7	
Selenium	1450	U	0.0016	0.016	0.1	0.5	
Zinc	1450	U	< 0.0010	< 0.50	4	50	
Chloride	1220	U	1.9	19	800	15000	
Fluoride	1220	U	0.35	3.5	10	150	
Sulphate	1220	U	20	200	1000	20000	
Total Dissolved Solids	1020	N	150	1500	4000	60000	
Phenol Index	1920	U	< 0.030	< 0.30	1	-	
Dissolved Organic Carbon	1610	U	20	200	500	800	

<b>Solid Information</b>	
Dry mass of test portion/kg	0.090
Moisture (%)	12

### 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.

## **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"

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 45 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](mailto:customerservices@chemtest.com)