Appendix E3
Report No. 20-0399D

BusConnects Route 9
Tallaght/Clondalkin
to City Centre -
Ground Investigation

Bus Connects Route 9 Tallaght/Clondalkin to City Centre – Ground Investigation

Client:	National Transport Authority (NTA)
Client's Representative:	AECOM/Mott MacDonald
Report No.:	20-0399D
Date:	December 2020
Status:	Final for Issue

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APPENDICES

Document Control Sheet

Report No.:		20-0399D			
Project Title:		Bus Connects Route 9 Tallaght/Clondalkin to City Centre			
Client:		National Transport Authority (NTA)			
Client's Representative:		AECOM/Mott MacDonald			
Revision:	A01	**Status:**	Final for Issue	**Issue Date:**	14th November 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.

Bus Connects Route 9 Tallaght/Clondalkin to City Centre

1 AUTHORITY

On the instructions of AECOM/Mott MacDonald, ("the Client's Representative"), acting on the behalf of National Transport Authority (NTA) ("the Client"), a ground investigation was undertaken at the above location to provide geotechnical and environmental information to inform the planning stage design and enable the design of Bus Connects Core Bus Corridors.

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, trial pits, soil and rock core sampling, environmental sampling, groundwater monitoring, 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 along the proposed route from Tallaght in South Dublin to the Walkinstown Roundabout, with most locations undertaken along the Greenhills Road in grass areas, housing estates or industrial areas.

4 SITE OPERATIONS

4.1 Summary of site works

Site operations, which were conducted between 29th September and 29th October 2020, comprised:

- eighteen light cable percussion boreholes
- four boreholes by rotary follow-on methods
- one borehole by dynamic (windowless) sampling methods
- a standpipe installation in eight boreholes
- eleven machine dug trial pits
- indirect CBR tests at ten locations.

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 nineteen boreholes were put down in a minimum diameter of 150mm through soils and rock strata to their completion depths by a combination of methods, including light percussion boring using a Dando Terrier rig, light cable percussion boring using a Dando 2000 rig, and rotary drilling by a truck mounted Beretta T44 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 Light cable percussion boreholes

Fourteen boreholes (R9CP01-R9CP13) were put down to completion in minimum 200mm diameter using a Dando 2000 light cable percussion boring rig. All boreholes were terminated either at their scheduled completion depths, or else on encountering virtual refusal. R9CP13A was terminated due to encountering an old tank and removed to a new position at R9CP13.

Hand dug inspection pits were carried out between ground level and 1.20m depth to ensure boreholes were

put down at locations clear of services or subsurface obstruction
Disturbed (bulk and small bag) samples were taken within the encountered strata. Undisturbed (U100) samples were taken where appropriate and as directed within fine soils. Environmental samples were taken at standard intervals, as directed by the Client's Representative.

Standard penetration tests were carried out in accordance with BS EN 22476-3:2005+A1:2011 at standard depth intervals using the split spoon sampler ($SPT_{(s)}$) or solid cone attachment ($SPT_{(c)}$). The penetrations are stated for those tests for which the full 150mm seating drive or 300mm test drive was not possible. The N-values provided on the borehole logs are uncorrected and no allowance has been made for energy ratio corrections. The SPT hammer energy measurement report is provided in Appendix I.

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

Where water was added to assist with boring, a note has been added to the log to account for same.

Appendix B presents the borehole logs.

4.2.2 Boreholes by combined percussion boring and rotary follow-on drilling

Four boreholes (R9CPGS01-R9CPGS04) were put down by a combination of light cable percussion boring and rotary follow-on drilling techniques using a truck mounted Beretta T44 rotary drilling rig with core recovery in overburden and bedrock.

Hand dug inspection pits were carried out between ground level and 1.20m depth to ensure boreholes were put down at locations clear of services or subsurface obstructions.

In the cable percussion section of the boreholes, disturbed (bulk and small bag) samples were taken within the encountered strata. Undisturbed (U100) samples were taken where appropriate and as directed within fine soils. Environmental samples were taken at standard intervals, 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. Where water was added to assist with boring, a note has been added to the log to account for same.

Where the cable percussion borehole had not been advanced onto bedrock, rotary percussive methods were employed to advance the borehole to bedrock after which rotary coring was employed to recover core samples of the bedrock. Symmetrix cased full-hole drilling was used, with SPTs carried out at standard intervals as required.

Standard penetration tests were carried out in accordance with BS EN 22476-3:2005+A1:2011 at standard depth intervals throughout the overburden using the split spoon sampler ($SPT_{(s)}$) or solid cone attachment

($SPT_{(c)}$). The penetrations are stated for those tests for which the full 150mm seating drive or 300mm test drive was not possible. The N-values provided on the borehole logs are uncorrected and no allowance has been made for energy ratio corrections. The SPT hammer energy measurement report is provided in Appendix I.

Where coring was carried out, Geobor S Coring was used. The core was extracted in up to 1.5m lengths using a SK6L core barrel, which produced core of nominal 102mm diameter, and was placed in single channel wooden core boxes.

The core was subsequently photographed and examined by a qualified and experienced Engineering Geologist, thus enabling the production of an engineering log in accordance with *BS 5930: 2015: Code of practice for ground investigations*.

Appendix B presents the borehole logs, with core photographs presented in Appendix C.

4.2.3 Dynamic sampled boreholes

One borehole (R9WS01) was put down to completion by light percussion boring techniques using a Dando Terrier dynamic sampling rig.

A hand dug inspection pit was carried out between ground level and 1.20m depth to ensure the borehole was put down clear of services or subsurface obstructions.

The borehole was taken to a depth of 1.27m where it was terminated on encountering a service which was not picked up during the initial location clearance.

Disturbed (bulk) samples were taken within the encountered strata. Environmental samples were taken at standard intervals, as directed by the Client's Representative.

Appendix B presents the borehole logs.

4.3 Standpipe installations

A groundwater monitoring standpipe was installed in R9CP02, R9CP04, R9CP05, R9CP06, R9CP08, R9CP11, R9CPGS01 and R9CPGS04.

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

Eleven trial pits (R9TP01–R9TP11) were excavated using a 3t tracked excavator of JCB3CX fitted with a 600mm wide bucket, to a maximum depth of 4.20m.

Environmental samples were taken at standard intervals, as directed by the Client's Representative.

Disturbed (bulk bag) samples were taken at standard depth intervals and at change of strata.

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

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 (Irl)) at each location are recorded on the individual exploratory hole logs. The exploratory hole plan presented in Appendix A shows these as-built positions.

4.6 Archaeological monitoring

Archaeological monitoring was conducted by Shanarc Archaeology during the excavation of R9TP01, R9TP02, R9TP04-R9TP07, R9TP10, R9TP11 and during excavation of inspection pits for R9CP03, R9CP04 and R9CP07-R9CP13a.

The findings of the monitoring are presented as a report in Appendix J.

4.7 Groundwater monitoring

Following completion of site works, groundwater monitoring was conducted on one round. Ground water monitoring was carried out using a water interface probe.

The monitoring records are presented in Section 6.3.

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, lab shear vane
- **compaction related:** Moisture Condition Value, California bearing ratio tests
- **soil chemistry:** pH, water soluble sulphate content, acid soluble sulphate content and total sulphur

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 G.

5.2 Geotechnical laboratory testing of rock

Laboratory testing of rock sub-samples comprised:

- point load index
- unconfined compressive strength (UCS) tests

Test	Test carried out in accordance with
Point load index	ISRM Suggested Methods (1985) Suggested method for determining point-load strength. Int. J. Rock Mech. Min. Sci. Geomech. Abstr. 22, pp. 53–60
Uniaxial compression strength tests	ISRM Suggested Methods (1981) Suggested method for determining deformability of rock materials in uniaxial compression, Part 2 and ISRM (2007) Ulusay R, Hudson JA (eds) The complete ISRM suggested methods for rock characterization, testing and monitoring, 2007

The test results are presented in Appendix H.

5.3 Environmental laboratory testing of soils

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

Soil testing was carried out on a number of samples according to Engineer's Ireland Suite E and Rialta Suite of testing which included testing for a range of determinants:

- Metals

- Speciated total petroleum hydrocarbons (TPH)
- Speciated polycyclic aromatic hydrocarbons (PAH)
- Cyanides
- Asbestos screen
- pH
- Waste acceptance criteria (WAC) testing.

Groundwater testing was carried out on a number of samples according to Engineer's Ireland Suite F and additional testing which included testing for a range of determinants:

- Metals
- Speciated total petroleum hydrocarbons (TPH)
- Speciated polycyclic aromatic hydrocarbons (PAH)
- pH

Results of environmental laboratory testing are presented in Appendix H.

6 GROUND CONDITIONS

6.1 General geology of the area

Published geological mapping indicate the superficial deposits underlying the site comprise Glacial Till and fluvioglacial sands and gravels. These deposits are underlain by limestones and shales of the Lucan 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:** R9CP07, R9CP09, R9CP12 and R9CP13 encountered 100-200 of bitmac surfacing while R9CP11 and R9CP13A encountered 100-200mm of concrete surfacing.

- **Made Ground (gravel surfacing):** R9CP06, R9CP08, R9CP10, R9TP03 and R9TP09 encountered gravel surfacing ranging in thickness from 100-200mm.

- **Topsoil:** encountered across the site in all grass area adjacent to Greenhills road ranging in thickness from 100-600mm.

- **Made Ground (sub-base):** approximately 200-300mm of aggregate fill beneath the paved surface,

topsoil or gravel surfacing at R9CP02, R9CP07, R9CP09, R9CP11, R9CP12, R9CP13, R9TP03 and R9TP09.

- **Made Ground (fill):** reworked sandy gravelly clay/silt or sandy clayey gravel or gravelly silty sand fill encountered at all locations except R9CP04, R9CP07, R9CP09, R9CP11, R9CP12, R9CPGS01 and R9TP02 to a maximum depth of 6.50m in R9CPGS02. Varying amounts of red brick, wood, plastic, cloth, glass, rubber, carpet, ceramics and concrete were encountered across the site concentrated R9CP05, R9TP05 and R9TP06.

- **Fluvioglacial deposits:** typically medium dense to dense sands and gravels interspersed with layers of sandy gravelly clay or silt encountered predominantly at all locations north of the M50 where the Greenhills Road roughly follows the path of an old glacial river channel.

- **Glacial Till:** sandy gravelly clay, frequently with low cobble content, typically firm or stiff in upper horizons, becoming very stiff with increasing depth.

- **Bedrock (Limestone/Mudstone):** Rockhead was encountered at depths ranging from 10m in R9CPGS03 to 12.95m in R9CPGS02 in the vicinity of where the Greenhills Road crosses the M50.

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, rotary drilling and trial pit excavation as groundwater strikes as shown in Table 1 below.

Table 1: Groundwater strikes encountered during the ground investigation

GI Ref	Water Level (mbgl)	Comments
R9CP01	5.00	Slow seepage at 5.00m
R9CP08	4.10	Rose to 4.00m after 20 mins
R9CP13	2.00	Seepage
R9CPGS01	9.00	
R9CPGS02	9.00	
R9CPGS03	9.00	
R9CPGS04	9.00	
R9TP05	1.60	Rapid water strike at 1.60m

Groundwater was not noted during drilling at some of the borehole locations. However, 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 during excavation works should not be ruled out.

It should be noted that any groundwater strikes within bedrock may have been masked by the fluid used as the drilling flush medium.

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

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

Table 2: Groundwater monitoring

Date	Water level (mbgl)							
	R9CP02	R9CP04	R9CP05	R9CP06	R9CP08	R9CP11	R9CPGS01	R9CPGS04
19/11/20	1.16	Bung stuck	Dry	Dry	4.1	3.28	8.00	8.92

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 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.

BS EN ISO 22476-3:2005+A1:2011: Geotechnical investigation and testing. Field testing. Standard penetration test.

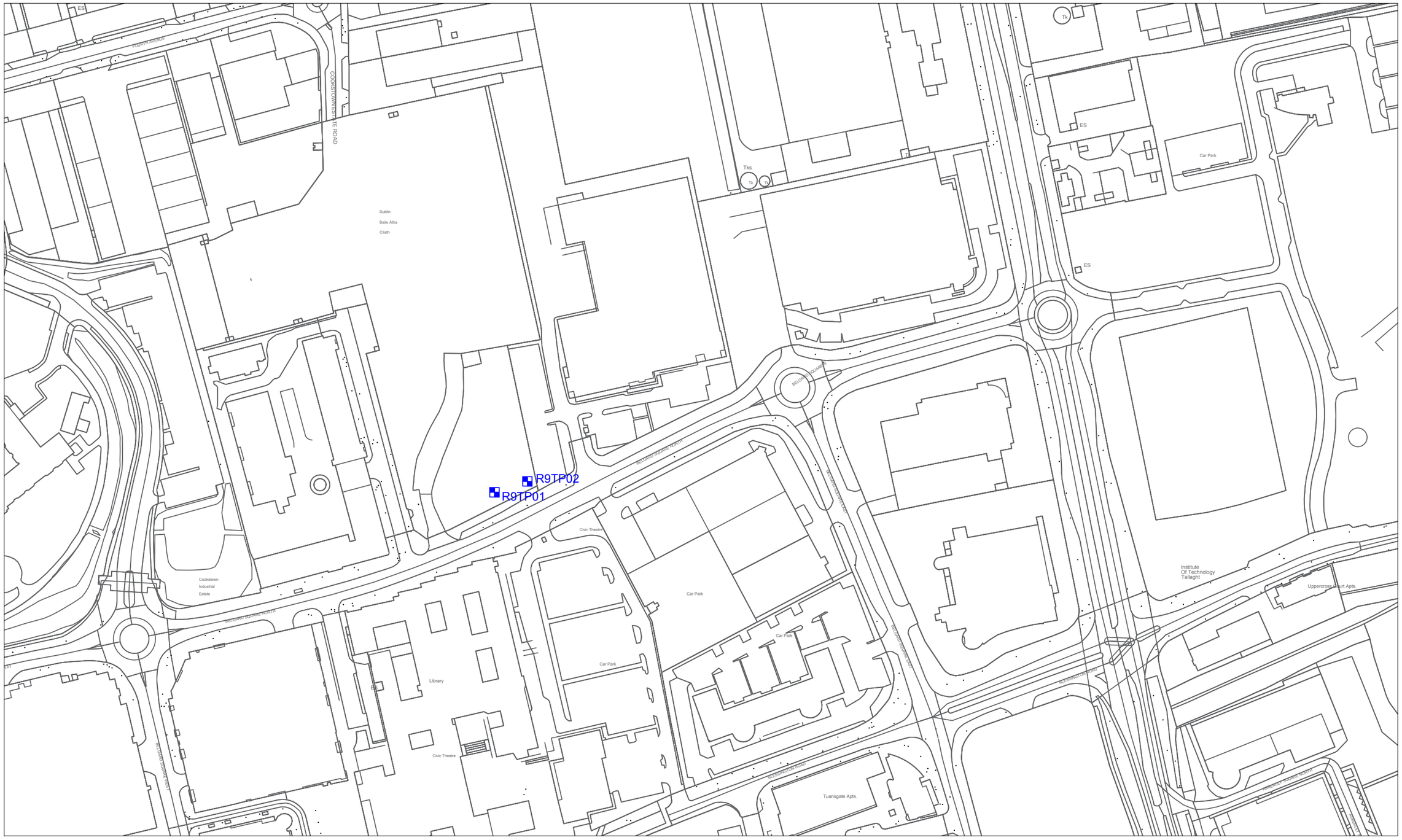
CAUSEWAY GEOTECH

APPENDIX A

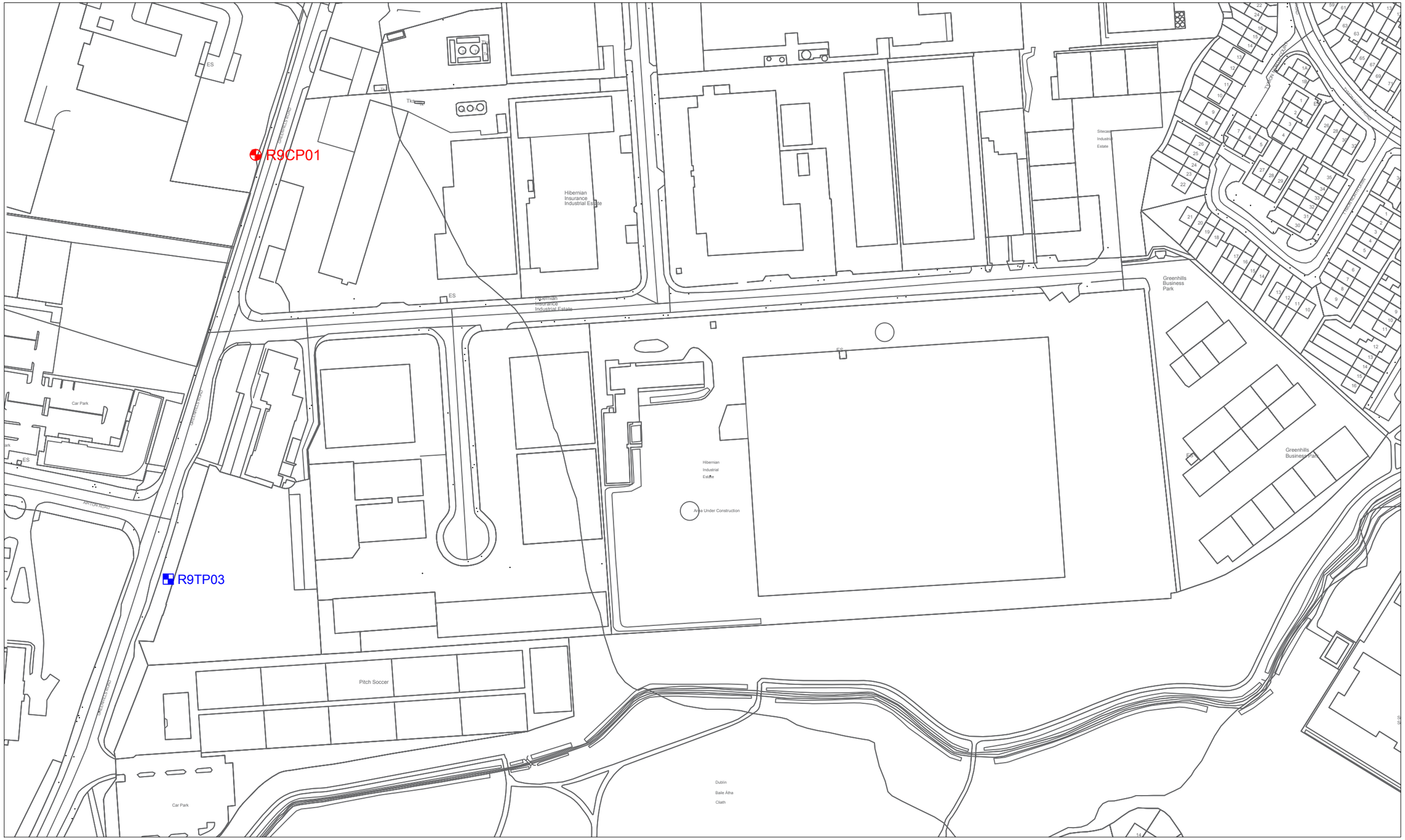
SITE AND EXPLORATORY HOLE LOCATION PLAN

PROJECT: Bus Connects Route 9 Tallaght/Clondalkin to City Centre		TITLE: Exploratory hole location plan (Overview)			
CLIENT: National Transport Authority (NTA)	KEY: Borehole, Trial Pits	CAUSEWAY GEOTECH	SCALE: NTS@A3	DATE: 23/11/2020	
ENGINEER: AECOM/Mott MacDonald			DRWN: BS CHCK: CH	SERIES: 1 of 2	DWG No: 20-0399D-EHL-001

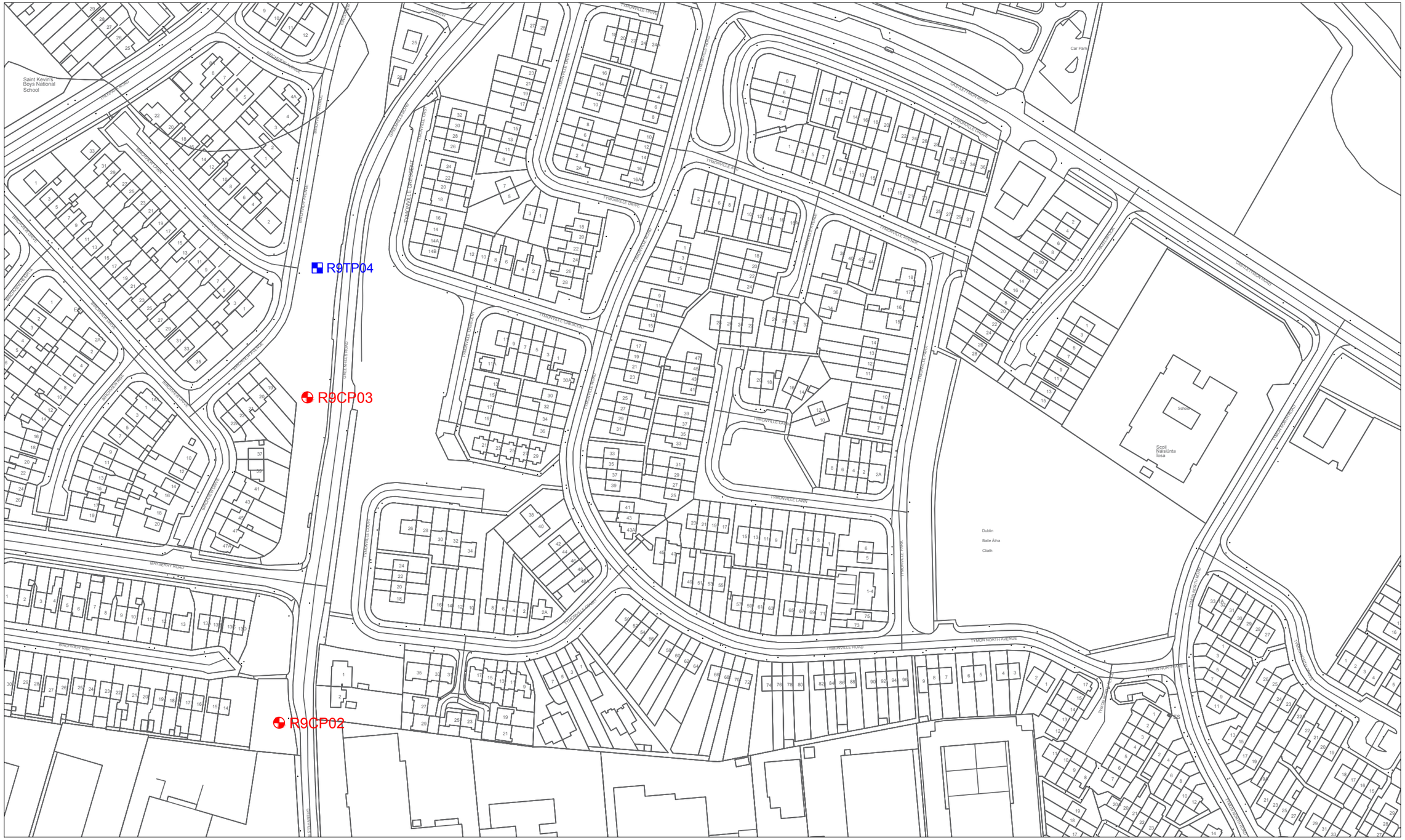
PROJECT: Bus Connects Route 9 Tallaght/Clondalkin to City Centre			TITLE: Exploratory hole location plan (Overview)		
CLIENT: National Transport Authority (NTA)	KEY: Borehole, Trial Pits	CAUSEWAY GEOTECH	SCALE: NTS@A3	DATE: 23/11/2020	
ENGINEER: AECOM/Mott MacDonald			DRWN: BS CHCK: CH	SERIES: 2 of 2	DWG No: 20-0399D-EHL-002



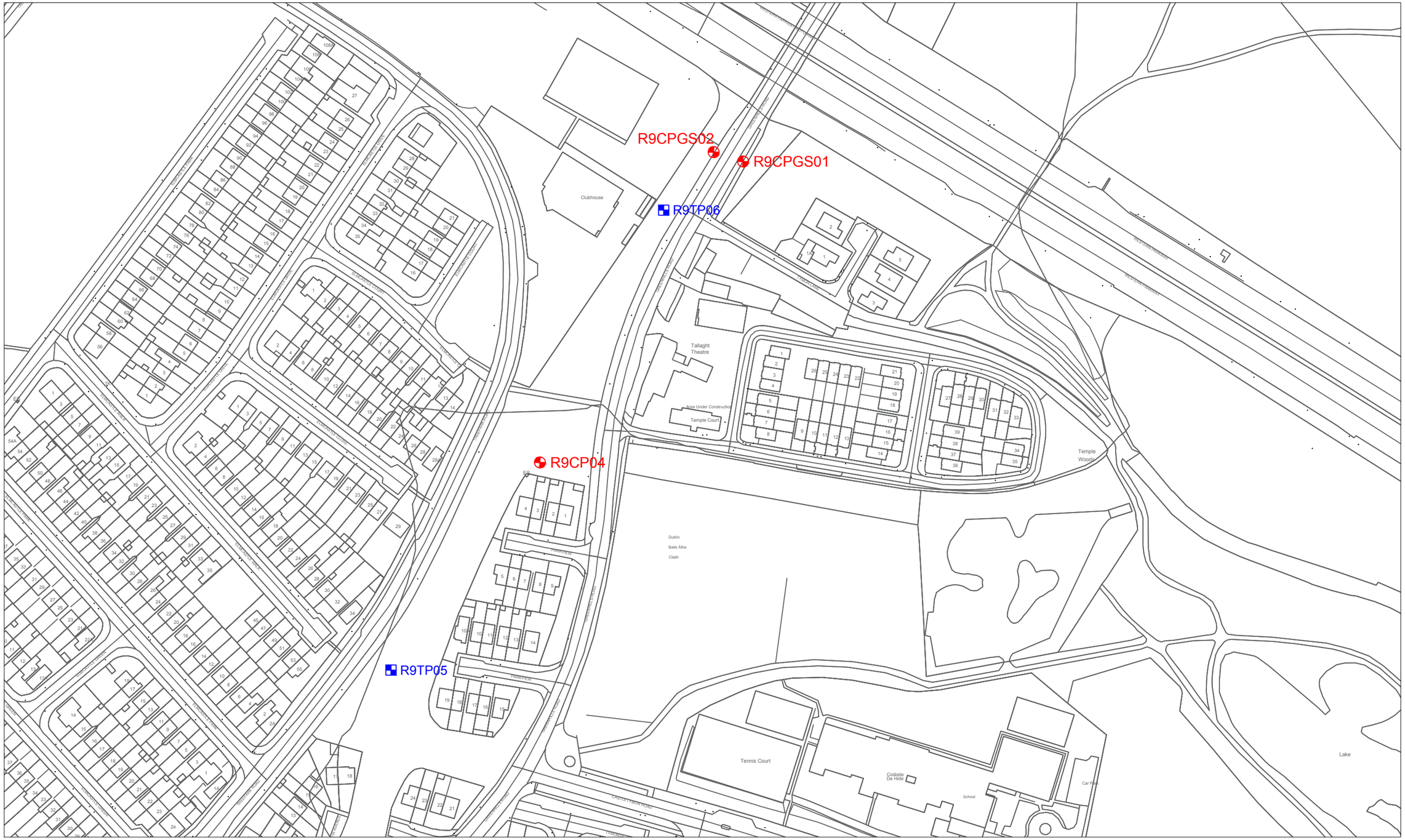
PROJECT: Bus Connects Route 9 Tallaght/Clondalkin to City Centre		TITLE: Exploratory hole location plan			
CLIENT: National Transport Authority (NTA)	KEY: Borehole; Trial Pits	CAUSEWAY GEOTECH	SCALE: NTS@A3	DATE: 23/11/2020	
ENGINEER: AECOM/Mott MacDonald			DRWN: BS CHCK: CH	SERIES: 1 of 7	DWG No: 20-0399D-EHL-001



PROJECT: Bus Connects Route 9 Tallaght/Clondalkin to City Centre		TITLE: Exploratory hole location plan			
CLIENT: National Transport Authority (NTA)	KEY: Borehole, Trial Pits	CAUSEWAY GEOTECH	SCALE: NTS@A3	DATE: 23/11/2020	
ENGINEER: AECOM/Mott MacDonald			DRWN: BS CHCK: CH	SERIES: 2 of 7	DWG No: 20-0399D-EHL-002



PROJECT: Bus Connects Route 9 Tallaght/Clondalkin to City Centre			TITLE: Exploratory hole location plan		
CLIENT: National Transport Authority (NTA)	KEY: Borehole; Trial Pits	CAUSEWAY GEOTECH	SCALE: NTS@A3	DATE: 23/11/2020	
ENGINEER: AECOM/Mott MacDonald			DRWN: BS; CHCK: CH	SERIES: 3 of 7	DWG No: 20-0399D-EHL-003



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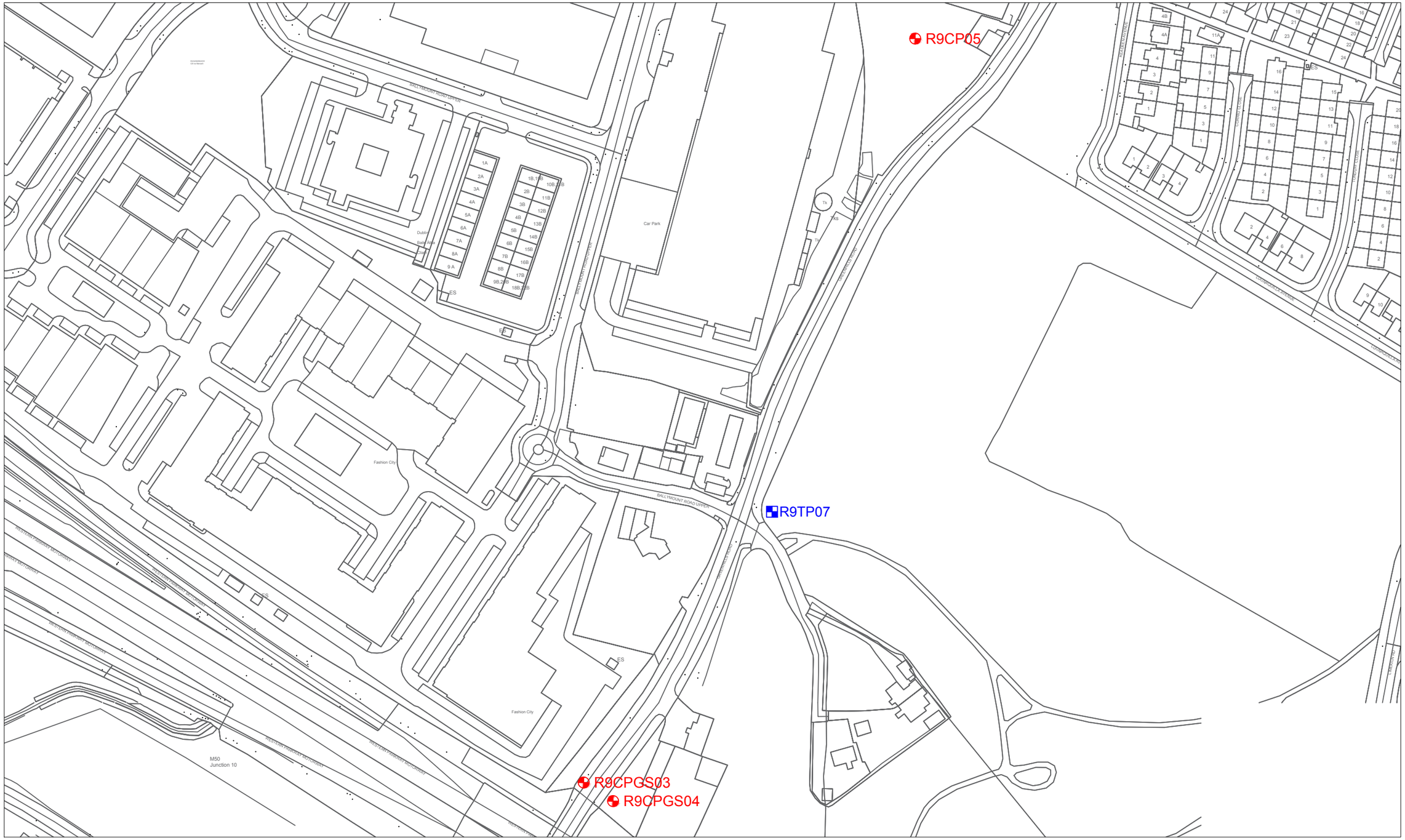
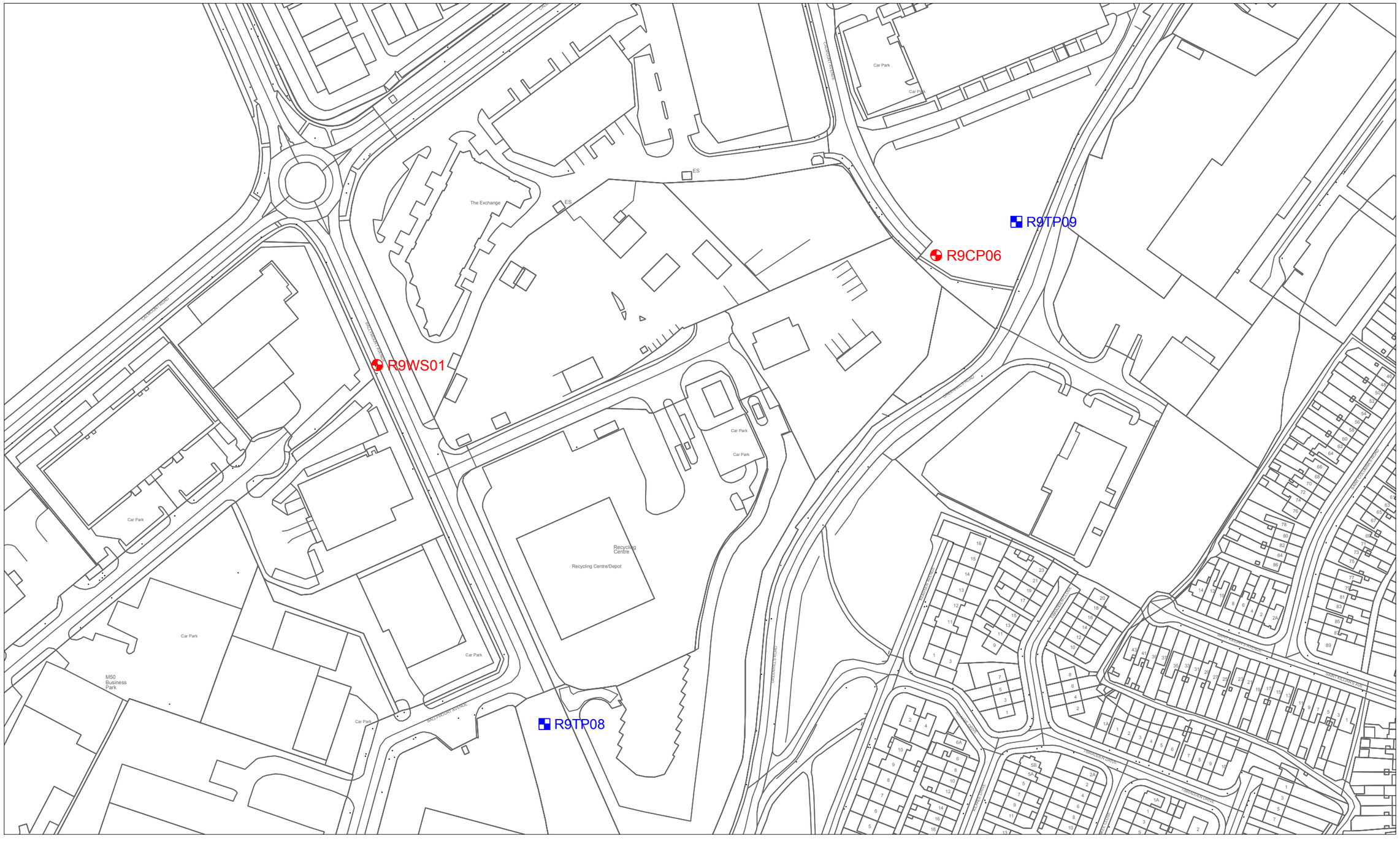
CLIENT: National Transport Authority (NTA)	KEY: Borehole, Trial Pits	CAUSEWAY GEOTECH	SCALE: NTS@A3	DATE: 23/11/2020	
ENGINEER: AECOM/Mott MacDonald			DRWN: BS CHCK: CH	SERIES: 4 of 7	DWG No: 20-0399D-EHL-004



PROJECT: Bus Connects Route 9 Tallaght/Clondalkin to City Centre		TITLE: Exploratory hole location plan			
CLIENT: National Transport Authority (NTA)	KEY: Borehole, Trial Pits	CAUSEWAY GEOTECH	SCALE: NTS@A3	DATE: 23/11/2020	
ENGINEER: AECOM/Mott MacDonald			DRWN: BS CHCK: CH	SERIES: 5 of 7	DWG No: 20-0399D-EHL-005



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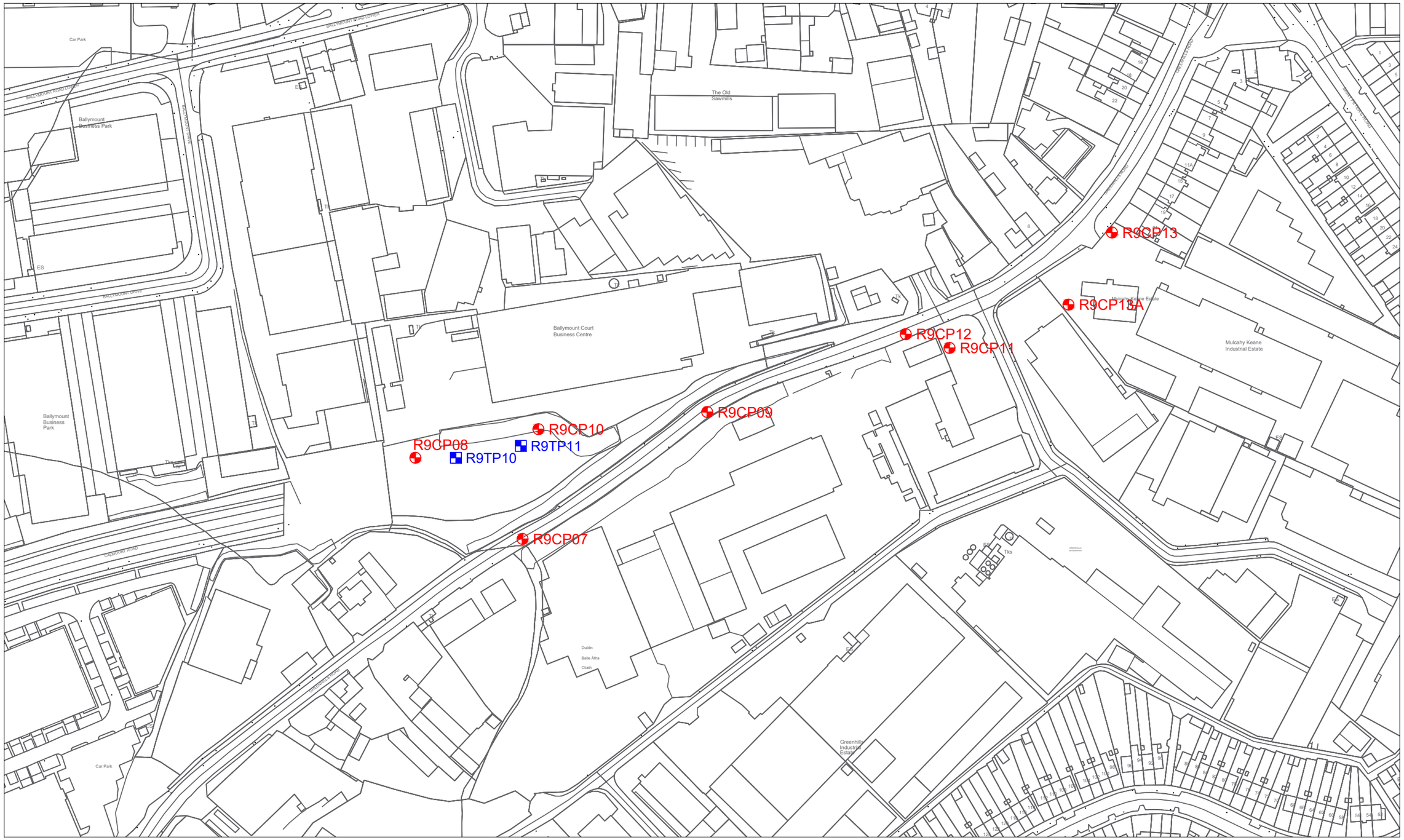
CLIENT: National Transport Authority (NTA)	KEY: Borehole; Trial Pits	CAUSEWAY GEOTECH	SCALE: NTS@A3	DATE: 23/11/2020	
ENGINEER: AECOM/Mott MacDonald			DRWN: BS CHCK: CH	SERIES: 6 of 7	DWG No: 20-0399D-EHL-006



PROJECT: Bus Connects Route 9 Tallaght/Clondalkin to City Centre		TITLE: Exploratory hole location plan			
CLIENT: National Transport Authority (NTA)	KEY: Borehole; Trial Pits	C:\Users\will.campbell\Documents\Causeway_Geotech_Colour_jpg.jpg	SCALE: NTS@A3	DATE: 23/11/2020	
ENGINEER: AECOM/Mott MacDonald			DRWN: BS CHCK: CH	SERIES: 7 of 7	DWG No: 20-0399D-EHL-007

CAUSEWAY GEOTECH

APPENDIX B

BOREHOLE LOGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
20-0399D	Bus Connects Route 9 Tallaght/Clondalkin to City Centre	R9CP01
	Client: National Transport Authority (NTA)	
	Client's Rep: AECOM/Mott MacDonald	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Cable Percussion	Dando 2000	0.00	6.20	709660.16 E 728495.79 N

Final Depth:	Start Date:	Driller:	Sheet 1 of 1
6.20 m	29/09/2020	BM	Scale: 1:40
Elevation: 87.89 mOD	**End Date:** 29/09/2020	**Logger:** CH	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description
					87.49	0.40		MADE GROUND: Soft brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.
0.50	B5							Stiff becoming very stiff brown slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium of mixed lithologies.
0.50	ES							
0.50	ES1							
1.00	B6							
1.00	ES2							
1.00	ES6							
1.20	D12							
1.20 - 1.65	SPT (S)	N=35 (3,3/3,5,12,15) Hammer SN = 0643	1.00	Dry				
2.00	B7							
2.00	D13							
2.00	ES3							
2.00 - 2.10	SPT (S)	N=50 (25 for 75mm/50 for 25mm) Hammer SN = 0643	1.50	Dry				
3.00	B8				84.89	3.00		Stiff locally very stiff greyish black slightly gravelly sandy CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium of mixed lithologies. Cobbles are subrounded of mixed lithologies.
3.00	ES4							
3.00 - 3.45	U18	Ublow=40 100%	3.00	Dry				
3.50	D14							
4.00	B9							
4.00	D15							
4.00 - 4.45	SPT (S)	N=40 (12,7/8,10,10,12) Hammer SN = 0643	3.00	Dry				
5.00	B10							
5.00	D16							
5.00 - 5.45	U19	Ublow=60 100% Slow seepage at 5.00m	3.00	5.00				
6.00	B11				81.89	6.00		Very stiff brown slightly sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies. Cobbles are subrounded of mixed lithologies.
6.00	D17							
6.00 - 6.14	SPT (S)	N=50 (18 for 100mm/50 for 35mm) Hammer SN = 0643	3.00	5.60	81.69	6.20		End of Borehole at 6.20m

Water: ▼ at 5.00

Backfill: 0.00 – 6.20

Water Strikes

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

Casing Details

To (m)	Diameter
3.00	200

Water Added

From (m)	To (m)

Chiselling Details

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

Remarks

Hand dug inspection pit excavated to 1.20m.

Termination Reason

Terminated on refusal.

Last Updated

16/12/2020

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
20-0399D	Bus Connects Route 9 Tallaght/Clondalkin to City Centre	R9CP02
	Client: National Transport Authority (NTA)	
	Client's Rep: AECOM/Mott MacDonald	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Cable Percussion	Dando 2000	0.00	3.10	709689.76 E 728736.49 N

Final Depth:	Start Date:	Driller:	Sheet 1 of 1
3.10 m	01/10/2020	BM	Scale: 1:40
Elevation: 85.84 mOD	**End Date:** 01/10/2020	**Logger:** CH	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description
					85.74	0.10		TOPSOIL
								MADE GROUND: Grey angular fine to coarse GRAVEL of mixed lithologies.
					85.44	0.40		
0.50	B5							MADE GROUND: Brownish grey sandy clayey subangular to subrounded fine to coarse GRAVEL of mixed lithologies with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies. Cobbles are subrounded of mixed lithologies.
0.50	ES1							
					85.04	0.80		
1.00	B6							MADE GROUND: Stiff brownish grey sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.
1.00	ES2							
1.00	ES6							
1.16	EW				84.54	1.30		
1.20 - 1.45	U12	Ublow=25 100%	1.00	Dry				Firm brown slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.
1.70	D9							
2.00	B7							
2.00	D10							
2.00	ES3							
2.00 - 2.45	SPT (S)	N=11 (2,2/2,3,3,3) Hammer SN = 0643	1.50	Dry				
					83.04	2.80		
3.00	B8							Very stiff greyish black slightly sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies. Cobbles are subrounded of mixed lithologies.
3.00	D11				82.74	3.10		
3.00	ES4							
3.00 - 3.15	SPT (S)	N=50 (40 for 135mm/50 for 15mm) Hammer SN = 0643	3.00	Dry				End of Borehole at 3.10m

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
3.00	200

Water Added

From (m)	To (m)

Chiselling Details

From (m)	To (m)	Time (hh:mm)
3.00	3.10	01:00

Remarks

Hand dug inspection pit excavated to 1.20m.
No groundwater encountered.

Termination Reason

Terminated on refusal.

Last Updated

16/12/2020

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
20-0399D	Bus Connects Route 9 Tallaght/Clondalkin to City Centre	R9CP03
	Client: National Transport Authority (NTA)	
	Client's Rep: AECOM/Mott MacDonald	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Cable Percussion	Dando 2000	0.00	8.00	709704.90 E 728910.79 N

Final Depth:	8.00 m	Start Date:	06/10/2020	Driller:	BM	Sheet 1 of 2 Scale: 1:40
Elevation:	81.19 mOD	End Date:	06/10/2020	Logger:	CH	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
								TOPSOIL		
					80.79	0.40				
0.50	B11							MADE GROUND: Firm brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.		
0.50	ES1									
1.00	B12									
1.00	ES2									
1.00	ES3									
1.20	U26	Ublow=20 90%	0.00	Dry						
2.00	B13				79.19	2.00				
2.00	D19							Stiff brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.		
2.00	ES4									
2.00 - 2.45	SPT (S)	N=19 (2,2/2,4,6,7) Hammer SN = 0643	0.00	Dry						
2.50	ES5									
3.00	B14									
3.00	D20									
3.00	ES6									
3.00 - 3.45	SPT (S)	N=29 (4,4/6,7,7,9) Hammer SN = 0643	0.00	Dry						
3.50	ES7									
4.00	B15				77.19	4.00				
4.00	D21							Stiff becoming very stiff greyish black slightly sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies. Cobbles are subrounded of mixed lithologies.		
4.00	ES8									
4.00 - 4.45	SPT (S)	N=24 (4,4/5,5,7,7) Hammer SN = 0643	0.00	Dry						
5.00	B16									
5.00	D22									
5.00	ES22									
5.00	ES9									
5.00 - 5.45	SPT (S)	N=30 (4,5/6,7,7,10) Hammer SN = 0643	0.00	Dry						
6.00	B17									
6.00	D23									
6.00	ES10									
6.00 - 6.45	SPT (S)	N=38 (5,7/9,9,9,11) Hammer SN = 0643	0.00	Dry						
7.00	D24									
7.00 - 7.45	SPT (S)	N=38 (5,6/8,8,10,12) Hammer SN = 0643	0.00	Dry						

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

Hand dug inspection pit excavated to 1.20m.
No groundwater encountered.

Termination Reason

Terminated at scheduled depth.

Last Updated

16/12/2020

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
20-0399D	Bus Connects Route 9 Tallaght/Clondalkin to City Centre	R9CP03
	Client: National Transport Authority (NTA)	
	Client's Rep: AECOM/Mott MacDonald	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Cable Percussion	Dando 2000	0.00	8.00	709704.90 E 728910.79 N

Final Depth:	8.00 m	Start Date:	06/10/2020	Driller:	BM	Sheet 2 of 2 Scale: 1:40
Elevation:	81.19 mOD	End Date:	06/10/2020	Logger:	CH	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
7.50	B18							Stiff becoming very stiff greyish black slightly sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies. Cobbles are subrounded of mixed lithologies.		
8.00	D25				73.19	8.00		End of Borehole at 8.00m		
8.00 - 8.45	SPT (S)	N=41 (5,6/9,10,10,12) Hammer SN = 0643	0.00	Dry						

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

Hand dug inspection pit excavated to 1.20m.
No groundwater encountered.

Termination Reason

Terminated at scheduled depth.

Last Updated

16/12/2020

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
20-0399D	Bus Connects Route 9 Tallaght/Clondalkin to City Centre	R9CP04
	Client: National Transport Authority (NTA)	
	Client's Rep: AECOM/Mott MacDonald	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Cable Percussion	Dando 2000	0.00	3.00	709837.71 E 729319.29 N

Final Depth:	Start Date:	Driller:	Sheet 1 of 1
3.00 m	05/10/2020	BM	Scale: 1:40
Elevation: 73.67 mOD	**End Date:** 05/10/2020	**Logger:** CH	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
					73.47	0.20		TOPSOIL		
0.50	B5							Soft becoming firm brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.		
0.50	ES1									
1.00	B6									
1.00	ES2									
1.00	ES6									
1.20	D9									
1.20 - 1.65	SPT (S)	N=9 (2,2/2,2,2,3) Hammer SN = 0643	0.00	Dry						
1.50	ES									
1.50	ES3									
2.00	B7				71.67	2.00				
2.00	D10							Stiff brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.		
2.00	ES4									
2.00 - 2.45	SPT (S)	N=18 (2,2/3,3,5,7) Hammer SN = 0643	0.00	Dry						
3.00	B8				70.67	3.00		End of Borehole at 3.00m		
3.00	D11									
3.00 - 3.02	SPT (S)	N=50 (25 for 10mm/50 for 15mm) Hammer SN = 0643	0.00	Dry						

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)
3.00	3.10	01:00

Remarks

Hand dug inspection pit excavated to 1.20m.
No groundwater encountered.

Termination Reason

Terminated on refusal.

Last Updated

16/12/2020

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
20-0399D	Bus Connects Route 9 Tallaght/Clondalkin to City Centre	R9CP05
	Client: National Transport Authority (NTA)	
	Client's Rep: AECOM/Mott MacDonald	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Cable Percussion	Dando 2000	0.00	8.00	710173.58 E 729983.05 N

Final Depth:	Start Date:	Driller:	Sheet 1 of 2
8.00 m	12/10/2020	BM	Scale: 1:40
Elevation: 73.20 mOD	**End Date:** 12/10/2020	**Logger:** CH	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
								MADE GROUND: Soft becoming firm brown sandy gravelly CLAY with fragments of wood and pieces of cloth and plastic. Sand is fine to coarse. Gravel is subangular to surrounded fine to coarse.		
0.50	B10									
0.50	ES1									
1.00	B11									
1.00	ES2									
1.20	D19									
1.20 - 1.65	SPT (S)	N=8 (2,2/2,2,2,2) Hammer SN = 0643	0.00	Dry						
1.50	ES									
1.50	ES3									
2.00	B12									
2.00	D20									
2.00	ES20									
2.00	ES4									
2.00 - 2.45	SPT (S)	N=9 (2,3/2,2,2,3) Hammer SN = 0643	1.50	Dry						
2.50	ES5									
3.00	B13									
3.00	D21									
3.00	ES6									
3.00 - 3.45	SPT (S)	N=11 (2,3/3,2,3,3) Hammer SN = 0643	3.00	Dry						
4.00	B14									
4.00	D22									
4.00	ES7									
4.00 - 4.45	SPT (S)	N=13 (2,3/3,4,3,3) Hammer SN = 0643	3.00	Dry						
					68.40	4.80		Medium dense brown very sandy silty subangular to subrounded fine to coarse GRAVEL of mixed lithologies. Sand is fine to coarse.		
5.00	B15									
5.00	D23									
5.00	ES8									
5.00 - 5.45	SPT (C)	N=18 (2,3/4,4,5,5) Hammer SN = 0643	4.50	Dry						
6.00	B16				67.20	6.00		Medium dense brown slightly gravelly very silty fine to coarse SAND. Gravel is subrounded fine of mixed lithologies.		
6.00	D24									
6.00	ES9									
6.00 - 6.45	SPT (C)	N=23 (3,4/5,5,6,7)	6.00	Dry						
7.00	B17				66.20	7.00		Medium dense brown sandy subangular to subrounded fine to coarse GRAVEL of mixed lithologies. Sand is fine to coarse.		
7.00	D25									
7.00 - 7.45	SPT (C)	N=26 (4,5/6,6,7,7) Hammer SN = 0643	6.00	Dry						

Water Strikes

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

Casing Details

To (m)	Diameter
6.00	200

Water Added

From (m)	To (m)

Chiselling Details

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

Remarks

Hand dug inspection pit excavated to 1.20m.
No groundwater encountered.

Termination Reason

Terminated at scheduled depth.

Last Updated

16/12/2020

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
20-0399D	Bus Connects Route 9 Tallaght/Clondalkin to City Centre	R9CP05
	Client: National Transport Authority (NTA)	
	Client's Rep: AECOM/Mott MacDonald	

Method	Plant Used	Top (m)	Base (m)	Coordinates	Final Depth:	Start Date:	Driller:	Sheet 2 of 2
Cable Percussion	Dando 2000	0.00	8.00	710173.58 E	8.00 m	12/10/2020	BM	Scale: 1:40
				729983.05 N	Elevation: 73.20 mOD	End Date: 12/10/2020	Logger: CH	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
					65.70	7.50		Medium dense brown sandy subangular to subrounded fine to coarse GRAVEL of mixed lithologies. Sand is fine to coarse.		
					65.40	7.80		Firm brown slightly sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies. Cobbles are subrounded of mixed lithologies.		
8.00	B18				65.20	8.00		Stiff greyish black slightly sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies. Cobbles are subrounded of mixed lithologies.		
8.00 - 8.40	U26	Ublow=30 100%	6.00	Dry				End of Borehole at 8.00m		

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

Casing Details		Water Added	
To (m)	Diameter	From (m)	To (m)
6.00	200		

Remarks

Hand dug inspection pit excavated to 1.20m.
No groundwater encountered.

Termination Reason	Last Updated
Terminated at scheduled depth.	16/12/2020

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
20-0399D	Bus Connects Route 9 Tallaght/Clondalkin to City Centre	R9CP06
	Client: National Transport Authority (NTA)	
	Client's Rep: AECOM/Mott MacDonald	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Cable Percussion	Dando 2000	0.00	6.00	710348.72 E 730324.95 N

Final Depth:	Start Date:	Driller:	Sheet 1 of 1
6.00 m	29/10/2020	BM	Scale: 1:40
Elevation: 66.81 mOD	**End Date:** 29/10/2020	**Logger:** GH	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)
					66.71	0.10
0.50	B1					
0.50	ES7					
1.00	B2					
1.00	ES					
1.00	ES8					
1.20	D14					
1.20 - 1.65	SPT (S)	N=18 (3,4/5,4,4,5) Hammer SN = 0643	1.00	Dry		
2.00	D15				64.81	2.00
2.00	ES9					
2.00 - 2.45	SPT (S)	N=8 (4,2/2,2,2,2) Hammer SN = 0643	1.50	Dry		
3.00	B3					
3.00	D16					
3.00	ES10					
3.00 - 3.45	SPT (S)	N=8 (2,1/2,2,2,2) Hammer SN = 0643	3.00	Dry		
4.00	B4				62.81	4.00
4.00	D17					
4.00	ES11					
4.00 - 4.45	SPT (S)	N=13 (2,2/3,3,3,4) Hammer SN = 0643	3.00	Dry		
5.00	B5					
5.00	D18					
5.00	ES12					
5.00 - 5.45	SPT (S)	N=16 (3,4/4,3,4,5) Hammer SN = 0643	3.00	Dry		
6.00	B6				60.81	6.00
6.00	D19					
6.00	ES13					
6.00 - 6.45	SPT (S)	N=18 (4,5/4,4,5,5) Hammer SN = 0643	3.00	Dry		

Legend	Description
	MADE GROUND: Grey sandy slightly clayey subangular fine to coarse GRAVEL of mixed lithologies. Sand is fine to coarse.
	MADE GROUND: Firm becoming stiff dark brownish black sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.
	MADE GROUND: Firm brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.
	Medium dense grey very sandy clayey subangular to subrounded fine to coarse GRAVEL of mixed lithologies. Sand is fine to coarse.
	End of Borehole at 6.00m

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
3.00	200

Water Added

From (m)	To (m)

Chiselling Details

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

Remarks

Hand dug inspection pit excavated to 1.20m.
No groundwater encountered.

Termination Reason

Terminated at scheduled depth.

Last Updated

16/12/2020

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
20-0399D	Bus Connects Route 9 Tallaght/Clondalkin to City Centre	R9CP07
	Client: National Transport Authority (NTA)	
	Client's Rep: AECOM/Mott MacDonald	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Cable Percussion	Dando 2000	0.00	6.00	710674.83 E 730617.42 N

Final Depth:	Start Date:	Driller:	Sheet 1 of 1
6.00 m	10/10/2020	BM	Scale: 1:40
Elevation: 63.72 mOD	**End Date:** 10/10/2020	**Logger:** CH	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
					63.52	0.20		BITMAC		
								MADE GROUND: Grey angular fine to coarse GRAVEL of mixed lithologies.		
0.50	B5				63.22	0.50		Medium dense brown sandy slightly silty subangular to subrounded fine to coarse GRAVEL of mixed lithologies with low cobble content. Sand is fine to coarse.		
0.50	ES1									
1.00	B6									
1.00	ES2									
1.20	D12									
1.20 - 1.65	SPT (C)	N=14 (2,3/3,3,4,4) Hammer SN = 0643	1.00	Dry						
2.00	B7									
2.00	D13									
2.00	ES3									
2.00 - 2.45	SPT (C)	N=18 (3,4/5,4,4,5) Hammer SN = 0643	2.00	1.80						
3.00	B8				60.72	3.00		Medium dense brown very sandy slightly silty subangular to subrounded fine to coarse GRAVEL of mixed lithologies with low cobble content. Sand is fine to coarse.		
3.00	D14									
3.00	ES4									
3.00 - 3.45	SPT (C)	N=19 (4,5/5,4,5,5) Hammer SN = 0643	3.00	2.70						
4.00	B9									
4.00	D15									
4.00 - 4.45	SPT (C)	N=23 (4,5/5,6,6,6) Hammer SN = 0643	4.00	3.50						
5.00	B10									
5.00	D16									
5.00 - 5.45	SPT (C)	N=23 (4,5/6,5,6,6) Hammer SN = 0643	5.00	3.00						
6.00	B11				57.72	6.00		End of Borehole at 6.00m		
6.00	D17									
6.00 - 6.45	SPT (C)	N=27 (7,9/9,6,6,6) Hammer SN = 0643	6.00	3.50						

Water Strikes

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

Casing Details

To (m)	Diameter
6.00	200

Water Added

From (m)	To (m)
1.20	6.00

Chiselling Details

From (m)	To (m)	Time (hh:mm)
6.00	6.20	01:00

Remarks

Hand dug inspection pit excavated to 1.20m.
No noticeable groundwater encountered, water added during drilling.

Termination Reason

Terminated at scheduled depth.

Last Updated

16/12/2020

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
20-0399D	Bus Connects Route 9 Tallaght/Clondalkin to City Centre	R9CP08
	Client: National Transport Authority (NTA)	
	Client's Rep: AECOM/Mott MacDonald	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Cable Percussion	Dando 2000	0.00	5.10	710617.34 E 730660.94 N

Final Depth:	Start Date:	Driller:	Sheet 1 of 1
5.10 m	07/10/2020	BM	Scale: 1:40
Elevation: 56.04 mOD	**End Date:** 07/10/2020	**Logger:** CH	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description
					55.84	0.20		MADE GROUND: Grey angular fine to coarse GRAVEL
0.50	B6							MADE GROUND: Soft to firm brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.
0.50	ES1							
1.00	B7							
1.20	D13							
1.20 - 1.65	SPT (S)	N=8 (2,2/2,2,2,2) Hammer SN = 0643	0.00	Dry				
1.50	ES							
1.50	ES2							
2.00	B8							
2.00	D14							
2.00	ES3							
2.00 - 2.45	SPT (S)	N=6 (2,1/1,2,1,2) Hammer SN = 0643	1.50	Dry	53.64	2.40		Soft brown sandy gravelly silty CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.
3.00	B9				53.04	3.00		Stiff brown sandy gravelly silty CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.
3.00	ES4							
3.00 - 3.45	U18	Ublow=20 100%	3.00	Dry				
3.50	D15				52.54	3.50		Stiff to very stiff brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium of mixed lithologies.
4.00	B10							
4.00	D16							
4.00	ES5							
4.00 - 4.45	SPT (S)	N=34 (4,5/8,8,9,9) Hammer SN = 0643	4.00	4.00				
4.10	EW	Slow seepage at 4.10						
5.00	B11				51.04	5.00		Grey BOULDER of limestone. Recovered through chiselling as grey angular gravel of limestone.
5.00	D17				50.94	5.10		End of Borehole at 5.10m
5.00 - 5.22	SPT (S)	N=31 (15,25/31 for 75mm) Hammer SN = 0643	4.50	4.80				
5.10	B12							

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)
4.10	4.10	20	4.00

Casing Details

To (m)	Diameter
4.50	200

Water Added

From (m)	To (m)

Chiselling Details

From (m)	To (m)	Time (hh:mm)
5.00	5.10	01:00

Remarks

Hand dug inspection pit excavated to 1.20m.

Termination Reason

Terminated on refusal.

Last Updated

16/12/2020

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
20-0399D	Bus Connects Route 9 Tallaght/Clondalkin to City Centre	R9CP09
	Client: National Transport Authority (NTA)	
	Client's Rep: AECOM/Mott MacDonald	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Cable Percussion	Dando 2000	0.00	2.30	710773.86 E 730685.45 N

Final Depth:	Start Date:	Driller:	Sheet 1 of 1
2.30 m	10/10/2020	BM	Scale: 1:40
Elevation: 61.79 mOD	**End Date:** 10/10/2020	**Logger:** CH	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
					61.59	0.20		BITMAC		
					61.39	0.40		MADE GROUND: Grey angular fine to coarse GRAVEL of mixed lithologies.		
0.50	B5							Medium dense brown very gravelly silty fine to coarse SAND. Gravel is subangular to subangular fine to coarse of mixed lithologies.		
0.50	ES1									
1.00	B6									
1.00	ES2									
1.20	D8									
1.20 - 1.65	SPT (S)	N=16 (2,3/3,4,4,5) Hammer SN = 0643	1.00	Dry						
1.50	ES3									
2.00	B7									
2.00	D9									
2.00 - 2.05	SPT (S)	N=50 (25 for 25mm/50 for 25mm) Hammer SN = 0643	2.00	1.50	59.49	2.30		End of Borehole at 2.30m		
2.30	ES4									

Water Strikes

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

Casing Details

To (m)	Diameter
2.00	200

Water Added

From (m)	To (m)
1.20	2.30

Chiselling Details

From (m)	To (m)	Time (hh:mm)
2.30	2.50	01:00

Remarks

Hand dug inspection pit excavated to 1.20m.
No noticeable groundwater encountered, water added during drilling.

Termination Reason

Terminated on refusal.

Last Updated

16/12/2020

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
20-0399D	Bus Connects Route 9 Tallaght/Clondalkin to City Centre	R9CP10
	Client: National Transport Authority (NTA)	
	Client's Rep: AECOM/Mott MacDonald	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Cable Percussion	Dando 2000	0.00	3.00	710683.34 E 730676.26 N

Final Depth:	Start Date:	Driller:	Sheet 1 of 1
3.00 m	07/10/2020	BM	Scale: 1:40
Elevation: 55.12 mOD	**End Date:** 07/10/2020	**Logger:** CH	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
0.00	ES1				54.92	0.20		MADE GROUND: Grey angular fine to coarse GRAVEL of mixed lithologies.		
0.50	B6							MADE GROUND: Soft to firm brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.		
1.00	B7									
1.00	ES2									
1.20	D10									
1.20 - 1.65	SPT (S)	N=9 (2,3/2,3,2,2) Hammer SN = 0643	0.00	Dry	53.72	1.40				
1.50	ES3							Soft brown sandy gravelly silty CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.		
2.00	B8									
2.00	D11									
2.00	ES4									
2.00 - 2.45	SPT (S)	N=6 (1,1/1,1,2,2) Hammer SN = 0643	0.00	Dry						
					52.52	2.60		Grey BOULDER of limestone. Recovered through chiselling as grey angular gravel of limestone.		
3.00	B9				52.12	3.00		End of Borehole at 3.00m		
3.00	D12									
3.00	ES5									
3.00 - 3.05	SPT (S)	N=50 (25 for 25mm/50 for 25mm) Hammer SN = 0643	0.00	Dry						

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)
2.60	3.00	01:00

Remarks

Hand dug inspection pit excavated to 1.20m.
No groundwater encountered.

Termination Reason

Terminated on refusal.

Last Updated

16/12/2020

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
20-0399D	Bus Connects Route 9 Tallaght/Clondalkin to City Centre	R9CP11
	Client: National Transport Authority (NTA)	
	Client's Rep: AECOM/Mott MacDonald	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Cable Percussion	Dando 2000	0.00	4.30	710903.81 E 730719.84 N

Final Depth:	Start Date:	Driller:	Sheet 1 of 1
4.30 m	30/09/2020	BM	Scale: 1:40
Elevation: 54.07 mOD	**End Date:** 30/09/2020	**Logger:** CH	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Description
					53.87	0.20	CONCRETE
					53.67	0.40	MADE GROUND: Grey angular fine to coarse GRAVEL
0.50	B5						Medium dense becoming dense brown sandy silty subangular to subrounded fine to coarse GRAVEL of mixed lithologies with low cobble content. Sand is fine to coarse. Cobbles are subrounded of mixed lithologies.
0.50	ES1						
1.00	B6						
1.00	ES2						
1.20	U12	Ublow=50 0%	1.00	Dry			
2.00	B7						
2.00	D10						
2.00	ES3						
2.00 - 2.45	SPT (C)	N=18 (2,4/4,4,5,5)	2.00	1.90			
3.00	B8						
3.00	D11						
3.00	ES4						
3.00 - 3.45	SPT (C)	N=31 (5,6/6,7,9,9)	3.00	2.50			
3.28	EW						
					50.37	3.70	Very stiff greyish black sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.
4.00	B9						
4.00 - 4.05	SPT (S)	N=50 (25 for 25mm/50 for 25mm)	4.00	Dry			
4.30 - 4.32	SPT (S)	N=50 (0 for 0mm/50 for 25mm)	4.00	Dry	49.77	4.30	End of Borehole at 4.30m

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
4.00	200

Water Added

From (m)	To (m)
1.50	3.50

Chiselling Details

From (m)	To (m)	Time (hh:mm)
4.00	4.30	01:00

Remarks

Hand dug inspection pit excavated to 1.20m.
No noticeable groundwater encountered, water added during drilling.

Termination Reason

Terminated on refusal.

Last Updated

16/12/2020

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
20-0399D	Bus Connects Route 9 Tallaght/Clondalkin to City Centre	R9CP12
	Client: National Transport Authority (NTA)	
	Client's Rep: AECOM/Mott MacDonald	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Cable Percussion	Dando 2000	0.00	6.00	710880.38 E 730727.20 N

Final Depth:	Start Date:	Driller:	Sheet 1 of 1
6.00 m	11/10/2020	BM	Scale: 1:40
Elevation: 56.99 mOD	**End Date:** 11/10/2020	**Logger:** CH	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
					56.79	0.20		BITMAC		
								MADE GROUND: Grey angular fine to coarse GRAVEL of mixed lithologies.		
0.50	B5				56.49	0.50		Medium dense brown sandy silty subangular to subrounded fine to coarse GRAVEL of mixed lithologies with low cobble content. Sand is fine to coarse. Cobbles are subrounded of mixed lithologies.		
0.50	ES1									
1.00	B6									
1.00	ES2									
1.20	D12									
1.20 - 1.65	SPT (C)	N=14 (2,2/3,3,3,5) Hammer SN = 0643	1.20	Dry						
2.00	B7									
2.00	D13									
2.00	ES3									
2.00 - 2.45	SPT (C)	N=19 (3,5/4,5,5,5) Hammer SN = 0643	2.00	Dry						
3.00	B8									
3.00	D14									
3.00	ES4									
3.00 - 3.45	SPT (C)	N=23 (4,5/5,5,6,7) Hammer SN = 0643	3.00	Dry						
4.00	B9									
4.00	D15									
4.00 - 4.45	SPT (C)	N=23 (4,5/5,5,6,7) Hammer SN = 0643	4.00	Dry						
					52.29	4.70		Firm brown silty sandy CLAY. Sand is fine to coarse.		
5.00	B10									
5.00	D16									
5.00 - 5.45	SPT (S)	N=10 (3,2/2,3,2,3) Hammer SN = 0643	5.00	Dry						
					51.49	5.50		Very stiff greyish brown slightly sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies. Cobbles are subrounded of mixed lithologies.		
6.00	B11				50.99	6.00		End of Borehole at 6.00m		
6.00	D17									
6.00 - 6.08	SPT (S)	N=50 (25 for 50mm/50 for 25mm) Hammer SN = 0643	6.00	Dry						

Water Strikes

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

Chiselling Details

From (m)	To (m)	Time (hh:mm)
5.80	6.00	01:00

Casing Details

To (m)	Diameter
5.50	200

Water Added

From (m)	To (m)
1.20	4.70

Remarks

Hand dug inspection pit excavated to 1.20m.
No noticeable groundwater encountered, water added during drilling.

Termination Reason

Terminated on refusal.

Last Updated

16/12/2020

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
20-0399D	Bus Connects Route 9 Tallaght/Clondalkin to City Centre	R9CP13
	Client: National Transport Authority (NTA)	
	Client's Rep: AECOM/Mott MacDonald	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Cable Percussion	Dando 2000	0.00	2.70	710990.93 E 730781.72 N

Final Depth:	Start Date:	Driller:	Sheet 1 of 1
2.70 m	09/10/2020	BM	Scale: 1:40
Elevation: 52.22 mOD	**End Date:** 09/10/2020	**Logger:** CH	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
					52.12	0.10		BITMAC		
					51.92	0.30		MADE GROUND: Grey angular fine to coarse GRAVEL of mixed lithologies.		
0.50	B5							MADE GROUND: Soft to firm brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.		
0.50	ES1									
1.00	B6									
1.00	ES2									
1.20	D9				51.02	1.20		Firm brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.		
1.20 - 1.65	SPT (S)	N=10 (2,3/2,2,3,3) Hammer SN = 0643	1.00	Dry						
					50.72	1.50		Firm brownish grey slightly gravelly sandy silty CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.		
1.50	ES3									
2.00	B7									
2.00	D10									
2.00	ES4									
2.00 - 2.45	SPT (S)	N=10 (1,2/1,2,3,4) Hammer SN = 0643 Seepage at 2.00m	1.70	2.00	49.82	2.40		Grey BOULDER of limestone. Recovered through chiselling as grey angular gravel of limestone.		
2.60 - 2.65	SPT (S)	N=50 (25 for 25mm/50 for 25mm) Hammer SN = 0643	2.60	1.70	49.52	2.70		End of Borehole at 2.70m		
2.70	B8									

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
2.00			

Casing Details

To (m)	Diameter
2.60	200

Water Added

From (m)	To (m)

Chiselling Details

From (m)	To (m)	Time (hh:mm)
2.40	2.70	01:00

Remarks

Hand dug inspection pit excavated to 1.20m.

Termination Reason

Terminated on refusal.

Last Updated

16/12/2020

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
20-0399D	Bus Connects Route 9 Tallaght/Clondalkin to City Centre	R9CP13A
	Client: National Transport Authority (NTA)	
	Client's Rep: AECOM/Mott MacDonald	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Cable Percussion	Dando 2000	0.00	2.00	710967.63 E 730743.05 N

Final Depth:	Start Date:	Driller:	Sheet 1 of 1
2.00 m	08/10/2020	BM	Scale: 1:40
Elevation: 52.38 mOD	**End Date:** 08/10/2020	**Logger:** CH	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
					52.28	0.10		CONCRETE Void encountered - possible old tank.		
					50.38	2.00		End of Borehole at 2.00m		

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

Void encountered - possible old tank.
Moved to new position - R9CP13.

Termination Reason

Terminated on refusal.

Last Updated

16/12/2020

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
20-0399D	Bus Connects Route 9 Tallaght/Clondalkin to City Centre	R9CPGS01
	Client: National Transport Authority (NTA)	
	Client's Rep: AECOM/Mott MacDonald	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Cable Percussion	Dando 2000	0.00	6.00	
Rotary Drilling	Beretta T44	6.00	12.00	709946.53 E
Rotary Coring	Beretta T44	12.00	17.50	729480.52 N

Final Depth:	17.50 m	Start Date:	04/10/2020	Driller:	BM+GT	Sheet 1 of 2
Elevation:	72.60 mOD	End Date:	10/10/2020	Logger:	CH+RS	Scale: 1:50
						FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description
					72.30	0.30		TOPSOIL
0.50	B8							Possible MADE GROUND: Firm to stiff brown slightly sandy gravelly SILT with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies. Cobbles are subrounded of mixed lithologies.
0.50	ES1							
1.00	B9							
1.00	ES2							
1.20	D15							
1.20 - 1.65	SPT (S)	N=9 (2,2/2,2,2,3) Hammer SN = 0643	0.00	Dry				
2.00	B10							
2.00	D16							
2.00	ES10							
2.00	ES3							
2.00 - 2.45	SPT (S)	N=11 (2,3/2,3,3,3) Hammer SN = 0643	0.00	Dry				
3.00	B11							
3.00	D17							
3.00	ES4							
3.00 - 3.45	SPT (S)	N=16 (3,4/4,4,4,4) Hammer SN = 0643	0.00	Dry				
4.00	B12							
4.00	D18							
4.00	ES12							
4.00	ES5							
4.00 - 4.45	SPT (S)	N=14 (2,3/3,3,4,4) Hammer SN = 0643	0.00	Dry				
5.00	B13							
5.00	D19							
5.00	ES6							
5.00 - 5.45	SPT (S)	N=18 (4,5/4,5,4,5) Hammer SN = 0643	0.00	Dry				
6.00	B14				66.60	6.00		Stiff brown sandy gravelly CLAY with cobbles and boulders. (Driller's description)
6.00	D20							
6.00	ES7							
6.50 - 6.95	SPT (C)	N=27 (7,8/8,6,6,7) Hammer SN = 0209	6.50					
8.00	EW							
8.00 - 8.15	SPT (C)	N=50 (25 for 75mm/50 for 75mm) Hammer SN = 0209	8.00					
		Water strike at 9.00m						

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 7.5 8.0 8.5 9.0

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
9.00	9.00		

Casing Details

To (m)	Diam (mm)
8.00	200

Water Added

From (m)	To (m)

Chiselling Details

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

Remarks

Hand dug inspection pit excavated to 1.20m.
Services encountered in hand pit.

Core Barrel	Flush Type	Termination Reason	Last Updated
SK6L	Polymer	Terminated at scheduled depth.	16/12/2020

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
20-0399D	Bus Connects Route 9 Tallaght/Clondalkin to City Centre	R9CPGS01
	Client: National Transport Authority (NTA)	
	Client's Rep: AECOM/Mott MacDonald	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Cable Percussion	Dando 2000	0.00	6.00	
Rotary Drilling	Beretta T44	6.00	12.00	709946.53 E
Rotary Coring	Beretta T44	12.00	17.50	729480.52 N

Final Depth:	17.50 m	Start Date:	04/10/2020	Driller:	BM+GT	Sheet 2 of 2
Elevation:	72.60 mOD	End Date:	10/10/2020	Logger:	CH+RS	Scale: 1:50
						FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
9.50 - 9.95	SPT (C)	N=26 (4,4/6,6,7,7) Hammer SN = 0209	9.50					Stiff brown sandy gravelly CLAY with cobbles and boulders. (Driller's description)		
					62.60	10.00		Medium dense brownish grey sandy clayey GRAVEL. (Driller's description)		
11.00 - 11.45	SPT (C)	N=27 (7,8/8,6,6,7) Hammer SN = 0209	11.0							
12.00 - 13.50	C				60.60	12.00		Medium strong thinly laminated black argillaceous LIMESTONE. Partially weathered: probably slightly reduced strength. Probably slightly closer fracture spacing. Discontinuities: 1. 0 to 30 degree bedding fractures very closely spaced (5/40/185), planar, smooth. 2. 90 degree joint from 12.90m to 13.10m, undulating, rough. 3. 90 degree joint from 16.80m to 17.15m, undulating, rough.		
12.30	C									
12.55	C									
12.80	C	100 80 33								
13.20	C									
13.50										
13.75	C									
14.00	C									
14.15	C	100 100 46								
14.50	C					(5.50)				
15.00										
15.35	C									
15.85	C	100 85 49								
16.50										
17.20	C	100 72 22								
17.40	C									
17.50					55.10	17.50		End of Borehole at 17.50m		
		TCR SCR RQD FI								

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
9.00	9.00		

Casing Details

To (m)	Diam (mm)
8.00	200

Water Added

From (m)	To (m)

Remarks

Hand dug inspection pit excavated to 1.20m.
Services encountered in hand pit.

Core Barrel	Flush Type	Termination Reason	Last Updated
SK6L	Polymer	Terminated at scheduled depth.	16/12/2020

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
20-0399D	Bus Connects Route 9 Tallaght/Clondalkin to City Centre	R9CPGS02
	Client: National Transport Authority (NTA)	
	Client's Rep: AECOM/Mott MacDonald	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Cable Percussion	Dando 2000	0.00	5.00	
Rotary Drilling	Beretta T44	5.00	10.50	709930.78 E
Rotary Coring	Beretta T44	10.50	18.00	729485.56 N

Final Depth:	18.00 m	Start Date:	03/10/2020	Driller:	BM+GT	Sheet 1 of 2
Elevation:	72.38 mOD	End Date:	09/10/2020	Logger:	CH+RS	Scale: 1:50
						FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
					72.18	0.20		TOPSOIL		
0.50	B7							MADE GROUND: Firm becoming stiff brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.		
0.50	ES1									
1.00	B8									
1.00	ES2									
1.00	ES8									
1.20	D13									
1.20 - 1.65	SPT (S)	N=12 (2,2/3,3,3,3) Hammer SN = 0643	0.00	Dry						
2.00	B9									
2.00	ES									
2.00	ES3									
2.00	ES9				69.98	2.40		MADE GROUND: Firm becoming stiff brownish grey sandy gravelly SILT. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.		
2.00 - 2.45	U17	Ublow=25 100%	0.00	Dry						
2.50	D14									
3.00	B10									
3.00	D15									
3.00	ES4									
3.00 - 3.45	SPT (S)	N=14 (3,3/3,3,4,4) Hammer SN = 0643	0.00	Dry						
4.00	B11									
4.00	D16									
4.00	ES5									
4.00 - 4.45	SPT (S)	N=23 (3,4/5,6,6,6) Hammer SN = 0643	0.00	Dry						
5.00	B12				67.38	5.00		MADE GROUND: Firm brown sandy gravelly CLAY with fragments of red brick. (Driller's description)		
5.00	ES12									
5.00	ES6									
6.50 - 6.95	SPT (C)	N=11 (2,2/3,3,3,2) Hammer SN = 0209	6.50		65.88	6.50		Firm brownish grey sandy gravelly silty CLAY with boulders. (Driller's description)		
8.00 - 8.45	SPT (C)	N=14 (2,2/3,3,4,4) Hammer SN = 0209	8.00		64.38	8.00		Firm brown sandy gravelly CLAY with boulders. (Driller's description)		
		Water strike at 9.00m							▼	

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
9.00			

Casing Details

To (m)	Diam (mm)
10.50	200

Water Added

From (m)	To (m)
9.00	18.00

Chiselling Details

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

Remarks

Hand dug inspection pit excavated to 1.20m.
Service encountered at 5.00m..
BH moved 2m for rotary section.

Core Barrel	Flush Type	Termination Reason	Last Updated
SK6L	Polymer	Terminated at scheduled depth.	16/12/2020

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
20-0399D	Bus Connects Route 9 Tallaght/Clondalkin to City Centre	R9CPGS02
	Client: National Transport Authority (NTA)	
	Client's Rep: AECOM/Mott MacDonald	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Cable Percussion	Dando 2000	0.00	5.00	
Rotary Drilling	Beretta T44	5.00	10.50	709930.78 E
Rotary Coring	Beretta T44	10.50	18.00	729485.56 N

Final Depth:	18.00 m	Start Date:	03/10/2020	Driller:	BM+GT	Sheet 2 of 2
Elevation:	72.38 mOD	End Date:	09/10/2020	Logger:	CH+RS	Scale: 1:50
						FINAL

Depth (m)	Sample / Tests	Field Records	TCR	SCR	RQD	FI	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
9.50 - 9.95	SPT (C)	N=13 (2,2/3,3,3,4) Hammer SN = 0209					9.50					Firm brown sandy gravelly CLAY with boulders. (Driller's description)		
									62.38	10.00		Firm dark grey sandy gravelly CLAY. (Driller's description)		
10.50	C11		46						61.88	10.50		Firm brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse of limestone.		
12.00										(2.45)				
12.00	C11													
12.00 - 13.50	C		100	9	7									
									59.43	12.95		Medium strong thinly laminated black argillaceous LIMESTONE. Partially weathered: probably slightly closer fracture spacing. Probably slightly reduced strength.		
13.35	C													
13.50												Discontinuities:		
13.70	C													
13.90	C											1. 0 to 30 degree bedding fractures closely spaced (5/80/190), planar, smooth.		
14.10	C		100	100	53									
14.65	C													
15.00														
15.10	C													
15.40	C					15				(5.05)				
15.70	C		100	100	47									
16.10	C													
16.50														
16.75	C													
17.05	C													
			100	100	35									
18.00									54.38	18.00		End of Borehole at 18.00m		

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
9.00			

Casing Details

To (m)	Diam (mm)
10.50	200

Water Added

From (m)	To (m)
9.00	18.00

Remarks

Hand dug inspection pit excavated to 1.20m.
Service encountered at 5.00m..
BH moved 2m for rotary section.

Core Barrel	Flush Type	Termination Reason	Last Updated
SK6L	Polymer	Terminated at scheduled depth.	16/12/2020

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
20-0399D	Bus Connects Route 9 Tallaght/Clondalkin to City Centre	R9CPGS03
	Client: National Transport Authority (NTA)	
	Client's Rep: AECOM/Mott MacDonald	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Cable Percussion	Dando 2000	0.00	5.00	
Rotary Drilling	Beretta T44	5.00	10.50	709995.89 E
Rotary Coring	Beretta T44	10.50	16.00	729584.51 N

Final Depth:	16.00 m	Start Date:	03/10/2020	Driller:	BM+GT	Sheet 1 of 2
Elevation:	72.99 mOD	End Date:	11/10/2020	Logger:	CH+RS	Scale: 1:50
						FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
					72.79	0.20		TOPSOIL		
0.50	B6							MADE GROUND: Firm brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.		
0.50	ES1									
1.00	B7									
1.00	ES2									
1.20	D12									
1.20 - 1.65	SPT (S)	N=15 (3,3/4,3,4,4) Hammer SN = 0643	0.00	Dry						
2.00	B8				70.99	2.00		Stiff brown slightly gravelly sandy SILT. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.		
2.00	D13									
2.00	ES3									
2.00	ES8									
2.00 - 2.45	SPT (S)	N=20 (4,5/4,5,5,6) Hammer SN = 0643	0.00	Dry						
3.00	B9									
3.00	ES4									
3.00 - 3.45	U16	Ublow=25 80%	0.00	Dry	69.79	3.20		Dense brown gravelly very silty fine to coarse SAND. Gravel is subangular to subrounded fine to medium of mixed lithologies.		
4.00	B10									
4.00	D14									
4.00	ES10									
4.00	ES5									
4.00 - 4.45	SPT (S)	N=32 (4,5/6,8,8,10) Hammer SN = 0643	0.00	Dry						
5.00	B11				67.99	5.00		Very stiff brown sandy gravelly CLAY. (Driller's description)		
5.00	D15									
5.00 - 5.45	SPT (S)	N=37 (5,7/7,9,10,11) Hammer SN = 0643	0.00	Dry						
8.00 - 8.45	SPT (S)	N=24 (4,4/5,5,7,7) Hammer SN = 0209	8.00		64.99	8.00		Medium dense brown fine to coarse SAND and GRAVEL. (Driller's description)		
		Water strike at 9.00							▼	

Water Strikes			
Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
9.00			

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

Remarks

Hand dug inspection pit excavated to 1.20m.

Casing Details	
To (m)	Diam (mm)
10.50	200

Water Added	
From (m)	To (m)
9.00	16.00

Core Barrel	Flush Type	Termination Reason	Last Updated
	Polymer	Terminated at scheduled depth.	16/12/2020

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
20-0399D	Bus Connects Route 9 Tallaght/Clondalkin to City Centre	R9CPGS03
	Client: National Transport Authority (NTA)	
	Client's Rep: AECOM/Mott MacDonald	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Cable Percussion	Dando 2000	0.00	5.00	
Rotary Drilling	Beretta T44	5.00	10.50	709995.89 E
Rotary Coring	Beretta T44	10.50	16.00	729584.51 N

Final Depth:	16.00 m	Start Date:	03/10/2020	Driller:	BM+GT	Sheet 2 of 2
Elevation:	72.99 mOD	End Date:	11/10/2020	Logger:	CH+RS	Scale: 1:50
						FINAL

Depth (m)	Sample / Tests	Field Records	TCR	SCR	RQD	FI	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
9.50 - 9.95	SPT (S)	N=21 (3,4/4,5,5,7) Hammer SN = 0209					9.50					Medium dense brown fine to coarse SAND and GRAVEL. (Driller's description)		
									62.99	10.00		Grey weathered LIMESTONE. (Driller's description)		
10.50 - 12.00	C		100	100	24				62.49	10.50		Medium, strong thinly laminated black argillaceous LIMESTONE. Partially weathered: probably slightly reduced strength. Probably slightly closer fracture spacing. Discontinuities: 1. 0 to 30 degree bedding fractures very closely spaced (3/30/220), planar, smooth.		
11.50	C													
12.00														
12.00	C		100	100	12	>20				(5.50)				
12.40	C													
12.70	C													
12.95	C													
13.50			100	100	22									
13.80	C													
14.10	C													
14.55	C													
14.65	C													
15.00			100	100	14									
15.40	C													
15.60	C													
16.00									56.99	16.00		End of Borehole at 16.00m		

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
9.00			

Casing Details

To (m)	Diam (mm)
10.50	200

Water Added

From (m)	To (m)
9.00	16.00

Remarks

Hand dug inspection pit excavated to 1.20m.

Core Barrel	Flush Type	Termination Reason	Last Updated
	Polymer	Terminated at scheduled depth.	16/12/2020

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
20-0399D	Bus Connects Route 9 Tallaght/Clondalkin to City Centre	R9CPGS04
	Client: National Transport Authority (NTA)	
	Client's Rep: AECOM/Mott MacDonald	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Cable Percussion	Dando 2000	0.00	6.00	
Rotary Drilling	Beretta T44	6.00	10.50	710011.67 E
Rotary Coring	Beretta T44	10.50	16.00	729574.57 N

Final Depth:	16.00 m	Start Date:	02/10/2020	Driller:	BM+G	Sheet 1 of 2
Elevation:	73.07 mOD	End Date:	08/10/2020	Logger:	CH+RS	Scale: 1:50
						FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description
					72.97	0.10		TOPSOIL
					72.77	0.30		MADE GROUND: Grey angular fine to coarse GRAVEL of mixed lithologies.
0.50	B6							MADE GROUND: Firm brownish sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.
0.50	ES2							
1.00	B7							
1.00	ES3							
1.00	ES7				71.77	1.30		Stiff to very stiff brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.
1.20	D13							
1.20 - 1.65	SPT (S)	N=18 (3,3/3,5,5,5) Hammer SN = 0643	0.00	Dry				
2.00	B8							
2.00	D14							
2.00	ES4							
2.00 - 2.45	SPT (S)	N=38 (5,6/7,10,10,11) Hammer SN = 0643	0.00	Dry				
3.00	B9				70.07	3.00		Medium dense brown gravelly silty fine to coarse SAND. Gravel is subangular to subrounded fine to coarse of mixed lithologies.
3.00	ES5							
3.00 - 3.45	U19	Ublow=25 100%	0.00	Dry				
3.50	D15							
4.00	B10							
4.00	D16							
4.00 - 4.45	SPT (C)	N=17 (3,4/4,4,4,5) Hammer SN = 0643	0.00	Dry				
5.00	B11							
5.00	D17							
5.00	ES11							
5.00 - 5.45	SPT (C)	N=18 (4,4/5,5,4,4) Hammer SN = 0643	0.00	Dry				
6.00	B12				67.07	6.00		Medium dense brown silty SAND and GRAVEL. (Driller's description)
6.00	D18							
6.00 - 6.45	SPT (C)	N=19 (4,4/4,5,5,5) Hammer SN = 0643	0.00	Dry				
7.50 - 7.95	SPT (C)	N=18 (4,4/4,5,5,4) Hammer SN = 0209	7.50					
8.92	EW							
9.00 - 9.45	SPT (C)	N=20 (4,4/5,5,5,5) Hammer SN = 0209 Water strike at 9.00m	9.00					

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 7.5 8.0 8.5 9.0

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
9.00			

Casing Details

To (m)	Diam (mm)
10.50	200

Water Added

From (m)	To (m)
9.00	16.00

Chiselling Details

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

Remarks

Hand dug inspection pit excavated to 1.20m.

Core Barrel	Flush Type	Termination Reason	Last Updated
	Polymer	Terminated at scheduled depth.	16/12/2020

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
20-0399D	Bus Connects Route 9 Tallaght/Clondalkin to City Centre	R9CPGS04
	Client: National Transport Authority (NTA)	
	Client's Rep: AECOM/Mott MacDonald	

Method	Plant Used	Top (m)	Base (m)
Cable Percussion	Dando 2000	0.00	6.00
Rotary Drilling	Beretta T44	6.00	10.50
Rotary Coring	Beretta T44	10.50	16.00

Coordinates: 710011.67 E, 729574.57 N

Final Depth:	16.00 m	Start Date:	02/10/2020	Driller:	BM+G	Sheet 2 of 2
Elevation:	73.07 mOD	End Date:	08/10/2020	Logger:	CH+RS	Scale: 1:50
						FINAL

Depth (m)	Sample / Tests	Field Records	TCR	SCR	RQD	FI	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
									63.67	9.40		Medium dense brown silty SAND and GRAVEL. (Driller's description) Stiff greyish brown sandy gravelly CLAY. (Driller's description)		
10.50 - 12.00	C						10.5		62.57	10.50		Medium dense brown silty gravelly fine to coarse SAND.		
10.50 - 10.60	SPT(C) N=50 (25 for 80mm/50 for 20mm) Hammer SN = 0209								62.02	(0.55) 11.05		Medium strong thinly laminated black MUDSTONE. Partially weathered: probably slightly closer fracture spacing. Probably slightly reduced strength. Discontinuities: 1. 0 to 30 degree bedding fractures very closely spaced (2/35/125), planar, smooth.		
11.15	C	100	56	7	20+									
11.70	C													
12.00										(2.00)				
12.50	C	100	85	45										
12.90	C													
13.05	C								60.02	13.05		Medium strong very thinly bedded dark grey argillaceous LIMESTONE with calcite veining up to 9mm thick. Partially weathered: probably slightly closer fracture spacing. Discontinuities: 1. 30 to 45 degree bedding fractures closely spaced (30/110/350), planar, rough.		
13.50														
13.50	C													
13.95	C													
14.05	C													
14.30	C	100	49	29	10					(2.95)				
15.00														
15.65	C	85	72	72										
16.00									57.07	16.00		End of Borehole at 16.00m		

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
9.00			

Casing Details

To (m)	Diam (mm)
10.50	200

Water Added

From (m)	To (m)
9.00	16.00

Remarks

Hand dug inspection pit excavated to 1.20m.

Core Barrel	Flush Type	Termination Reason	Last Updated
	Polymer	Terminated at scheduled depth.	16/12/2020

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
20-0399D	Bus Connects Route 9 Tallaght/Clondalkin to City Centre	R9WS01
	Client: National Transport Authority (NTA)	
	Client's Rep: AECOM/Mott MacDonald	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Light Percussion	Dando Terrier	0.00	1.20	710048.06 E 730265.91 N

Final Depth:	Start Date:	Driller:	Sheet 1 of 1
1.20 m	19/10/2020	JC	Scale: 1:50
Elevation: 64.16 mOD	**End Date:** 19/10/2020	**Logger:** GH	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
0.50	ES1							TOPSOIL with rootlets		
0.60 - 1.20	B2				63.56	0.60		MADE GROUND: Soft brown sandy gravelly SILT with concrete fragments. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.		
1.00	ES3				62.96	1.20		End of Borehole at 1.20m		

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 7.5 8.0 8.5 9.0

Water Strikes

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

Casing Details

To (m)	Diameter

Remarks

Hand dug inspection pit excavated to 1.20m.
ESB cable struck at 1.27m.

Termination Reason

Terminated due to encountering service.

Last Updated

16/12/2020

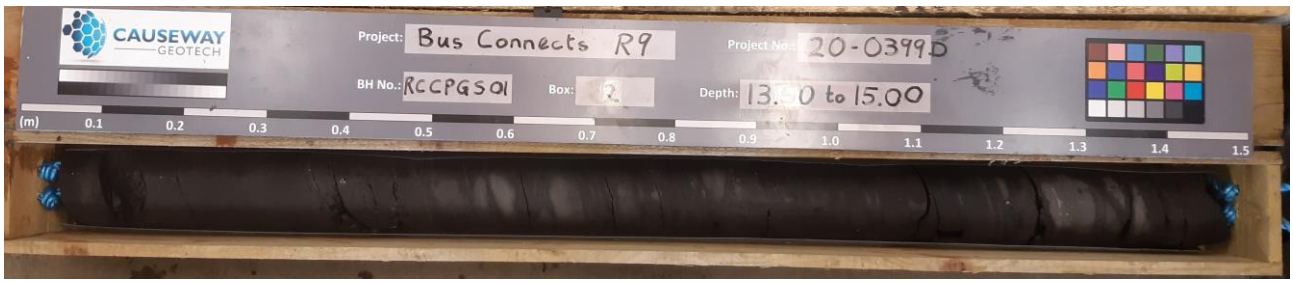
AGS

CAUSEWAY GEOTECH

APPENDIX C

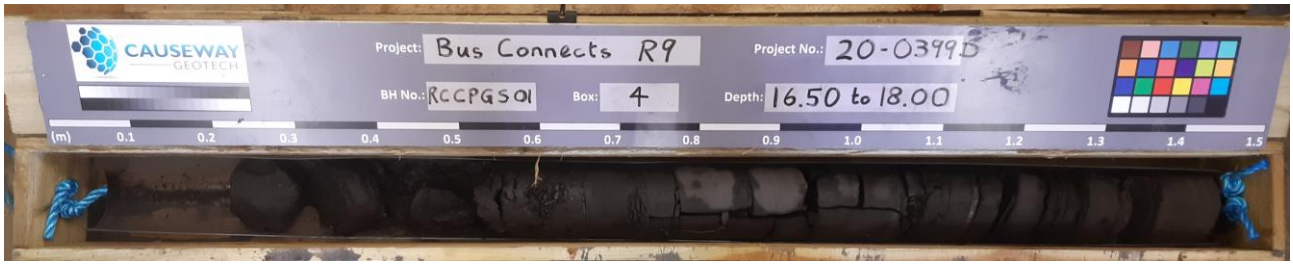
CORE PHOTOGRAPHS

R9-CPGS01 Box 1 12.00-13.50m

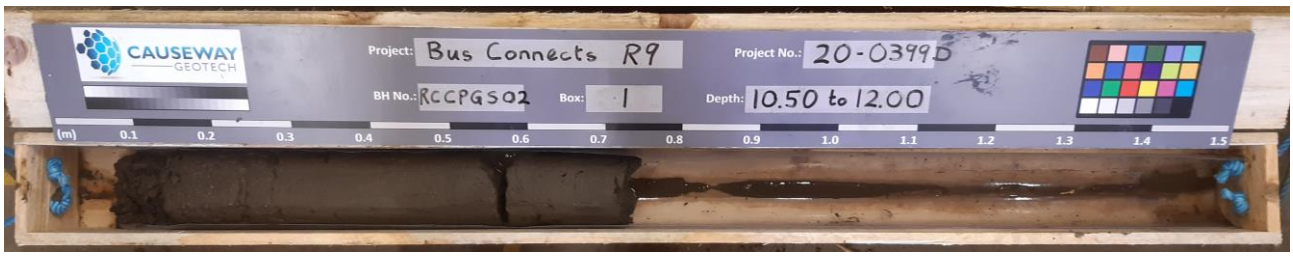


R9-CPGS01 Box 2 13.00-15.00m

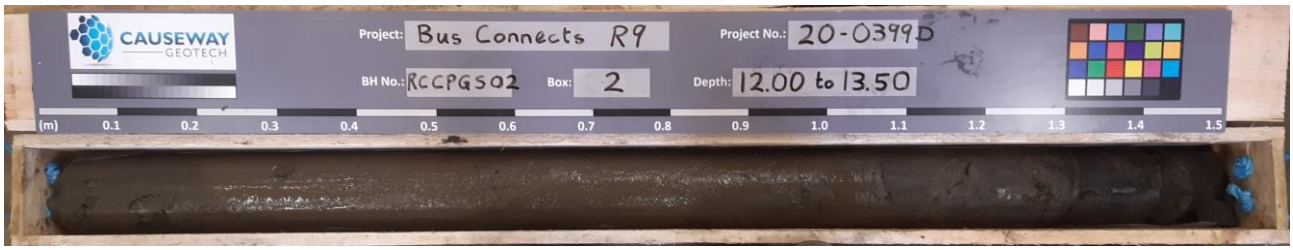
R9-CPGS01 Box 3 15.00-16.50m



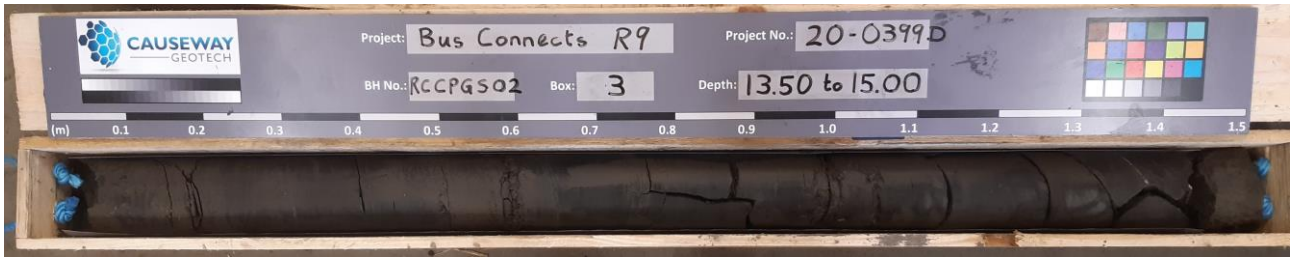
R9-CPGS01 Box 4 16.50-18.00m



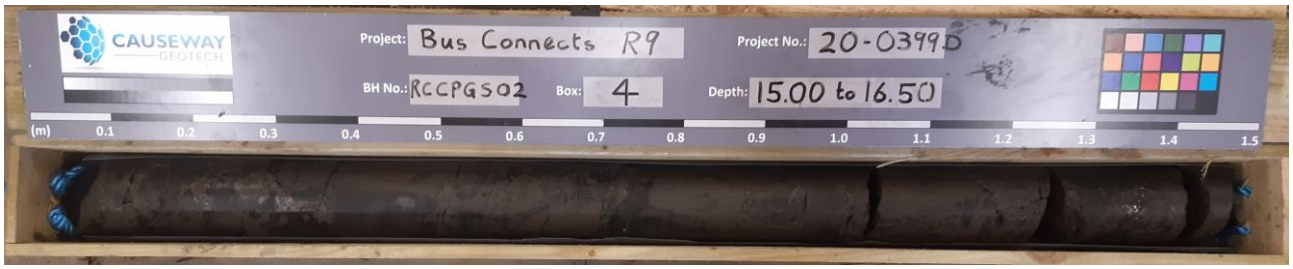
R9-CPGS02 Box 1 10.50-12.00m



R9-CPGS02 Box 2 12.00-13.50m



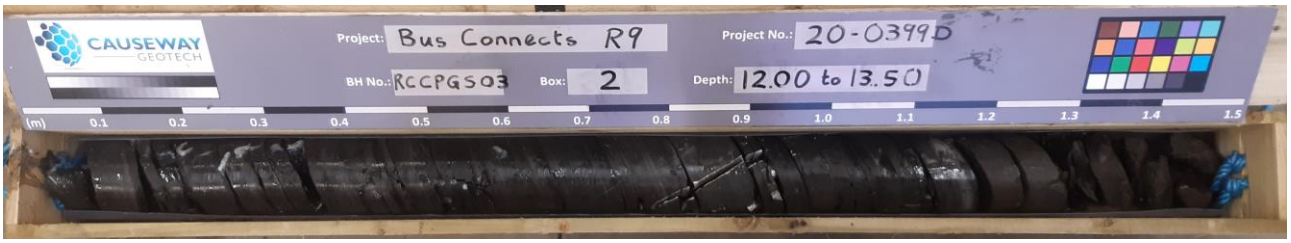
R9-CPGS02 Box 3 13.50-15.00m



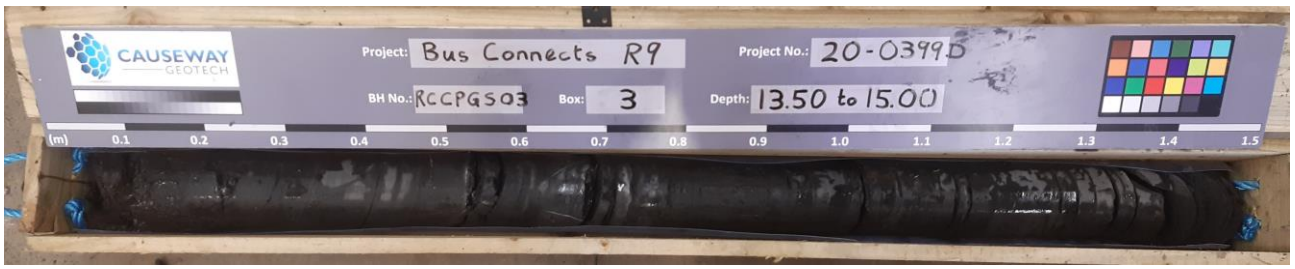
R9-CPGS02 Box 4 15.00-16.50m

R9-CPGS02 Box 5 16.50-18.00m

R9-CPGS03 Box 1 10.50-12.00m



R9-CPGS03 Box 2 12.00-13.50m

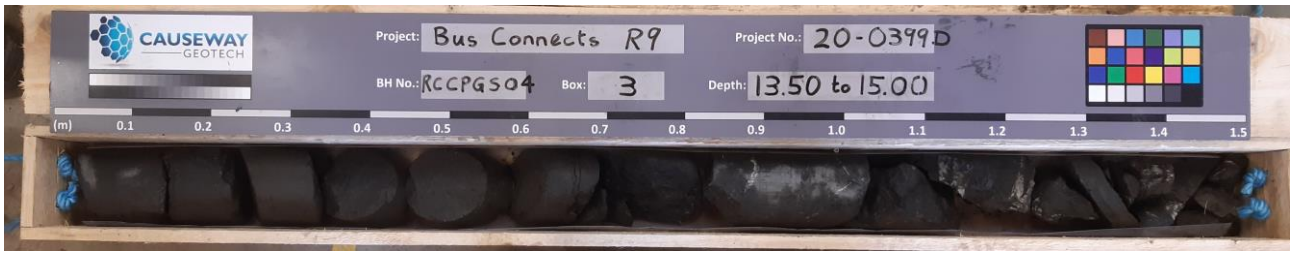


R9-CPGS03 Box 3 13.50-15.00m

R9-CPGS03 Box 4 15.00-16.00m

R9-CPGS04 Box 1 10.50-12.00m

R9-CPGS04 Box 2 12.00-13.50m



R9-CPGS04 Box 3 13.50-15.00m

R9-CPGS04 Box 4 15.00-16.00m

CAUSEWAY GEOTECH

APPENDIX D

TRIAL PIT LOGS

CAUSEWAY GEOTECH

Project No. 20-0399D	**Project Name:** Bus Connects Route 9 Tallaght/Clondalkin to City Centre		**Trial Pit ID** R9TP01
Coordinates 708488.70 E 727849.19 N	**Client:** National Transport Authority (NTA)		
Method: Trial Pitting	**Client's Representative:** AECOM/Mott MacDonald		Sheet 1 of 1 Scale: 1:25
Plant: JCB 3CX	**Elevation** 101.70 mOD	**Date:** 08/10/2020	**Logger:** RS	FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
						TOPSOIL	
			101.40	0.30		MADE GROUND: Stiff greyish brown slightly sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular fine to coarse of limestone. Cobbles are of limestone.	
0.50	ES1						
0.50		HVP=108, HVR=17					
0.50		HVP=115, HVR=17					
0.50		HVP=161, HVR=26					
1.00	B2						
1.00	ES3						
1.00		HVP=175, HVR=9					
1.00		HVP=201, HVR=29					
1.00		HVP=201, HVR=80					
1.50	ES4						
2.00	B5		99.70	2.00		End of trial pit at 2.00m	
2.00	ES6						

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: 3.00

Remarks: No groundwater encountered.

Stability: Stable

Termination Reason: Terminated on refusal.

Last Updated 16/12/2020

AGS

CAUSEWAY GEOTECH

Project No. 20-0399D	**Project Name:** Bus Connects Route 9 Tallaght/Clondalkin to City Centre		**Trial Pit ID** R9TP02
Coordinates 708506.36 E 727855.02 N	**Client:** National Transport Authority (NTA)		
Method: Trial Pitting	**Client's Representative:** AECOM/Mott MacDonald		Sheet 1 of 1 Scale: 1:25
Plant: JCB 3CX	**Elevation** 101.68 mOD	**Date:** 08/10/2020	**Logger:** RS	FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
						TOPSOIL	
			101.38	0.30		Stiff brown slightly sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular fine to coarse of limestone. Cobbles are of limestone.	
0.50	ES1						
0.50		HVP=147, HVR=20					
0.50		HVP=178, HVR=26					
0.50		HVP=184, HVR=34					
1.00	B2						
1.00	ES3						
1.00		HVP=124, HVR=26					
1.00		HVP=195, HVR=14					
1.00		HVP=201, HVR=32					
1.50	ES4						
2.00	B5						
2.00	ES6						
			99.28	2.40		End of trial pit at 2.40m	

Water Strikes	
Struck at (m)	Remarks

Depth: 2.40
Width: 0.60
Length: 3.00

Remarks: No groundwater encountered.

Stability: Stable

Termination Reason: Terminated on refusal.

Last Updated 16/12/2020

AGS

CAUSEWAY GEOTECH

Project No. 20-0399D	**Project Name:** Bus Connects Route 9 Tallaght/Clondalkin to City Centre		**Trial Pit ID** R9TP03
Coordinates 709613.40 E 728268.52 N	**Client:** National Transport Authority (NTA)		
Method: Trial Pitting	**Client's Representative:** AECOM/Mott MacDonald		Sheet 1 of 1 Scale: 1:25
Plant: JCB 3CX	**Elevation** 87.31 mOD	**Date:** 09/10/2020	**Logger:** RS	FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
			87.21	0.10		MADE GROUND: Grey rounded coarse GRAVEL of mixed lithologies.	
						MADE GROUND: Greyish brown very sandy very silty subangular fine to coarse GRAVEL of mixed lithologies. Sand is fine to coarse.	
			86.96	0.35		MADE GROUND: Dark grey sandy subangular fine to coarse GRAVEL of limestone with high cobble content. Sand is fine to coarse. Cobbles are of limestone.	
0.50 0.50	B2 ES1						
			86.41	0.90		CONCRETE	
			86.31	1.00		End of trial pit at 1.00m	

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: 1.00
Width: 0.60
Length: 2.50

Remarks:
No groundwater encountered.
Potential water main below cement cover
No hand vane tests possible due to granular material.

Stability: Unstable

Termination Reason: Terminated on concrete.

Last Updated 16/12/2020

AGS

CAUSEWAY GEOTECH

Project No. 20-0399D	**Project Name:** Bus Connects Route 9 Tallaght/Clondalkin to City Centre		**Trial Pit ID** R9TP04
Coordinates 709710.24 E 728980.16 N	**Client:** National Transport Authority (NTA)		
Method: Trial Pitting	**Client's Representative:** AECOM/Mott MacDonald		Sheet 1 of 1 Scale: 1:25
Plant: JCB 3CX	**Elevation** 78.40 mOD	**Date:** 08/10/2020	**Logger:** RS	FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
			78.10	0.30		TOPSOIL	
0.50	ES1					MADE GROUND: Stiff brown slightly sandy slightly gravelly CLAY with low cobble content and fragments of red brick. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies. Cobbles are of mudstone.	
0.50		HVP=201, HVR=29					
1.00	B2						
1.00	ES2		77.30	1.10			
1.00	ES3					MADE GROUND: Stiff yellowish brown slightly sandy slightly gravelly CLAY with fragments of red brick. Sand is fine to coarse. Gravel is subangular fine to coarse of mudstone.	
1.50	B4						
1.50	ES						
1.50	ES5		76.70	1.70		Grey sandy very clayey subrounded fine to coarse GRAVEL of limestone with low cobble content. Sand is fine to coarse. Cobbles are of limestone.	
2.00	B6		76.40	2.00		End of trial pit at 2.00m	
2.00	ES7						

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: 3.00

Remarks: No groundwater encountered.

Stability: Stable

Termination Reason: Terminated on refusal.

Last Updated 16/12/2020

AGS

CAUSEWAY GEOTECH	**Project No.** 20-0399D	**Project Name:** Bus Connects Route 9 Tallaght/Clondalkin to City Centre	**Trial Pit ID** R9TP05
	Coordinates 709757.92 E 729208.08 N	**Client:** National Transport Authority (NTA)	
Method: Trial Pitting		**Client's Representative:** AECOM/Mott MacDonald	Sheet 1 of 1 Scale: 1:25
Plant: JCB 3CX	**Elevation** 75.20 mOD	**Date:** 08/10/2020	**Logger:** RS FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
0.50	ES1					MADE GROUND: Firm brown slightly sandy slightly gravelly CLAY with medium cobble content and fragments of red brick and wood and pieces of rubber and carpet. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium of mixed lithologies. Cobbles are of mixed lithologies.	
0.50		HVP=158, HVR=26					
0.50		HVP=50, HVR=9					
0.50		HVP=78, HVR=20					
1.00	B2						
1.00	ES						
1.00	ES2						
1.00	ES3						
1.00		HVP=53, HVR=7					
1.00		HVP=55, HVR=10					
1.00		HVP=86, HVR=11					
1.50	ES4						
		Rapid water strike at 1.60m					▼
			73.40	1.80		End of trial pit at 1.80m	

Water Strikes	
Struck at (m)	Remarks
1.60	Rapid water strike at 1.60m

Depth: 1.80
Width: 0.60
Length: 3.00

Remarks:

Stability: Unstable

Termination Reason: Terminated due to water ingress and wall collapse.

Last Updated 16/12/2020

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Trial Pit ID
20-0399D	Bus Connects Route 9 Tallaght/Clondalkin to City Centre	R9TP06
Coordinates 709904.05 E 729454.47 N	**Client:** National Transport Authority (NTA)	
Method: Trial Pitting	**Client's Representative:** AECOM/Mott MacDonald	Sheet 1 of 1 Scale: 1:25
Plant: JCB 3CX	**Elevation** 70.98 mOD / **Date:** 08/10/2020 / **Logger:** RS	FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
			70.88	0.10		TOPSOIL	
			70.78	0.20		MADE GROUND: Firm orangish brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subrounded fine to coarse of mudstone.	
0.50	ES					MADE GROUND: Stiff greyish brown slightly sandy gravelly CLAY with medium cobble and boulder content and fragments of concrete, red brick and pieces of rubber tubes. Sand is fine to coarse. Gravel is subrounded fine to coarse of predominantly limestone. Cobbles and boulders are of limestone.	
0.50	ES1						
0.50		HVP=118, HVR=26					
0.50		HVP=132, HVR=20					
1.00	B2						
1.00	ES3		69.93	1.05		End of trial pit at 1.05m	

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: 1.05
Width: 0.60
Length: 3.00

Remarks: No groundwater encountered.

Stability:	Termination Reason:	Last Updated
Unstable	Terminated on refusal.	16/12/2020

AGS

CAUSEWAY GEOTECH

Project No. 20-0399D	**Project Name:** Bus Connects Route 9 Tallaght/Clondalkin to City Centre		**Trial Pit ID** R9TP07
Coordinates 710096.86 E 729729.58 N	**Client:** National Transport Authority (NTA)		
Method: Trial Pitting	**Client's Representative:** AECOM/Mott MacDonald		Sheet 1 of 1 Scale: 1:25
Plant: 3T Tracked Excavator	**Elevation** 74.80 mOD	**Date:** 24/10/2020	**Logger:** GH	FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
						TOPSOIL	
			74.50	0.30		MADE GROUND: Firm brown slightly sandy slightly gravelly silty CLAY with medium cobble and boulder content and pieces of red brick and concrete. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies. Cobbles and boulders are angular of mixed lithologies.	
0.50	B1						
0.50	ES						
0.50	ES4						
1.00	B2						
1.00	ES5						
			73.00	1.80		Brown gravelly silty fine to coarse SAND. Gravel is subrounded fine to medium.	
2.00	B3		72.80	2.00		End of trial pit at 2.00m	
2.00	ES6						

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: 0.55
Length: 2.80

Remarks:
Hand dug inspection pit excavated to 1.20m.

Stability:	Termination Reason:	Last Updated
Stable	Terminated on instruction of engineer.	16/12/2020

AGS

CAUSEWAY GEOTECH

Project No. 20-0399D	**Project Name:** Bus Connects Route 9 Tallaght/Clondalkin to City Centre		**Trial Pit ID** R9TP08
Coordinates 710138.06 E 730072.84 N	**Client:** National Transport Authority (NTA)		
Method: Trial Pitting	**Client's Representative:** AECOM/Mott MacDonald		Sheet 1 of 1 Scale: 1:25
Plant: JCB 3CX	**Elevation** 67.36 mOD	**Date:** 08/10/2020	**Logger:** RS	FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
0.50	ES					MADE GROUND: Stiff brown slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is subrounded fine to coarse of limestone.	
0.50	ES1		66.81	0.55			
1.00	B2					Brown sandy clayey subangular fine to coarse GRAVEL of limestone. Sand is fine to coarse.	
1.00	ES3						
			66.06	1.30		End of trial pit at 1.30m	

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: 1.30
Width: 0.60
Length: 2.00

Remarks:
No groundwater encountered.
No hand vane tests possible due to granular nature of clay.

Stability:	Termination Reason:	Last Updated
Unstable	Terminated on refusal.	16/12/2020

AGS

CAUSEWAY GEOTECH	**Project No.** 20-0399D	**Project Name:** Bus Connects Route 9 Tallaght/Clondalkin to City Centre	**Trial Pit ID** R9TP09
	Coordinates 710391.88 E 730342.97 N	**Client:** National Transport Authority (NTA)	
Method: Trial Pitting		**Client's Representative:** AECOM/Mott MacDonald	Sheet 1 of 1 Scale: 1:25
Plant: JCB 3CX	**Elevation** 69.54 mOD	**Date:** 09/10/2020	**Logger:** RS — FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
			69.39	0.15		MADE GROUND: Grey sandy very silty subangular fine to coarse GRAVEL of limestone. Sand is fine to coarse.	
			69.29	0.25		MADE GROUND: Light yellowish brown slightly sandy clayey subangular fine to coarse GRAVEL of mudstone. Sand is fine to coarse.	
			69.19	0.35		MADE GROUND: Brown very sandy very clayey subangular to subrounded fine to coarse GRAVEL of mixed lithologies. Sand is fine to coarse.	
			69.09	0.45		MADE GROUND: Dark brown very gravelly very silty fine to coarse SAND. Gravel is subangular fine to coarse of mixed lithologies.	
0.50	ES1					MADE GROUND: Greyish brown slightly sandy gravelly CLAY with high cobble content and fragments of glass and red brick. Sand is fine to coarse. Gravel is subangular fine to coarse of mixed lithologies. Cobbles are mixed lithologies.	
1.00	B3						
1.00	ES						
1.00	ES2						
1.50	ES4						
2.00	ES						
2.00	ES5						
			67.34	2.20		Yellowish brown sandy silty subrounded fine to coarse GRAVEL of mixed lithologies with low cobble content. Cobbles are subrounded of limestone.	
2.50	B6						
2.50	ES7						
			66.79	2.75		End of trial pit at 2.75m	

Water Strikes	
Struck at (m)	Remarks

Depth: 2.75
Width: 0.60
Length: 3.00

Remarks: No groundwater encountered.

Stability: Stable

Termination Reason: Terminated on refusal.

Last Updated 16/12/2020

AGS

CAUSEWAY GEOTECH

Project No. 20-0399D	**Project Name:** Bus Connects Route 9 Tallaght/Clondalkin to City Centre		**Trial Pit ID** R9TP10
Coordinates 710639.12 E 730660.94 N	**Client:** National Transport Authority (NTA)		
Method: Trial Pitting	**Client's Representative:** AECOM/Mott MacDonald		Sheet 1 of 1 Scale: 1:25
Plant: JCB 3CX	**Elevation** 56.58 mOD	**Date:** 08/10/2020	**Logger:** RS	FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
0.50	ES1					MADE GROUND: Firm brown slightly sandy slightly gravelly CLAY with fragments of red brick. Sand is fine to coarse. Gravel is subrounded fine to coarse of mixed lithologies.	
0.50		HVP=101, HVR=23	56.02	0.55		MADE GROUND: Soft yellowish brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subrounded fine to medium of mudstone.	
0.50		HVP=92, HVR=14					
0.50		HVP=93, HVR=15					
0.75	B2		55.78	0.80		Brown gravelly silty fine to coarse SAND. Gravel is subrounded fine to medium of mudstone.	
1.00	B4						
1.00	ES3		55.52	1.05		Brown sandy clayey subrounded fine to coarse GRAVEL of limestone with low cobble content. Sand is fine to coarse.	
1.50	ES5						
2.00	B6						
2.00	ES7						
			54.38	2.20		Stiff brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subrounded fine to medium of mixed lithologies. Contains occasional lenses of brown fine to medium SAND.	
3.00	ES8						
4.00	B9						
4.00	ES10						
			52.38	4.20		End of trial pit at 4.20m	

Water Strikes

Struck at (m)	Remarks

Depth: 4.20
Width: 0.60
Length: 4.00

Remarks: No groundwater encountered.

Stability: Stable

Termination Reason: Terminated on refusal.

Last Updated 16/12/2020

AGS

CAUSEWAY GEOTECH

Project No. 20-0399D	**Project Name:** Bus Connects Route 9 Tallaght/Clondalkin to City Centre		**Trial Pit ID** R9TP11
Coordinates 710673.95 E 730667.32 N	**Client:** National Transport Authority (NTA)		
Method: Trial Pitting	**Client's Representative:** AECOM/Mott MacDonald		Sheet 1 of 1 Scale: 1:25
Plant: JCB 3CX	**Elevation** 56.61 mOD	**Date:** 08/10/2020	**Logger:** RS	FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
0.50	ES1					MADE GROUND: Stiff brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subrounded fine to coarse of mixed lithologies.	
0.50		HVP=201, HVR=25					
0.50		HVP=201, HVR=29					
0.50		HVP=201, HVR=31					
			55.71	0.90			
1.00	B2					MADE GROUND: Stiff yellowish brown slightly sandy slightly gravelly CLAY and fragments of ceramic. Sand is fine to coarse. Gravel is subangular fine to medium of mudstone.	
1.00	ES						
1.00	ES3						
1.00		HVP=141, HVR=44					
1.00		HVP=201, HVR=80					
1.00		HVP=55, HVR=9					
1.50	ES4						
			55.01	1.60		Stiff brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subrounded fine of mixed lithologies. Contains occasional lenses of brown fine to medium SAND.	
2.00	B5						
2.00	ES6						
3.00	B7						
3.00	ES8						
			53.01	3.60		End of trial pit at 3.60m	

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: 3.60
Width: 0.60
Length: 3.00

Remarks: No groundwater encountered.

Stability: Stable

Termination Reason: Terminated on refusal.

Last Updated 16/12/2020

AGS

CAUSEWAY GEOTECH

APPENDIX E

TRIAL PIT PHOTOGRAPHS


CAUSEWAY
GEOTECH
Project Name
Bus Connects R9
Project Number
20-0399
Date
08/10/2020
ER Number
R9 TP 01
(m) 0.1 0.2 0.3 0.4 0.5

R9-TP01


CAUSEWAY
GEOTECH
Project Name
Bus Connects R9
Project Number
20-0399D
Date
08/10/2020
ID Number
R9 TP 01
(m) 0.1 0.2 0.3 0.4

R9-TP01

R9-TP01

R9-TP01

R9-TP01

R9-TP01

R9-TP01

R9-TP01


CAUSEWAY
Project Name
Bus Connects R9
Project Number
20-0399
Date
08/10/2020
TP Number
R9 TP 02
(m) 0.1 0.2 0.3 0.4 0.5

R9-TP02


CAUSEWAY
GEOTECH
Project Name
Bus Connects R9
Project Number
20-0399D
Date
08/10/2020
TP Number
R9 TP02

R9-TP02

R9-TP02

R9-TP02

R9-TP02

R9-TP02

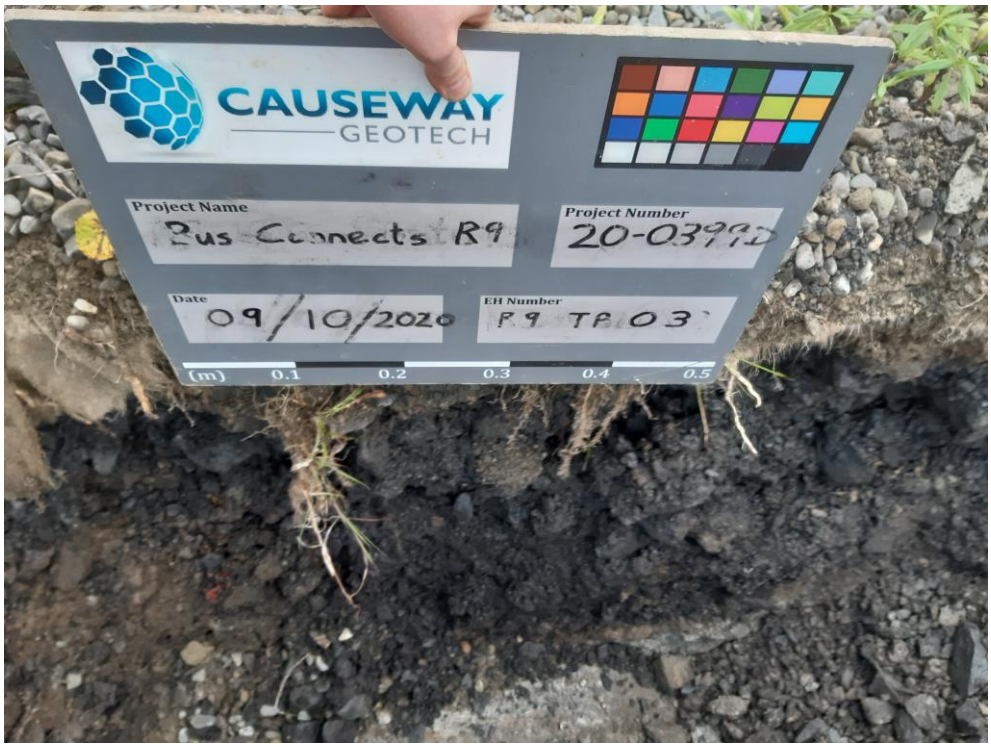
R9-TP02


CAUSEWAY
GEOTECH
Project Name
Bus Connects R9
Project Number
20-03
Date
09/10/2020
EH Number
R9 TP03
(m)
0.1
0.2
0.3
0.4
0.5

R9-TP03


CAUSEWAY
GEOTECH
Project Number
20-0399D
Project Name
Bus Connects R9
EH Number
R9 TP03
Date
09/10/2020
(m)
0.1
0.2
0.3
0.4
0.5

R9-TP03



R9-TP03

R9-TP03

R9-TP03

R9-TP03

R9-TP03


CAUSEWAY
GEOTECH
Project Name
Bus Connects R9
Project Number
20-0399D
Date
08/10/2020
EH Number
R9 TP04
(m)
0.1
0.2
0.3
0.4

R9-TP04


CAUSEWAY
GEOTECH
Project Name
Bus Connects R9
Project Number
20-0399D
EH Number
R9 TP04
Date
08/10/2020
(m)
0.1
0.2
0.3
0.4
0.5

R9-TP04

R9-TP04

R9-TP04


CAUSEWAY
GEOTECH
Project Number
20-0399D
Bus Connects R9
EH Number
R9 TP04
Date
08/10/2020
(m)
0.1
0.2
0.3
0.4
0.5

R9-TP04

R9-TP04

R9-TP04


CAUSEWAY
GEOTECH
Project Name
Bus Connects R9
Date
08/10/2020
BH Number
R9 TP05
Project Number
20-0399

R9-TP05

R9-TP05

R9-TP05


CAUSEWAY
GEOTECH
Project Name
Bus Connects R9
Project Number
20-039
EH Number
R9 TP05
Date
08/10/2020
(m)
0.1
0.2
0.3
0.4
0.5

R9-TP05

R9-TP05

R9-TP05

R9-TP05


CAUSEWAY
GEOTECH
Project Name
Bus Connects R9
Project Number
20-0399D
Date
08/10/2020
EH Number
R9 TP06
(m) 0.1 0.2 0.3 0.4 0.5

R9-TP06


CAUSEWAY
GEOTECH
Project Name
Bus Connects R9
Project Number
20-0399D
Date
08/10/2020
EH Number
R9 TP06
0.1
0.2
0.3
0.4
0.5

R9-TP06

R9-TP06

R9-TP06

R9-TP06

R9-TP06

R9-TP06

R9-TP06

R9-TP06

R9-TP07

R9-TP07

R9-TP07

R9-TP07

R9-TP07

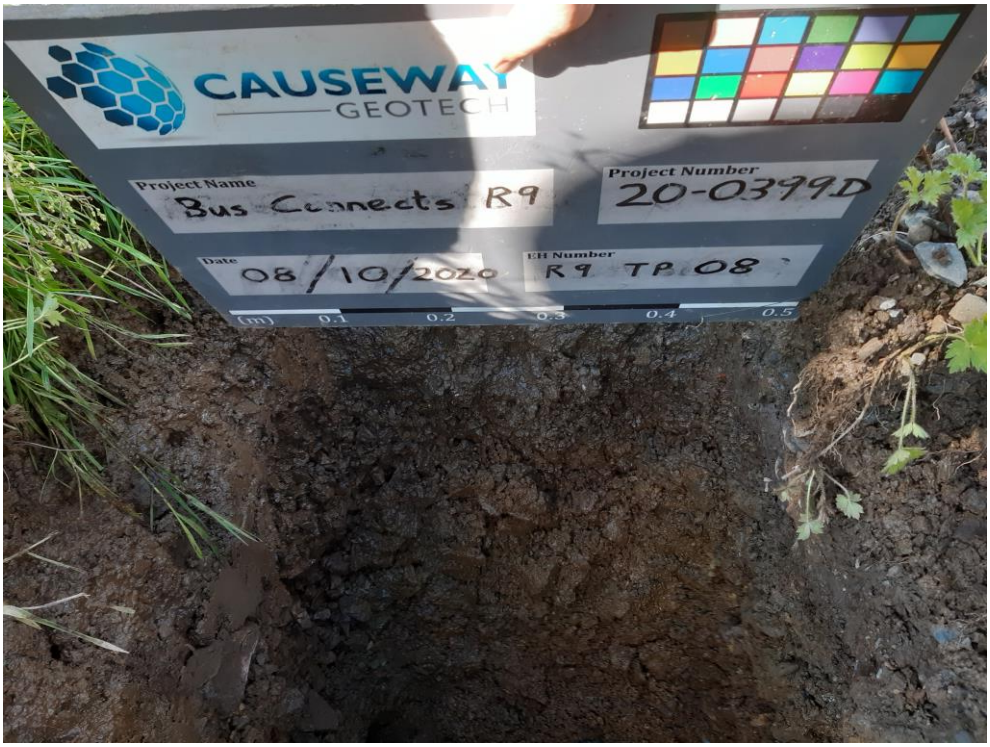
R9-TP07

R9-TP07


CAUSEWAY
GEOTECH
Project Name
Bus Connects R9
Project Number
20-0399D
Date
08/10/2020
EH Number
R9 TP 08
0.3
0.4
0.5

R9-TP08

R9-TP08



R9-TP08

R9-TP08

R9-TP08

R9-TP08

R9-TP08

R9-TP08

R9-TP08


Bus Connects R9
Project Number
20-0399D
Date
09/10/2020
EH Number
R9 TP 09
(m) 0.1 0.2 0.3 0.4 0.5

R9-TP09


CAUSEWAY
GEOTECH
Project Name
Bus Connects R9
Project Number
20-0399D
Date
09/10/2020
EH Number
R9 TP 09
0.1
0.2
0.3
0.4
0.5

R9-TP09

R9-TP09

R9-TP09

R9-TP09

R9-TP09

R9-TP09


CAUSEWAY
GEOTECH
Project Name
Bus Connects R9
Project Number
20-0399D
Date
08/10/2020
EH Number
R9 TP10
(m) 0.1 0.2 0.3 0.4 0.5

R9-TP10


CAUSEWAY
GEOTECH
Project Name
Bus Connects R9
Project Number
20-0399D
Date
08/10/2020
TP Number
R9 TP 10
(m) 0.1 0.2 0.3 0.4 0.5

R9-TP10

R9-TP10

R9-TP10

R9-TP10

R9-TP10

R9-TP10


CAUSEWAY
GEOTECH
Project Name
Bus Connects R9
Project Number
20-0399D
Date
08/10/2020
EH Number
R9 TP11

R9-TP11


CAUSEWAY
GEOTECH
Project Name
Bus Connects R9
Project Number
20-0399D
Date
08/10/2020
EH Number
R9 TP11
(m)
0.1
0.2
0.3
0.4
0.5

R9-TP11


CAUSEWAY
GEOTECH
Project Number
20-0399D
Bus Connects R9
EH Number
R9 TP11
Date
08/10/2020
(m) 0.1 0.2 0.3 0.4 0.5

R9-TP11

R9-TP11


GEOTECH
Project Name
Bus Connects R9
Project Number
20-0399D
Date
08/10/2020
TH Number
R9 TP11
(m) 0.1 0.2 0.3 0.4 0.5

R9-TP11


CAUSEWAY
GEOTECH
Project Name
Bus Connects R9
Project Number
20-0399D
Date
08/10/2020
EH Number
R9 TP11
(m)
0.1
0.2
0.3
0.4
0.5

R9-TP11

R9-TP11

R9-TP11

CAUSEWAY GEOTECH

APPENDIX F

INDIRECT IN-SITU CBR TEST RESULTS

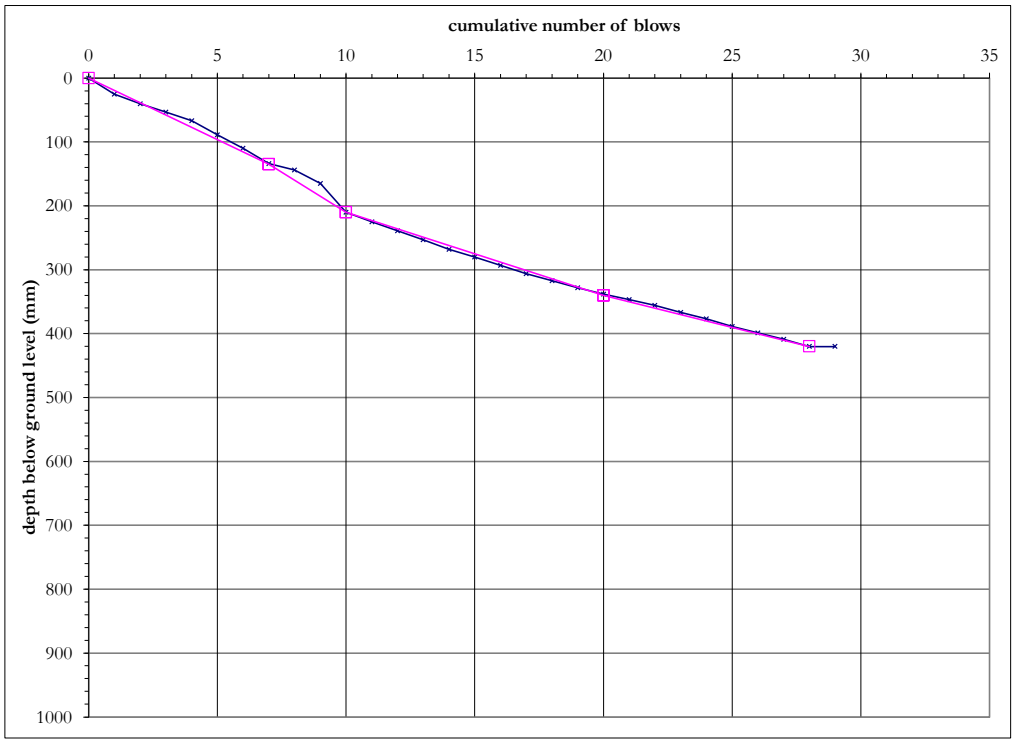
Dynamic Cone Penetrometer (DCP) test results and estimated CBR

Project Number	20-0399D
Project Name	Bus Connects Route 9
Site Location	R9-TP01

Test Number	1	**Date Tested**	30/10/2020
Depth bgl (m)	0.00	**Weather**	Raining

Test conducted in accordance with Documented In-House Technical Procedure IMS TP7-4.
CBR calculated using the TRL equation: log10(CBR) = 2.48 - 1.057 x log10(mm/blow) iaw IAN 73/06 Rev 1 2009.

Surface preparation	**Description of surface material**
Natural Ground	Topsoil



top / base of layer (mm)	mm/ blow	CBR (%)
0	19	13
135		
135	25	10
210		
210	13	20
340		
340	10	26
420		

CBR Range	Min: 10 Max: 26	The selection of layers is based on visual interpretation of the data. The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing; variation in moisture content or other factors may affect the insitu value.

Deviation(s) from standard procedure	None

Observations and comments	

Approved Name and Appointment		
Darren O'Mahony Director		November 2020

UKAS TESTING 10122

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

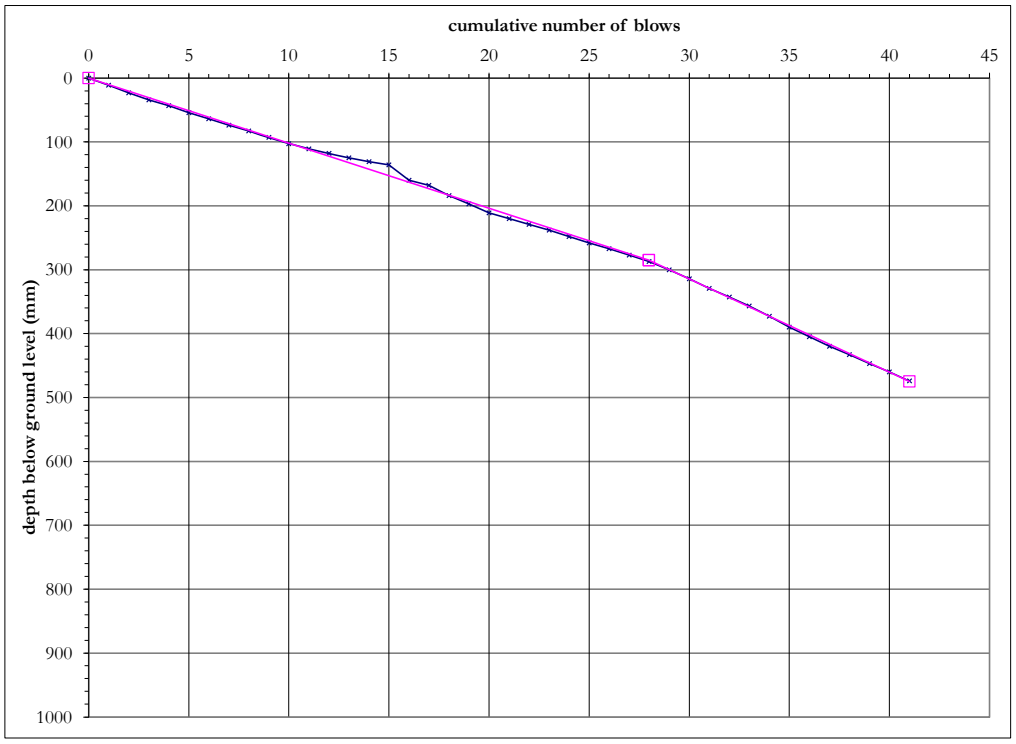
Project Number	20-0399D
Project Name	Bus Connects Route 9
Site Location	R9-TP02

Test Number	1
Depth bgl (m)	0.00

Date Tested	30/10/2020
Weather	Raining

Test conducted in accordance with Documented In-House Technical Procedure IMS TP7-4.
CBR calculated using the TRL equation: log10(CBR) = 2.48 - 1.057 x log10(mm/blow) iaw IAN 73/06 Rev 1 2009.

Surface preparation	Description of surface material
Natural Ground	Topsoil



top / base of layer (mm)	mm/ blow	CBR (%)
0	10	26
285		
285	15	18
475		

CBR Range	Min: 18 Max: 26	The selection of layers is based on visual interpretation of the data. The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing; variation in moisture content or other factors may affect the insitu value.

Deviation(s) from standard procedure	None

Observations and comments	

Approved Name and Appointment		
Darren O'Mahony Director		November 2020

UKAS TESTING 10122

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

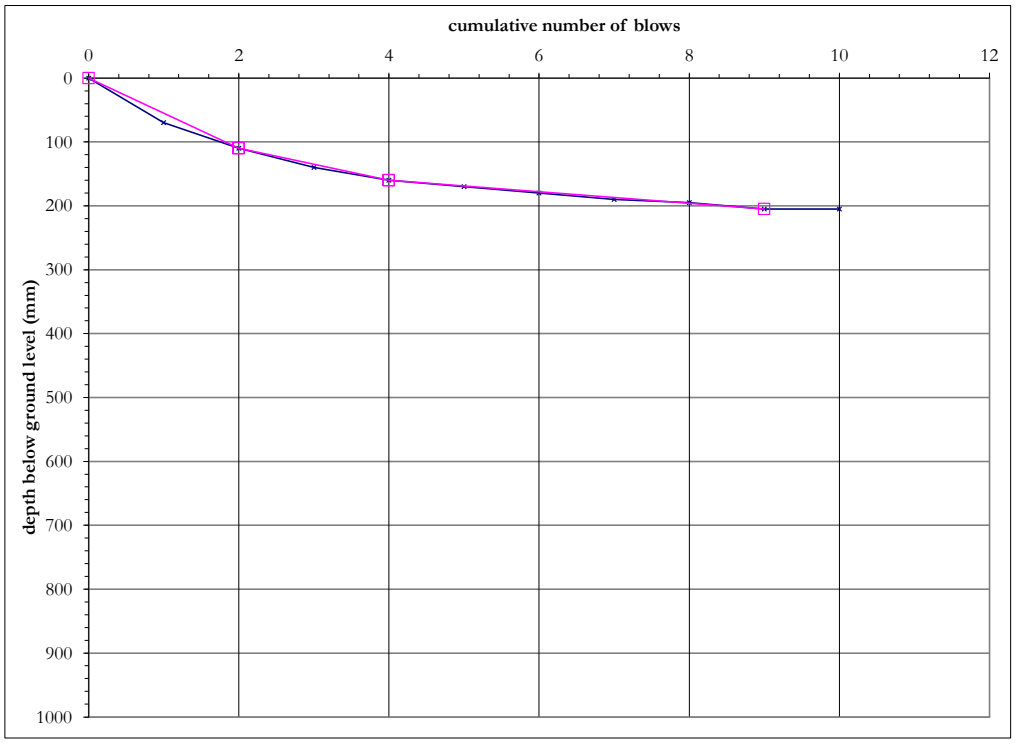
Project Number	20-0399D
Project Name	Bus Connects Route 9
Site Location	R9-TP04

Test Number	1
Depth bgl (m)	0.00

Date Tested	30/10/2020
Weather	Raining

Test conducted in accordance with Documented In-House Technical Procedure IMS TP7-4.
CBR calculated using the TRL equation: log10(CBR) = 2.48 - 1.057 x log10(mm/blow) iaw IAN 73/06 Rev 1 2009.

Surface preparation	Description of surface material
Natural Ground	Topsoil



top / base of layer (mm)	mm/ blow	CBR (%)
0	55	4.4
110		
110	25	10
160		
160	9	30
205		

CBR Range	Min: 4.4 Max: 30	The selection of layers is based on visual interpretation of the data. The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing; variation in moisture content or other factors may affect the insitu value.

Deviation(s) from standard procedure	None

Observations and comments	Terminated due to refusal

Approved Name and Appointment		
Darren O'Mahony Director		November 2020

UKAS TESTING 10122

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

Project Number	20-0399D
Project Name	Bus Connects Route 9
Site Location	R9-TP05

Test Number	1	**Date Tested**	30/10/2020
Depth bgl (m)	0.00	**Weather**	Raining

Test conducted in accordance with Documented In-House Technical Procedure IMS TP7-4.
CBR calculated using the TRL equation: log10(CBR) = 2.48 - 1.057 x log10(mm/blow) iaw IAN 73/06 Rev 1 2009.

Surface preparation	**Description of surface material**
Natural Ground	Topsoil

top / base of layer (mm)	mm/ blow	CBR (%)
0	55	4.4
110		
110	21	12
195		
195	11	23
275		
275	28	8.9
500		
500	13	20
540		
540	26	9.7
850		

CBR Range	Min: 4.4 Max: 23	The selection of layers is based on visual interpretation of the data. The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing; variation in moisture content or other factors may affect the insitu value.

Deviation(s) from standard procedure	None

Observations and comments	

Approved Name and Appointment		
Darren O'Mahony Director		November 2020

UKAS TESTING 10122

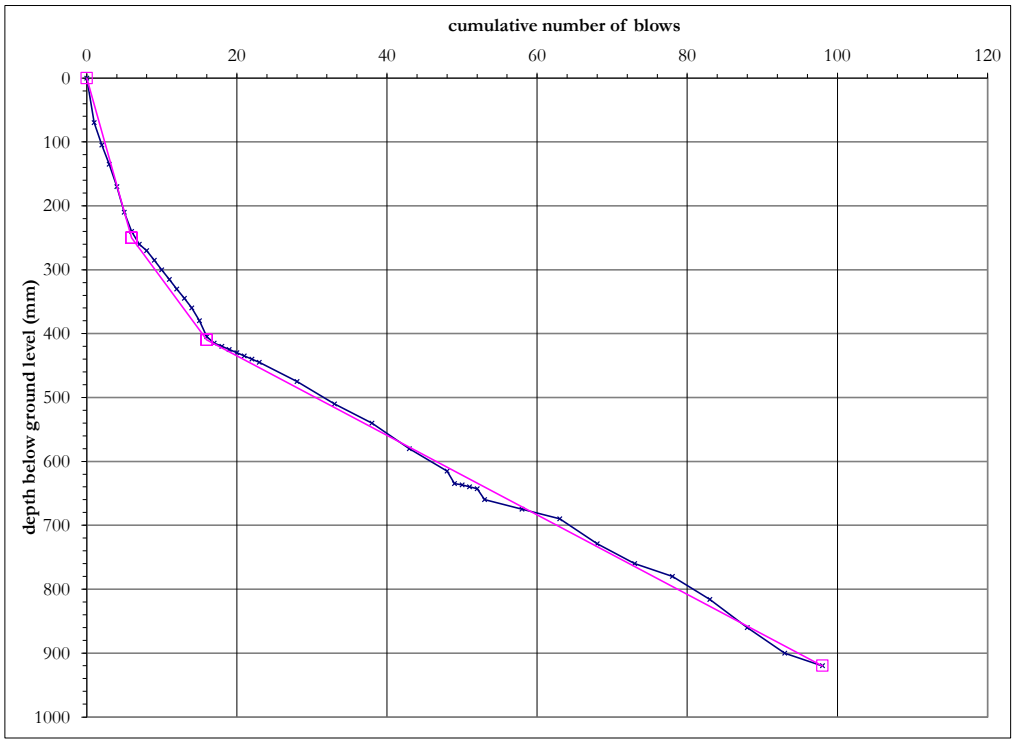
Dynamic Cone Penetrometer (DCP) test results and estimated CBR

Project Number	20-0399D
Project Name	Bus Connects Route 9
Site Location	R9-TP06

Test Number	1	**Date Tested**	30/10/2020
Depth bgl (m)	0.00	**Weather**	Raining

Test conducted in accordance with Documented In-House Technical Procedure IMS TP7-4.
CBR calculated using the TRL equation: log10(CBR) = 2.48 - 1.057 x log10(mm/blow) iaw IAN 73/06 Rev 1 2009.

Surface preparation	**Description of surface material**
Natural Ground	Topsoil



top / base of layer (mm)	mm/ blow	CBR (%)
0	42	5.9
250		
250	16	16
410		
410	6.2	44
920		

CBR Range	Min: 5.9 Max: 44	The selection of layers is based on visual interpretation of the data. The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing; variation in moisture content or other factors may affect the insitu value.

Deviation(s) from standard procedure	None

Observations and comments	

Approved Name and Appointment		
Darren O'Mahony Director		November 2020

UKAS TESTING 10122

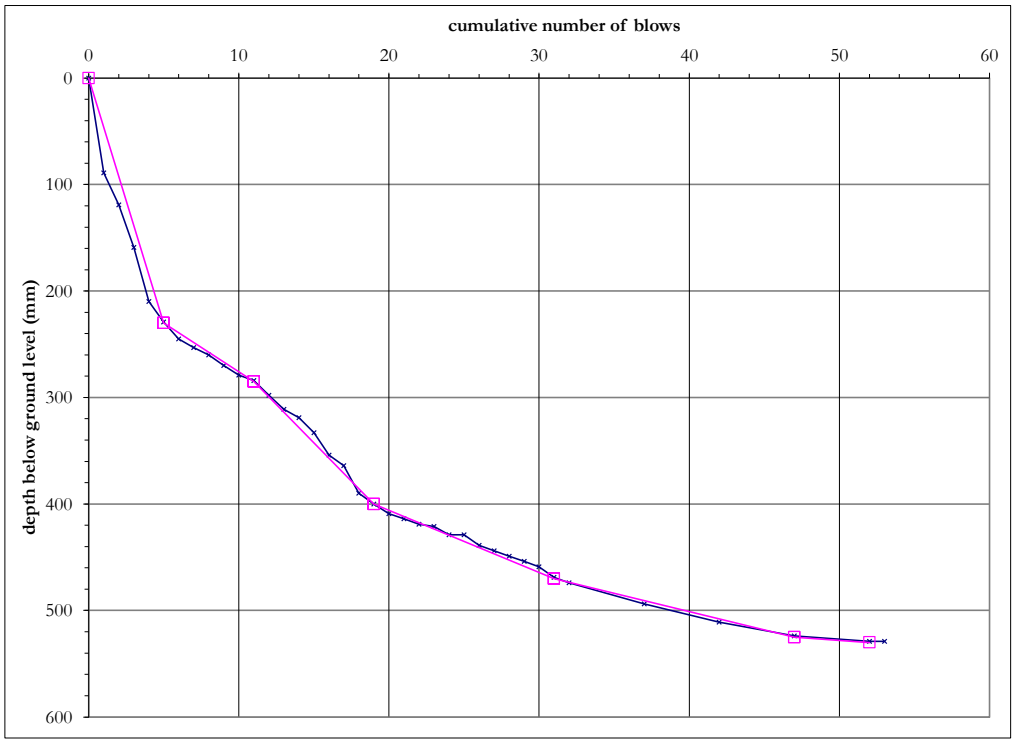
Dynamic Cone Penetrometer (DCP) test results and estimated CBR

Project Number	20-0399D
Project Name	Bus Connects Route 9
Site Location	R9-TP07

Test Number	1	**Date Tested**	30/10/2020
Depth bgl (m)	0.00	**Weather**	Raining

Test conducted in accordance with Documented In-House Technical Procedure IMS TP7-4.
CBR calculated using the TRL equation: log10(CBR) = 2.48 - 1.057 x log10(mm/blow) iaw IAN 73/06 Rev 1 2009.

Surface preparation	**Description of surface material**
Natural Ground	Topsoil



top / base of layer (mm)	mm/ blow	CBR (%)
0	46	5.3
230		
230	9.2	29
285		
285	14	18
400		
400	5.8	47
470		
470	3.4	82
525		
525	1	>100
530		

CBR Range	Min: 5.3 Max: >100	The selection of layers is based on visual interpretation of the data. The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing; variation in moisture content or other factors may affect the insitu value.

Deviation(s) from standard procedure	None

Observations and comments	

Approved Name and Appointment		
Darren O'Mahony Director		November 2020

UKAS TESTING 10122

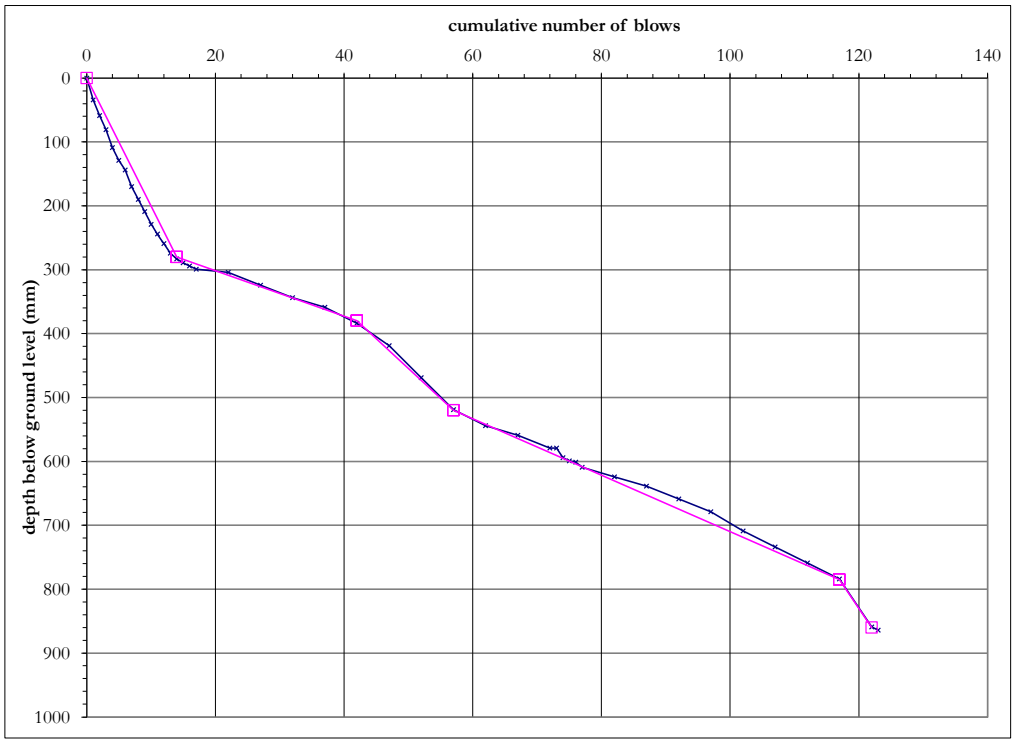
Dynamic Cone Penetrometer (DCP) test results and estimated CBR

Project Number	20-0399D
Project Name	Bus Connects Route 9
Site Location	R9-TP08

Test Number	1	**Date Tested**	30/10/2020
Depth bgl (m)	0.00	**Weather**	Raining

Test conducted in accordance with Documented In-House Technical Procedure IMS TP7-4.
CBR calculated using the TRL equation: log10(CBR) = 2.48 - 1.057 x log10(mm/blow) iaw IAN 73/06 Rev 1 2009.

Surface preparation	**Description of surface material**
Natural Ground	MADE GROUND: Stiff brown sandy gravelly CLAY



top / base of layer (mm)	mm/ blow	CBR (%)
0	20	13
280		
280	3.6	79
380		
380	9.3	28
520		
520	4.4	63
785		
785	15	17
860		

CBR Range	Min: 13 Max: 79	The selection of layers is based on visual interpretation of the data. The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing; variation in moisture content or other factors may affect the insitu value.

Deviation(s) from standard procedure	None

Observations and comments	

Approved Name and Appointment		
Darren O'Mahony Director		November 2020

UKAS TESTING 10122

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

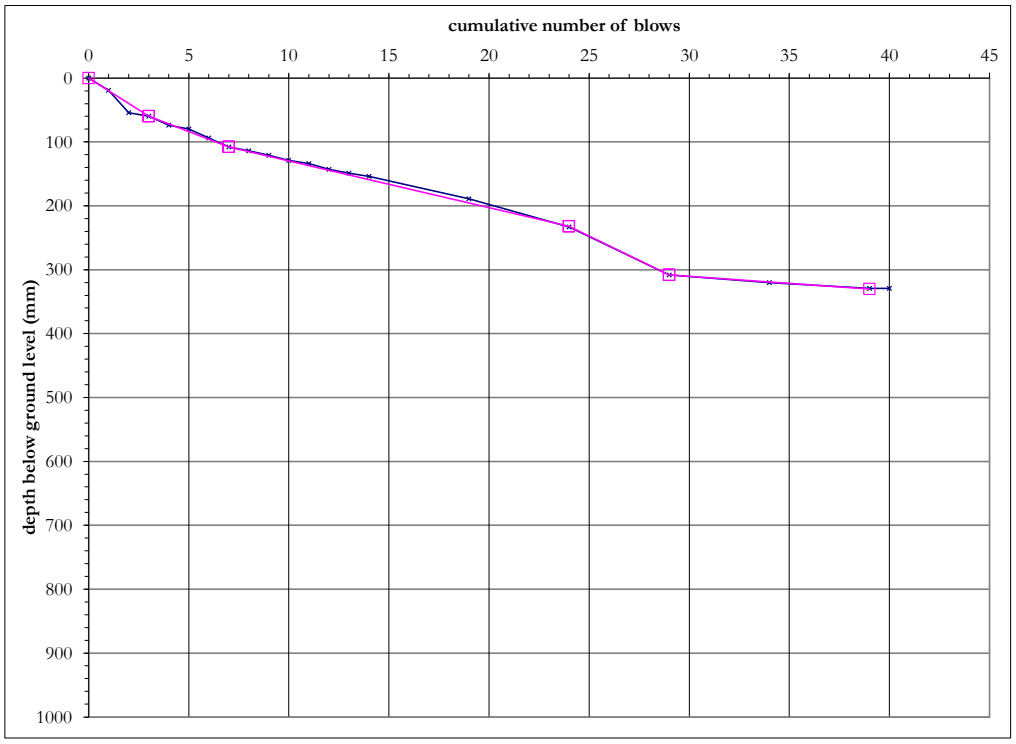
Project Number	20-0399D
Project Name	Bus Connects Route 9
Site Location	R9-TP09

Test Number	1
Depth bgl (m)	0.00

Date Tested	30/10/2020
Weather	Raining

Test conducted in accordance with Documented In-House Technical Procedure IMS TP7-4.
CBR calculated using the TRL equation: log10(CBR) = 2.48 - 1.057 x log10(mm/blow) iaw IAN 73/06 Rev 1 2009.

Surface preparation	Description of surface material
Natural Ground	MADE GROUND: Grey sandy very silty GRAVEL



top / base of layer (mm)	mm/ blow	CBR (%)
0	20	13
60		
60	12	22
108		
108	7.3	37
232		
232	15	17
308		
308	2.2	>100
330		

CBR Range	Min: 13 Max: >100	The selection of layers is based on visual interpretation of the data. The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing; variation in moisture content or other factors may affect the insitu value.

Deviation(s) from standard procedure	None

Observations and comments	Terminated due to refusal

Approved Name and Appointment		
Darren O'Mahony Director		November 2020

UKAS TESTING 10122

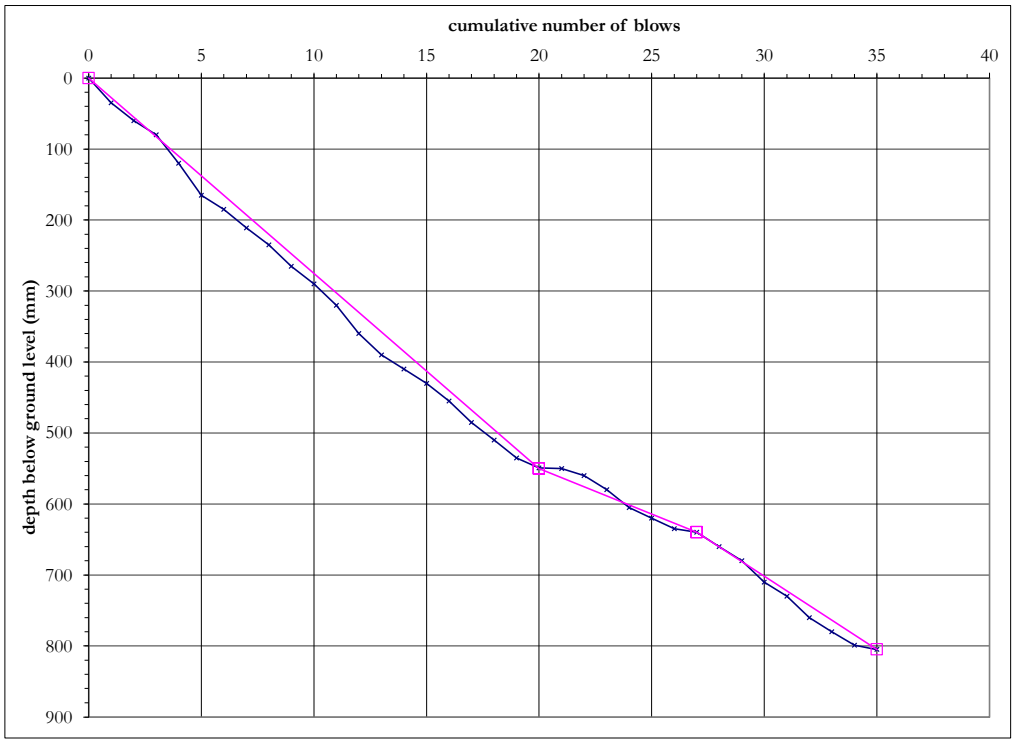
Dynamic Cone Penetrometer (DCP) test results and estimated CBR

Project Number	20-0399D
Project Name	Bus Connects Route 9
Site Location	R9-TP10

Test Number	1	**Date Tested**	30/10/2020
Depth bgl (m)	0.00	**Weather**	Raining

Test conducted in accordance with Documented In-House Technical Procedure IMS TP7-4.
CBR calculated using the TRL equation: log10(CBR) = 2.48 - 1.057 x log10(mm/blow) iaw IAN 73/06 Rev 1 2009.

Surface preparation	**Description of surface material**
Natural Ground	MADE GROUND: Firm brown slightly sandy slightly gravelly CLAY with fragments of red brick



top / base of layer (mm)	mm/ blow	CBR (%)
0	28	9.1
550		
550	13	20
640		
640	21	12
805		

CBR Range	Min: 9.1 Max: 20	The selection of layers is based on visual interpretation of the data. The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing; variation in moisture content or other factors may affect the insitu value.

Deviation(s) from standard procedure	None

Observations and comments	

Approved Name and Appointment		
Darren O'Mahony Director		November 2020

UKAS TESTING 10122

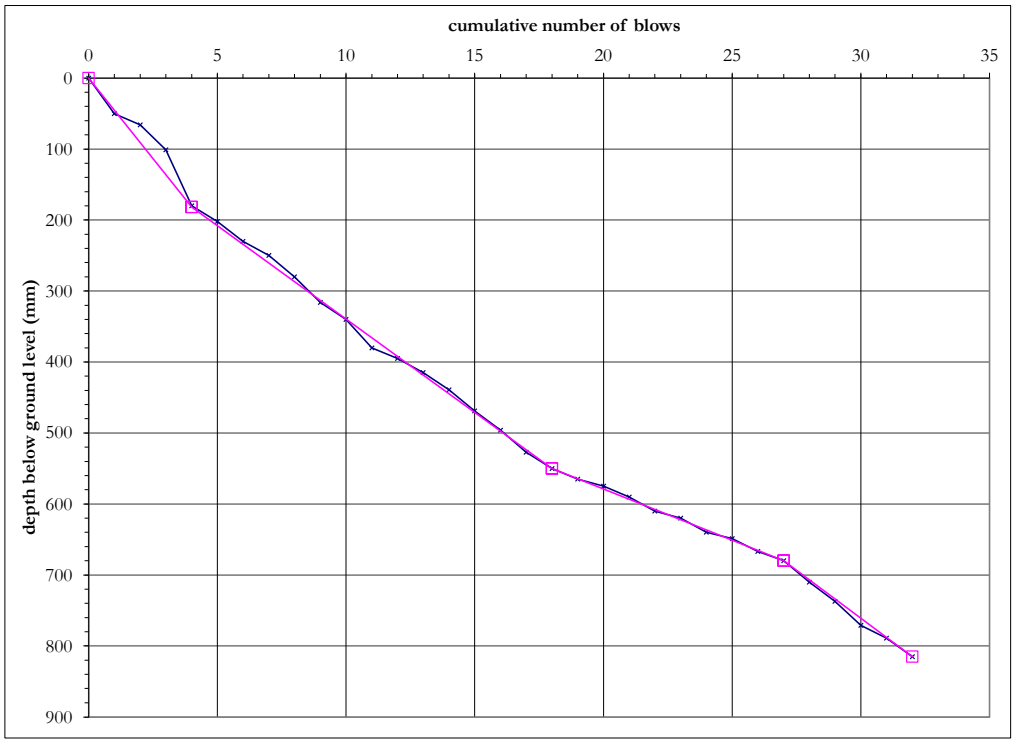
Dynamic Cone Penetrometer (DCP) test results and estimated CBR

Project Number	20-0399d
Project Name	Bus Connects Route 9
Site Location	R9-TP11

Test Number	1	**Date Tested**	30/10/2020
Depth bgl (m)	0.00	**Weather**	Raining

Test conducted in accordance with Documented In-House Technical Procedure IMS TP7-4.
CBR calculated using the TRL equation: log10(CBR) = 2.48 - 1.057 x log10(mm/blow) iaw IAN 73/06 Rev 1 2009.

Surface preparation	**Description of surface material**
Natural Ground	MADE GROUND: Stiff brown slightly sandy slightly gravelly CLAY



top / base of layer (mm)	mm/ blow	CBR (%)
0	46	5.3
182		
182	26	9.5
550		
550	14	18
680		
680	27	9.3
815		

CBR Range	Min: 5.3 Max: 18	The selection of layers is based on visual interpretation of the data. The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing; variation in moisture content or other factors may affect the insitu value.

Deviation(s) from standard procedure	None

Observations and comments	

Approved Name and Appointment		
Darren O'Mahony Director		November 2020

UKAS TESTING 10122

CAUSEWAY GEOTECH

APPENDIX G

GEOTECHNICAL LABORATORY TEST RESULTS

CAUSEWAY GEOTECH

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

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

www.causewaygeotech.com

SOIL AND ROCK SAMPLE ANALYSIS
LABORATORY TEST REPORT

20 November 2020

Project Name:	Bus Connects - Route 9 – Tallaght/Clondalkin to City Centre
Project No.:	20-0399D
Client:	National Transport Authority (NTA)
Engineer:	AECOM/Mott MacDonald

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

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

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

Stephen Watson

Laboratory Manager

Signed for and on behalf of Causeway Geotech Ltd

Project Name: Bus Connects - Route 9 – Tallaght/Clondalkin to City Centre

Report Reference: Schedule 1 & 2

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

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

Material tested	Type of test/Properties measured/Range of measurement	Standard specifications	No. of results included in the report
SOIL	Moisture Content of Soil	BS 1377-2: 1990: Cl 3.2	63
SOIL	Liquid and Plastic Limits of soil-1 point cone penetrometer method	BS 1377-2: 1990: Cl 4.4, 5.3 & 5.4	30
SOIL	Particle size distribution - wet sieving	BS 1377-2: 1990: Cl 9.2	32
SOIL	Particle size distribution - sedimentation hydrometer method	BS 1377-2: 1990: Cl 9.5	21
SOIL	Moisture Condition Value at natural moisture content	BS 1377-4: 1990: Cl 5.4	4
SOIL	California Bearing Ratio (CBR)	BS 1377-4: 1990: Cl 7	2
SOIL	Laboratory Vane Shear Strength (3 determinations) *	BS 1377-7: 1990: Cl 3	2
SOIL	Undrained shear strength – triaxial compression without measurement of pore pressure (loads from 0.12 to 24 kN)	BS 1377-7: 1990: Cl 8	7
ROCK	Point load index	ISRM Commission on Testing Methods. Suggested Method for Determining Point Load Strength 1985	43
ROCK	Uniaxial Compressive Strength (UCS)*	ISRM Suggested Methods -Rock Characterization Testing and Monitoring, Ed. E T Brown - 1981	2

SUB-CONTRACTED TESTS

In agreement with Client, the following tests were conducted by an approved sub-contractor. All sub-contracting laboratories used are UKAS accredited.

Material tested	Type of test/Properties measured/Range of measurement	Standard specifications	No. of results included in the report
SOIL – Subcontracted to Eurofins Chemtest Ltd *(UKAS 2183)*	pH Value of Soil		21
SOIL – Subcontracted to Eurofins Chemtest Ltd *(UKAS 2183)*	Sulphate Content water extract		21
SOIL – Subcontracted to Eurofins Chemtest Ltd (UKAS 2183)	Sulphate Content Acid extract		8
SOIL – Subcontracted to Eurofins Chemtest Ltd (UKAS 2183)	Total Sulphur		8

Summary of Classification Test Results

Project No.	Project Name
20-0399D	Bus Connects Route 9 Tallaght/Clondalkin to City Centre

Hole No.	Sample				Soil Description	Density bulk	Density dry	w	Passing 425µm	LL	PL	PI	Particle density	Casagrande Classification
	Ref	Top	Base	Type		Mg/m3		%	%	%	%	%	Mg/m3	
R9CP01	5	0.50		B	Brown sandy slightly gravelly silty CLAY.			20.0						
R9CP01	12	1.20		D	Brown sandy slightly gravelly silty CLAY.			14.0						
R9CP01	7	2.00		B	Brown sandy slightly gravelly silty CLAY.			11.0	68	31 -1pt	19	12		CL
R9CP01	18	3.00		U	Brown sandy slightly gravelly silty CLAY.			16.0						
R9CP01	15	4.00		D	Brownish grey sandy slightly gravelly silty CLAY.			22.0	74	35 -1pt	21	14		CL/CI
R9CP01	19	5.00		U	Brownish grey sandy slightly gravelly silty CLAY.			12.0						
R9CP02	5	0.50		B	Brownish grey sandy clayey subangular fine to coarse GRAVEL.			5.9	42	33 -1pt	20	13		CL
R9CP02	12	1.20		U	Greyish brown slightly sandy slightly gravelly silty CLAY.			21.0						
R9CP02	10	2.00		D	Brownish grey sandy gravelly silty CLAY.			11.0	47	33 -1pt	20	13		CL
R9CP02	11	3.00		D	Brownish grey sandy gravelly silty CLAY.			13.0						
R9CP03	12	1.00		B	Brownish grey sandy gravelly SILT.			21.0	48	24 -1pt	19	5		ML
R9CP03	26	1.20		U	Brownish grey sandy gravelly SILT.			14.0						

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

LAB 01R Version 4

Key

Density test	Liquid Limit	Particle density
Linear measurement unless :	4pt cone unless :	sp - small pyknometer
wd - water displacement	cas - Casagrande method	gj - gas jar
wi - immersion in water	1pt - single point test	

Date Printed

20/11/2020

Approved By

Stephen.Watson

UKAS TESTING

10122

Summary of Classification Test Results

Project No.	Project Name
20-0399D	Bus Connects Route 9 Tallaght/Clondalkin to City Centre

Hole No.	Sample				Soil Description	Density bulk	Density dry	*w*	Passing 425µm	LL	PL	PI	Particle density	Casagrande Classification
	Ref	Top	Base	Type		Mg/m3		%	%	%	%	%	Mg/m3	
R9CP03	19	2.00		D	Brownish grey sandy gravelly SILT.			12.0						
R9CP03	20	3.00		D	Brownish grey sandy gravelly silty CLAY.			9.1						
R9CP03	21	4.00		D	Brownish grey sandy gravelly silty CLAY.			11.0						
R9CP03	22	5.00		D	Brownish grey sandy gravelly silty CLAY.			13.0						
R9CP03	23	6.00		D	Brownish grey sandy gravelly silty CLAY.			14.0						
R9CP03	18	7.50		B	Brownish grey sandy gravelly silty CLAY.			15.0	74	30 -1pt	18	12		CL
R9CP03	25	8.00		D	Brownish grey sandy gravelly silty CLAY.			12.0						
R9CP04	9	1.20		D	Brownish grey sandy gravelly silty CLAY.			24.0						
R9CP04	10	2.00		D	Brownish grey sandy gravelly silty CLAY.			33.0						
R9CP04	11	3.00		D	Brownish grey sandy gravelly silty CLAY.			9.7						
R9CP05	10	0.50		B	Brownish grey sandy gravelly silty CLAY.			14.0						
R9CP05	19	1.20		D	Brownish grey sandy gravelly silty CLAY.			12.0						

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

LAB 01R Version 4

Key

Density test	Liquid Limit	Particle density
Linear measurement unless :	4pt cone unless :	sp - small pyknometer
wd - water displacement	cas - Casagrande method	gj - gas jar
wi - immersion in water	1pt - single point test	

Date Printed: 20/11/2020

Approved By: Stephen.Watson

UKAS TESTING 10122

Summary of Classification Test Results

Project No.	Project Name
20-0399D	Bus Connects Route 9 Tallaght/Clondalkin to City Centre

Hole No.	Sample				Soil Description	Density bulk / dry Mg/m3		*w* %	Passing 425µm %	LL %	PL %	PI %	Particle density Mg/m3	Casagrande Classification
	Ref	Top	Base	Type										
R9CP05	20	2.00		D	Brownish grey sandy gravelly silty CLAY.			14.0	44	31 -1pt	20	11		CL
R9CP05	21	3.00		D	Brownish grey sandy gravelly silty CLAY.			13.0						
R9CP05	22	4.00		D	Brownish grey sandy gravelly silty CLAY.			14.0						
R9CP05	26	8.00		U	Grey sandy slightly gravelly silty CLAY.			9.2						
R9CP06	2	1.00		B	Brownish grey sandy gravelly silty CLAY.			15.0	59	30 -1pt	17	13		CL
R9CP06	3	3.00		B	Brownish grey sandy gravelly silty CLAY.			14.0	63	33 -1pt	14	19		CL
R9CP08	7	1.00		B	Brownish grey sandy gravelly silty CLAY.			15.0						
R9CP08	14	2.00		D	Brownish grey sandy gravelly silty CLAY.			15.0						
R9CP08	18	3.00		U	Grey slightly sandy slightly gravelly silty CLAY.			14.0						
R9CP08	9	3.00		B	Brownish grey sandy gravelly silty CLAY.			13.0	63	24 -1pt	18	6		ML/CL
R9CP08	16	4.00		D	Brownish grey sandy slightly gravelly silty CLAY.			15.0	46	27 -1pt	19	8		CL
R9CP10	6	0.50		B	Brownish grey sandy gravelly silty CLAY.			17.0						

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

LAB 01R Version 4

Key

Density test	Liquid Limit	Particle density
Linear measurement unless :	4pt cone unless :	sp - small pyknometer
wd - water displacement	cas - Casagrande method	gj - gas jar
wi - immersion in water	1pt - single point test	

Date Printed

20/11/2020

Approved By

Stephen.Watson

UKAS TESTING

10122

Summary of Classification Test Results

Project No.	Project Name
20-0399D	Bus Connects Route 9 Tallaght/Clondalkin to City Centre

Hole No.	Sample				Soil Description	Density bulk / dry Mg/m3		*w* %	Passing 425µm %	LL %	PL %	PI %	Particle density Mg/m3	Casagrande Classification
	Ref	Top	Base	Type										
R9CP10	10	1.20		D	Brownish grey sandy gravelly silty CLAY.			21.0						
R9CP10	8	2.00		B	Brownish grey sandy gravelly silty CLAY.			15.0	71	43 -1pt	24	19		CI
R9CP11	9	4.00		B	Brownish grey sandy gravelly silty CLAY.			13.0	67	26 -1pt	18	8		CL
R9CP12	10	5.00		B	Brownish grey silty fine to coarse SAND.			24.0	93	26 -1pt	21	5		ML
R9CP12	16	5.00		D	Brownish grey silty fine to coarse SAND.			28.0						
R9CP12	17	6.00		D	Brownish grey sandy clayey subangular fine to coarse GRAVEL.			7.5						
R9CP13	9	1.20		D	Brownish grey sandy slightly gravelly SILT.			12.0						
R9CPGS01	9	1.00		B	Brownish grey sandy gravelly silty CLAY.			21.0	55	28 -1pt	18	10		CL
R9CPGS01	11	3.00		B	Brownish grey gravelly silty fine to coarse SAND.			9.8	40	21 -1pt	17	4		ML
R9CPGS01	13	5.00		B	Brown sandy gravelly SILT.			15.0	54	21 -1pt	20	1		ML
R9CPGS02	17	2.00		U	Greyish brown slightly sandy silty CLAY.			16.0						
R9CPGS02	9	2.00		B	Greyish brown slightly sandy silty CLAY.			12.0	44	33 -1pt	23	10		ML/CL

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

LAB 01R Version 4

Key

Density test	Liquid Limit	Particle density
Linear measurement unless :	4pt cone unless :	sp - small pyknometer
wd - water displacement	cas - Casagrande method	gj - gas jar
wi - immersion in water	1pt - single point test	

Date Printed

20/11/2020

Approved By

Stephen.Watson

UKAS TESTING

10122

Summary of Classification Test Results

Project No.	Project Name
20-0399D	Bus Connects Route 9 Tallaght/Clondalkin to City Centre

Hole No.	Sample				Soil Description	Density bulk / dry Mg/m3		*w* %	Passing 425µm %	LL %	PL %	PI %	Particle density Mg/m3	Casagrande Classification
	Ref	Top	Base	Type										
R9CPGS02	11	4.00		B	Greyish brown sandy gravelly silty CLAY.			22.0	60	44 -1pt	29	15		MI
R9CPGS02	11	10.50		C	Greyish brown sandy gravelly silty CLAY.			15.0						
R9CPGS02	11	12.00		C	Greyish brown sandy gravelly silty CLAY.			13.0						
R9CPGS03	13	2.00		D	Greyish brown sandy gravelly silty CLAY.			9.9						
R9CPGS03	9	3.00		B	Greyish brown slightly sandy slightly gravelly silty CLAY.			11.0	67	23 -1pt	17	6		ML/CL
R9CPGS04	14	2.00		D	Greyish brown sandy gravelly silty CLAY.			16.0	97	37 -1pt	20	17		CI
R9TP01	2	1.00		B	Greyish brown slightly sandy slightly gravelly silty CLAY.			12.0	63	29 -1pt	17	12		CL
R9TP02	2	1.00		B	Greyish brown slightly sandy slightly gravelly silty CLAY.			14.0	64	34 -1pt	19	15		CL
R9TP04	2	1.00		B	Brown sandy gravelly silty CLAY.			16.0	73	33 -1pt	16	17		CL
R9TP05	2	1.00		B	Brown sandy gravelly silty CLAY.			14.0	59	23 -1pt	17	6		ML/CL
R9TP06	2	1.00		B	Brown sandy gravelly silty CLAY.			12.0	41	32 -1pt	19	13		CL
R9TP07	1	0.50		B	Brown gravelly clayey fine to coarse SAND.			14.0	49	38 -1pt	20	18		CI

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

LAB 01R Version 4

Key

Density test	Liquid Limit	Particle density
Linear measurement unless :	4pt cone unless :	sp - small pyknometer
wd - water displacement	cas - Casagrande method	gj - gas jar
wi - immersion in water	1pt - single point test	

Date Printed

20/11/2020

Approved By

Stephen.Watson

UKAS TESTING

10122

Summary of Classification Test Results

Project No.	Project Name
20-0399D	Bus Connects Route 9 Tallaght/Clondalkin to City Centre

Hole No.	Sample				Soil Description	Density bulk	Density dry	*w*	Passing 425µm	LL	PL	PI	Particle density	Casagrande Classification
	Ref	Top	Base	Type		Mg/m3		%	%	%	%	%	Mg/m3	
R9TP10	9	4.00		B	Brown sandy silty CLAY.			27.0	97	25 -1pt	17	8		CL
R9TP11	2	1.00		B	Brown sandy slightly gravelly silty CLAY.			22.0	77	35 -1pt	22	13		CL/CI
R9TP11	5	2.00		B	Brown slightly sandy silty CLAY.			20.0	97	43 -1pt	20	23		CI

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

LAB 01R Version 4

Key

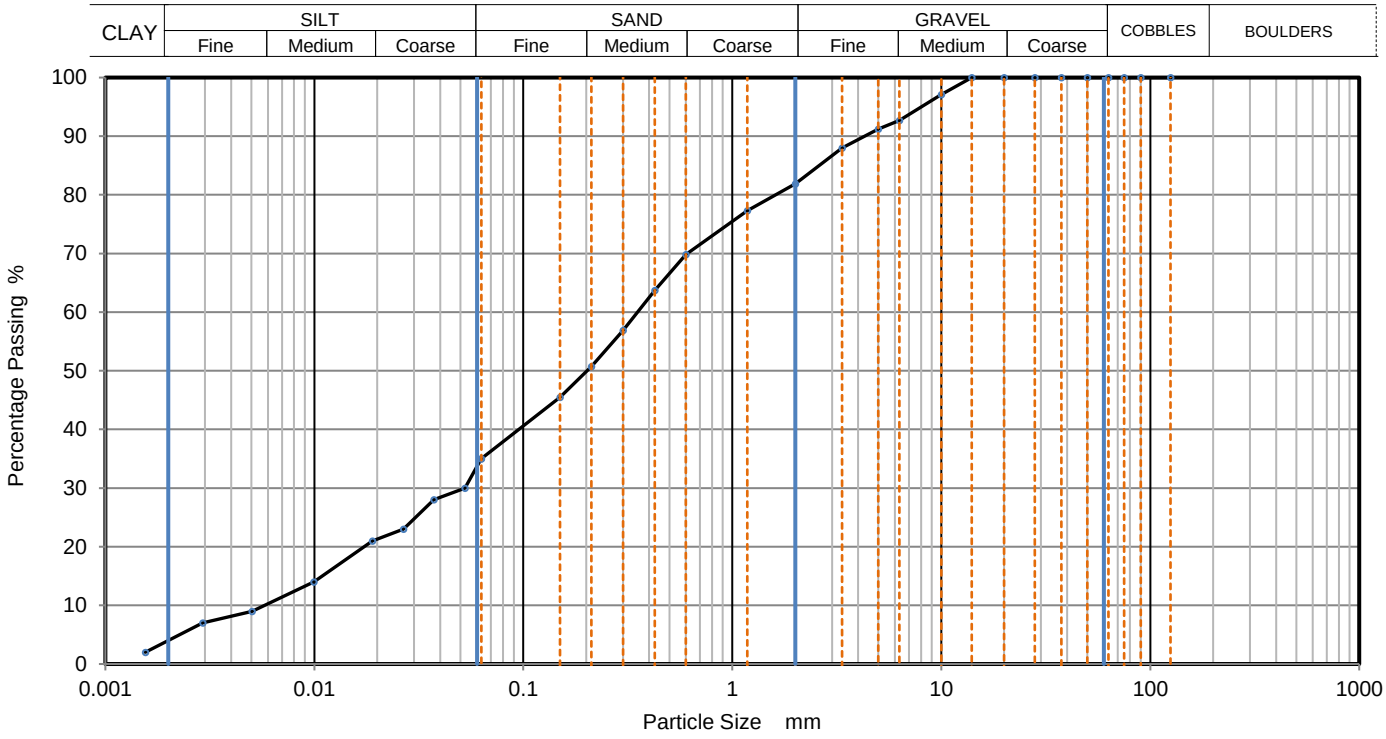
Density test	Liquid Limit	Particle density
Linear measurement unless :	4pt cone unless :	sp - small pyknometer
wd - water displacement	cas - Casagrande method	gj - gas jar
wi - immersion in water	1pt - single point test	

Date Printed: 20/11/2020

Approved By: Stephen.Watson

UKAS TESTING 10122

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION			Job Ref	20-0399D
				Borehole/Pit No.	R9CP01
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			Sample No.	7
Soil Description	Brown sandy slightly gravelly silty CLAY.			Depth, m	2.00
Specimen Reference	6	Specimen Depth	2 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus202010222



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	35
90	100	0.05248	30
75	100	0.03732	28
63	100	0.02669	23
50	100	0.01897	21
37.5	100	0.00996	14
28	100	0.00503	9
20	100	0.00292	7
14	100	0.00155	2
10	97		
6.3	93		
5	91		
3.35	88		
2	82		
1.18	77		
0.6	70	Particle density	(assumed)
0.425	64	2.65	Mg/m3
0.3	57		
0.212	51		
0.15	46		
0.063	35		

Dry Mass of sample, g	1003

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	18.1
Sand	46.9
Silt	30.8
Clay	4.2

Grading Analysis		
D100	mm	
D60	mm	0.351
D30	mm	0.05
D10	mm	0.00555
Uniformity Coefficient		63
Curvature Coefficient		1.3

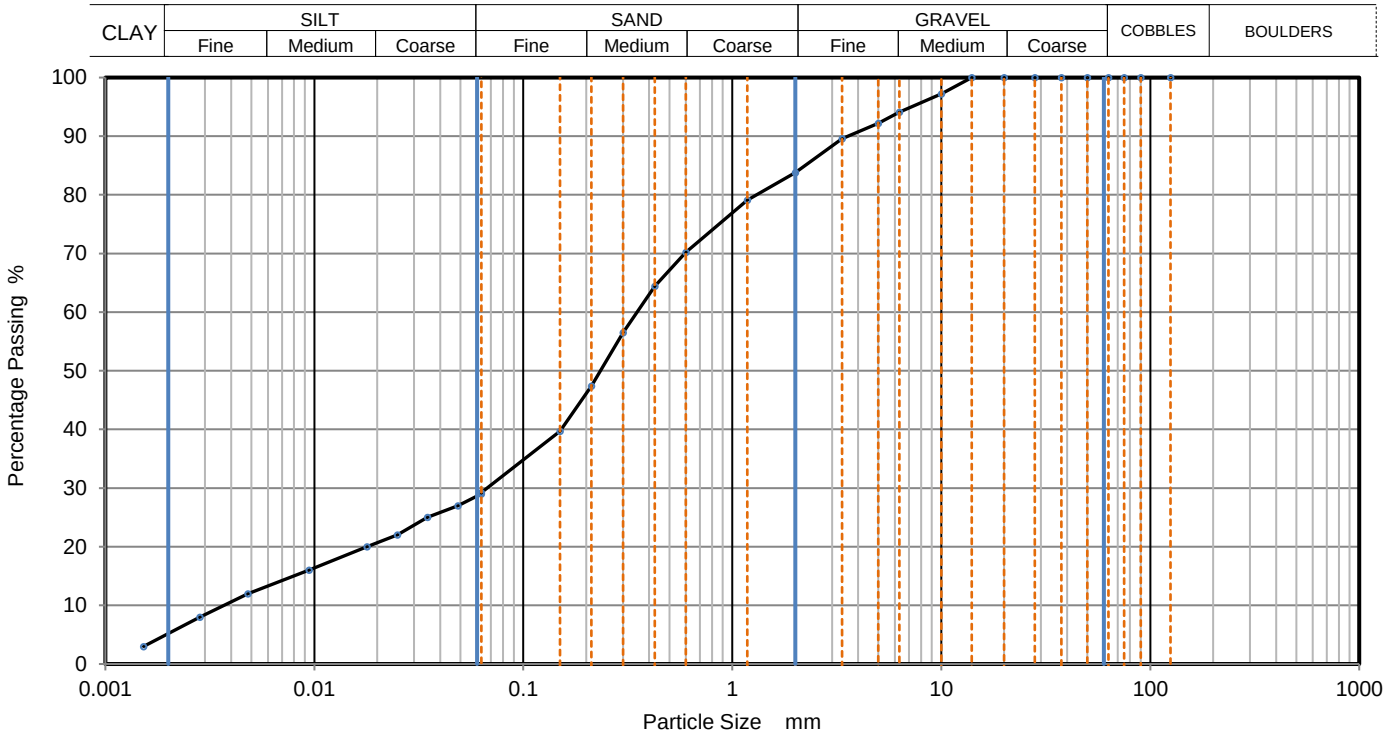
Remarks

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

Approved
Stephen.Watson

UKAS TESTING 10122

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION				Job Ref	20-0399D
					Borehole/Pit No.	R9CP01
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre				Sample No.	15
Soil Description	Brownish grey sandy slightly gravelly silty CLAY.				Depth, m	4.00
Specimen Reference	6	Specimen Depth	4	m	Sample Type	D
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5				KeyLAB ID	Caus202010224



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	29
90	100	0.04856	27
75	100	0.03479	25
63	100	0.02492	22
50	100	0.01784	20
37.5	100	0.00944	16
28	100	0.00480	12
20	100	0.00283	8
14	100	0.00152	3
10	97		
6.3	94		
5	92		
3.35	90		
2	84		
1.18	79		
0.6	70	Particle density	(assumed)
0.425	64	2.65	Mg/m3
0.3	57		
0.212	47		
0.15	40		
0.063	29		

Dry Mass of sample, g	519

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	16.2
Sand	54.6
Silt	23.9
Clay	5.3

Grading Analysis		
D100	mm	
D60	mm	0.35
D30	mm	0.0673
D10	mm	0.00364
Uniformity Coefficient		96
Curvature Coefficient		3.5

Remarks

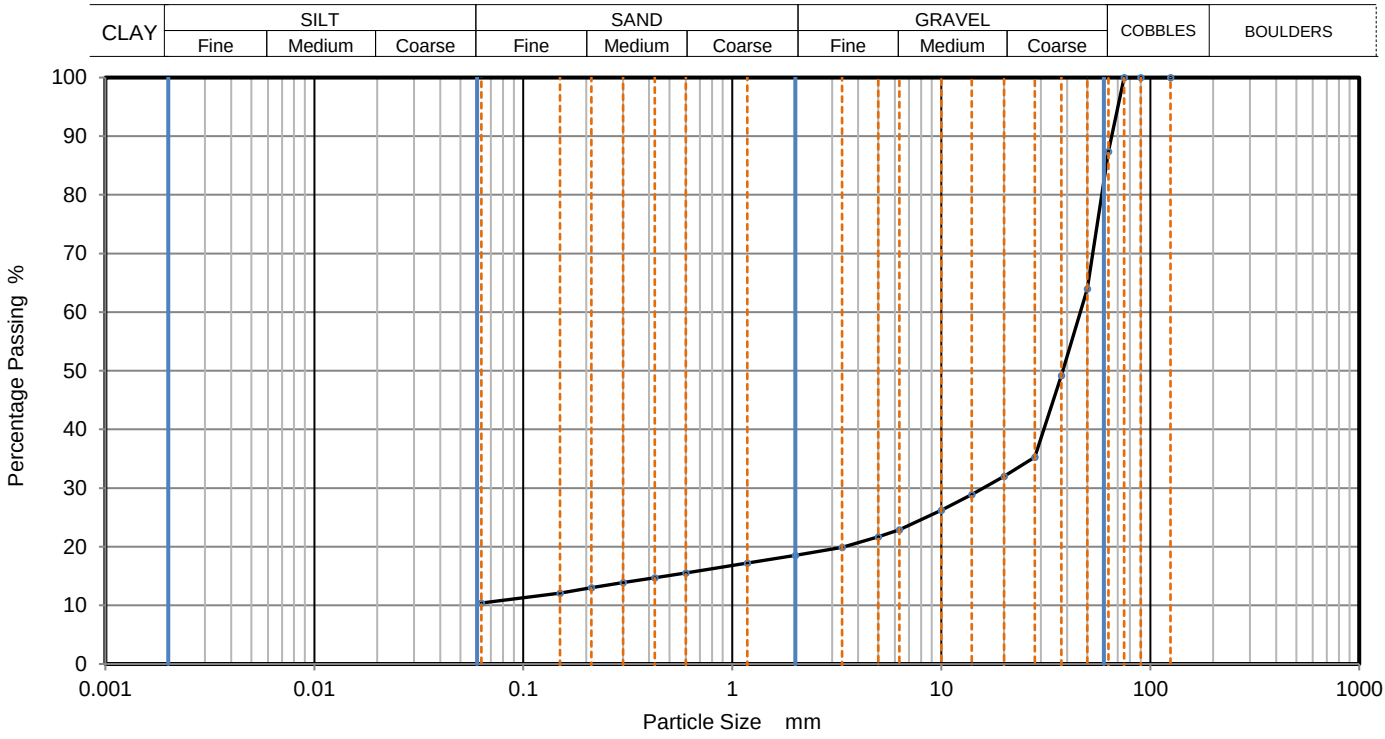
Preparation and testing in accordance with BS1377-2 :1990 unless noted below

Approved
Stephen.Watson

UKAS TESTING

10122

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION				Job Ref	20-0399D
					Borehole/Pit No.	R9CP02
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre				Sample No.	5
Soil Description	Brownish grey sandy clayey subangular fine to coarse GRAVEL.				Depth, m	0.50
Specimen Reference	6	Specimen Depth	0.5	m	Sample Type	B
Test Method	BS1377:Part 2:1990, clause 9.2				KeyLAB ID	Caus202010226



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	87		
50	64		
37.5	49		
28	35		
20	32		
14	29		
10	26		
6.3	23		
5	22		
3.35	20		
2	19		
1.18	17		
0.6	16		
0.425	15		
0.3	14		
0.212	13		
0.15	12		
0.063	10		

Dry Mass of sample, g	9739

Sample Proportions	% dry mass
Cobbles	12.6
Gravel	68.9
Sand	8.1
Fines <0.063mm	10.0

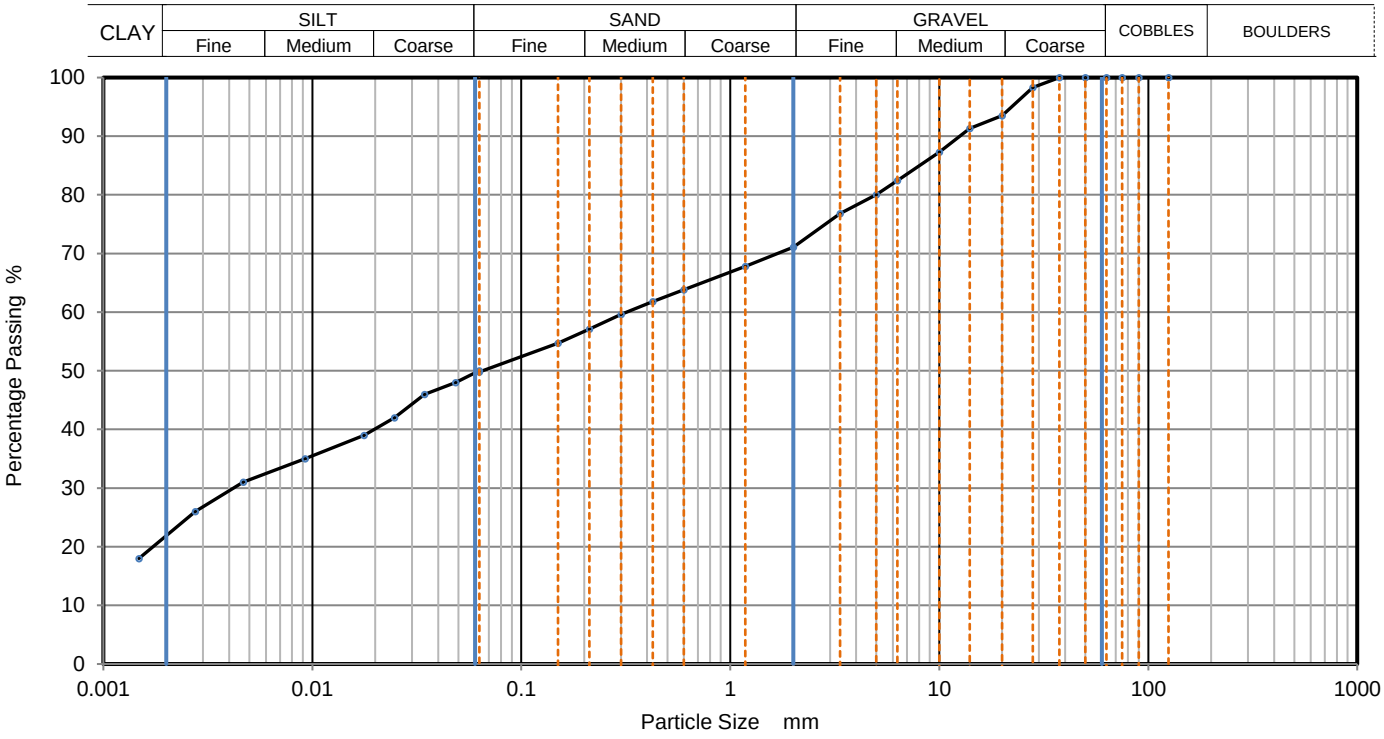
Grading Analysis		
D100	mm	
D60	mm	46.3
D30	mm	16
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

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

Approved
Stephen.Watson

CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**20-0399D**
				Borehole/Pit No.	R9CP03
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			Sample No.	17
Soil Description	Brownish grey sandy gravelly silty CLAY.			Depth, m	6.00
Specimen Reference	2	Specimen Depth	6 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2020102217



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	50
90	100	0.04843	48
75	100	0.03447	46
63	100	0.02470	42
50	100	0.01769	39
37.5	100	0.00925	35
28	98	0.00468	31
20	94	0.00275	26
14	91	0.00148	18
10	87		
6.3	82		
5	80		
3.35	77		
2	71		
1.18	68		
0.6	64	Particle density	(assumed)
0.425	62	2.65	Mg/m3
0.3	60		
0.212	57		
0.15	55		
0.063	50		

Dry Mass of sample, g	2470

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	28.9
Sand	21.3
Silt	27.8
Clay	22.0

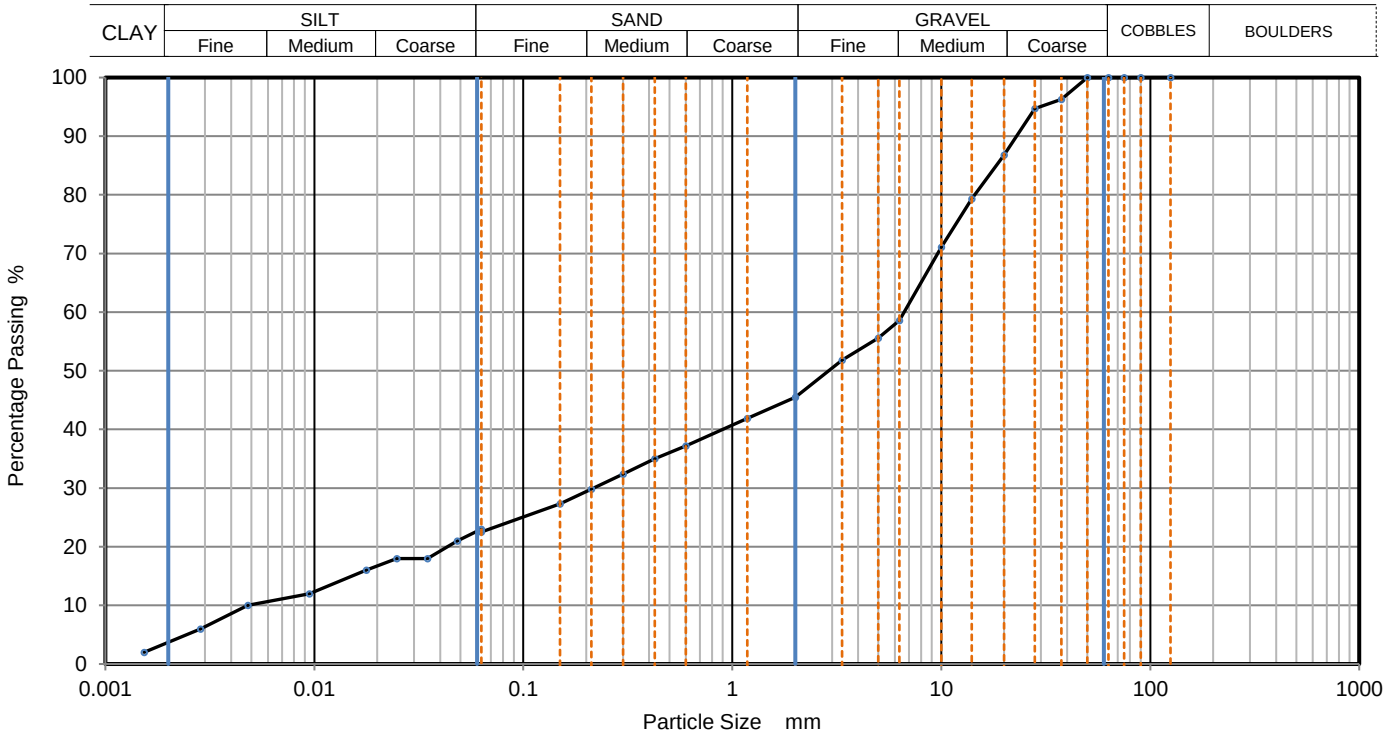
Grading Analysis		
D100	mm	
D60	mm	0.321
D30	mm	0.00411
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

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

Approved
Stephen.Watson

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION				Job Ref	20-0399D
					Borehole/Pit No.	R9CP05
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre				Sample No.	15
Soil Description	Brownish grey sandy gravelly silty CLAY.				Depth, m	5.00
Specimen Reference	2	Specimen Depth	5	m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5				KeyLAB ID	Caus2020102230



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	23
90	100	0.04830	21
75	100	0.03483	18
63	100	0.02479	18
50	100	0.01775	16
37.5	96	0.00945	12
28	95	0.00481	10
20	87	0.00285	6
14	79	0.00153	2
10	71		
6.3	59		
5	56		
3.35	52		
2	46		
1.18	42		
0.6	37	Particle density	(assumed)
0.425	35	2.65	Mg/m3
0.3	32		
0.212	30		
0.15	27		
0.063	23		

Dry Mass of sample, g	9698

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	54.5
Sand	23.0
Silt	18.7
Clay	3.8

Grading Analysis		
D100	mm	
D60	mm	6.63
D30	mm	0.219
D10	mm	0.00531
Uniformity Coefficient		1200
Curvature Coefficient		1.4

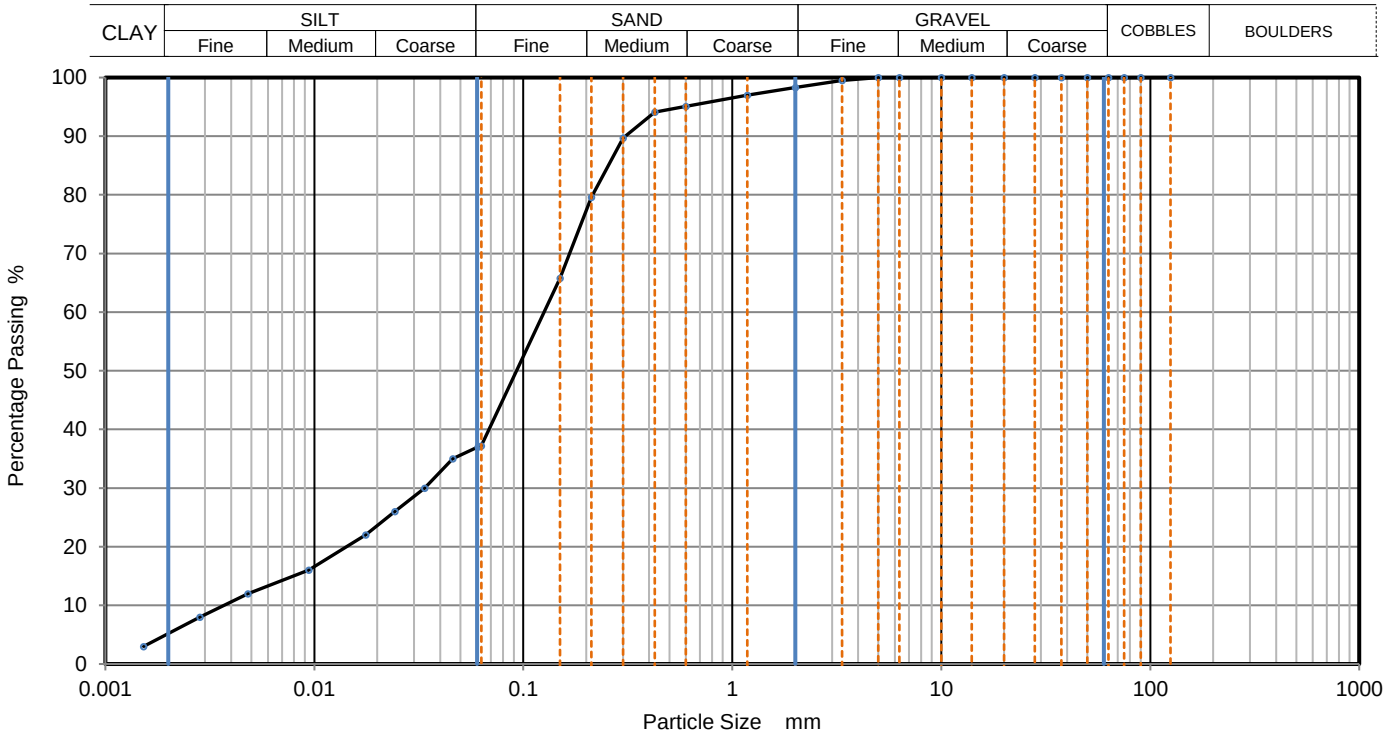
Remarks

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

Approved
Stephen.Watson

UKAS TESTING 10122

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION				Job Ref	20-0399D
					Borehole/Pit No.	R9CP05
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre				Sample No.	24
Soil Description	Brownish grey silty fine to coarse SAND.				Depth, m	6.00
Specimen Reference	2	Specimen Depth	6	m	Sample Type	D
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5				KeyLAB ID	Caus2020102231



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06080	37
90	100	0.04590	35
75	100	0.03364	30
63	100	0.02428	26
50	100	0.01762	22
37.5	100	0.00938	16
28	100	0.00480	12
20	100	0.00283	8
14	100	0.00152	3
10	100		
6.3	100		
5	100		
3.35	100		
2	98		
1.18	97		
0.6	95	Particle density	(assumed)
0.425	94	2.65	Mg/m3
0.3	90		
0.212	80		
0.15	66		
0.063	37		

Dry Mass of sample, g	215

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	1.7
Sand	61.1
Silt	32.0
Clay	5.2

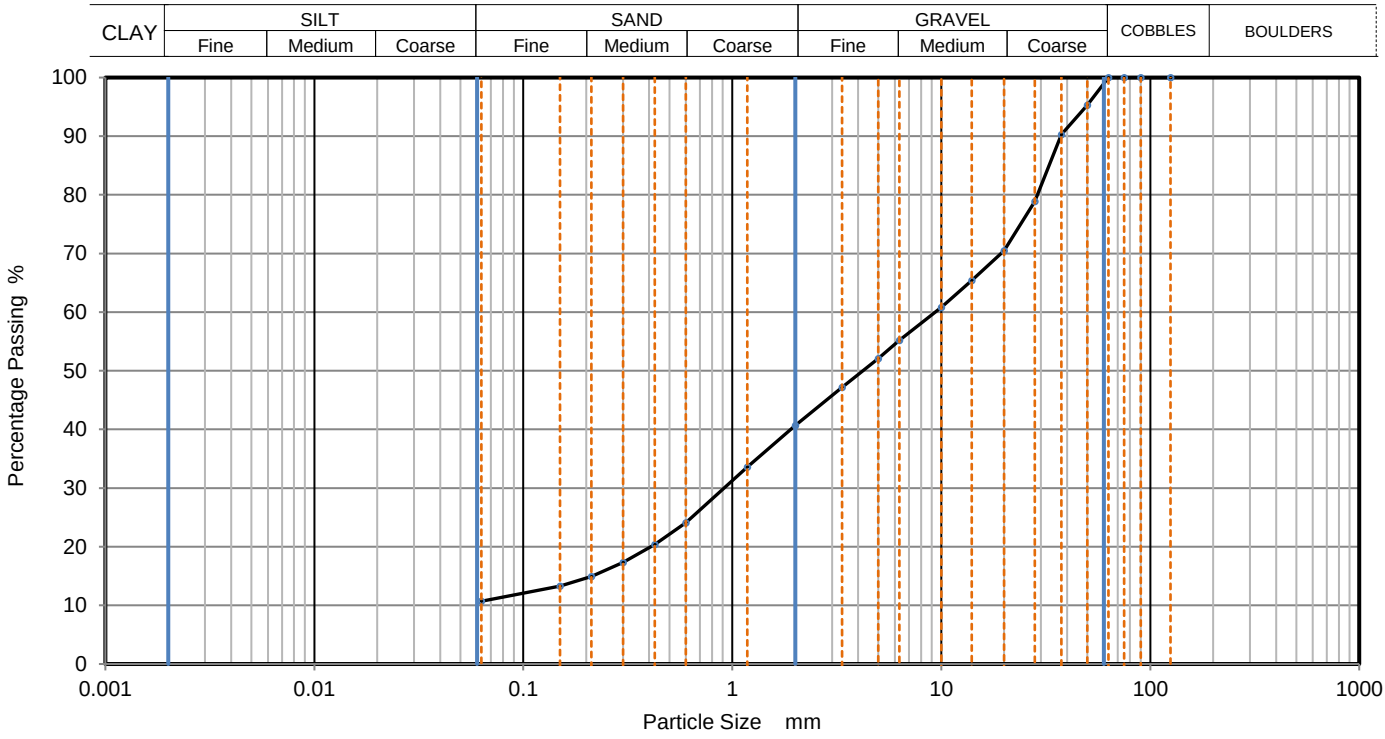
Grading Analysis		
D100	mm	
D60	mm	0.126
D30	mm	0.0345
D10	mm	0.00376
Uniformity Coefficient		33
Curvature Coefficient		2.5

Remarks

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

Approved
Stephen.Watson

CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**20-0399D**
				Borehole/Pit No.	R9CP06
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			Sample No.	5
Soil Description	Brownish grey sandy silty subangular fine to coarse GRAVEL.			Depth, m	5.00
Specimen Reference	2	Specimen Depth	5 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clause 9.2			KeyLAB ID	Caus202011032



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	95		
37.5	90		
28	79		
20	71		
14	65		
10	61		
6.3	55		
5	52		
3.35	47		
2	41		
1.18	34		
0.6	24		
0.425	20		
0.3	17		
0.212	15		
0.15	13		
0.063	11		

Dry Mass of sample, g	6254

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	59.3
Sand	30.0
Fines <0.063mm	11.0

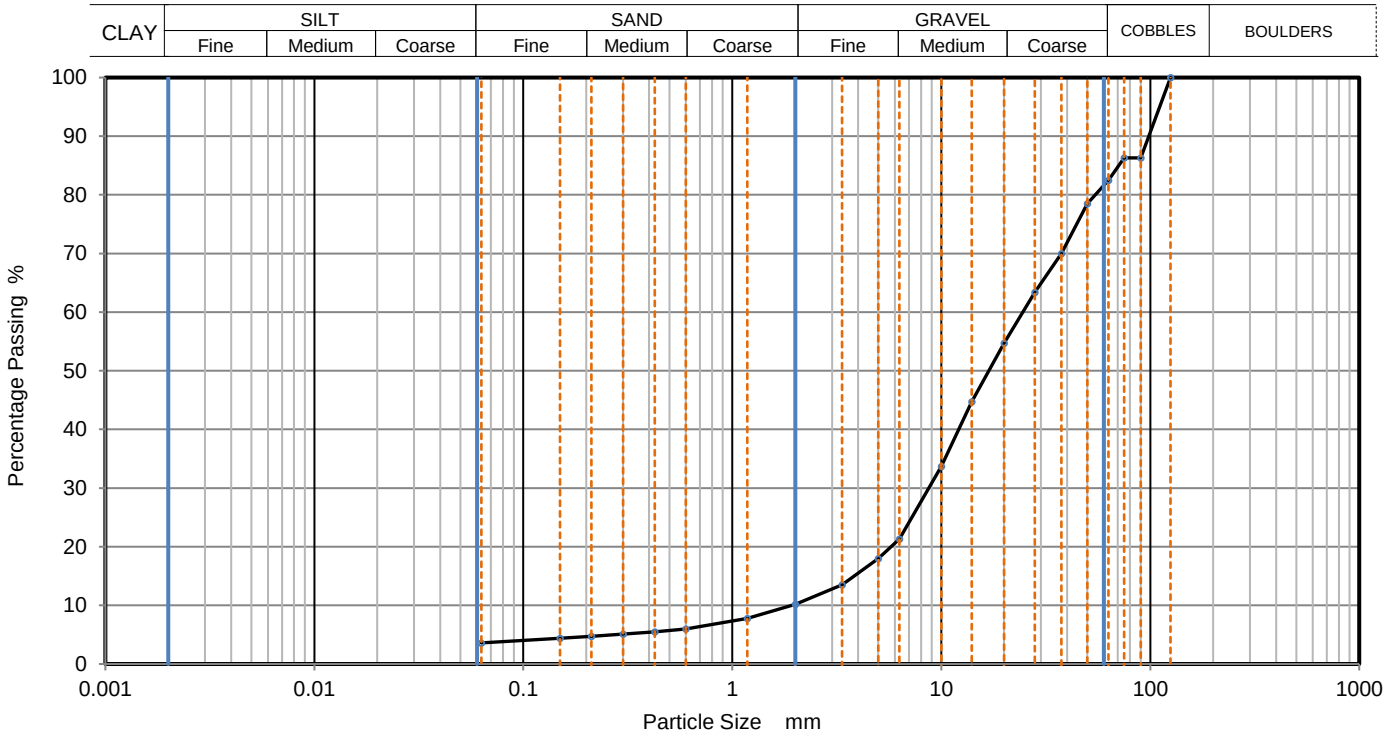
Grading Analysis		
D100	mm	
D60	mm	9.38
D30	mm	0.912
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

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

Approved
Stephen.Watson

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION				Job Ref	20-0399D
					Borehole/Pit No.	R9CP07
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre				Sample No.	5
Soil Description	Brownish grey sandy slightly clayey subangular fine to coarse GRAVEL.				Depth, m	0.50
Specimen Reference	2	Specimen Depth	0.5	m	Sample Type	B
Test Method	BS1377:Part 2:1990, clause 9.2				KeyLAB ID	Caus2020102233



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	86		
75	86		
63	83		
50	79		
37.5	70		
28	63		
20	55		
14	45		
10	34		
6.3	21		
5	18		
3.35	14		
2	10		
1.18	8		
0.6	6		
0.425	6		
0.3	5		
0.212	5		
0.15	4		
0.063	4		

Dry Mass of sample, g	16365

Sample Proportions	% dry mass
Cobbles	17.5
Gravel	72.3
Sand	6.6
Fines <0.063mm	4.0

Grading Analysis		
D100	mm	125
D60	mm	24.5
D30	mm	8.72
D10	mm	1.92
Uniformity Coefficient		13
Curvature Coefficient		1.6

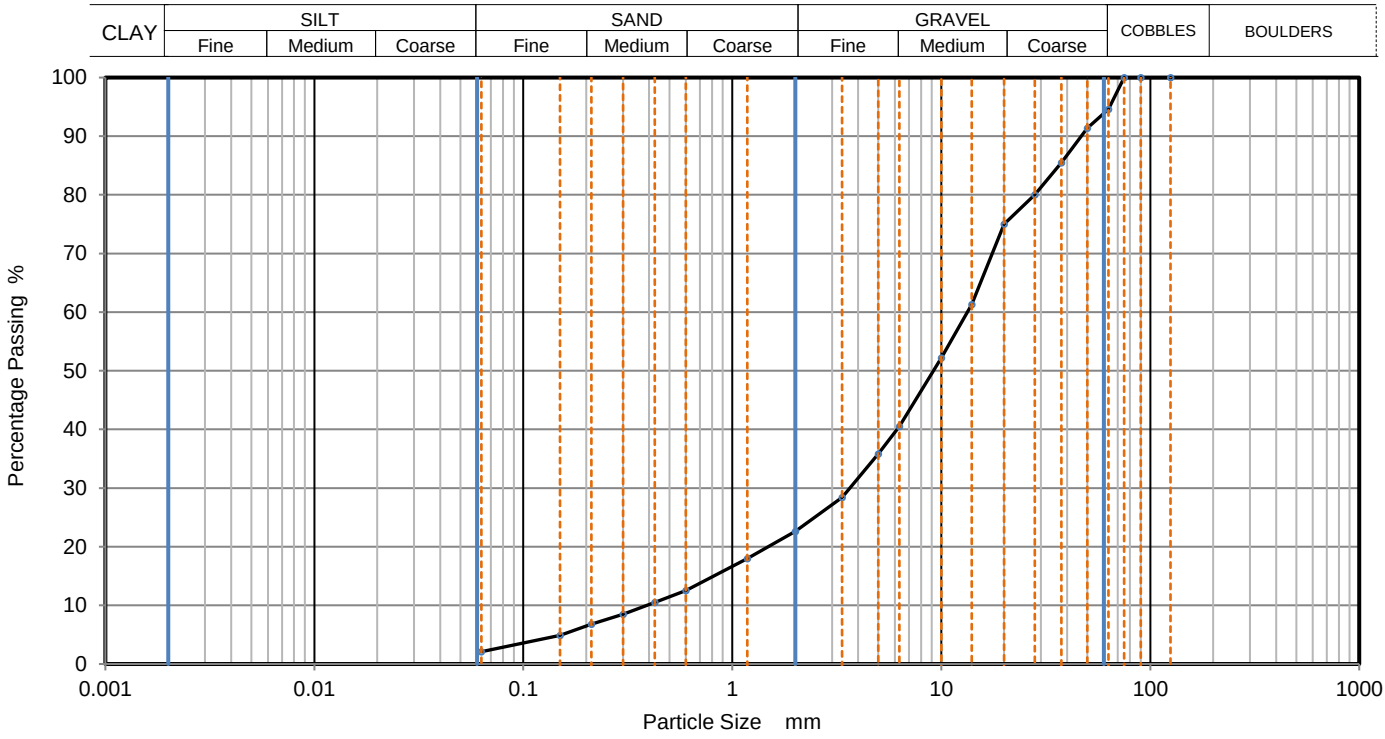
Remarks

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

Approved
Stephen.Watson

UKAS TESTING 10122

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION			Job Ref	20-0399D
				Borehole/Pit No.	R9CP07
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			Sample No.	8
Soil Description	Brownish grey sandy slightly silty subangular fine to coarse GRAVEL.			Depth, m	3.00
Specimen Reference	2	Specimen Depth	3 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clause 9.2			KeyLAB ID	Caus2020102234



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	95		
50	91		
37.5	86		
28	80		
20	75		
14	61		
10	52		
6.3	41		
5	36		
3.35	28		
2	23		
1.18	18		
0.6	13		
0.425	11		
0.3	9		
0.212	7		
0.15	5		
0.063	2		

Dry Mass of sample, g	17008

Sample Proportions	% dry mass
Cobbles	5.4
Gravel	72.0
Sand	20.5
Fines <0.063mm	2.0

Grading Analysis		
D100	mm	
D60	mm	13.3
D30	mm	3.66
D10	mm	0.39
Uniformity Coefficient		34
Curvature Coefficient		2.6

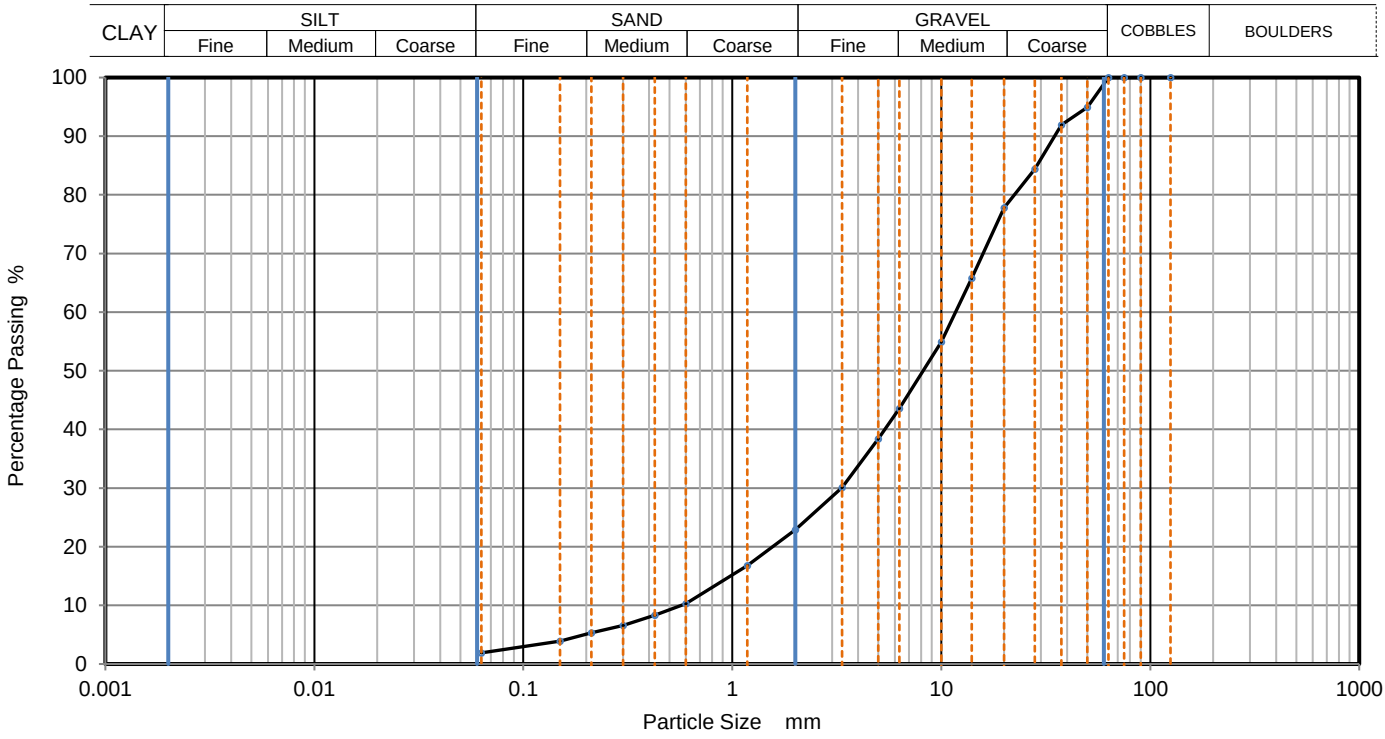
Remarks

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

Approved
Stephen.Watson

UKAS TESTING 10122

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION			Job Ref	20-0399D
				Borehole/Pit No.	R9CP07
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			Sample No.	11
Soil Description	Brownish grey sandy slightly silty subangular fine to coarse GRAVEL.			Depth, m	6.00
Specimen Reference	2	Specimen Depth	6 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clause 9.2			KeyLAB ID	Caus2020102235



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	95		
37.5	92		
28	84		
20	78		
14	66		
10	55		
6.3	44		
5	38		
3.35	30		
2	23		
1.18	17		
0.6	10		
0.425	8		
0.3	7		
0.212	5		
0.15	4		
0.063	2		

Dry Mass of sample, g	16691

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	77.1
Sand	21.0
Fines <0.063mm	2.0

Grading Analysis		
D100	mm	
D60	mm	11.7
D30	mm	3.33
D10	mm	0.569
Uniformity Coefficient		21
Curvature Coefficient		1.7

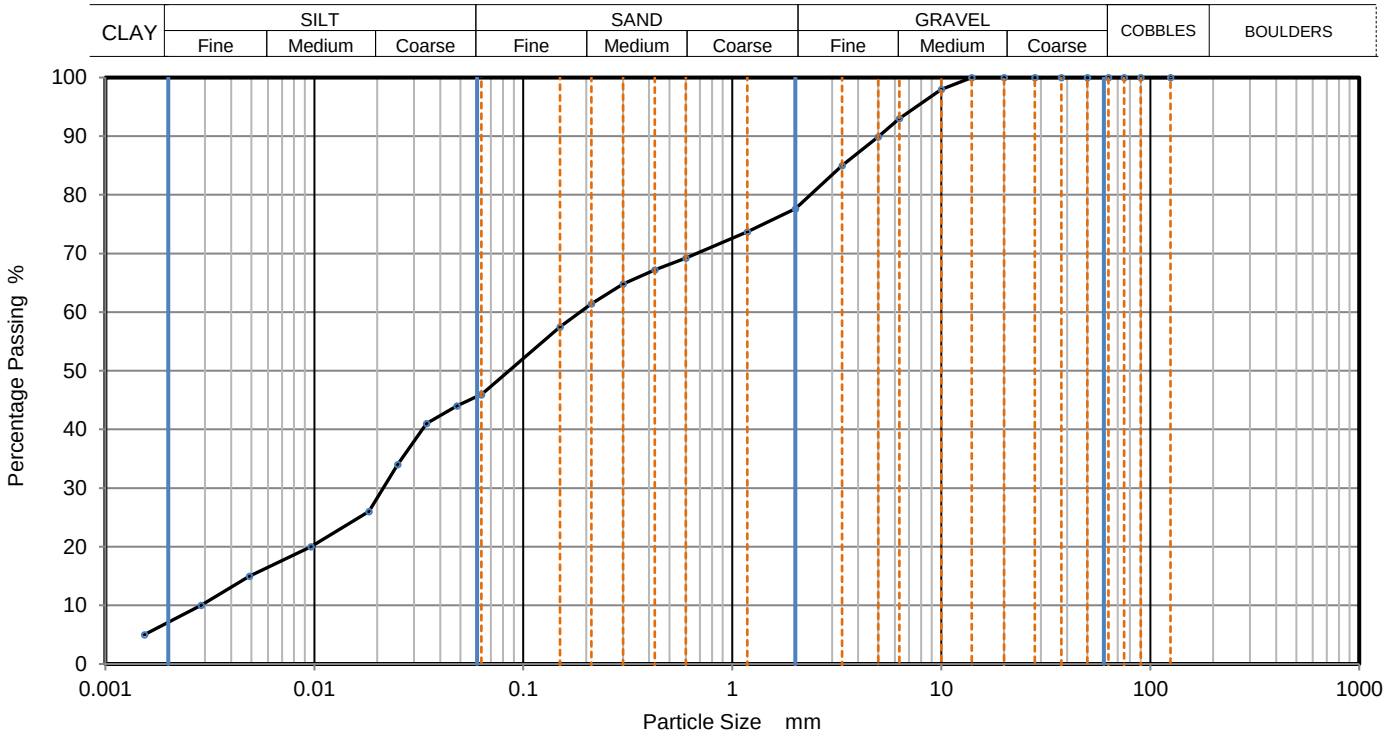
Remarks

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

Approved
Stephen.Watson

UKAS TESTING 10122

CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**20-0399D**
				Borehole/Pit No.	R9CP08
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			Sample No.	10
Soil Description	Brownish grey sandy slightly gravelly silty CLAY.			Depth, m	4.00
Specimen Reference	2	Specimen Depth	4 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2020102241



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	46
90	100	0.04810	44
75	100	0.03447	41
63	100	0.02501	34
50	100	0.01823	26
37.5	100	0.00964	20
28	100	0.00490	15
20	100	0.00287	10
14	100	0.00154	5
10	98		
6.3	93		
5	90		
3.35	85		
2	78		
1.18	74		
0.6	69	Particle density	(assumed)
0.425	67	2.65	Mg/m3
0.3	65		
0.212	61		
0.15	58		
0.063	46		

Dry Mass of sample, g: 529

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	22.4
Sand	31.7
Silt	38.9
Clay	7.0

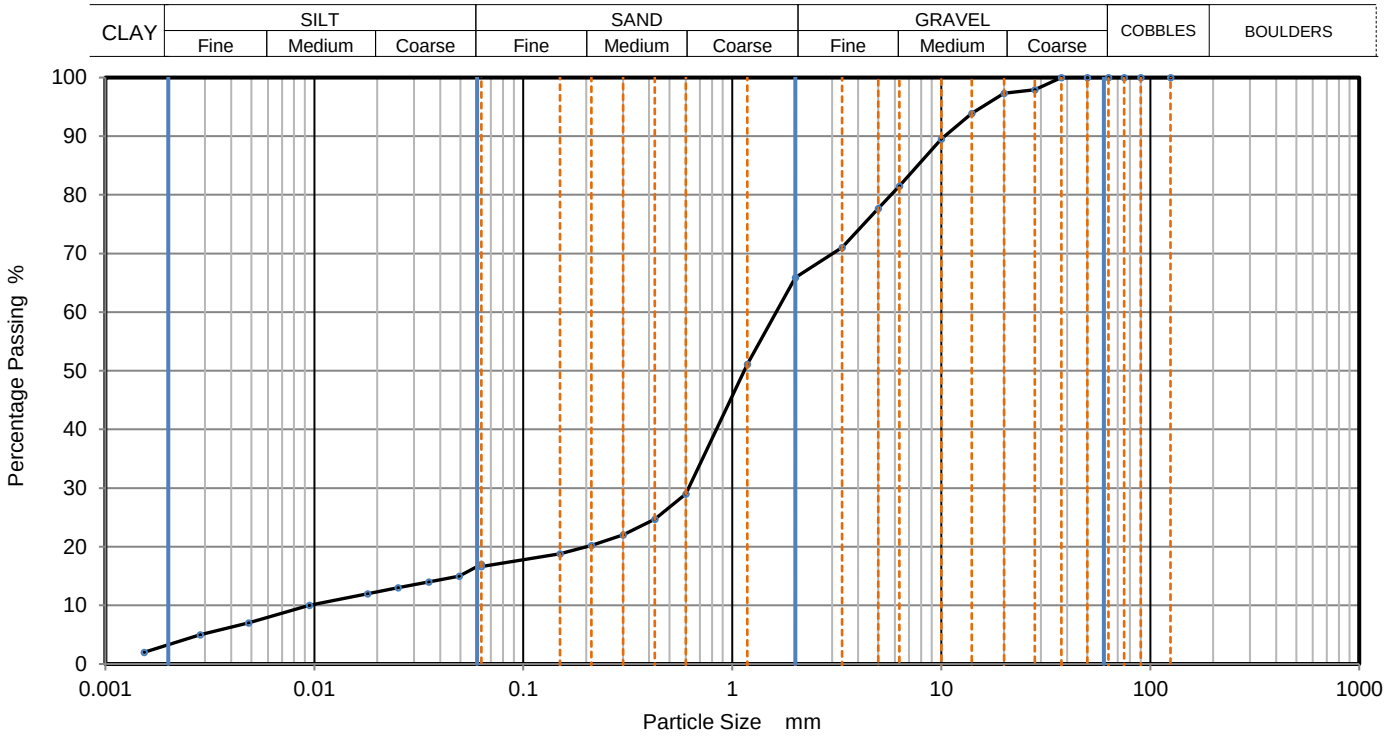
Grading Analysis		
D100	mm	
D60	mm	0.187
D30	mm	0.0211
D10	mm	0.00293
Uniformity Coefficient		64
Curvature Coefficient		0.81

Remarks

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

Approved
Stephen.Watson

CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**20-0399D**
				Borehole/Pit No.	R9CP09
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			Sample No.	7
Soil Description	Brownish grey gravelly silty fine to coarse SAND.			Depth, m	2.00
Specimen Reference	2	Specimen Depth	2 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2020102242



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	17
90	100	0.04926	15
75	100	0.03528	14
63	100	0.02511	13
50	100	0.01797	12
37.5	100	0.00945	10
28	98	0.00483	7
20	97	0.00284	5
14	94	0.00153	2
10	90		
6.3	82		
5	78		
3.35	71		
2	66		
1.18	51		
0.6	29	Particle density	(assumed)
0.425	25	2.65	Mg/m3
0.3	22		
0.212	20		
0.15	19		
0.063	17		

Dry Mass of sample, g	7046

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	34.1
Sand	49.3
Silt	13.2
Clay	3.4

Grading Analysis		
D100	mm	
D60	mm	1.62
D30	mm	0.619
D10	mm	0.00957
Uniformity Coefficient		170
Curvature Coefficient		25

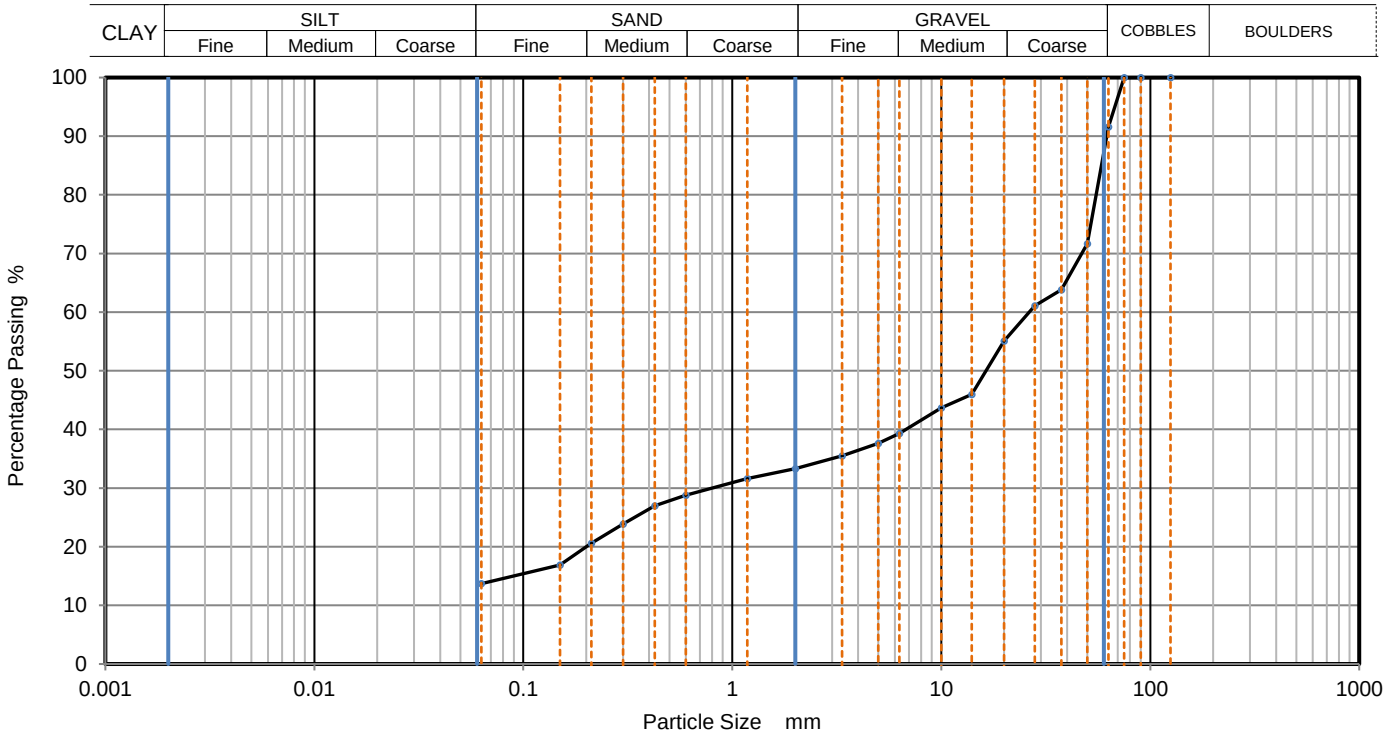
Remarks

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

Approved
Stephen.Watson

UKAS TESTING
10122

CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**20-0399D**
				Borehole/Pit No.	R9CP11
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			Sample No.	6
Soil Description	Brownish grey sandy silty subangular fine to coarse GRAVEL.			Depth, m	1.00
Specimen Reference	2	Specimen Depth	1 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clause 9.2			KeyLAB ID	Caus2020102246



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	92		
50	72		
37.5	64		
28	61		
20	55		
14	46		
10	44		
6.3	39		
5	38		
3.35	36		
2	33		
1.18	32		
0.6	29		
0.425	27		
0.3	24		
0.212	21		
0.15	17		
0.063	14		

Dry Mass of sample, g	12486

Sample Proportions	% dry mass
Cobbles	8.4
Gravel	58.3
Sand	19.6
Fines <0.063mm	14.0

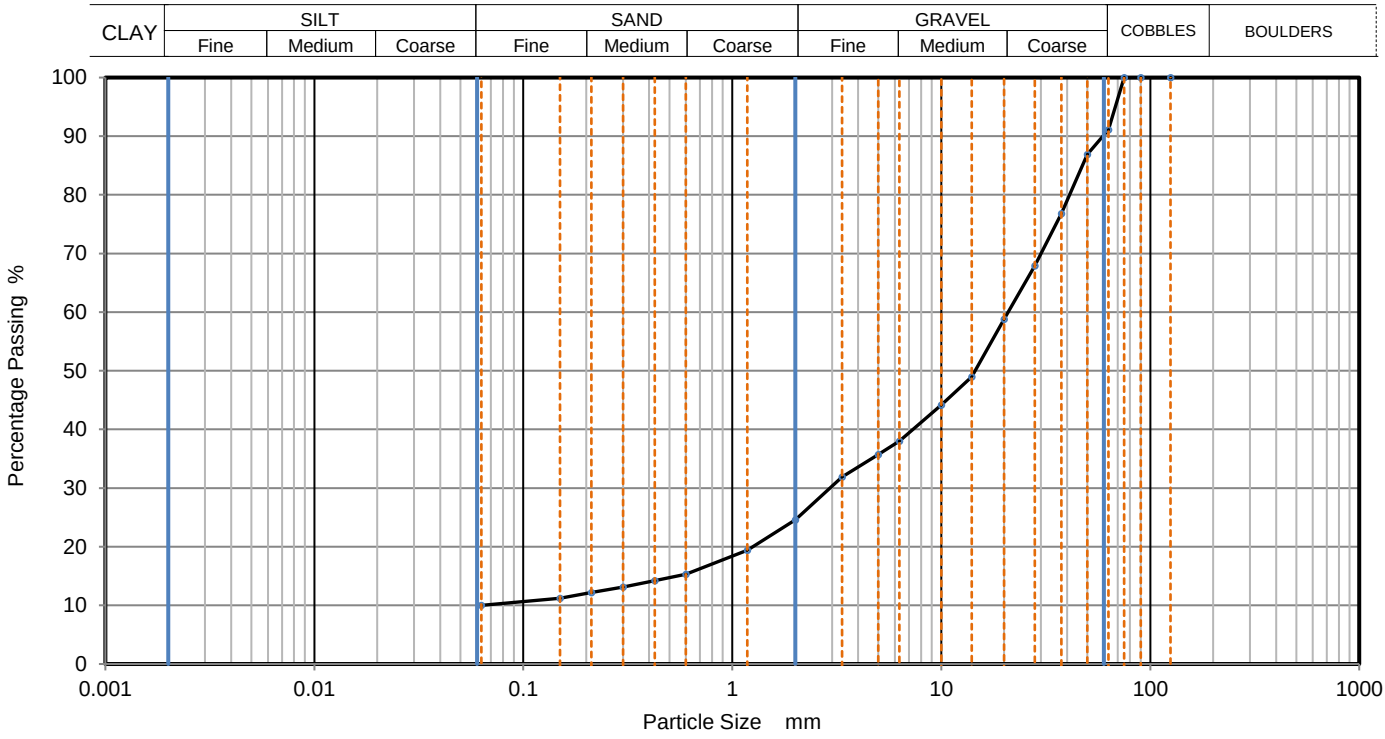
Grading Analysis		
D100	mm	
D60	mm	26.3
D30	mm	0.804
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

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

Approved
Stephen.Watson

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION				Job Ref	20-0399D
					Borehole/Pit No.	R9CP12
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre				Sample No.	8
Soil Description	Brownish grey sandy silty subangular fine to coarse GRAVEL.				Depth, m	3.00
Specimen Reference	2	Specimen Depth	3	m	Sample Type	B
Test Method	BS1377:Part 2:1990, clause 9.2				KeyLAB ID	Caus2020102248



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	91		
50	87		
37.5	77		
28	68		
20	59		
14	49		
10	44		
6.3	38		
5	36		
3.35	32		
2	25		
1.18	19		
0.6	15		
0.425	14		
0.3	13		
0.212	12		
0.15	11		
0.063	10		

Dry Mass of sample, g	16119

Sample Proportions	% dry mass
Cobbles	8.9
Gravel	66.5
Sand	14.6
Fines <0.063mm	10.0

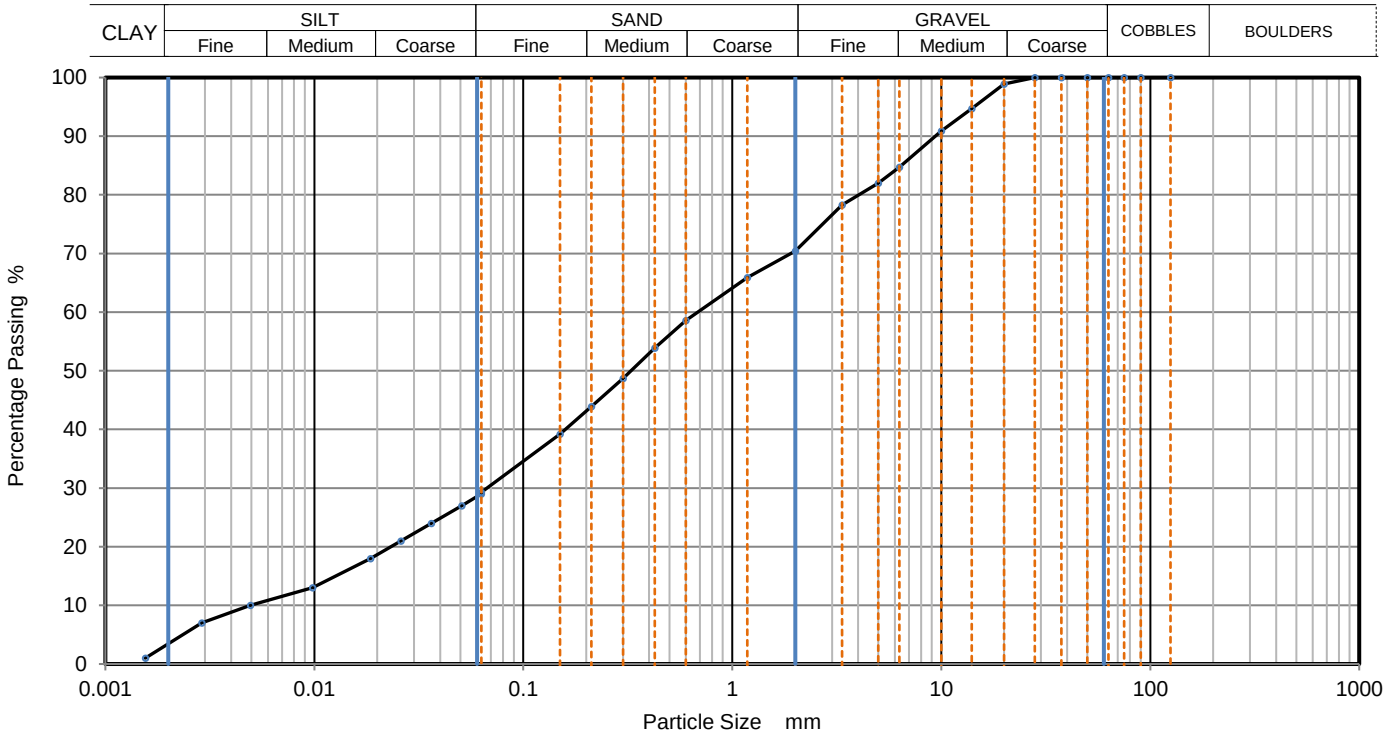
Grading Analysis		
D100	mm	
D60	mm	20.9
D30	mm	2.93
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

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

Approved
Stephen.Watson

CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**20-0399D**
				Borehole/Pit No.	R9CP13
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			Sample No.	7
Soil Description	Brownish grey sandy slightly gravelly SILT.			Depth, m	2.00
Specimen Reference	2	Specimen Depth	2 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2020102253



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	29
90	100	0.05065	27
75	100	0.03625	24
63	100	0.02594	21
50	100	0.01855	18
37.5	100	0.00980	13
28	100	0.00495	10
20	99	0.00289	7
14	95	0.00155	1
10	91		
6.3	85		
5	82		
3.35	78		
2	70		
1.18	66		
0.6	59	Particle density	(assumed)
0.425	54	2.65	Mg/m3
0.3	49		
0.212	44		
0.15	39		
0.063	29		

Dry Mass of sample, g	2361

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	29.6
Sand	41.1
Silt	25.6
Clay	3.7

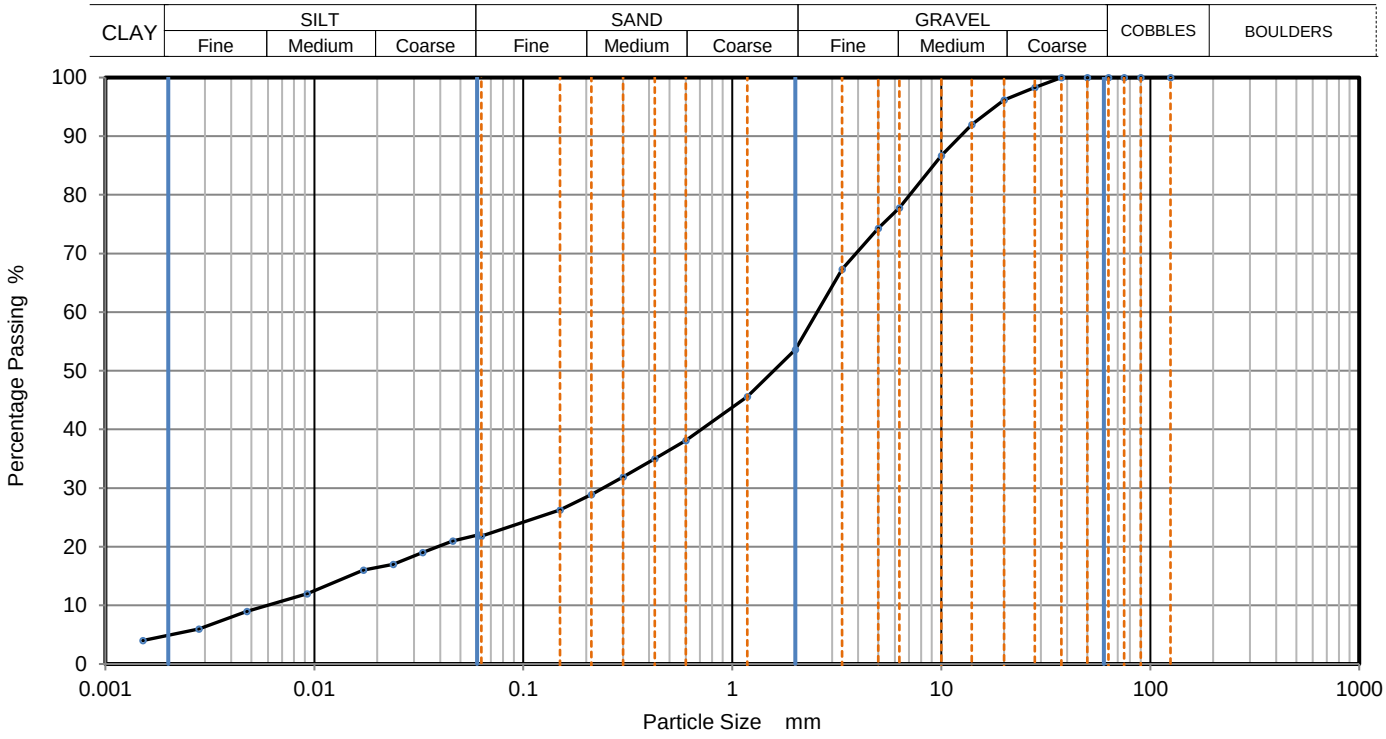
Grading Analysis		
D100	mm	
D60	mm	0.683
D30	mm	0.067
D10	mm	0.00524
Uniformity Coefficient		130
Curvature Coefficient		1.3

Remarks

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

Approved
Stephen.Watson

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION				Job Ref	20-0399D
					Borehole/Pit No.	R9CPGS01
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre				Sample No.	11
Soil Description	Brownish grey gravelly silty fine to coarse SAND.				Depth, m	3.00
Specimen Reference	6	Specimen Depth	3	m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5				KeyLAB ID	Caus2020102255



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06088	22
90	100	0.04596	21
75	100	0.03298	19
63	100	0.02382	17
50	100	0.01719	16
37.5	100	0.00922	12
28	98	0.00475	9
20	96	0.00281	6
14	92	0.00151	4
10	87		
6.3	78		
5	74		
3.35	67		
2	54		
1.18	46		
0.6	38	Particle density	(assumed)
0.425	35	2.65	Mg/m3
0.3	32		
0.212	29		
0.15	26		
0.063	22		

Dry Mass of sample, g	2472

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	46.4
Sand	31.8
Silt	16.9
Clay	4.9

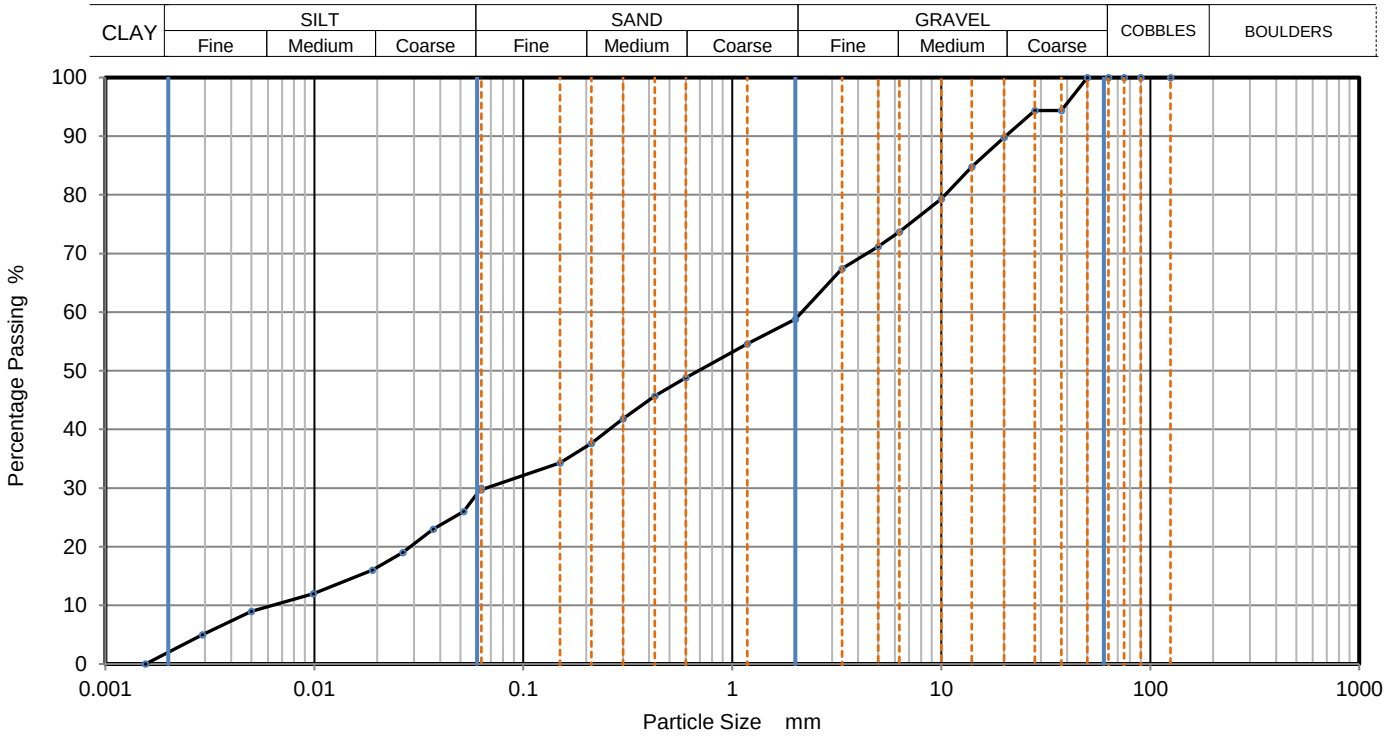
Grading Analysis		
D100	mm	
D60	mm	2.54
D30	mm	0.24
D10	mm	0.00624
Uniformity Coefficient		410
Curvature Coefficient		3.6

Remarks

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

Approved
Stephen.Watson

CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**20-0399D**
				Borehole/Pit No.	R9CPGS01
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			Sample No.	14
Soil Description	Brown sandy gravelly SILT.			Depth, m	6.00
Specimen Reference	2	Specimen Depth	6 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2020102257



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	30
90	100	0.05176	26
75	100	0.03702	23
63	100	0.02648	19
50	100	0.01893	16
37.5	94	0.00988	12
28	94	0.00499	9
20	90	0.00291	5
14	85	0.00156	0
10	79		
6.3	74		
5	71		
3.35	67		
2	59		
1.18	55		
0.6	49	Particle density	(assumed)
0.425	46	2.65	Mg/m3
0.3	42		
0.212	38		
0.15	34		
0.063	30		

Dry Mass of sample, g	2616

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	41.2
Sand	29.0
Silt	27.7
Clay	2.1

Grading Analysis		
D100	mm	
D60	mm	2.15
D30	mm	0.0663
D10	mm	0.00639
Uniformity Coefficient		340
Curvature Coefficient		0.32

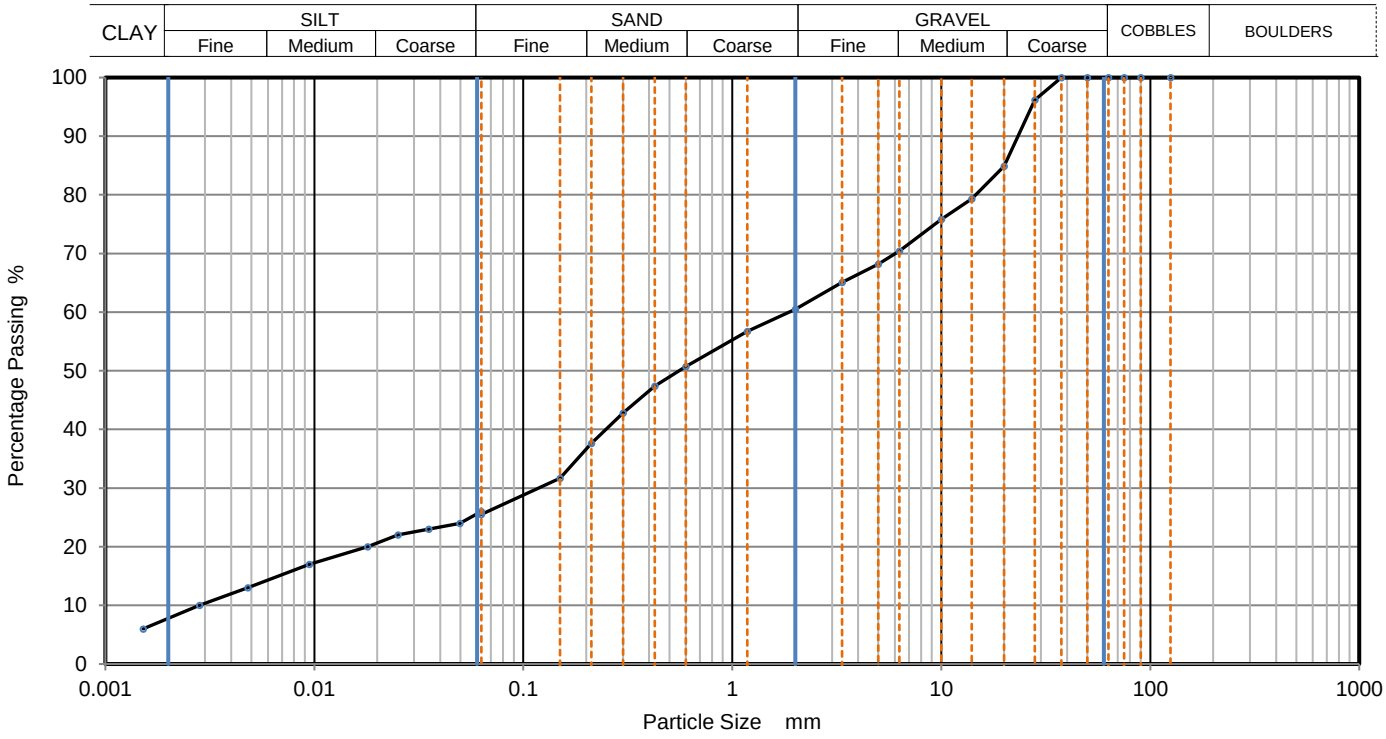
Remarks

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

Approved
Stephen.Watson

UKAS TESTING 10122

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION				Job Ref	20-0399D
					Borehole/Pit No.	R9CPGS02
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre				Sample No.	11
Soil Description	Greyish brown sandy gravelly silty CLAY.				Depth, m	4.00
Specimen Reference	6	Specimen Depth	4	m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5				KeyLAB ID	Caus2020102260



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	26
90	100	0.04958	24
75	100	0.03528	23
63	100	0.02511	22
50	100	0.01797	20
37.5	100	0.00945	17
28	96	0.00481	13
20	85	0.00282	10
14	79	0.00152	6
10	76		
6.3	70		
5	68		
3.35	65		
2	61		
1.18	57		
0.6	51	Particle density	(assumed)
0.425	47	2.65	Mg/m3
0.3	43		
0.212	38		
0.15	32		
0.063	26		

Dry Mass of sample, g	2058

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	39.5
Sand	35.0
Silt	18.0
Clay	7.5

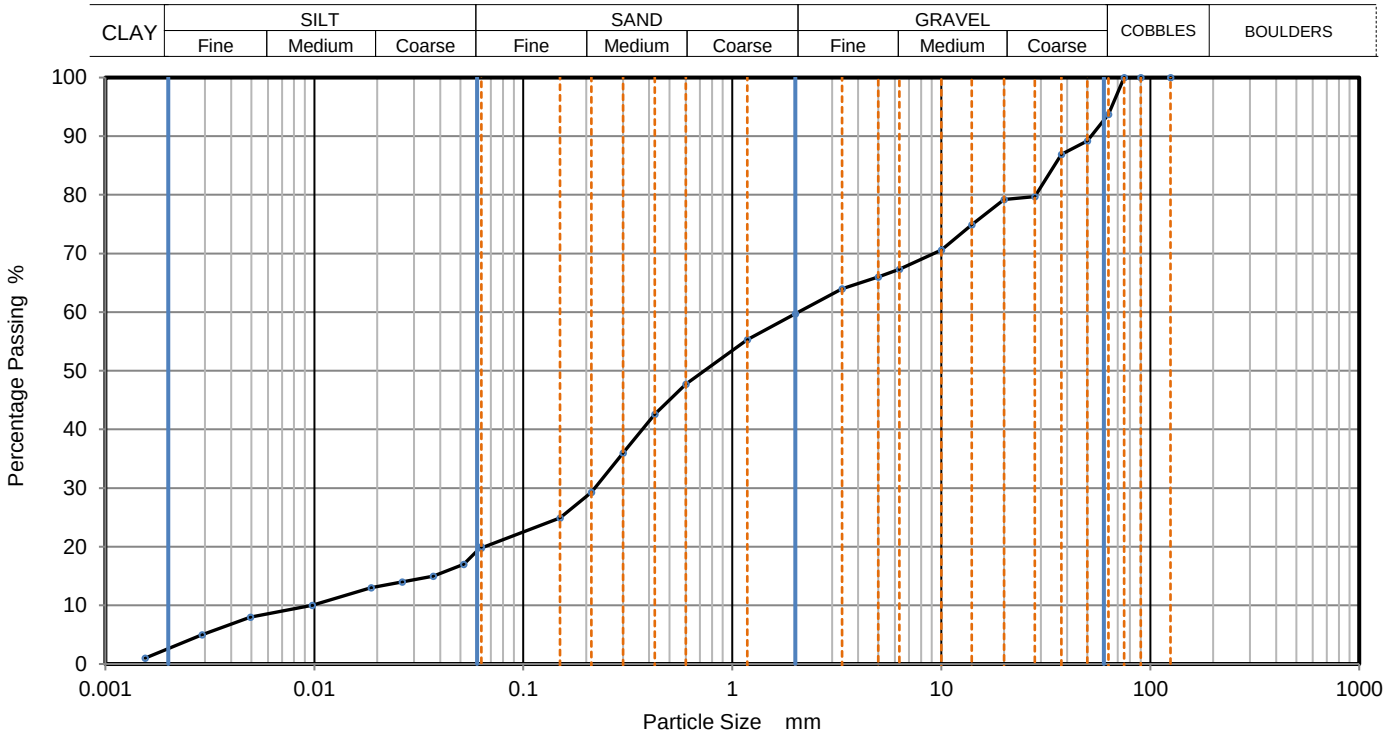
Grading Analysis		
D100	mm	
D60	mm	1.87
D30	mm	0.119
D10	mm	0.00283
Uniformity Coefficient		660
Curvature Coefficient		2.7

Remarks

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

Approved
Stephen.Watson

CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**20-0399D**
				Borehole/Pit No.	R9CPGS03
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			Sample No.	9
Soil Description	Greyish brown slightly sandy slightly gravelly silty CLAY.			Depth, m	3.00
Specimen Reference	6	Specimen Depth	3 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2020102264



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	20
90	100	0.05176	17
75	100	0.03702	15
63	94	0.02633	14
50	89	0.01872	13
37.5	87	0.00978	10
28	80	0.00494	8
20	79	0.00290	5
14	75	0.00155	1
10	71		
6.3	67		
5	66		
3.35	64		
2	60		
1.18	55		
0.6	48	Particle density	(assumed)
0.425	43	2.65	Mg/m3
0.3	36		
0.212	29		
0.15	25		
0.063	20		

Dry Mass of sample, g	13423

Sample Proportions	% dry mass
Cobbles	6.3
Gravel	34.0
Sand	40.0
Silt	17.1
Clay	2.6

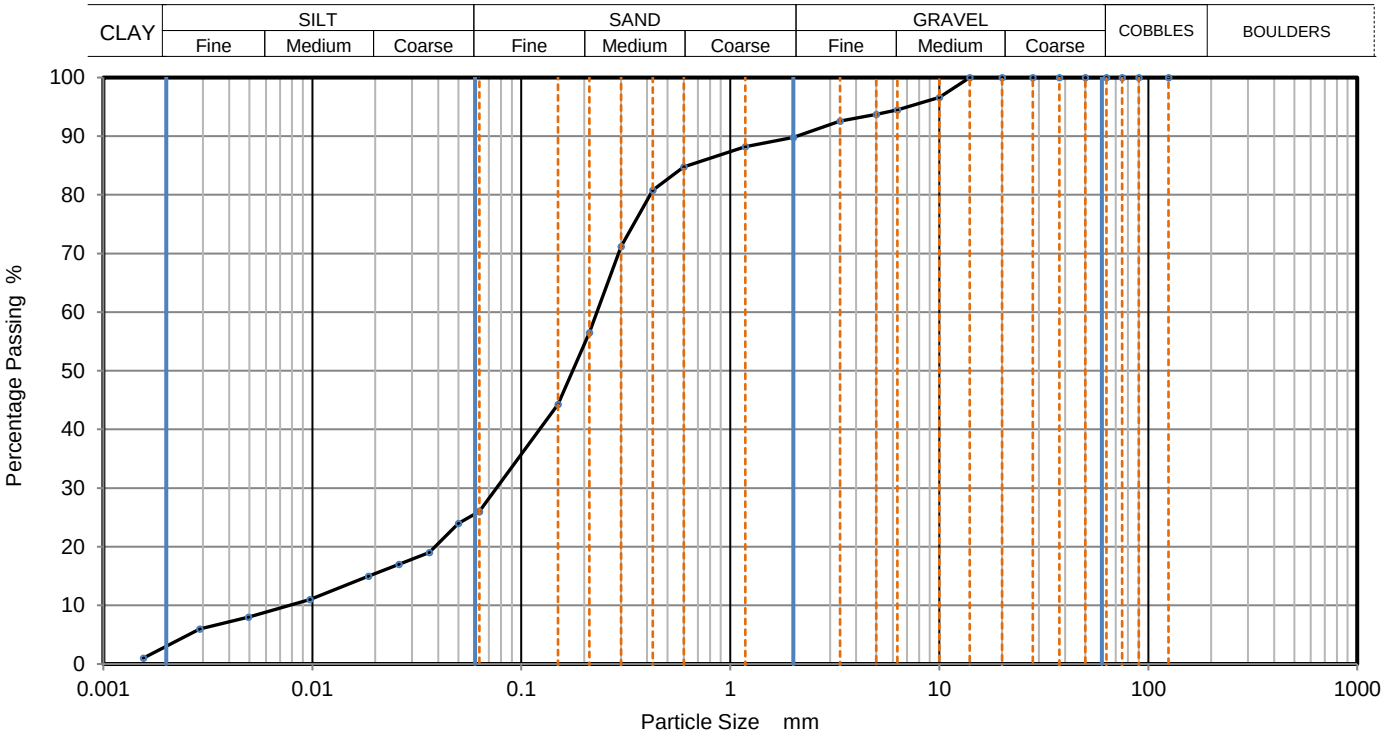
Grading Analysis		
D100	mm	
D60	mm	2.07
D30	mm	0.219
D10	mm	0.00849
Uniformity Coefficient		240
Curvature Coefficient		2.7

Remarks

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

Approved
Stephen.Watson

CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**20-0399D**
				Borehole/Pit No.	R9CPGS03
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			Sample No.	10
Soil Description	Greyish brown slightly gravelly silty fine to coarse SAND.			Depth, m	4.00
Specimen Reference	2	Specimen Depth	4 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2020102266



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	26
90	100	0.05002	24
75	100	0.03625	19
63	100	0.02594	17
50	100	0.01855	15
37.5	100	0.00974	11
28	100	0.00495	8
20	100	0.00289	6
14	100	0.00155	1
10	97		
6.3	95		
5	94		
3.35	93		
2	90		
1.18	88		
0.6	85	Particle density	(assumed)
0.425	81	2.65	Mg/m3
0.3	71		
0.212	57		
0.15	44		
0.063	26		

Dry Mass of sample, g	505

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	10.2
Sand	63.7
Silt	23.1
Clay	3.0

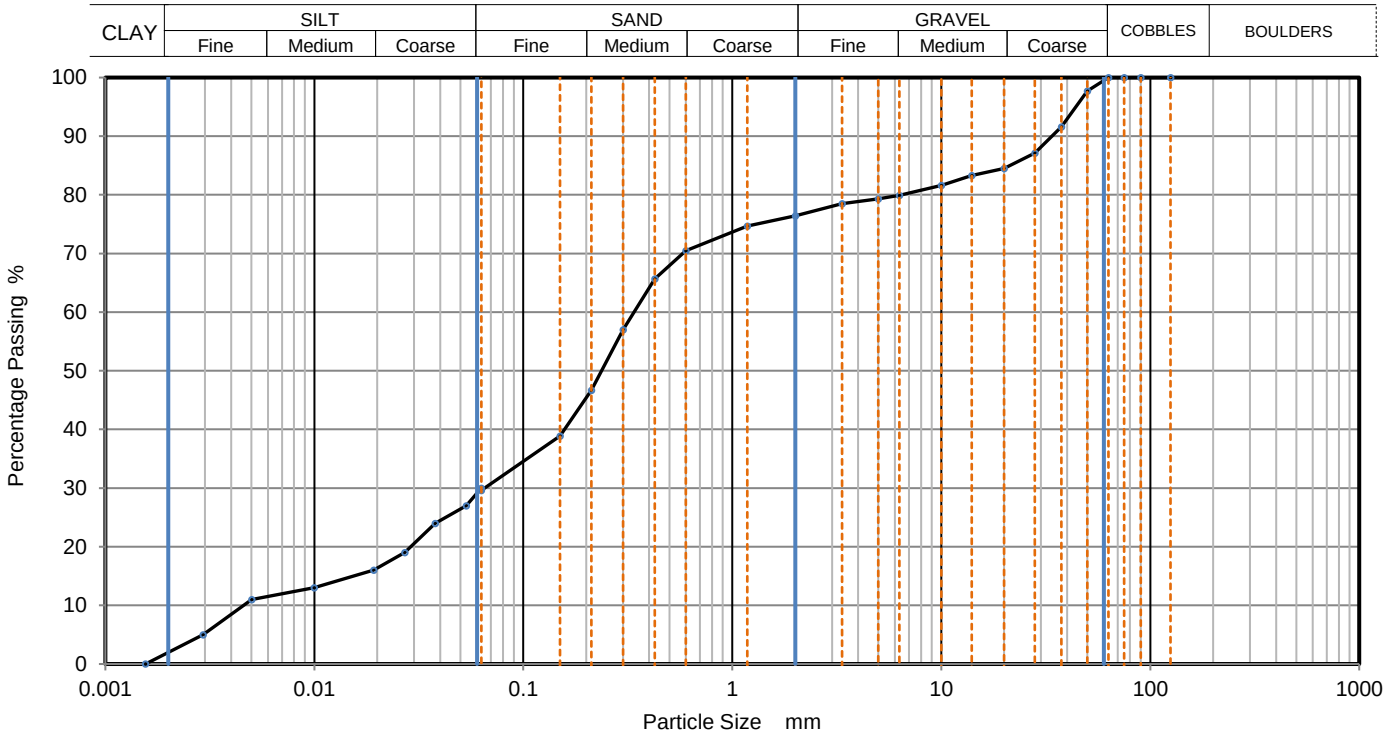
Grading Analysis		
D100	mm	
D60	mm	0.23
D30	mm	0.076
D10	mm	0.00751
Uniformity Coefficient		31
Curvature Coefficient		3.3

Remarks

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

Approved
Stephen.Watson

CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**20-0399D**
				Borehole/Pit No.	R9CPGS04
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			Sample No.	10
Soil Description	Greyish brown sandy gravelly silty CLAY.			Depth, m	4.00
Specimen Reference	2	Specimen Depth	4 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2020102268



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	30
90	100	0.05325	27
75	100	0.03787	24
63	100	0.02707	19
50	98	0.01924	16
37.5	92	0.00999	13
28	87	0.00502	11
20	85	0.00293	5
14	83	0.00156	0
10	82		
6.3	80		
5	79		
3.35	79		
2	76		
1.18	75		
0.6	71	Particle density	(assumed)
0.425	66	2.65	Mg/m3
0.3	57		
0.212	47		
0.15	39		
0.063	30		

Dry Mass of sample, g	14527

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	23.6
Sand	46.8
Silt	27.5
Clay	2.1

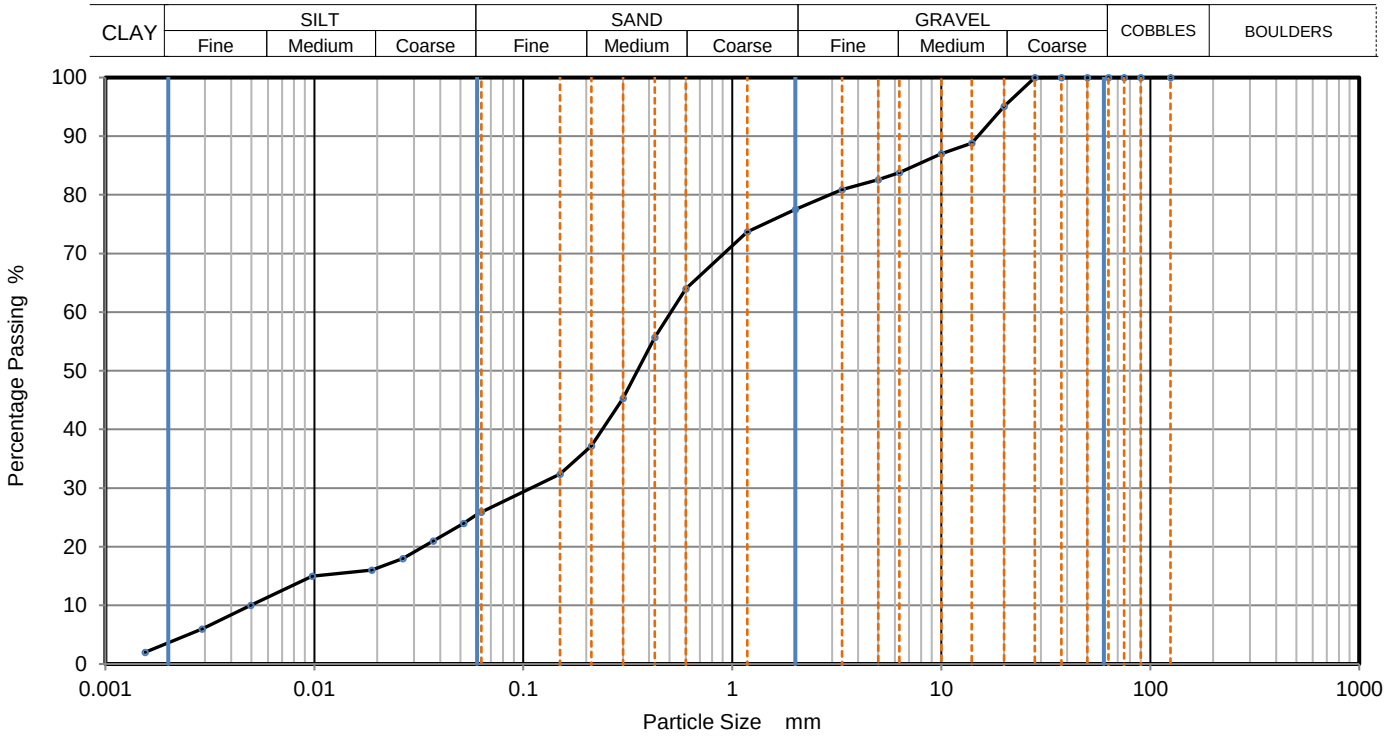
Grading Analysis		
D100	mm	
D60	mm	0.338
D30	mm	0.0654
D10	mm	0.00465
Uniformity Coefficient		73
Curvature Coefficient		2.7

Remarks

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

Approved
Stephen.Watson

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION			Job Ref	20-0399D
				Borehole/Pit No.	R9CPGS04
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			Sample No.	12
Soil Description	Greyish brown sandy gravelly silty CLAY.			Depth, m	6.00
Specimen Reference	2	Specimen Depth	6 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2020102269



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	26
90	100	0.05176	24
75	100	0.03702	21
63	100	0.02648	18
50	100	0.01883	16
37.5	100	0.00978	15
28	100	0.00497	10
20	95	0.00290	6
14	89	0.00155	2
10	87		
6.3	84		
5	83		
3.35	81		
2	78		
1.18	74		
0.6	64	Particle density	(assumed)
0.425	56	2.65	Mg/m3
0.3	45		
0.212	37		
0.15	32		
0.063	26		

Dry Mass of sample, g	3044

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	22.5
Sand	51.6
Silt	22.3
Clay	3.6

Grading Analysis		
D100	mm	
D60	mm	0.508
D30	mm	0.109
D10	mm	0.00517
Uniformity Coefficient		98
Curvature Coefficient		4.5

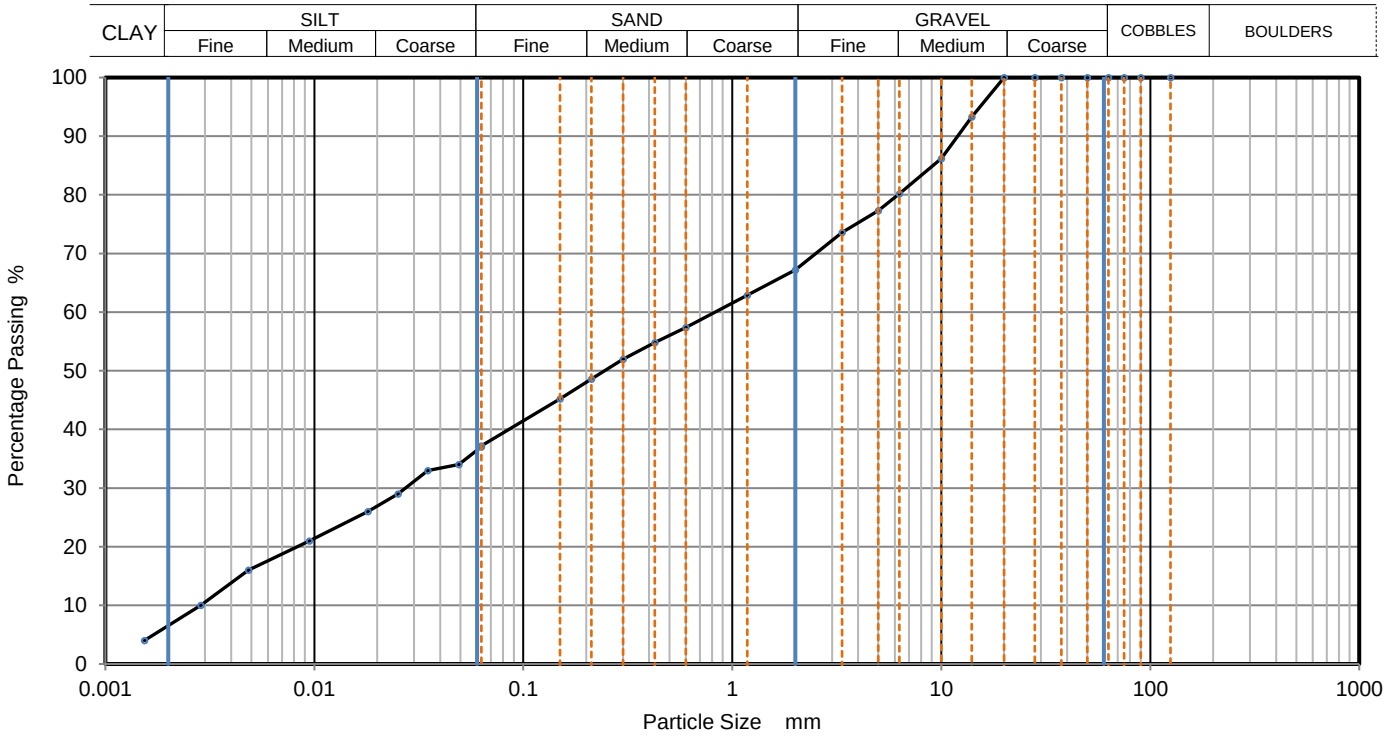
Remarks

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

Approved
Stephen.Watson

UKAS TESTING
10122

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION			Job Ref	20-0399D
				Borehole/Pit No.	R9TP05
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			Sample No.	2
Soil Description	Brown sandy gravelly silty CLAY.			Depth, m	1.00
Specimen Reference	6	Specimen Depth	1 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2020102273



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	37
90	100	0.04907	34
75	100	0.03492	33
63	100	0.02517	29
50	100	0.01802	26
37.5	100	0.00947	21
28	100	0.00485	16
20	100	0.00286	10
14	93	0.00154	4
10	86		
6.3	80		
5	77		
3.35	74		
2	67		
1.18	63		
0.6	57	Particle density	(assumed)
0.425	55	2.65	Mg/m3
0.3	52		
0.212	49		
0.15	45		
0.063	37		

Dry Mass of sample, g	512

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	32.8
Sand	30.0
Silt	30.5
Clay	6.7

Grading Analysis		
D100	mm	
D60	mm	0.824
D30	mm	0.028
D10	mm	0.00285
Uniformity Coefficient		290
Curvature Coefficient		0.33

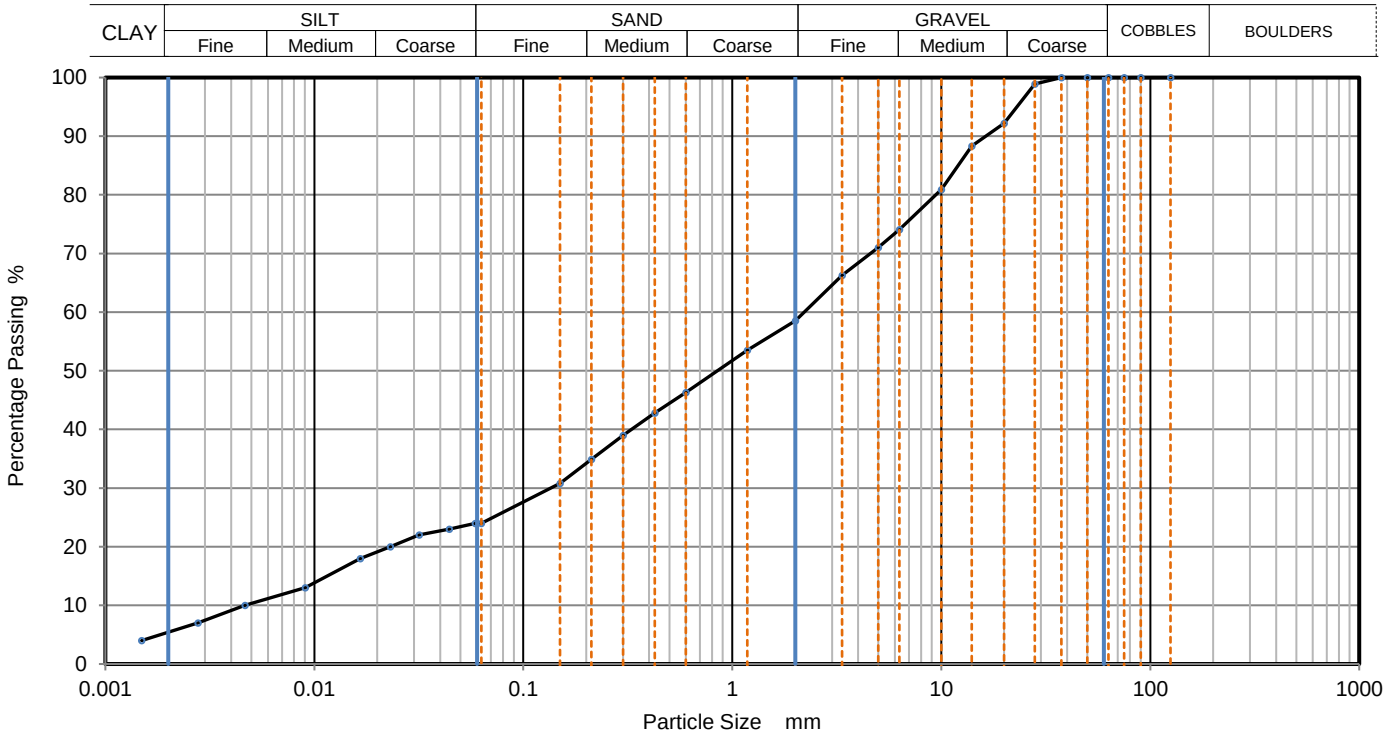
Remarks

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

Approved
Stephen.Watson

UKAS TESTING
10122

CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**20-0399D**
				Borehole/Pit No.	R9TP07
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			Sample No.	1
Soil Description	Brown gravelly clayey fine to coarse SAND.			Depth, m	0.50
Specimen Reference	6	Specimen Depth	0.5 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus202011033



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.05889	24
90	100	0.04415	23
75	100	0.03172	22
63	100	0.02312	20
50	100	0.01659	18
37.5	100	0.00904	13
28	99	0.00466	10
20	92	0.00277	7
14	88	0.00149	4
10	81		
6.3	74		
5	71		
3.35	66		
2	59		
1.18	54		
0.6	46	Particle density	(assumed)
0.425	43	2.65	Mg/m3
0.3	39		
0.212	35		
0.15	31		
0.063	24		

Dry Mass of sample, g	2464

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	41.5
Sand	34.5
Silt	18.4
Clay	5.6

Grading Analysis		
D100	mm	
D60	mm	2.21
D30	mm	0.135
D10	mm	0.00458
Uniformity Coefficient		480
Curvature Coefficient		1.8

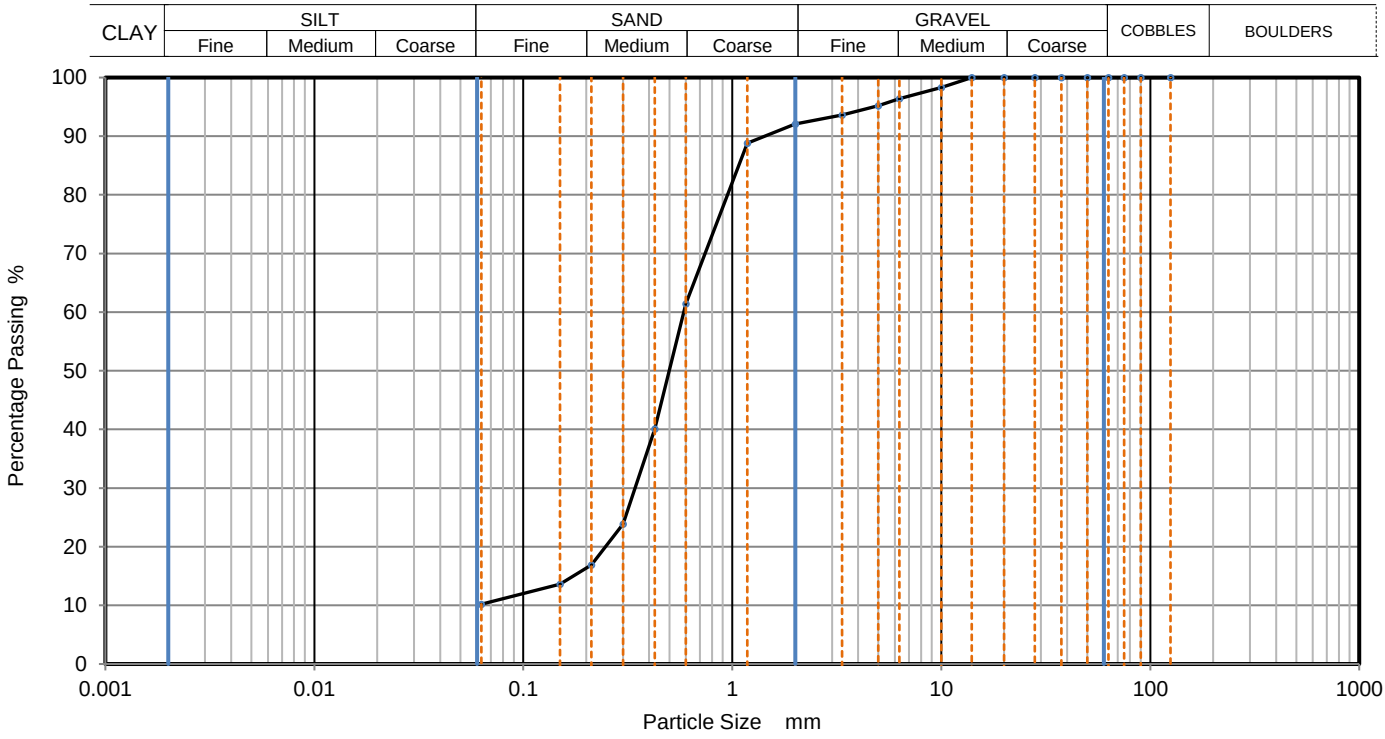
Remarks

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

Approved
Stephen.Watson

UKAS TESTING 10122

CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**20-0399D**
				Borehole/Pit No.	R9TP07
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			Sample No.	3
Soil Description	Brown gravelly slightly clayey fine to coarse SAND.			Depth, m	2.00
Specimen Reference	2	Specimen Depth	2 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clause 9.2			KeyLAB ID	Caus202011034



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	98		
6.3	96		
5	95		
3.35	94		
2	92		
1.18	89		
0.6	61		
0.425	40		
0.3	24		
0.212	17		
0.15	14		
0.063	10		

Dry Mass of sample, g	530

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	7.9
Sand	81.9
Fines <0.063mm	10.0

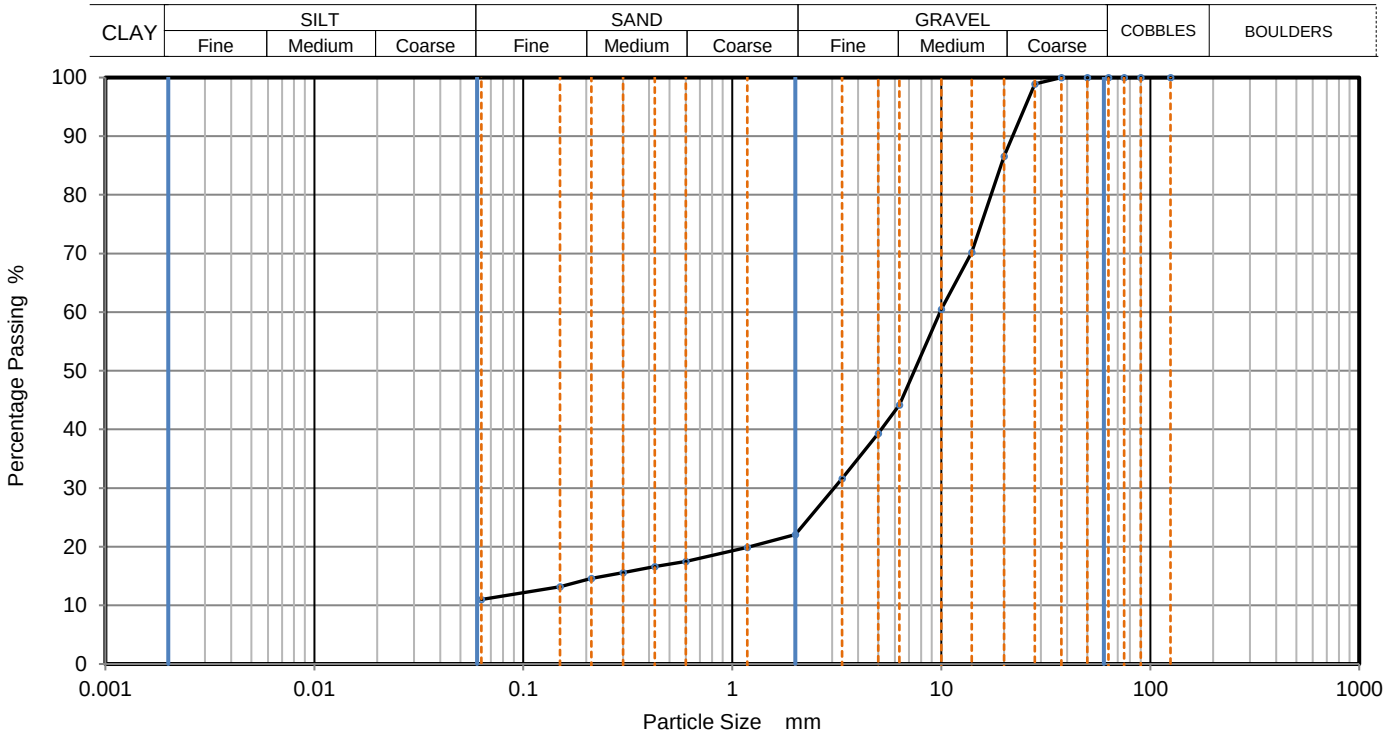
Grading Analysis		
D100	mm	
D60	mm	0.587
D30	mm	0.342
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

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

Approved
Stephen.Watson

CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**20-0399D**
				Borehole/Pit No.	R9TP08
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			Sample No.	2
Soil Description	Brown sandy slightly silty subangular fine to coarse GRAVEL.			Depth, m	1.00
Specimen Reference	4	Specimen Depth	1 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clause 9.2			KeyLAB ID	Caus2020102275



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	99		
20	87		
14	70		
10	61		
6.3	44		
5	39		
3.35	32		
2	22		
1.18	20		
0.6	18		
0.425	17		
0.3	16		
0.212	15		
0.15	13		
0.063	11		

Dry Mass of sample, g	2621

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	77.9
Sand	11.1
Fines <0.063mm	11.0

Grading Analysis		
D100	mm	
D60	mm	9.87
D30	mm	3.07
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

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

Approved
Stephen.Watson

UKAS TESTING
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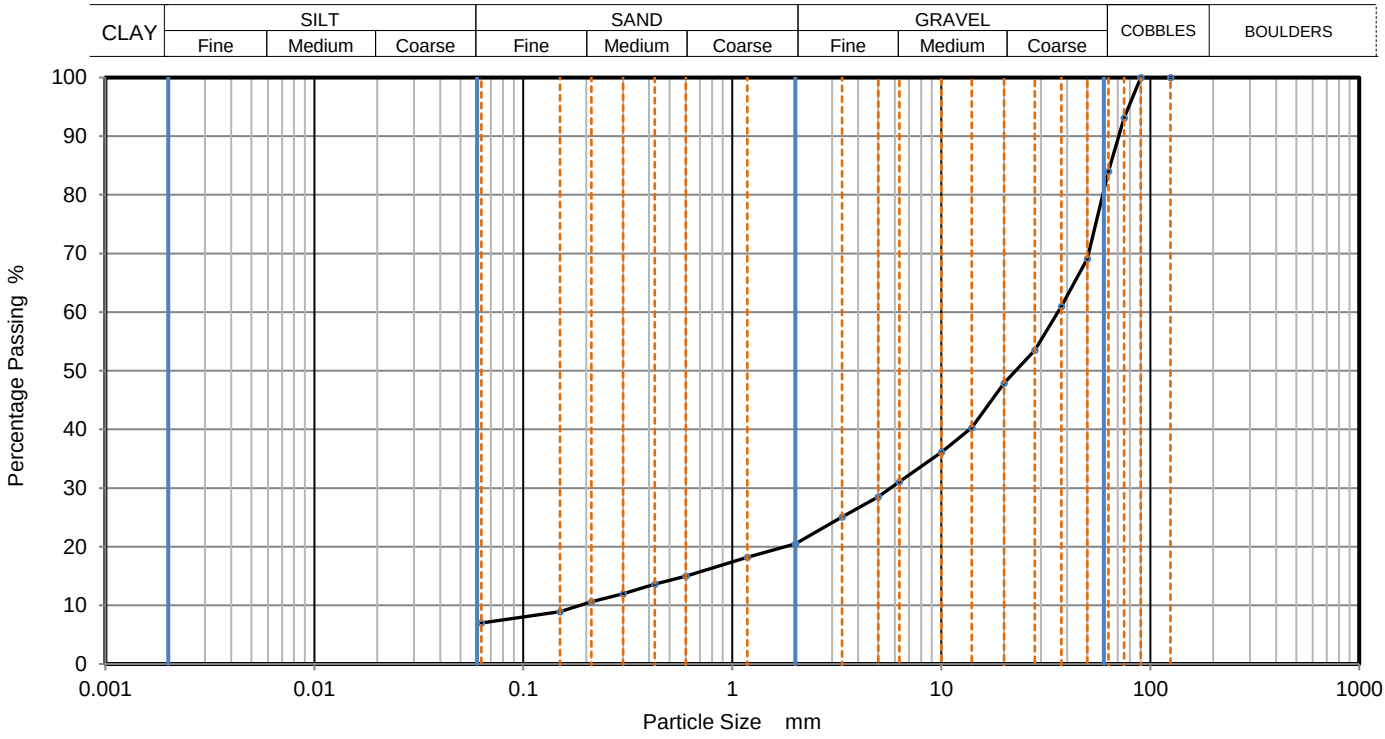
CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION				Job Ref	20-0399D
					Borehole/Pit No.	R9TP09
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre				Sample No.	6
Soil Description	Brown sandy slightly silty subangular fine to coarse GRAVEL.				Depth, m	2.50
Specimen Reference	2	Specimen Depth	2.5	m	Sample Type	B
Test Method	BS1377:Part 2:1990, clause 9.2				KeyLAB ID	Caus2020102276



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	93		
63	84		
50	69		
37.5	61		
28	54		
20	48		
14	40		
10	36		
6.3	31		
5	29		
3.35	25		
2	21		
1.18	18		
0.6	15		
0.425	14		
0.3	12		
0.212	11		
0.15	9		
0.063	7		

Dry Mass of sample, g	9866

Sample Proportions	% dry mass
Cobbles	16.0
Gravel	63.4
Sand	13.5
Fines <0.063mm	7.0

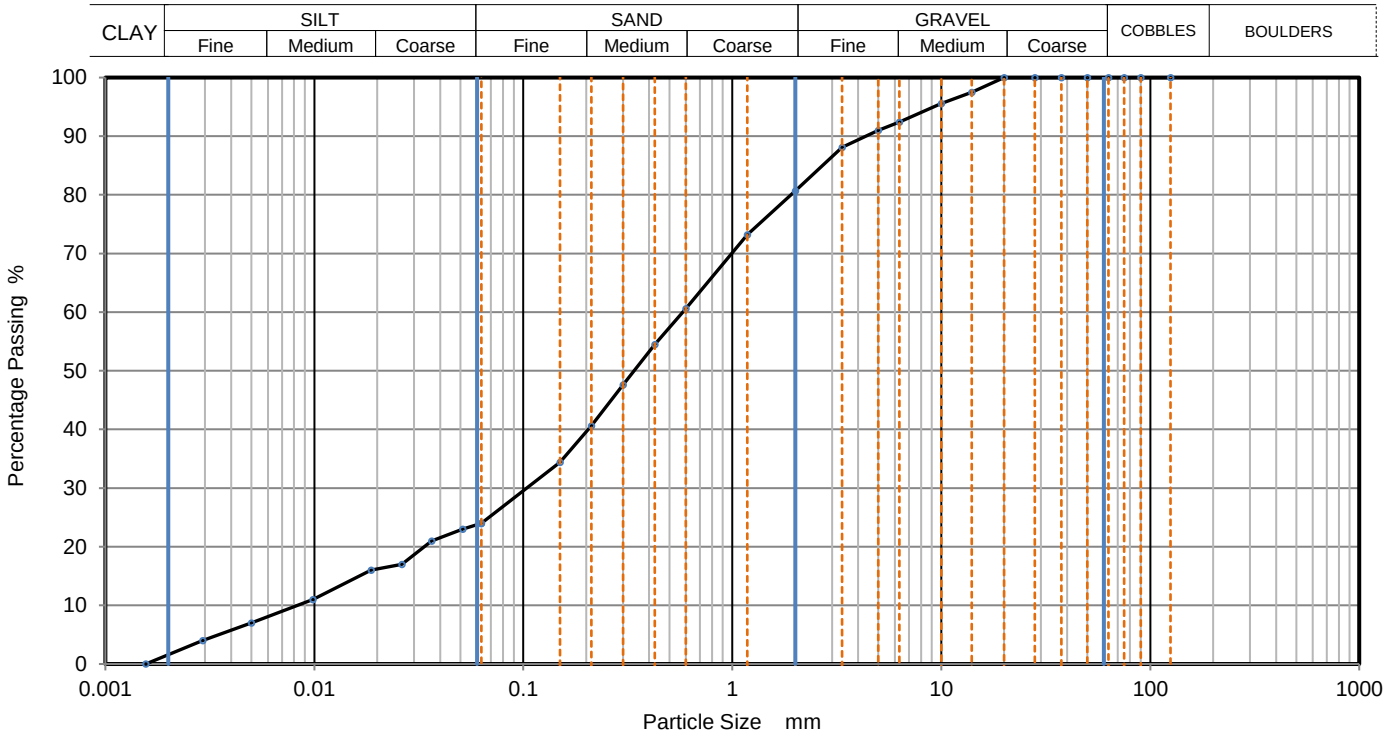
Grading Analysis		
D100	mm	
D60	mm	36.1
D30	mm	5.72
D10	mm	0.186
Uniformity Coefficient		190
Curvature Coefficient		4.9

Remarks

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

Approved
Stephen.Watson

CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**20-0399D**
				Borehole/Pit No.	R9TP10
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			Sample No.	4
Soil Description	Brown silty fine to coarse SAND.			Depth, m	1.00
Specimen Reference	2	Specimen Depth	1 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2020102277



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	24
90	100	0.05127	23
75	100	0.03647	21
63	100	0.02624	17
50	100	0.01866	16
37.5	100	0.00985	11
28	100	0.00501	7
20	100	0.00292	4
14	98	0.00156	0
10	96		
6.3	92		
5	91		
3.35	88		
2	81		
1.18	73		
0.6	61	Particle density	(assumed)
0.425	55	2.65	Mg/m3
0.3	48		
0.212	41		
0.15	34		
0.063	24		

Dry Mass of sample, g: 507

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	19.3
Sand	56.8
Silt	22.3
Clay	1.6

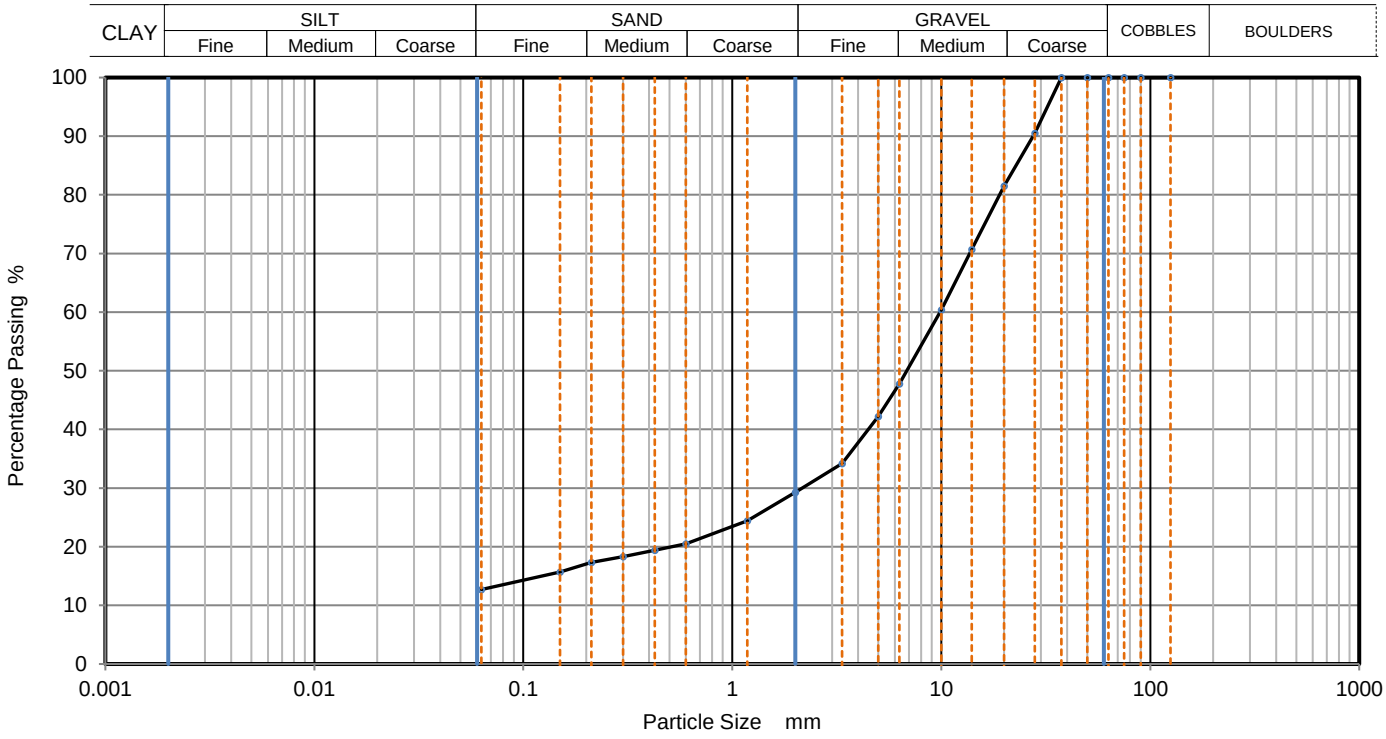
Grading Analysis		
D100	mm	
D60	mm	0.58
D30	mm	0.104
D10	mm	0.0088
Uniformity Coefficient		66
Curvature Coefficient		2.1

Remarks

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

Approved
Stephen.Watson

CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**20-0399D**
				Borehole/Pit No.	R9TP10
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			Sample No.	6
Soil Description	Brown slightly sandy silty subangular fine to coarse GRAVEL.			Depth, m	2.00
Specimen Reference	2	Specimen Depth	2 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clause 9.2			KeyLAB ID	Caus2020102278



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	91		
20	82		
14	71		
10	60		
6.3	48		
5	42		
3.35	34		
2	29		
1.18	24		
0.6	21		
0.425	19		
0.3	18		
0.212	17		
0.15	16		
0.063	13		

Dry Mass of sample, g	16682

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	70.7
Sand	16.6
Fines <0.063mm	13.0

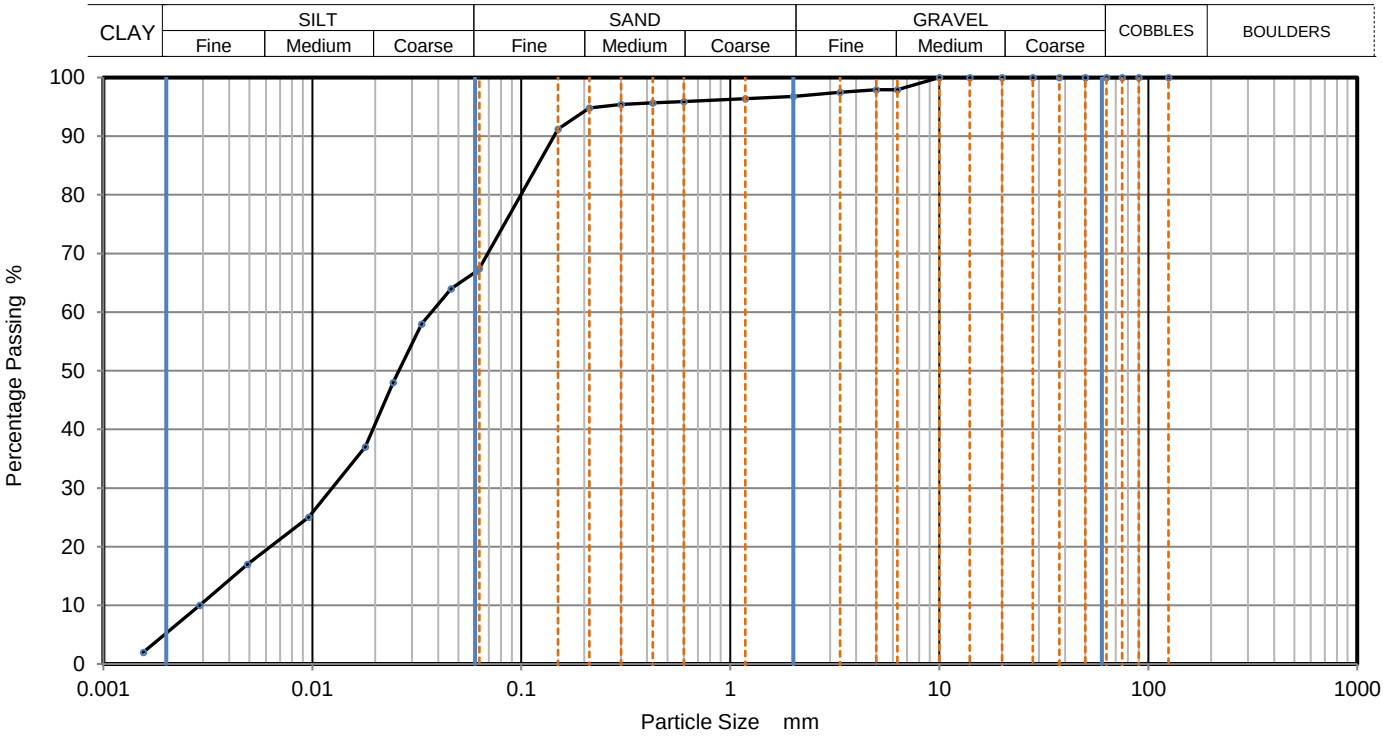
Grading Analysis		
D100	mm	
D60	mm	9.85
D30	mm	2.16
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

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

Approved
Stephen.Watson

CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**20-0399D**
				Borehole/Pit No.	R9TP10
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			Sample No.	9
Soil Description	Brown sandy silty CLAY.			Depth, m	4.00
Specimen Reference	6	Specimen Depth	4 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2020102279



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06107	67
90	100	0.04609	64
75	100	0.03331	58
63	100	0.02437	48
50	100	0.01791	37
37.5	100	0.00958	25
28	100	0.00490	17
20	100	0.00289	10
14	100	0.00155	2
10	100		
6.3	98		
5	98		
3.35	98		
2	97		
1.18	96		
0.6	96	Particle density	(assumed)
0.425	96	2.65	Mg/m3
0.3	95		
0.212	95		
0.15	91		
0.063	67		

Dry Mass of sample, g	205

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	3.2
Sand	29.5
Silt	62.2
Clay	5.1

Grading Analysis		
D100	mm	
D60	mm	0.0378
D30	mm	0.0125
D10	mm	0.00296
Uniformity Coefficient		13
Curvature Coefficient		1.4

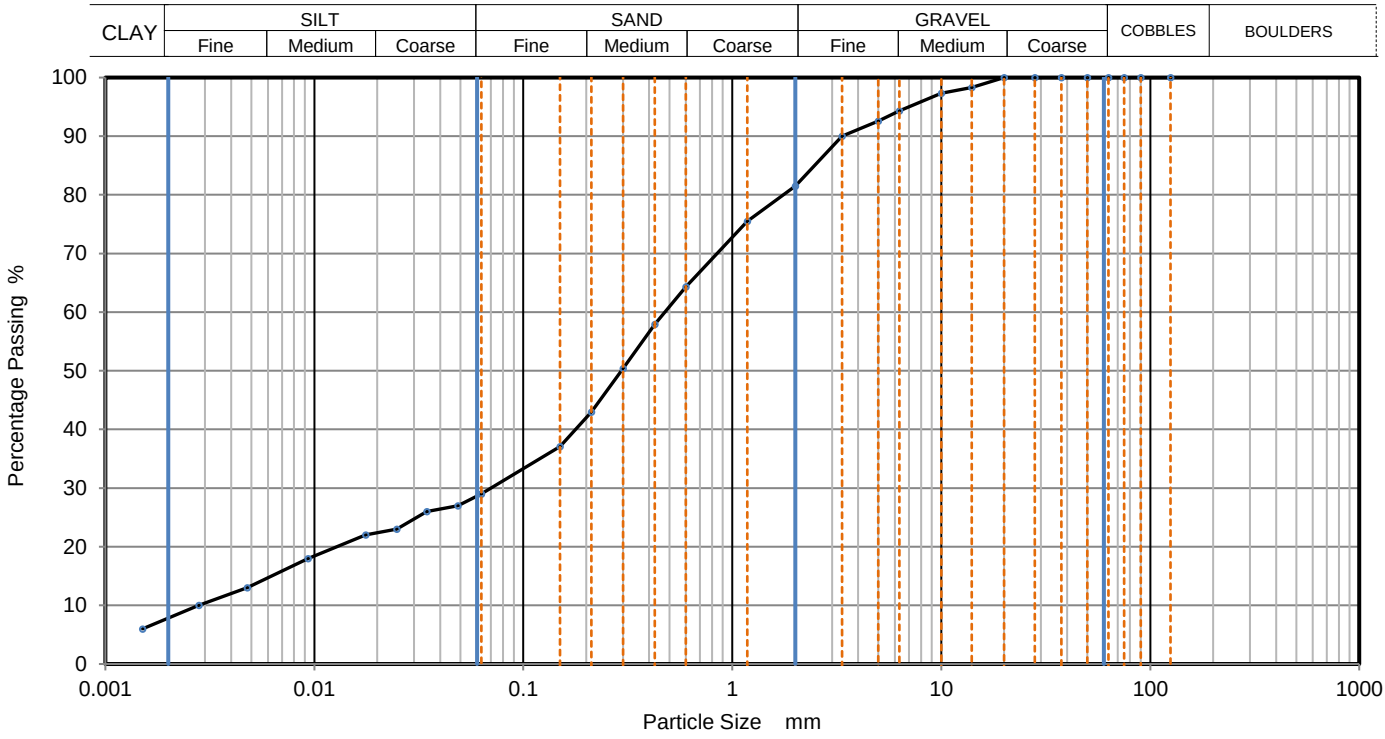
Remarks

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

Approved
Stephen.Watson

UKAS TESTING 10122

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION				Job Ref	20-0399D
					Borehole/Pit No.	R9TP11
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre				Sample No.	2
Soil Description	Brown sandy slightly gravelly silty CLAY.				Depth, m	1.00
Specimen Reference	6	Specimen Depth	1	m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5				KeyLAB ID	Caus2020102280



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	29
90	100	0.04856	27
75	100	0.03457	26
63	100	0.02476	23
50	100	0.01762	22
37.5	100	0.00933	18
28	100	0.00477	13
20	100	0.00280	10
14	98	0.00151	6
10	97		
6.3	94		
5	93		
3.35	90		
2	82		
1.18	76		
0.6	64	Particle density	(assumed)
0.425	58	2.65	Mg/m3
0.3	50		
0.212	43		
0.15	37		
0.063	29		

Dry Mass of sample, g	522

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	18.5
Sand	52.5
Silt	21.4
Clay	7.6

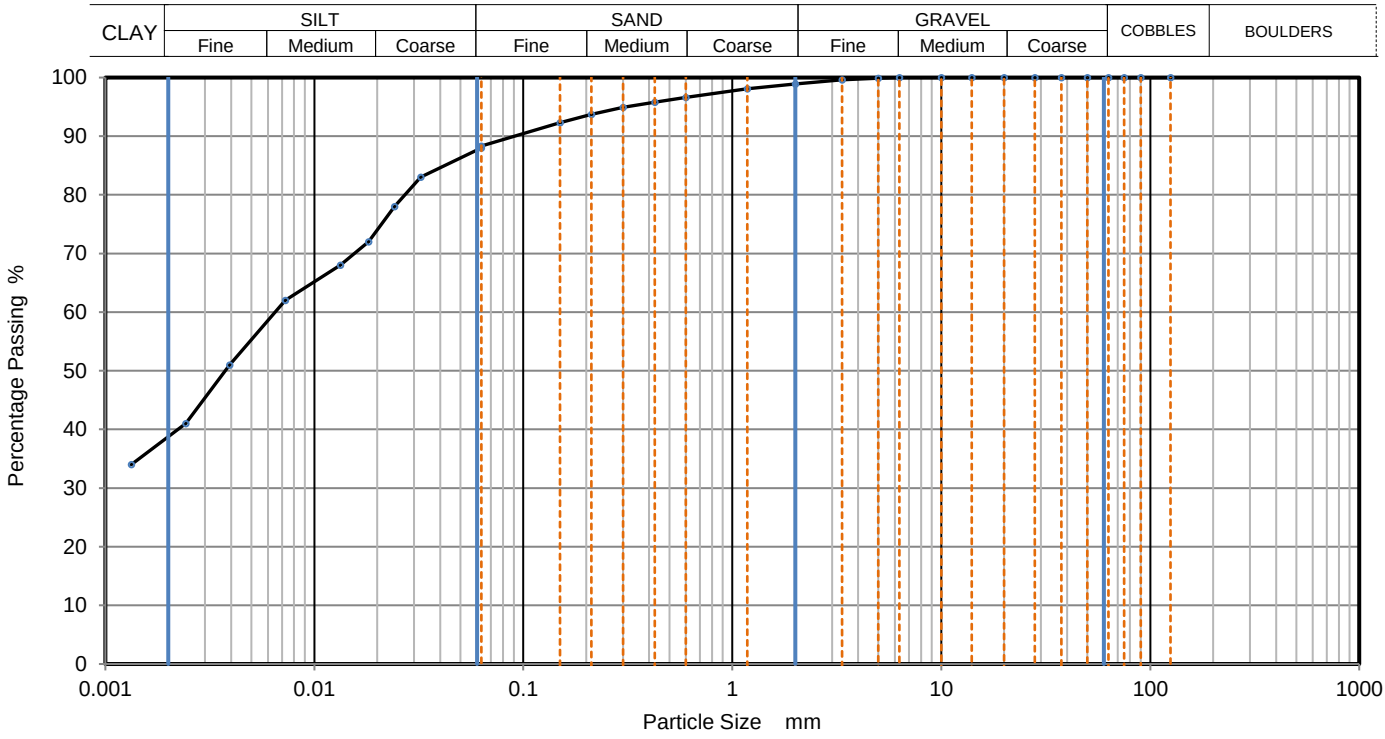
Grading Analysis		
D100	mm	
D60	mm	0.477
D30	mm	0.07
D10	mm	0.00279
Uniformity Coefficient		170
Curvature Coefficient		3.7

Remarks

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

Approved
Stephen.Watson

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION			Job Ref	20-0399D
				Borehole/Pit No.	R9TP11
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			Sample No.	5
Soil Description	Brown slightly sandy silty CLAY.			Depth, m	2.00
Specimen Reference	6	Specimen Depth	2 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2020102281



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	88
90	100	0.03228	83
75	100	0.02417	78
63	100	0.01820	72
50	100	0.01332	68
37.5	100	0.00725	62
28	100	0.00394	51
20	100	0.00242	41
14	100	0.00133	34
10	100		
6.3	100		
5	100		
3.35	100		
2	99		
1.18	98		
0.6	97	Particle density	(assumed)
0.425	96	2.65	Mg/m3
0.3	95		
0.212	94		
0.15	92		
0.063	88		

Dry Mass of sample, g	213

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	1.1
Sand	10.6
Silt	49.6
Clay	38.7

Grading Analysis		
D100	mm	
D60	mm	0.00644
D30	mm	
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

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

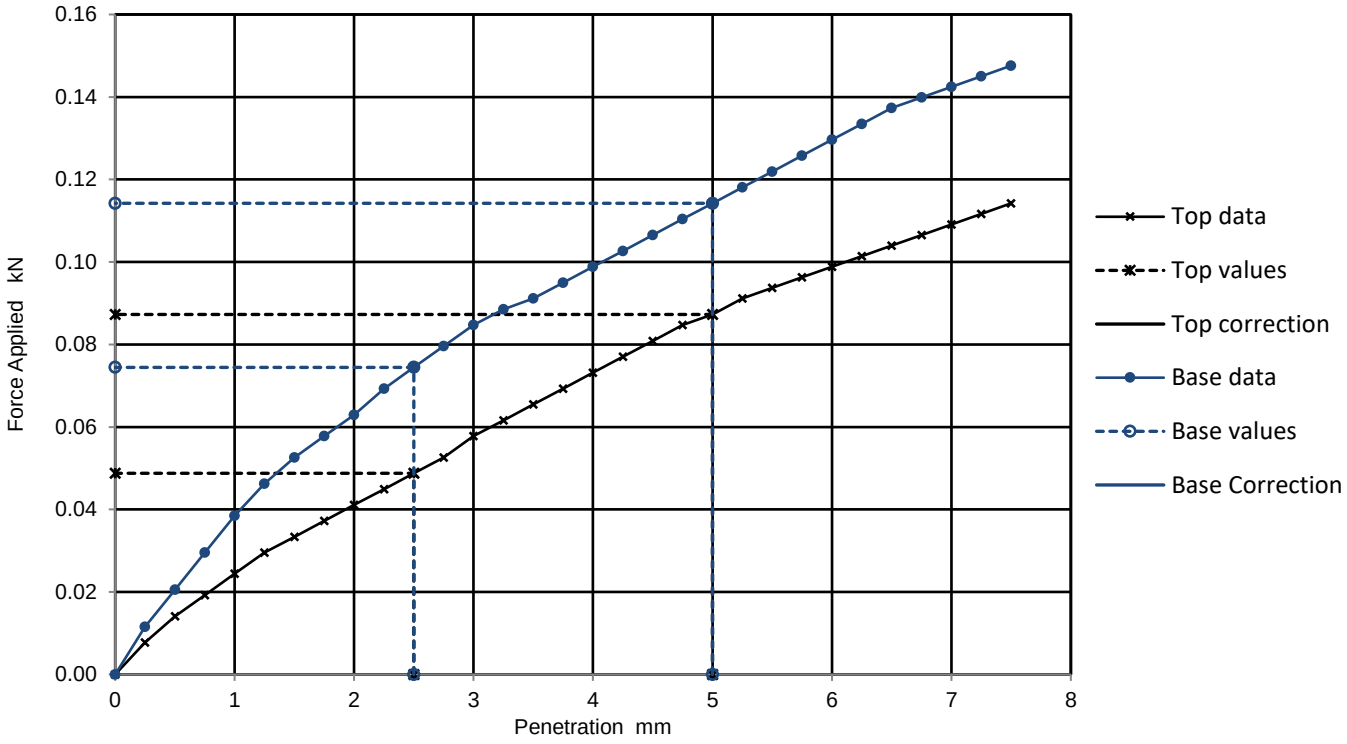
Approved
Stephen.Watson

CAUSEWAY GEOTECH	**California Bearing Ratio (CBR)**			Job Ref	20-0399D
				Borehole/Pit No.	R9CP01
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			Sample No.	5
Soil Description	Brown sandy slightly gravelly silty CLAY.			Depth m	0.50
Specimen Reference		Specimen Depth	m	Sample Type	B
Specimen Description	Brown sandy slightly gravelly silty CLAY.			KeyLAB ID	Caus202010220
Test Method	BS1377 : Part 4 : 1990, clause 7			CBR Test Number	1

Specimen Preparation

Condition	REMOULDED			Soaking details	Not soaked	
Details	Recompacted with specified standard effort using 2.5kg rammer			Period of soaking		days
				Time to surface		days
				Amount of swell recorded		mm
Material retained on 20mm sieve removed		3	%	Dry density after soaking		Mg/m3
Initial Specimen details	Bulk density	2.06	Mg/m3	Surcharge applied	4.5	kg
	Dry density	1.73	Mg/m3		3	kPa
	Moisture content	19.4	%			

Force v Penetration Plots



Results

	Curve correction applied	CBR Values, %				Moisture Content %
		2.5mm	5mm	Highest	Average	
TOP	No	0	0	0		20
BASE	No	1	1	1		19

General remarks	Test specific remarks	Approved
Tested at natural moisture content.	Average result may be reported if within 10% of the mean CBR value of top and base.	Stephen.Watson

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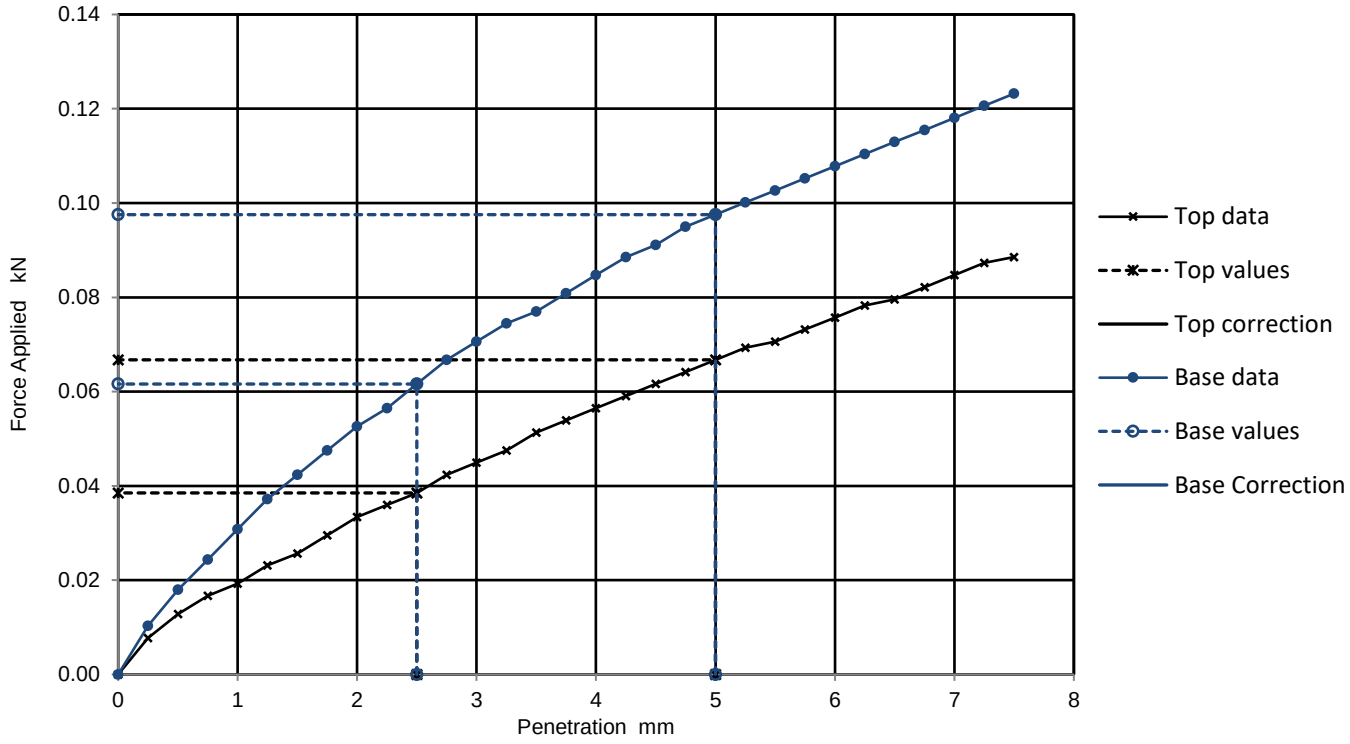
CAUSEWAY GEOTECH	California Bearing Ratio (CBR)			Job Ref	20-0399D
				Borehole/Pit No.	R9CP03
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			Sample No.	11
Soil Description	Brownish grey sandy gravelly silty CLAY.			Depth m	0.50
Specimen Reference		Specimen Depth	m	Sample Type	B
Specimen Description	Brownish grey sandy gravelly silty CLAY.			KeyLAB ID	Caus2020102210
Test Method	BS1377 : Part 4 : 1990, clause 7			CBR Test Number	1

Specimen Preparation

Condition	REMOULDED			Soaking details	Not soaked	
Details	Recompacted with specified standard effort using 2.5kg rammer			Period of soaking		days
				Time to surface		days
				Amount of swell recorded		mm
Material retained on 20mm sieve removed		1	%	Dry density after soaking		Mg/m3
Initial Specimen details	Bulk density	2.07	Mg/m3	Surcharge applied	4.5	kg
	Dry density	1.40	Mg/m3		3	kPa
	Moisture content	48.0	%			

Force v Penetration Plots



Results

	Curve correction applied	CBR Values, %				Moisture Content %
		2.5mm	5mm	Highest	Average	
TOP	No	0	0	0		50
BASE	No	0	0	0		46

General remarks	Test specific remarks	Approved
Tested at natural moisture content.	Average result may be reported if within 10% of the mean CBR value of top and base.	Stephen.Watson

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Moisture Condition Value at Natural Moisture Content
Summary of Results

Project No.	Project Name
20-0399D	Bus Connects Route 9 Tallaght/Clondalkin to City Centre

Hole No.	Sample				Soil Description	Retained on 20mm sieve	Moisture Content <20mm	Moisture Condition Value	Method of Interpretation	Remarks
	Ref	Top	Base	Type		%	%			
R9CP01	5	0.50		B	Brown sandy slightly gravelly silty CLAY.	3	20	2.5	Best fit line	
R9CP03	11	0.50		B	Brownish grey sandy gravelly silty CLAY.	1	48	5.7	Best fit line	
R9CP05	11	1.00		B	Brownish grey sandy gravelly silty CLAY.	4	13	10.6	Best fit line	
R9TP08	2	1.00		B	Brown sandy slightly silty subangular fine to coarse GRAVEL.	34	6.3	>18	Best fit line	

LAB 10R Version 5

Key

Test performed in accordance with BS1377:Part4:1990, clause 5.4 unless annotated otherwise

Date Printed

18/11/2020

Approved By

Stephen.Watson

UKAS TESTING

10122

Summary of Laboratory Vane Test Results

Project No.	Project Name
20-0399D	Bus Connects Route 9 Tallaght/Clondalkin to City Centre

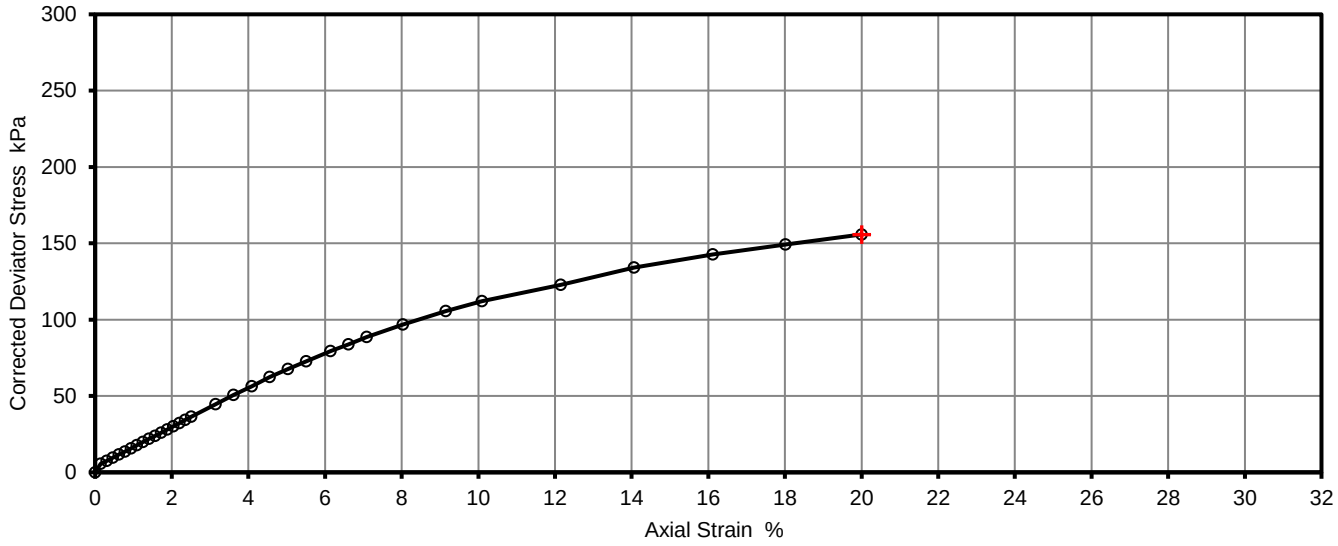
Hole No.	Sample				Soil Description at test horizon	Moisture Content	Vane shear strength		Sensitivity	Remarks
	Ref	Top	Base	Type		%	Undisturbed kPa	Remoulded kPa		
R9CP02	12	1.20		U	Greyish brown slightly sandy slightly gravelly silty CLAY.	21	93			
R9CPGS03	16	3.00		U	Greyish brown slightly sandy slightly gravelly silty CLAY.	11	48			

Notes	Date Printed	Approved By	Table
Tests performed in accordance with BS 1377:Part 7:clause 3 using 19mm x 30mm vane Tests carried out in nominally 100mm diameter tube unless noted otherwise Shear strengths are average of at least 3 tests unless noted otherwise	18/11/2020	Stephen.Watson	1 sheet 1

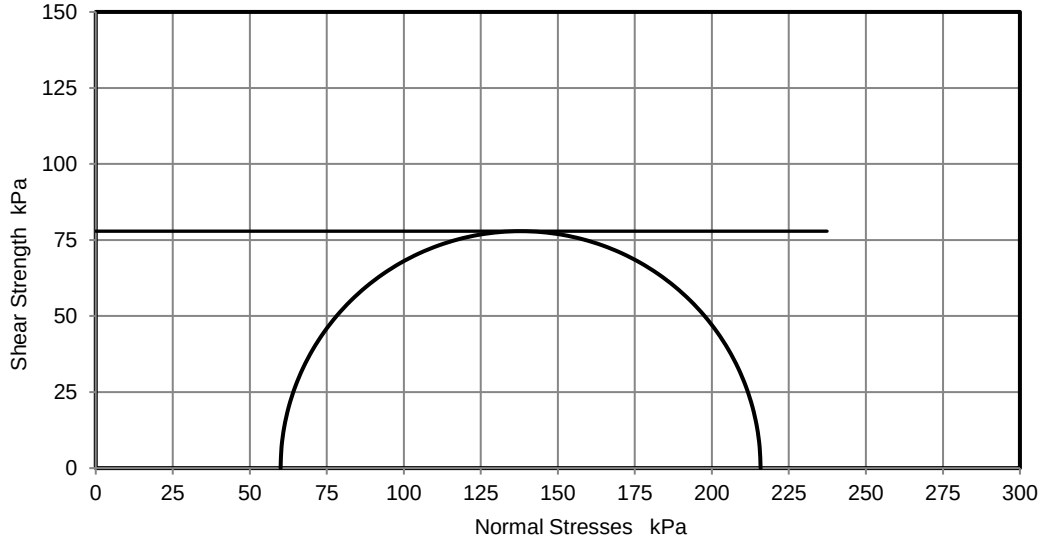
CAUSEWAY GEOTECH	**Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen**				Job Ref	20-0399D
					Borehole/Pit No.	R9CP01
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre				Sample No.	18
Soil Description	Brown sandy slightly gravelly silty CLAY.				Depth	3.00
Specimen Reference	4	Specimen Depth	3.05	m	Sample Type	U
Specimen Description	Stiff brown sandy slightly gravelly silty CLAY.				KeyLAB ID	Caus202010223
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen				Date of test	28/10/2020

Test Number		1	
Length		209.9	mm
Diameter		105.2	mm
Bulk Density		2.27	Mg/m3
Moisture Content		15.6	%
Dry Density		1.96	Mg/m3
Rate of Strain		2.0	%/min
Cell Pressure		60	kPa
At failure	Axial Strain	20.0	%
	Deviator Stress, (σ1 - σ3)f	156	kPa
	Undrained Shear Strength, cu	78	kPa ½(σ1 - σ3)f
	Mode of Failure		

Deviator Stress v Axial Strain



Mohr Circles



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

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

Remarks

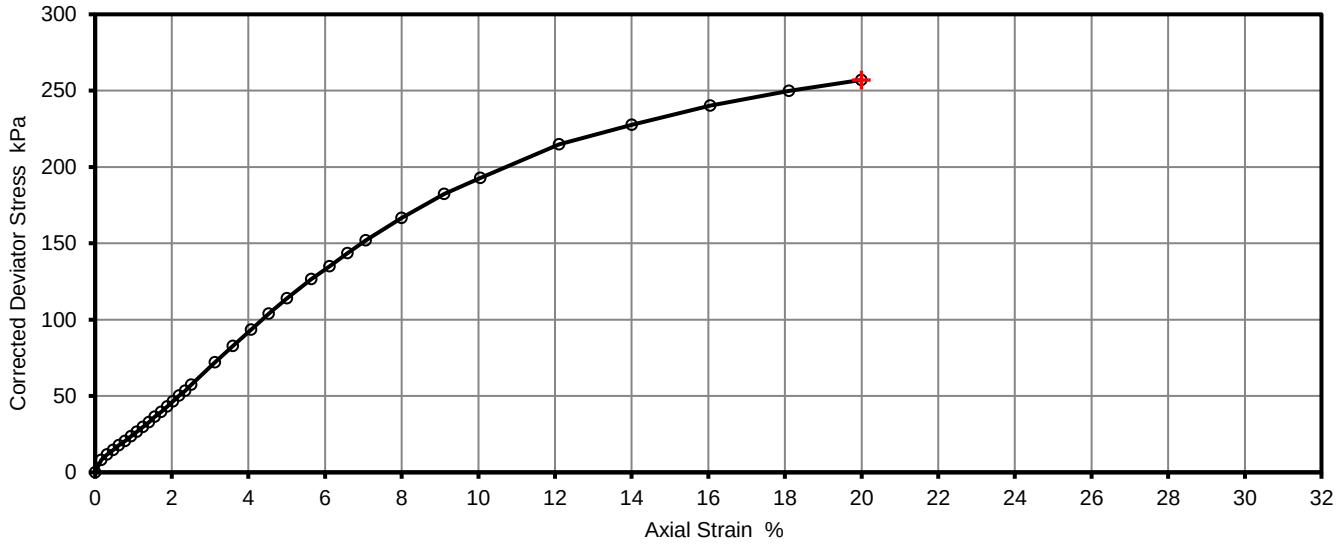
No failure defined. Testing terminated at 20% axial strain.

Approved	Printed
Stephen.Watson	18/11/2020 15:10

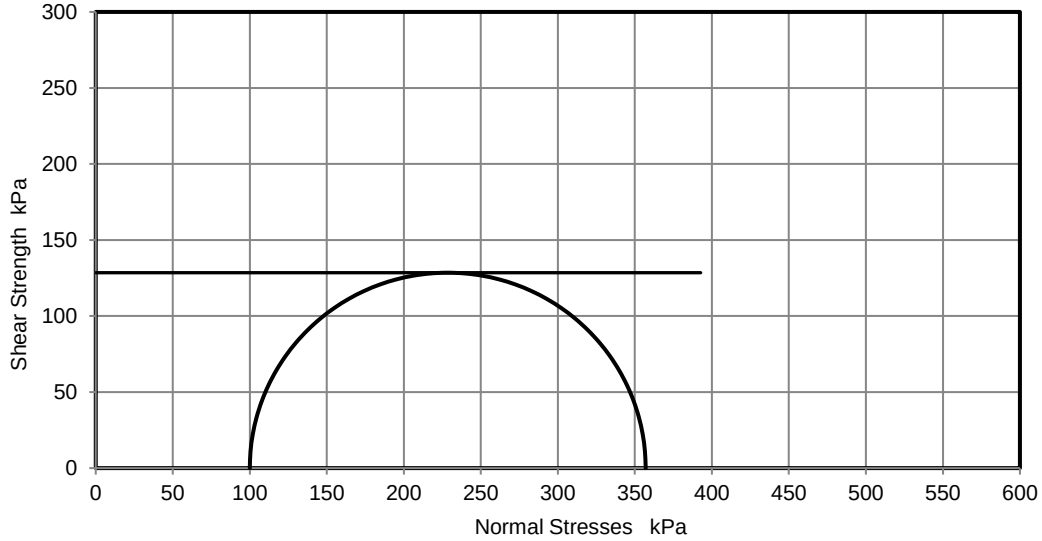
CAUSEWAY GEOTECH	**Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen**				Job Ref	20-0399D
					Borehole/Pit No.	R9CP01
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre				Sample No.	19
Soil Description	Brownish grey sandy slightly gravelly silty CLAY.				Depth	5.00
Specimen Reference	4	Specimen Depth	5.05	m	Sample Type	U
Specimen Description	Stiff brownish grey sandy slightly gravelly silty CLAY.				KeyLAB ID	Caus202010225
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen				Date of test	28/10/2020

Test Number		1	
Length		210.8	mm
Diameter		105.1	mm
Bulk Density		2.31	Mg/m3
Moisture Content		12.0	%
Dry Density		2.07	Mg/m3
Rate of Strain		2.0	%/min
Cell Pressure		100	kPa
At failure	Axial Strain	20.0	%
	Deviator Stress, (σ1 - σ3)f	257	kPa
	Undrained Shear Strength, cu	129	kPa ½(σ1 - σ3)f
	Mode of Failure		

Deviator Stress v Axial Strain



Mohr Circles



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

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

Remarks

No failure defined. Testing terminated at 20% axial strain.

Approved	Printed
Stephen.Watson	18/11/2020 15:10

LAB 15R Version 4

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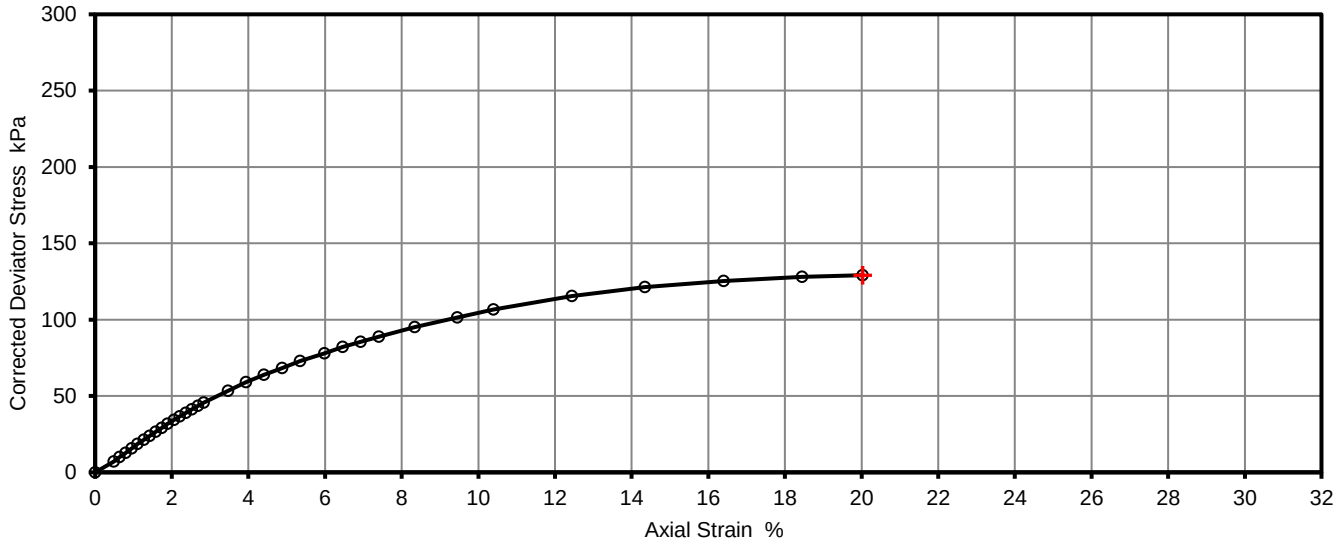
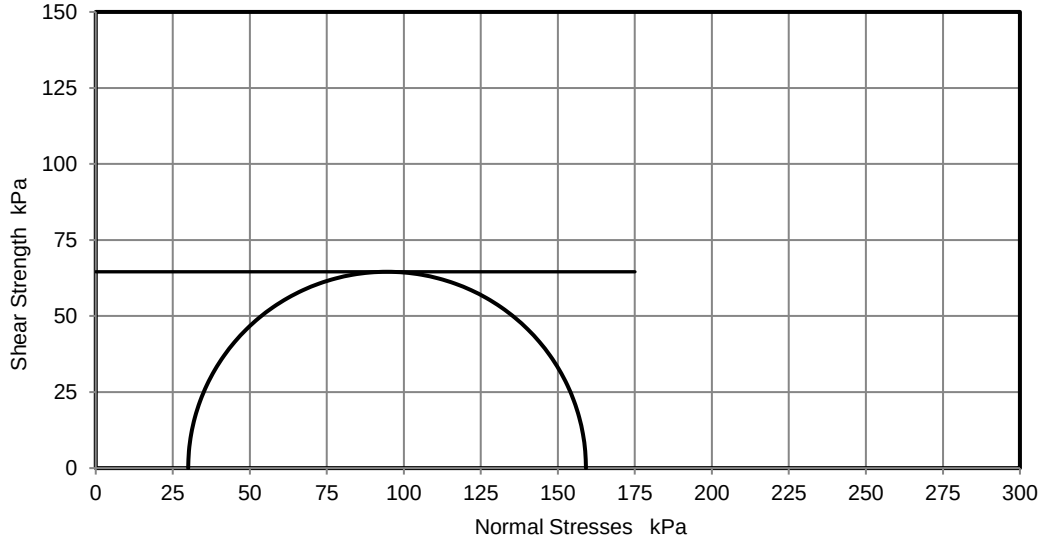
CAUSEWAY GEOTECH	**Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen**			Job Ref	20-0399D
				Borehole/Pit No.	R9CP03
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			Sample No.	26
Soil Description	Brownish grey sandy gravelly SILT.			Depth	1.20
Specimen Reference	4	Specimen Depth	1.25 m	Sample Type	U
Specimen Description	Firm brownish grey sandy gravelly SILT.			KeyLAB ID	Caus2020102212
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen			Date of test	29/10/2020

Test Number		1	
Length		210.7	mm
Diameter		105.2	mm
Bulk Density		2.28	Mg/m3
Moisture Content		14.3	%
Dry Density		2.00	Mg/m3
Rate of Strain		2.0	%/min
Cell Pressure		30	kPa
At failure	Axial Strain	20.0	%
	Deviator Stress, (σ1 - σ3)f	129	kPa
	Undrained Shear Strength, cu	65	kPa ½(σ1 - σ3)f
	Mode of Failure		

Deviator Stress v Axial Strain



Mohr Circles



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

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

Remarks

No failure defined. Testing terminated at 20% axial strain.

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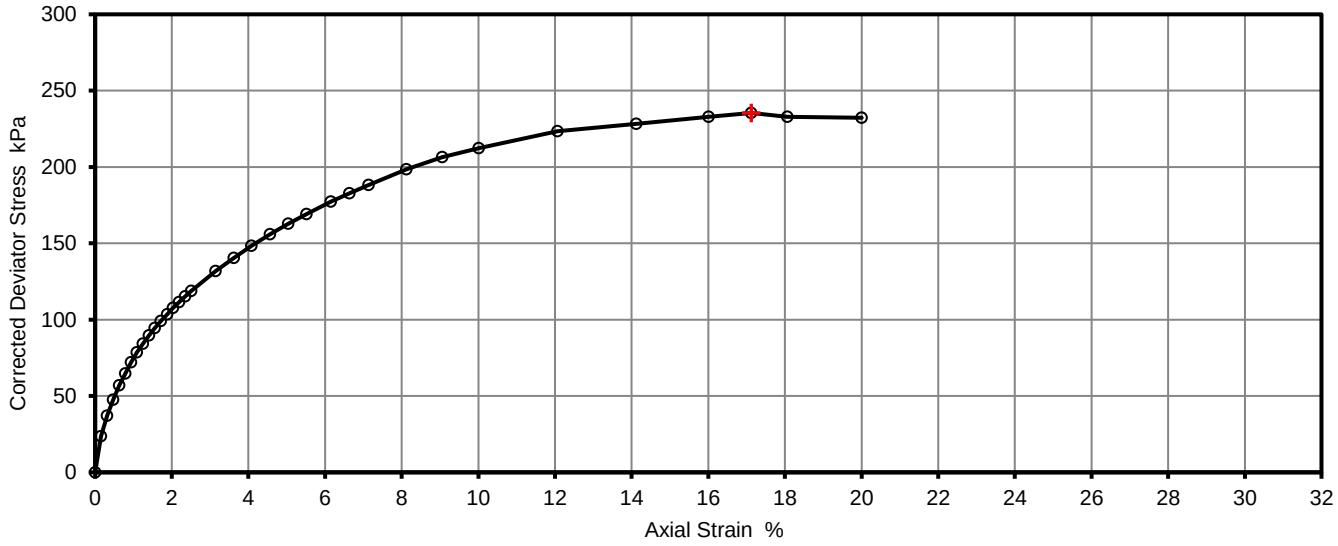
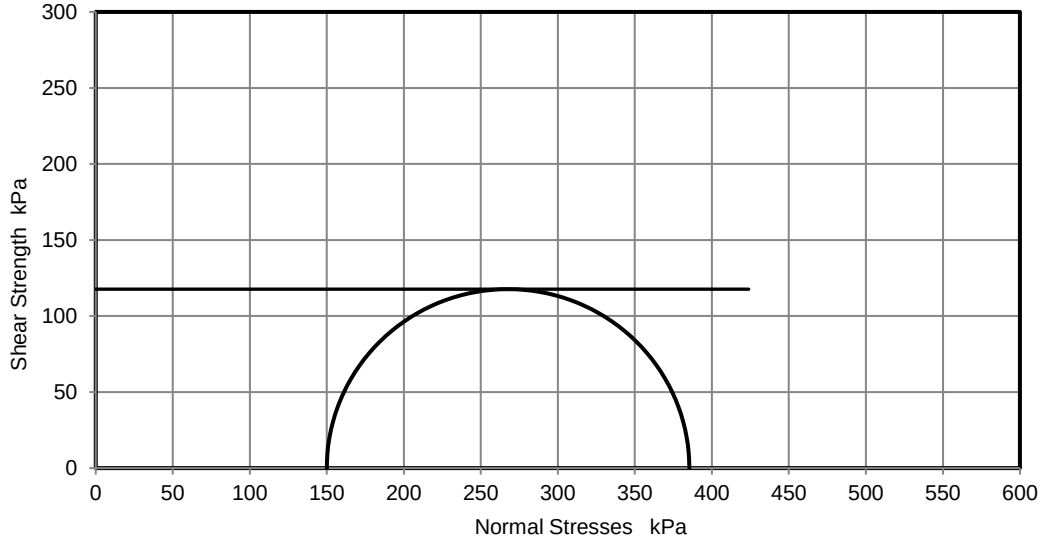
CAUSEWAY GEOTECH	**Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen**				Job Ref	20-0399D
					Borehole/Pit No.	R9CP05
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre				Sample No.	26
Soil Description	Grey sandy slightly gravelly silty CLAY.				Depth	8.00
Specimen Reference	4	Specimen Depth	8.05	m	Sample Type	U
Specimen Description	Stiff grey sandy slightly gravelly silty CLAY.				KeyLAB ID	Caus2020102232
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen				Date of test	29/10/2020

Test Number		1	
Length		210.6	mm
Diameter		104.0	mm
Bulk Density		2.14	Mg/m3
Moisture Content		9.2	%
Dry Density		1.96	Mg/m3
Rate of Strain		2.0	%/min
Cell Pressure		150	kPa
At failure	Axial Strain	17.1	%
	Deviator Stress, (σ1 - σ3)f	235	kPa
	Undrained Shear Strength, cu	118	kPa ½(σ1 - σ3)f
	Mode of Failure	Plastic	

Deviator Stress v Axial Strain



Mohr Circles



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

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

Remarks

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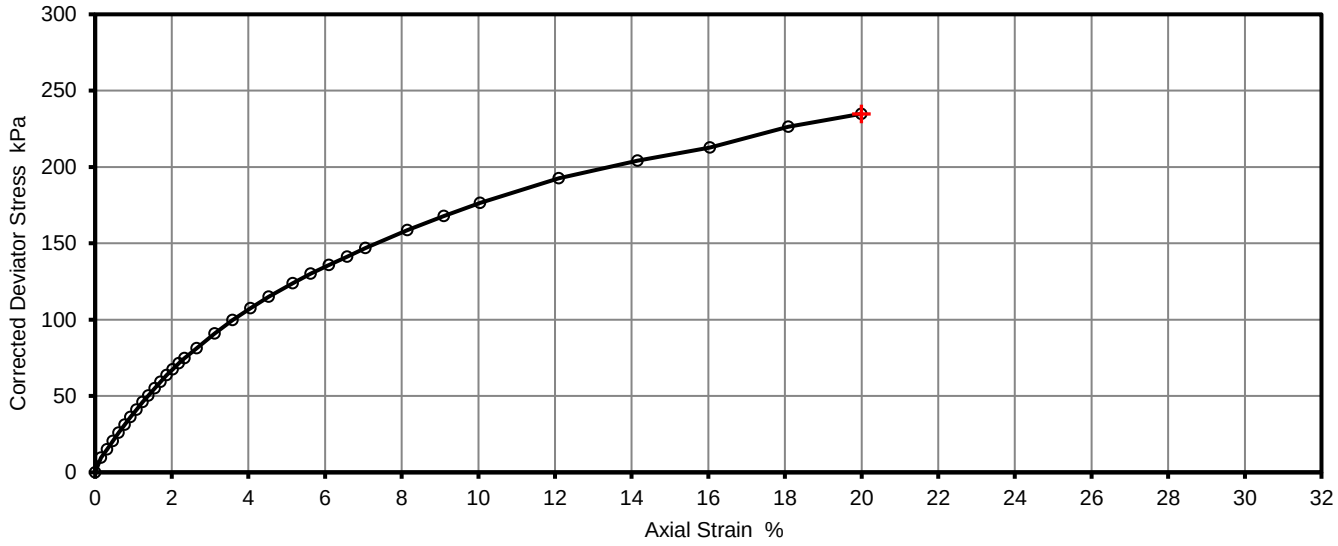
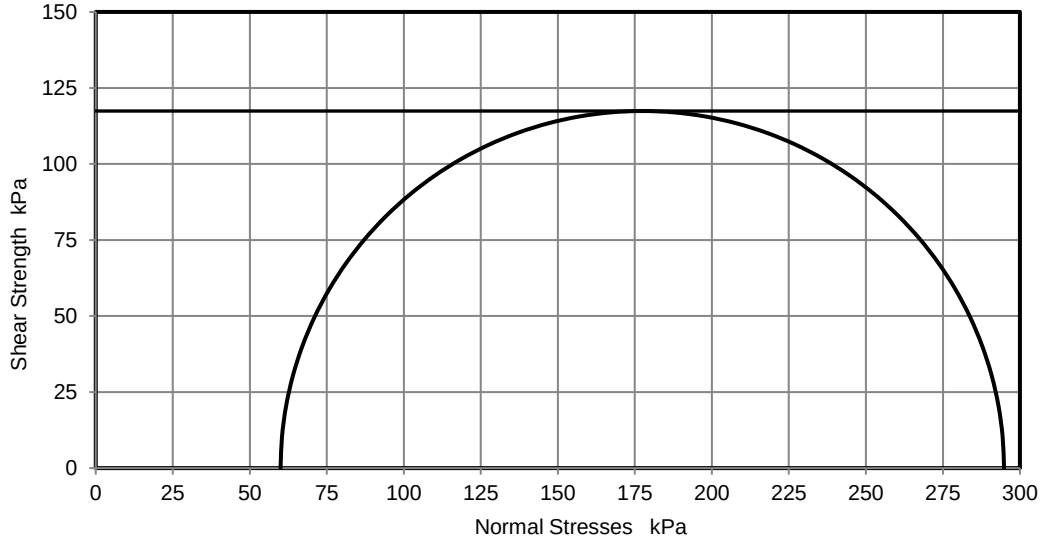
CAUSEWAY GEOTECH	**Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen**				Job Ref	20-0399D
					Borehole/Pit No.	R9CP08
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre				Sample No.	18
Soil Description	Grey slightly sandy slightly gravelly silty CLAY.				Depth	3.00
Specimen Reference	4	Specimen Depth	3.05	m	Sample Type	U
Specimen Description	Stiff grey slightly sandy slightly gravelly silty CLAY.				KeyLAB ID	Caus2020102239
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen				Date of test	29/10/2020

Test Number		1	
Length		210.8	mm
Diameter		104.9	mm
Bulk Density		2.22	Mg/m3
Moisture Content		14.0	%
Dry Density		1.95	Mg/m3
Rate of Strain		2.0	%/min
Cell Pressure		60	kPa
At failure	Axial Strain	20.0	%
	Deviator Stress, (σ1 - σ3)f	235	kPa
	Undrained Shear Strength, cu	117	kPa ½(σ1 - σ3)f
	Mode of Failure		

Deviator Stress v Axial Strain



Mohr Circles



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

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

Remarks

No failure defined. Testing terminated at 20% axial strain.

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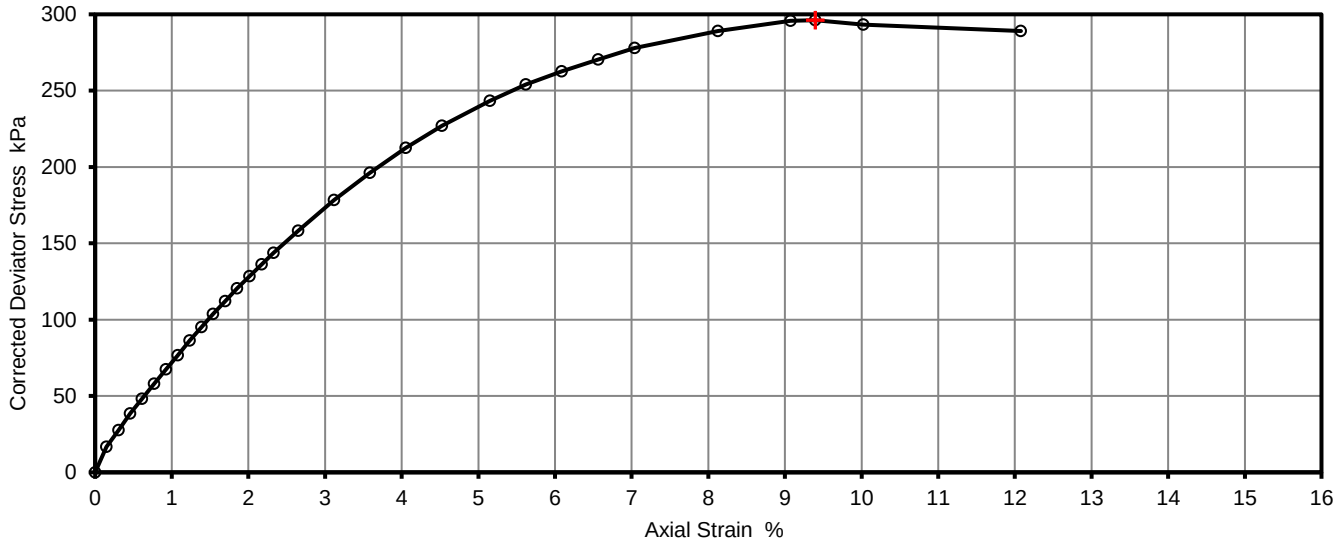
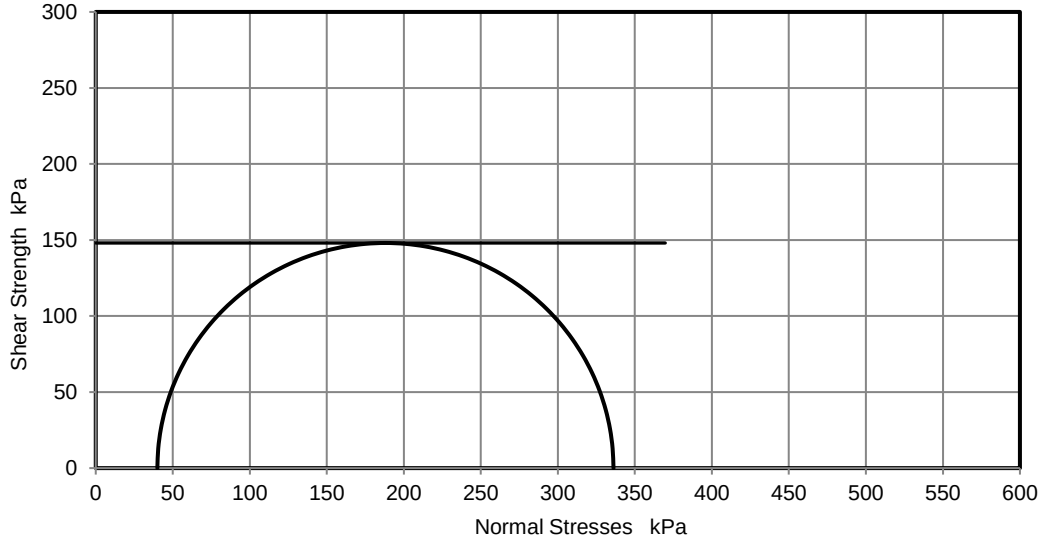
CAUSEWAY GEOTECH	**Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen**				Job Ref	20-0399D
					Borehole/Pit No.	R9CPGS02
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre				Sample No.	17
Soil Description	Greyish brown slightly sandy silty CLAY.				Depth	2.00
Specimen Reference	4	Specimen Depth	2.05	m	Sample Type	U
Specimen Description	Stiff greyish brown slightly sandy silty CLAY.				KeyLAB ID	Caus2020102258
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen				Date of test	29/10/2020

Test Number		1	
Length		210.7	mm
Diameter		104.9	mm
Bulk Density		2.11	Mg/m3
Moisture Content		15.7	%
Dry Density		1.82	Mg/m3
Rate of Strain		2.0	%/min
Cell Pressure		40	kPa
At failure	Axial Strain	9.4	%
	Deviator Stress, (σ1 - σ3)f	296	kPa
	Undrained Shear Strength, cu	148	kPa ½(σ1 - σ3)f
	Mode of Failure	Brittle	

Deviator Stress v Axial Strain



Mohr Circles



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

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

Remarks

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Stephen.Watson	18/11/2020 15:10

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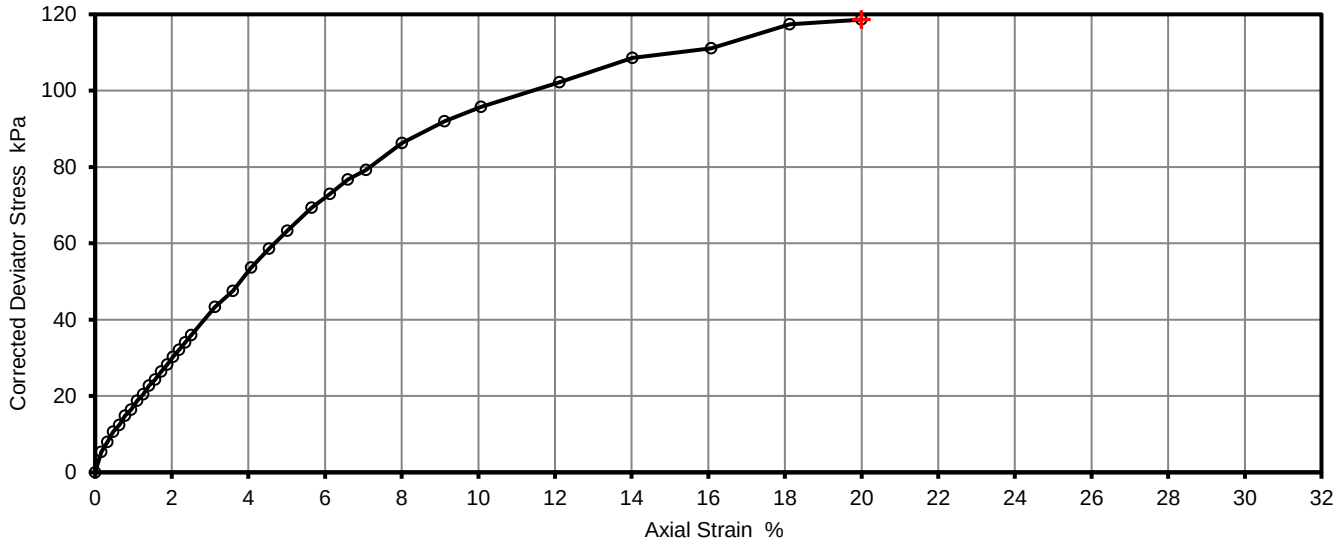
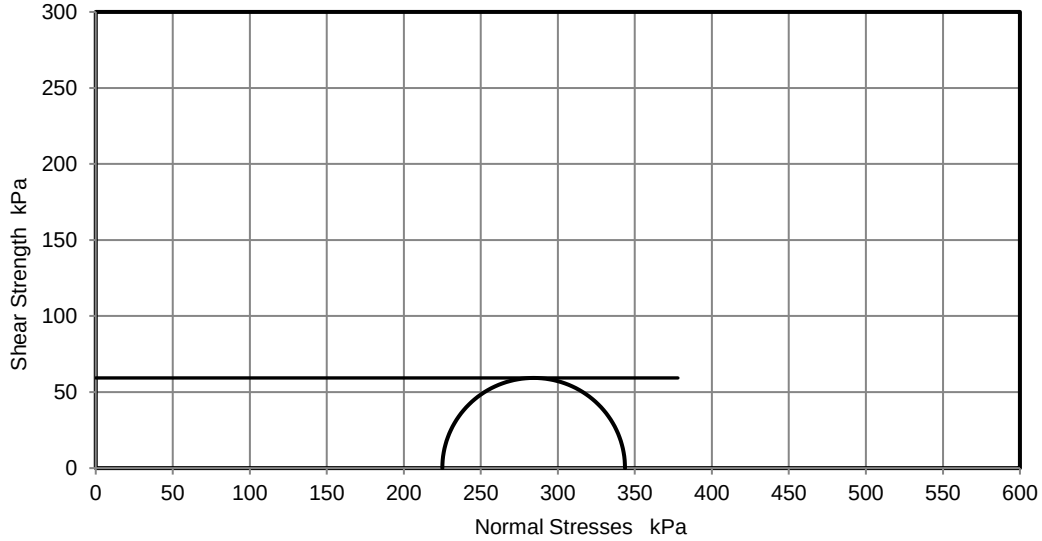
CAUSEWAY GEOTECH	**Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen**				Job Ref	20-0399D
					Borehole/Pit No.	R9CPGS02
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre				Sample No.	11
Soil Description	Greyish brown sandy gravelly silty CLAY.				Depth	12.00
Specimen Reference	4	Specimen Depth	12.05	m	Sample Type	C
Specimen Description	Firm greyish brown sandy gravelly silty CLAY.				KeyLAB ID	Caus2020102262
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen				Date of test	28/10/2020

Test Number		1	
Length		210.7	mm
Diameter		105.3	mm
Bulk Density		2.25	Mg/m3
Moisture Content		12.8	%
Dry Density		2.00	Mg/m3
Rate of Strain		2.0	%/min
Cell Pressure		225	kPa
At failure	Axial Strain	20.0	%
	Deviator Stress, (σ1 - σ3)f	119	kPa
	Undrained Shear Strength, cu	59	kPa ½(σ1 - σ3)f
	Mode of Failure		

Deviator Stress v Axial Strain



Mohr Circles



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

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

Remarks

No failure defined. Testing terminated at 20% axial strain.

Approved: Stephen.Watson

Printed: 18/11/2020 15:10

UKAS TESTING
10122

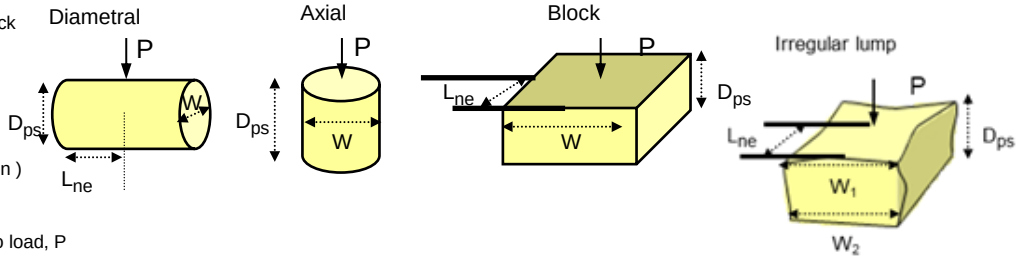
CAUSEWAY GEOTECH

Point Load Strength Index Tests
Summary of Results

Project No.	Project Name
20-0399D	Bus Connects Route 9 Tallaght/Clondalkin to City Centre

Borehole No.	Sample			Specimen		Rock Type	Test Type see ISRM		Failure Valid (Y/N)	Dimensions				Force P	Equivalent diameter, De	Point Load Strength Index		Remarks (including water content if measured)
	Depth	Ref.	Type	Ref.	Depth		Type (D, A, I, B)	Direction (L, P or U)		Lne	W	Dps	Dps'			Is	Is(50)	
	m				m					mm	mm	mm	mm	kN	mm	MPa	MPa	
R9CPGS01	12.30		C	2	12.30	LIMESTONE	D	U	NO	87.5	101.3	101.3	96.0	8.2	98.6	0.8	1.1	
R9CPGS01	12.55		C	2	12.55	LIMESTONE	A	U	NO		101.4	68.0	66.0	6.1	92.3	0.7	0.9	
R9CPGS01	12.80		C	2	12.80	LIMESTONE	D	U	NO	81.2	101.4	101.4	98.0	9.6	99.7	1.0	1.3	
R9CPGS01	13.20		C	2	13.20	LIMESTONE	A	U	YES		101.6	57.0	54.0	4.7	83.6	0.7	0.8	
R9CPGS01	13.75		C	2	13.75	LIMESTONE	D	U	NO	79.6	101.3	101.3	98.0	7.5	99.6	0.8	1.0	
R9CPGS01	14.00		C	2	14.00	LIMESTONE	D	U	YES	80.5	101.5	101.5	96.0	9.0	98.7	0.9	1.3	
R9CPGS01	14.15		C	2	14.15	LIMESTONE	A	U	NO		101.9	90.0	88.0	5.8	106.9	0.5	0.7	
R9CPGS01	14.50		C	2	14.50	LIMESTONE	A	U	NO		101.6	65.0	63.0	2.0	90.3	0.2	0.3	
R9CPGS01	15.35		C	2	15.35	LIMESTONE	D	U	NO	76.6	101.6	101.6	97.0	6.5	99.3	0.7	0.9	
R9CPGS01	15.85		C	2	15.85	LIMESTONE	A	U	NO		101.8	60.0	56.0	4.4	85.2	0.6	0.8	
R9CPGS01	17.20		C	2	17.20	LIMESTONE	D	U	NO	79.2	101.6	101.6	98.0	10.1	99.8	1.0	1.4	
R9CPGS01	17.40		C	2	17.40	LIMESTONE	D	U	NO	88.2	101.4	101.4	98.0	8.6	99.7	0.9	1.2	
R9CPGS02	13.35		C	2	13.35	LIMESTONE	A	U	NO		101.5	51.0	48.0	8.0	78.8	1.3	1.6	
R9CPGS02	13.70		C	2	13.70	LIMESTONE	D	U	YES	75.1	101.4	101.4	94.0	2.4	97.6	0.3	0.3	
R9CPGS02	13.90		C	2	13.90	LIMESTONE	A	U	NO		101.3	47.0	42.0	7.3	73.6	1.3	1.6	
R9CPGS02	14.10		C	2	14.10	LIMESTONE	A	U	NO		101.4	50.0	41.0	5.7	72.8	1.1	1.3	
R9CPGS02	14.65		C	2	14.65	LIMESTONE	D	U	YES	66.3	101.4	101.4	95.0	6.4	98.1	0.7	0.9	
R9CPGS02	15.10		C	2	15.10	LIMESTONE	D	U	NO	88.6	101.6	101.6	96.0	9.2	98.8	0.9	1.3	

Test Type
D - Diametral, A - Axial, I - Irregular Lump, B - Block
Direction
L - parallel to planes of weakness
P - perpendicular to planes of weakness
U - unknown or random
Dimensions
Dps - Distance between platens (platen separation)
Dps' - at failure (see ISRM note 6)
Lne - Length from platens to nearest free end
W - Width of shortest dimension perpendicular to load, P



Test performed in accordance with ISRM Suggested Methods : 2007, unless noted otherwise

Detailed legend for test and dimensions, based on ISRM, is shown above.

Size factor, F = (De/50)0.45 for all tests.

LAB 17R Version 4

Date Printed: 16/11/2020

Approved By: Stephen.Watson

UKAS TESTING 10122

CAUSEWAY GEOTECH

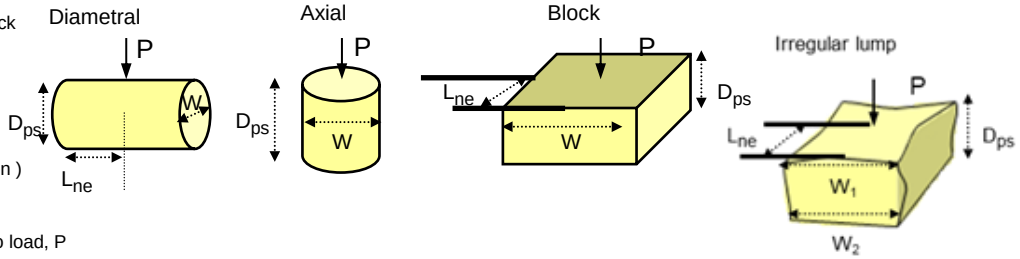
Point Load Strength Index Tests
Summary of Results

Project No.: 20-0399D

Project Name: Bus Connects Route 9 Tallaght/Clondalkin to City Centre

Borehole No.	Sample			Specimen		Rock Type	Test Type see ISRM		Failure Valid (Y/N)	Dimensions				Force P	Equivalent diameter, De	Point Load Strength Index		Remarks (including water content if measured)
	Depth m	Ref.	Type	Ref.	Depth m		Type (D, A, I, B)	Direction (L, P or U)		Lne mm	W mm	Dps mm	Dps' mm	kN	mm	Is MPa	Is(50) MPa	
R9CPGS02	15.40		C	2	15.40	LIMESTONE	D	U	YES	90.2	101.9	101.9	91.0	11.6	96.3	1.3	1.7	
R9CPGS02	15.70		C	2	15.70	LIMESTONE	A	U	NO		101.5	50.0	42.0	4.1	73.7	0.8	0.9	
R9CPGS02	16.10		C	2	16.10	LIMESTONE	A	U	NO		101.8	93.0	74.0	7.4	97.9	0.8	1.0	
R9CPGS02	16.75		C	2	16.75	LIMESTONE	D	U	NO	55.6	101.6	101.6	98.0	6.9	99.8	0.7	0.9	
R9CPGS02	17.05		C	2	17.05	LIMESTONE	D	U	NO	77.2	101.4	101.4	98.0	9.7	99.7	1.0	1.3	
R9CPGS03	11.50		C	3	11.50	LIMESTONE	D	U	YES	92.3	101.3	101.3	89.2	24.6	95.1	2.7	3.6	
R9CPGS03	11.50		C	4	11.55	LIMESTONE	A	U	YES		101.3	57.0	54.0	13.2	83.5	1.9	2.4	
R9CPGS03	12.00		C	2	12.00	LIMESTONE	A	U	NO		101.4	58.0	55.0	11.5	84.3	1.6	2.0	
R9CPGS03	12.40		C	2	12.40	LIMESTONE	A	U	NO		101.8	71.0	69.0	8.9	94.6	1.0	1.3	
R9CPGS03	12.70		C	2	12.70	LIMESTONE	D	U	YES	85.0	101.6	101.6	97.0	8.5	99.3	0.9	1.2	
R9CPGS03	12.95		C	2	12.95	LIMESTONE	A	U	YES		101.5	101.5	97.0	5.5	112.0	0.4	0.6	
R9CPGS03	13.80		C	2	13.80	LIMESTONE	D	U	YES	66.0	101.6	101.6	98.0	3.7	99.8	0.4	0.5	
R9CPGS03	14.10		C	2	14.10	LIMESTONE	A	U	NO		101.6	96.0	94.0	0.5	110.3	0.0	0.1	
R9CPGS03	14.55		C	2	14.55	LIMESTONE	A	U	NO		101.4	101.0	97.2	4.9	112.0	0.4	0.6	
R9CPGS03	14.65		C	2	14.65	LIMESTONE	D	U	YES	81.0	101.6	101.6	91.0	21.4	96.2	2.3	3.1	
R9CPGS03	15.40		C	2	15.40	LIMESTONE	A	U	YES		101.3	60.0	56.0	9.6	85.0	1.3	1.7	
R9CPGS03	15.60		C	2	15.60	LIMESTONE	D	U	NO	71.0	101.4	101.4	98.0	11.7	99.7	1.2	1.6	
R9CPGS04	11.15		C	2	11.15	LIMESTONE	D	U	NO	85.2	101.6	101.6	99.0	12.1	100.3	1.2	1.6	

Test Type
D - Diametral, A - Axial, I - Irregular Lump, B - Block
Direction
L - parallel to planes of weakness
P - perpendicular to planes of weakness
U - unknown or random
Dimensions
Dps - Distance between platens (platen separation)
Dps' - at failure (see ISRM note 6)
Lne - Length from platens to nearest free end
W - Width of shortest dimension perpendicular to load, P



Test performed in accordance with ISRM Suggested Methods : 2007, unless noted otherwise

Detailed legend for test and dimensions, based on ISRM, is shown above.

Size factor, F = (De/50)0.45 for all tests.

LAB 17R Version 4

Date Printed: 16/11/2020

Approved By: Stephen.Watson

UKAS TESTING 10122

CAUSEWAY GEOTECH

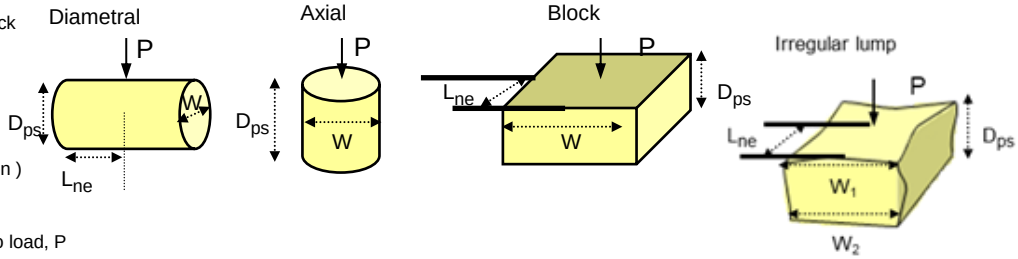
Point Load Strength Index Tests
Summary of Results

Project No.: 20-0399D

Project Name: Bus Connects Route 9 Tallaght/Clondalkin to City Centre

Borehole No.	Sample			Specimen		Rock Type	Test Type see ISRM		Failure Valid (Y/N)	Dimensions				Force P	Equivalent diameter, De	Point Load Strength Index		Remarks (including water content if measured)
	Depth	Ref.	Type	Ref.	Depth		Type (D, A, I, B)	Direction (L, P or U)		Lne	W	Dps	Dps'			Is	Is(50)	
	m				m					mm	mm	mm	mm	kN	mm	MPa	MPa	
R9CPGS04	11.70		C	2	11.70	LIMESTONE	A	U	NO		103.9	56.0	53.0	9.3	83.7	1.3	1.7	
R9CPGS04	12.50		C	2	12.50	LIMESTONE	D	U	YES	72.4	101.4	101.4	97.0	8.4	99.2	0.9	1.2	
R9CPGS04	12.90		C	2	12.90	LIMESTONE	A	U	YES		101.5	64.0	60.0	12.2	88.1	1.6	2.0	
R9CPGS04	13.50		C	2	13.50	LIMESTONE	D	U	YES	77.9	101.4	101.4	97.0	16.9	99.2	1.7	2.3	
R9CPGS04	13.95		C	2	13.95	LIMESTONE	D	U	YES	76.2	101.7	101.7	98.0	14.1	99.8	1.4	1.9	
R9CPGS04	14.05		C	2	14.05	LIMESTONE	A	U	YES		101.6	55.0	52.0	8.2	82.0	1.2	1.5	
R9CPGS04	14.30		C	2	14.30	LIMESTONE	D	U	YES	82.6	101.2	101.1	97.0	21.0	99.1	2.1	2.9	

Test Type
D - Diametral, A - Axial, I - Irregular Lump, B - Block
Direction
L - parallel to planes of weakness
P - perpendicular to planes of weakness
U - unknown or random
Dimensions
Dps - Distance between platens (platen separation)
Dps' - at failure (see ISRM note 6)
Lne - Length from platens to nearest free end
W - Width of shortest dimension perpendicular to load, P



Test performed in accordance with ISRM Suggested Methods : 2007, unless noted otherwise

Detailed legend for test and dimensions, based on ISRM, is shown above.

Size factor, F = (De/50)0.45 for all tests.

LAB 17R Version 4

Date Printed: 16/11/2020

Approved By: Stephen.Watson

UKAS TESTING 10122

UNIAXIAL COMPRESSION TEST ON ROCK - SUMMARY OF RESULTS

Project No.	Project Name
20-0399D	Bus Connects Route 9 Tallaght/Clondalkin to City Centre

Hole No.	Sample				Rock Type	Specimen Dimensions2			Bulk Density2	Water Content 1	Uniaxial Compression3			Remarks
	Ref	Top	Base	Type		Dia. mm	Length mm	H/D	Mg/m3	%	Condition	Mode of failure	UCS MPa	
R9CPGS04		13.05		C	LIMESTONE	101.2	256.8	2.5	2.69	1.0	as received	F	75.6	
R9CPGS04		15.65		C	LIMESTONE	101.2	257.5	2.5	2.68	1.0	as received	F	39.0	

Notes

1 ISRM p87 test 1, water content at 105 ± 3 oC, specimen as tested for UCS

2 ISRM p86 clause (vii), Caliper method used for determination of bulk volume and derivation of bulk density

3 ISRM p153 part 1, determination of Uniaxial Compressive Strength (UCS) of Rock Materials

above notes apply unless annotated otherwise in the remarks

Mode of failure :

S - Single shear MS - multiple shear

AC - Axial cleavage F - Fragmented

Test Specification	Date Printed	Approved By	Table
International Society for Rock Mechanics, The complete ISRM suggested methods for Rock Characterization Testing and Monitoring, 2007	16/11/2020	Stephen.Watson	1 sheet 1

Eurofins Chemtest Ltd
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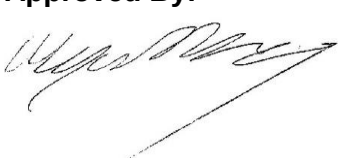
Email: info@chemtest.com

Final Report

Report No.:	20-29098-1
Initial Date of Issue:	02-Nov-2020
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 Martin Gardiner Matthew Gilbert Neil Haggan Paul Dunlop Sean Ross Stephen Franey Stephen McCracken Stephen Watson Stuart Abraham Thomas McAllis
Project	20-0399D Bus Connects Route 9 Tallaght/Clondalkin to City Centre

Quotation No.:		**Date Received:**	28-Oct-2020
Order No.:		**Date Instructed:**	28-Oct-2020
No. of Samples:	16		
Turnaround (Wkdays):	5	**Results Due:**	03-Nov-2020
Date Approved:	02-Nov-2020		

Approved By:



Details: Glynn Harvey, Technical Manager

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

Results - Soil

Project: 20-0399D Bus Connects Route 9 Tallaght/Clondalkin to City Centre

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		20-29098	20-29098	20-29098	20-29098	20-29098	20-29098	20-29098	20-29098	20-29098
Quotation No.:			**Chemtest Sample ID.:**		1087486	1087487	1087488	1087489	1087490	1087491	1087492	1087493	1087494
Order No.:			Client Sample Ref.:		6	6	22	6	20	10	12	8	9
			Sample Location:		R9CP01	R9CP02	R9CP03	R9CP04	R9CP05	R9CPGS01	R9CPGS01	R9CPGS02	R9CPGS02
			Sample Type:		SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Top Depth (m):		1.00	1.00	5.00	1.00	2.00	2.00	4.00	1.00	2.00
			Date Sampled:		27-Oct-2020	27-Oct-2020	27-Oct-2020	27-Oct-2020	27-Oct-2020	27-Oct-2020	27-Oct-2020	27-Oct-2020	27-Oct-2020
Determinand	**Accred.**	**SOP**	**Units**	**LOD**									
Moisture	N	2030	%	0.020	11	16	9.5	13	16	12	14	11	8.4
pH	U	2010		4.0	8.6	8.5	8.6	8.6	8.4	8.8	8.8	8.7	8.4
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	0.12	< 0.010	0.057	< 0.010	1.5	< 0.010	< 0.010	< 0.010	0.12
Total Sulphur	U	2175	%	0.010					0.77	0.030		0.041	
Sulphate (Acid Soluble)	U	2430	%	0.010					1.9	0.050		0.039	

Results - Soil

Project: 20-0399D Bus Connects Route 9 Tallaght/Clondalkin to City Centre

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		20-29098	20-29098	20-29098	20-29098	20-29098	20-29098	20-29098
Quotation No.:			**Chemtest Sample ID.:**		1087495	1087496	1087497	1087498	1087499	1087500	1087501
Order No.:			Client Sample Ref.:		12	8	10	7	11	2	2
			Sample Location:		R9CPGS02	R9CPGS03	R9CPGS03	R9CPGS04	R9CPGS04	R9TP04	R9TP05
			Sample Type:		SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Top Depth (m):		5.00	2.00	4.00	1.00	5.00	1.00	1.00
			Date Sampled:		27-Oct-2020	27-Oct-2020	27-Oct-2020	27-Oct-2020	27-Oct-2020	27-Oct-2020	27-Oct-2020
Determinand	**Accred.**	**SOP**	**Units**	**LOD**							
Moisture	N	2030	%	0.020	5.5	10	12	13	6.7	13	10
pH	U	2010		4.0	11.3	10.1	8.7	9.1	9.0	8.7	8.5
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	0.65	0.010	< 0.010	0.013	< 0.010	< 0.010	0.095
Total Sulphur	U	2175	%	0.010		0.065		0.013		0.028	0.25
Sulphate (Acid Soluble)	U	2430	%	0.010		0.055		0.041		0.067	0.087

Test Methods

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
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
2175	Total Sulphur in Soils	Total Sulphur	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2430	Total Sulphate in soils	Total Sulphate	Acid digestion followed by determination of sulphate in extract by ICP-OES.

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

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

Final Report

Report No.:	20-30004-1
Initial Date of Issue:	10-Nov-2020
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 Martin Gardiner Matthew Gilbert Neil Haggan Paul Dunlop Sean Ross Stephen Franey Stephen McCracken Stephen Watson Stuart Abraham Thomas McAllis
Project	20-0399D Bus Connects Route 9

Quotation No.:		**Date Received:**	05-Nov-2020
Order No.:		**Date Instructed:**	05-Nov-2020
No. of Samples:	4		
Turnaround (Wkdays):	5	**Results Due:**	11-Nov-2020
Date Approved:	10-Nov-2020		

Approved By:

Details: Glynn Harvey, Technical Manager

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

Results - Soil

Project: 20-0399D Bus Connects Route 9

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		20-30004	20-30004	20-30004	20-30004
Quotation No.:			**Chemtest Sample ID.:**		1092175	1092176	1092177	1092178
			Sample Location:		R9CPGS01	R9CPGS02	R9CPGS03	R9CPGS04
			Sample Type:		SOIL	SOIL	SOIL	SOIL
			Top Depth (m):		12.0	12.0	10.5	10.5
			Bottom Depth (m):		13.5	13.5	12.0	12.0
			Date Sampled:		04-Nov-2020	04-Nov-2020	04-Nov-2020	04-Nov-2020
Determinand	**Accred.**	**SOP**	**Units**	**LOD**				
Moisture	N	2030	%	0.020	3.7	2.0	1.7	2.0
pH	U	2010		4.0	9.1	8.9	9.2	8.8
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	< 0.010	< 0.010	< 0.010	0.090

Test Methods

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
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

Report Information

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U/S	Unsuitable Sample
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>	"greater than"

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The results relate only to the items tested

Uncertainty of measurement for the determinands tested are available upon request

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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

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

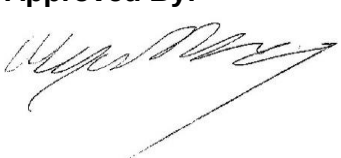
UKAS TESTING
2183

Final Report

Report No.:	20-30603-1
Initial Date of Issue:	16-Nov-2020
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 Martin Gardiner Matthew Gilbert Neil Haggan Paul Dunlop Sean Ross Stephen Franey Stephen McCracken Stephen Watson Stuart Abraham Thomas McAllis
Project	20-0399D ROUTE 9 Tallaght/ Clondalkin to City Centre

Quotation No.:		**Date Received:**	11-Nov-2020
Order No.:		**Date Instructed:**	11-Nov-2020
No. of Samples:	1		
Turnaround (Wkdays):	5	**Results Due:**	17-Nov-2020
Date Approved:	16-Nov-2020		

Approved By:



Details: Glynn Harvey, Technical Manager

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

Results - Soil

Project: 20-0399D ROUTE 9 Tallaght/Clondalkin to City Centre

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		20-30603
Quotation No.:			**Chemtest Sample ID.:**		1095074
Order No.:			Client Sample Ref.:		2
			Sample Location:		R9CP06
			Sample Type:		SOIL
			Top Depth (m):		1.00
			Date Sampled:		09-Nov-2020
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
Moisture	N	2030	%	0.020	11
pH	U	2010		4.0	8.8
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	< 0.010
Total Sulphur	U	2175	%	0.010	0.024
Sulphate (Acid Soluble)	U	2430	%	0.010	0.019

Test Methods

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
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
2175	Total Sulphur in Soils	Total Sulphur	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2430	Total Sulphate in soils	Total Sulphate	Acid digestion followed by determination of sulphate in extract by ICP-OES.

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

LABORATORY RESTRICTION REPORT

Project Reference	20-0399D	To	Sean Ross
Project Name	Bus Connects Route 9 - Tallaght/Clondalkin to City Centre	Position	Project Manager
TR reference	20-0399D / G01	From	Joseph Nicholl
		Position	Laboratory Quality Manager

The following sample(s) and test(s) are restricted as detailed below. Could you please complete the "Required Action" column and return the completed form to the laboratory.

Hole Number	Sample			Test Type	Reason for Restriction	Required Action
	Number	Depth (m)	Type			
R9CP GS02		10.50	C	UU Triaxial	Insufficient intact material to obtain test specimen	CANCEL

For electronic reporting a form of electronic signature or printed name is acceptable

Laboratory Signature Joseph Nicholl	Project Manager Signature Sean Ross
Date 04 November 2020	Date

CAUSEWAY GEOTECH

APPENDIX H

ENVIRONMENTAL LABORATORY TEST RESULTS

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

Final Report

Report No.:	20-26467-1
Initial Date of Issue:	12-Oct-2020
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 Martin Gardiner Matthew Gilbert Neil Haggan Paul Dunlop Sean Ross Stephen Franey Stephen McCracken Stephen Watson Stuart Abraham Thomas McAllis
Project	20-0399D Bus Connects-Greenhills

Quotation No.:	Q20-21063	**Date Received:**	01-Oct-2020
Order No.:		**Date Instructed:**	05-Oct-2020
No. of Samples:	1		
Turnaround (Wkdays):	5	**Results Due:**	09-Oct-2020
Date Approved:	12-Oct-2020		

Approved By:

Details: Glynn Harvey, Technical Manager

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

Results - Leachate

Project: 20-0399D Bus Connects-Greenhills

Client: Causeway Geotech Ltd				**Chemtest Job No.:**		20-26467
Quotation No.: Q20-21063				**Chemtest Sample ID.:**		1073480
				Sample Location:		R9CP01
				Sample Type:		SOIL
				Top Depth (m):		0.50
				Date Sampled:		29-Sep-2020
Determinand	**Accred.**	**SOP**	**Type**	**Units**	**LOD**	
Ammonium	U	1220	10:1	mg/l	0.050	0.071
Ammonium	N	1220	10:1	mg/kg	0.10	0.74

Results - Soil

Project: 20-0399D Bus Connects-Greenhills

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		20-26467
Quotation No.: Q20-21063			**Chemtest Sample ID.:**		1073480
			Sample Location:		R9CP01
			Sample Type:		SOIL
			Top Depth (m):		0.50
			Date Sampled:		29-Sep-2020
			Asbestos Lab:		COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
ACM Type	U	2192		N/A	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected
ACM Detection Stage	U	2192		N/A	-
Moisture	N	2030	%	0.020	10
pH	M	2010		4.0	8.9
Boron (Hot Water Soluble)	M	2120	mg/kg	0.40	< 0.40
Sulphur (Elemental)	M	2180	mg/kg	1.0	1.5
Cyanide (Total)	M	2300	mg/kg	0.50	< 0.50
Sulphide (Easily Liberatable)	N	2325	mg/kg	0.50	8.7
Sulphate (Total)	M	2430	%	0.010	0.024
Arsenic	M	2450	mg/kg	1.0	5.4
Barium	M	2450	mg/kg	10	22
Cadmium	M	2450	mg/kg	0.10	0.85
Chromium	M	2450	mg/kg	1.0	7.1
Molybdenum	M	2450	mg/kg	2.0	< 2.0
Antimony	N	2450	mg/kg	2.0	< 2.0
Copper	M	2450	mg/kg	0.50	12
Mercury	M	2450	mg/kg	0.10	< 0.10
Nickel	M	2450	mg/kg	0.50	20
Lead	M	2450	mg/kg	0.50	8.7
Selenium	M	2450	mg/kg	0.20	0.22
Zinc	M	2450	mg/kg	0.50	35
Chromium (Trivalent)	N	2490	mg/kg	1.0	7.1
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50
Total Organic Carbon	M	2625	%	0.20	0.49
Mineral Oil	N	2670	mg/kg	10	< 10
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0

Results - Soil

Project: 20-0399D Bus Connects-Greenhills

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		20-26467
Quotation No.: Q20-21063			**Chemtest Sample ID.:**		1073480
			Sample Location:		R9CP01
			Sample Type:		SOIL
			Top Depth (m):		0.50
			Date Sampled:		29-Sep-2020
			Asbestos Lab:		COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	< 10
Benzene	M	2760	µg/kg	1.0	< 1.0
Toluene	M	2760	µg/kg	1.0	< 1.0
Ethylbenzene	M	2760	µg/kg	1.0	< 1.0
m & p-Xylene	M	2760	µg/kg	1.0	< 1.0
o-Xylene	M	2760	µg/kg	1.0	< 1.0
Methyl Tert-Butyl Ether	M	2760	µg/kg	1.0	< 1.0
Naphthalene	M	2800	mg/kg	0.10	< 0.10
Acenaphthylene	N	2800	mg/kg	0.10	< 0.10
Acenaphthene	M	2800	mg/kg	0.10	< 0.10
Fluorene	M	2800	mg/kg	0.10	< 0.10
Phenanthrene	M	2800	mg/kg	0.10	< 0.10
Anthracene	M	2800	mg/kg	0.10	< 0.10
Fluoranthene	M	2800	mg/kg	0.10	< 0.10
Pyrene	M	2800	mg/kg	0.10	< 0.10
Benzo[a]anthracene	M	2800	mg/kg	0.10	< 0.10
Chrysene	M	2800	mg/kg	0.10	< 0.10
Benzo[b]fluoranthene	M	2800	mg/kg	0.10	< 0.10
Benzo[k]fluoranthene	M	2800	mg/kg	0.10	< 0.10
Benzo[a]pyrene	M	2800	mg/kg	0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	M	2800	mg/kg	0.10	< 0.10
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	< 0.10
Benzo[g,h,i]perylene	M	2800	mg/kg	0.10	< 0.10
Coronene	N	2800	mg/kg	0.10	< 0.10
Total Of 17 PAH's	N	2800	mg/kg	2.0	< 2.0
PCB 28	U	2815	mg/kg	0.010	< 0.010
PCB 52	U	2815	mg/kg	0.010	< 0.010
PCB 90+101	U	2815	mg/kg	0.010	< 0.010
PCB 118	U	2815	mg/kg	0.010	< 0.010
PCB 153	U	2815	mg/kg	0.010	< 0.010
PCB 138	U	2815	mg/kg	0.010	< 0.010
PCB 180	U	2815	mg/kg	0.010	< 0.010
Total PCBs (7 Congeners)	U	2815	mg/kg	0.10	< 0.10

Results - Soil

Project: 20-0399D Bus Connects-Greenhills

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		20-26467
Quotation No.: Q20-21063			**Chemtest Sample ID.:**		1073480
			Sample Location:		R9CP01
			Sample Type:		SOIL
			Top Depth (m):		0.50
			Date Sampled:		29-Sep-2020
			Asbestos Lab:		COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
Total Phenols	M	2920	mg/kg	0.30	< 0.30

Results - Single Stage WAC

Project: 20-0399D Bus Connects-Greenhills

					Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	20-26467						
Chemtest Sample ID:	1073480						
Sample Ref:							
Sample ID:							
Sample Location:	R9CP01						
Top Depth(m):	0.50						
Bottom Depth(m):							
Sampling Date:	29-Sep-2020						
Determinand	**SOP**	**Accred.**	**Units**		**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Total Organic Carbon	2625	M	%	0.49	3	5	6
Loss On Ignition	2610	M	%	2.7	--	--	10
Total BTEX	2760	M	mg/kg	< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	M	mg/kg	< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	M	mg/kg	< 10	500	--	--
Total (Of 17) PAH's	2800	N	mg/kg	< 2.0	100	--	--
pH	2010	M		8.9	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg	0.13	--	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	1450	U	< 0.0010	< 0.050	0.5	2	25
Barium	1450	U	0.0054	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.050	0.5	10	70
Copper	1450	U	< 0.0010	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.0036	< 0.050	0.5	10	30
Nickel	1450	U	< 0.0010	< 0.050	0.4	10	40
Lead	1450	U	< 0.0010	< 0.010	0.5	10	50
Antimony	1450	U	< 0.0010	< 0.010	0.06	0.7	5
Selenium	1450	U	< 0.0010	< 0.010	0.1	0.5	7
Zinc	1450	U	< 0.0010	< 0.50	4	50	200
Chloride	1220	U	< 1.0	< 10	800	15000	25000
Fluoride	1220	U	< 0.050	< 1.0	10	150	500
Sulphate	1220	U	< 1.0	< 10	1000	20000	50000
Total Dissolved Solids	1020	N	290	2900	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	3.7	< 50	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	10

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
1010	pH Value of Waters	pH	pH Meter
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.
1450	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
2180	Sulphur (Elemental) in Soils by HPLC	Sulphur	Dichloromethane extraction / HPLC with UV detection
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.
2325	Sulphide in Soils	Sulphide	Steam distillation with sulphuric acid / analysis by 'Aquakem 600' Discrete Analyser, using N,N–dimethyl-p-phenylenediamine.
2430	Total Sulphate in soils	Total Sulphate	Acid digestion followed by determination of sulphate in extract by ICP-OES.
2450	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.
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

Test Methods

SOP	Title	Parameters included	Method summary
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
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
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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

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

Final Report

Report No.:	20-26886-1
Initial Date of Issue:	14-Oct-2020
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 Martin Gardiner Matthew Gilbert Neil Haggan Paul Dunlop Sean Ross Stephen Franey Stephen McCracken Stephen Watson Stuart Abraham Thomas McAllis
Project	20-0399D Bus Connects Route 9
Quotation No.:	Q20-21063
Date Received:	06-Oct-2020
Order No.:	
Date Instructed:	08-Oct-2020
No. of Samples:	1
Turnaround (Wkdays):	5
Results Due:	14-Oct-2020
Date Approved:	14-Oct-2020
Approved By:	
Details:	Glynn Harvey, Technical Manager

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

Results - Soil

Project: 20-0399D Bus Connects Route 9

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		20-26886
Quotation No.: Q20-21063			**Chemtest Sample ID.:**		1075650
			Sample Location:		R9-CPGS02
			Sample Type:		SOIL
			Top Depth (m):		2.00
			Date Sampled:		03-Oct-2020
			Asbestos Lab:		COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
ACM Type	U	2192		N/A	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected
ACM Detection Stage	U	2192		N/A	-
Moisture	N	2030	%	0.020	9.9
pH	U	2010		4.0	8.6
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	< 0.40
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	< 0.010
Cyanide (Total)	U	2300	mg/kg	0.50	< 0.50
Arsenic	U	2450	mg/kg	1.0	24
Cadmium	U	2450	mg/kg	0.10	1.7
Chromium	U	2450	mg/kg	1.0	15
Copper	U	2450	mg/kg	0.50	25
Mercury	U	2450	mg/kg	0.10	0.22
Nickel	U	2450	mg/kg	0.50	60
Lead	U	2450	mg/kg	0.50	37
Zinc	U	2450	mg/kg	0.50	83
Organic Matter	U	2625	%	0.40	< 0.40
Total TPH >C6-C40	U	2670	mg/kg	10	< 10
Naphthalene	U	2700	mg/kg	0.10	< 0.10
Acenaphthylene	U	2700	mg/kg	0.10	< 0.10
Acenaphthene	U	2700	mg/kg	0.10	< 0.10
Fluorene	U	2700	mg/kg	0.10	< 0.10
Phenanthrene	U	2700	mg/kg	0.10	< 0.10
Anthracene	U	2700	mg/kg	0.10	< 0.10
Fluoranthene	U	2700	mg/kg	0.10	< 0.10
Pyrene	U	2700	mg/kg	0.10	< 0.10
Benzo[a]anthracene	U	2700	mg/kg	0.10	< 0.10
Chrysene	U	2700	mg/kg	0.10	< 0.10
Benzo[b]fluoranthene	U	2700	mg/kg	0.10	< 0.10
Benzo[k]fluoranthene	U	2700	mg/kg	0.10	< 0.10
Benzo[a]pyrene	U	2700	mg/kg	0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	U	2700	mg/kg	0.10	< 0.10
Dibenz(a,h)Anthracene	U	2700	mg/kg	0.10	< 0.10
Benzo[g,h,i]perylene	U	2700	mg/kg	0.10	< 0.10
Coronene	N	2700	mg/kg	0.10	< 0.10
Total Of 17 PAH's	N	2700	mg/kg	2.0	< 2.0
Total Phenols	U	2920	mg/kg	0.30	< 0.30

Test Methods

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
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.
2450	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.
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
2700	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-FID	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-FID (GC-FID detection is non-selective and can be subject to interference from co-eluting compounds)
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.

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I/S	Insufficient Sample
U/S	Unsuitable Sample
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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

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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

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

Final Report

Report No.:	20-27122-1
Initial Date of Issue:	15-Oct-2020
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 Martin Gardiner Matthew Gilbert Neil Haggan Paul Dunlop Sean Ross Stephen Franey Stephen McCracken Stephen Watson Stuart Abraham Thomas McAllis
Project	20-0399D Bus Connects Route 9

Quotation No.:	Q20-21063	**Date Received:**	08-Oct-2020
Order No.:		**Date Instructed:**	09-Oct-2020
No. of Samples:	1		
Turnaround (Wkdays):	5	**Results Due:**	15-Oct-2020
Date Approved:	15-Oct-2020		

Approved By:

Details: Glynn Harvey, Technical Manager

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

Results - Soil

Project: 20-0399D Bus Connects Route 9

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		20-27122
Quotation No.: Q20-21063			**Chemtest Sample ID.:**		1077012
			Sample Location:		R9-CP04
			Sample Type:		SOIL
			Top Depth (m):		1.50
			Date Sampled:		05-Oct-2020
			Asbestos Lab:		COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
ACM Type	U	2192		N/A	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected
ACM Detection Stage	U	2192		N/A	-
Moisture	N	2030	%	0.020	19
pH	U	2010		4.0	8.3
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	1.2
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	0.10
Cyanide (Total)	U	2300	mg/kg	0.50	< 0.50
Arsenic	U	2450	mg/kg	1.0	25
Cadmium	U	2450	mg/kg	0.10	1.8
Chromium	U	2450	mg/kg	1.0	23
Copper	U	2450	mg/kg	0.50	65
Mercury	U	2450	mg/kg	0.10	0.24
Nickel	U	2450	mg/kg	0.50	60
Lead	U	2450	mg/kg	0.50	87
Zinc	U	2450	mg/kg	0.50	140
Organic Matter	U	2625	%	0.40	2.2
Total TPH >C6-C40	U	2670	mg/kg	10	< 10
Naphthalene	U	2700	mg/kg	0.10	< 0.10
Acenaphthylene	U	2700	mg/kg	0.10	< 0.10
Acenaphthene	U	2700	mg/kg	0.10	< 0.10
Fluorene	U	2700	mg/kg	0.10	< 0.10
Phenanthrene	U	2700	mg/kg	0.10	< 0.10
Anthracene	U	2700	mg/kg	0.10	< 0.10
Fluoranthene	U	2700	mg/kg	0.10	< 0.10
Pyrene	U	2700	mg/kg	0.10	< 0.10
Benzo[a]anthracene	U	2700	mg/kg	0.10	< 0.10
Chrysene	U	2700	mg/kg	0.10	< 0.10
Benzo[b]fluoranthene	U	2700	mg/kg	0.10	< 0.10
Benzo[k]fluoranthene	U	2700	mg/kg	0.10	< 0.10
Benzo[a]pyrene	U	2700	mg/kg	0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	U	2700	mg/kg	0.10	< 0.10
Dibenz(a,h)Anthracene	U	2700	mg/kg	0.10	< 0.10
Benzo[g,h,i]perylene	U	2700	mg/kg	0.10	< 0.10
Coronene	N	2700	mg/kg	0.10	< 0.10
Total Of 17 PAH's	N	2700	mg/kg	2.0	< 2.0
Total Phenols	U	2920	mg/kg	0.30	< 0.30

Test Methods

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
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.
2450	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.
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
2700	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-FID	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-FID (GC-FID detection is non-selective and can be subject to interference from co-eluting compounds)
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.

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

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

Final Report

Report No.:	20-27377-1
Initial Date of Issue:	19-Oct-2020
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 Martin Gardiner Matthew Gilbert Neil Haggan Paul Dunlop Sean Ross Stephen Franey Stephen McCracken Stephen Watson Stuart Abraham Thomas McAllis
Project	20-0399D Bus Connects Route 9
Quotation No.:	Q20-21063
Order No.:	
No. of Samples:	1
Turnaround (Wkdays):	5
Date Approved:	19-Oct-2020
Approved By:	
Details:	Glynn Harvey, Technical Manager

Date Received:	09-Oct-2020
Date Instructed:	13-Oct-2020
Results Due:	19-Oct-2020

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

Results - Soil

Project: 20-0399D Bus Connects Route 9

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		20-27377
Quotation No.: Q20-21063			**Chemtest Sample ID.:**		1078413
			Sample Location:		R9-CP08
			Sample Type:		SOIL
			Top Depth (m):		1.50
			Date Sampled:		07-Oct-2020
			Asbestos Lab:		COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
ACM Type	U	2192		N/A	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected
ACM Detection Stage	U	2192		N/A	-
Moisture	N	2030	%	0.020	11
pH	U	2010		4.0	8.6
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	1.7
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	0.13
Cyanide (Total)	U	2300	mg/kg	0.50	< 0.50
Arsenic	U	2450	mg/kg	1.0	25
Cadmium	U	2450	mg/kg	0.10	2.5
Chromium	U	2450	mg/kg	1.0	19
Copper	U	2450	mg/kg	0.50	32
Mercury	U	2450	mg/kg	0.10	< 0.10
Nickel	U	2450	mg/kg	0.50	60
Lead	U	2450	mg/kg	0.50	54
Zinc	U	2450	mg/kg	0.50	86
Organic Matter	U	2625	%	0.40	0.67
Total TPH >C6-C40	U	2670	mg/kg	10	< 10
Naphthalene	U	2700	mg/kg	0.10	< 0.10
Acenaphthylene	U	2700	mg/kg	0.10	< 0.10
Acenaphthene	U	2700	mg/kg	0.10	< 0.10
Fluorene	U	2700	mg/kg	0.10	< 0.10
Phenanthrene	U	2700	mg/kg	0.10	< 0.10
Anthracene	U	2700	mg/kg	0.10	< 0.10
Fluoranthene	U	2700	mg/kg	0.10	< 0.10
Pyrene	U	2700	mg/kg	0.10	< 0.10
Benzo[a]anthracene	U	2700	mg/kg	0.10	< 0.10
Chrysene	U	2700	mg/kg	0.10	< 0.10
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Benzo[k]fluoranthene	U	2700	mg/kg	0.10	< 0.10
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Coronene	N	2700	mg/kg	0.10	< 0.10
Total Of 17 PAH's	N	2700	mg/kg	2.0	< 2.0
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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.
2450	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.
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
2700	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-FID	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-FID (GC-FID detection is non-selective and can be subject to interference from co-eluting compounds)
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.

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customerservices@chemtest.com

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

Final Report

Report No.:	20-27524-1
Initial Date of Issue:	19-Oct-2020
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 Martin Gardiner Matthew Gilbert Neil Haggan Paul Dunlop Sean Ross Stephen Franey Stephen McCracken Stephen Watson Stuart Abraham Thomas McAllis
Project	20-0399D Bus Connects Route 9
Quotation No.:	Q20-21063
Date Received:	12-Oct-2020
Order No.:	
Date Instructed:	13-Oct-2020
No. of Samples:	6
Turnaround (Wkdays):	5
Results Due:	19-Oct-2020
Date Approved:	19-Oct-2020
Approved By:	
Details:	Glynn Harvey, Technical Manager

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

Results - Leachate

Project: 20-0399D Bus Connects Route 9

Client: Causeway Geotech Ltd				**Chemtest Job No.:**		20-27524	20-27524
Quotation No.: Q20-21063				**Chemtest Sample ID.:**		1079225	1079230
				Sample Location:		TP05	TP09
				Sample Type:		SOIL	SOIL
				Top Depth (m):		1.00	1.00
				Date Sampled:		08-Oct-2020	09-Oct-2020
Determinand	**Accred.**	**SOP**	**Type**	**Units**	**LOD**		
Ammonium	U	1220	10:1	mg/l	0.050	0.056	0.066
Ammonium	N	1220	10:1	mg/kg	0.10	0.71	0.78

Results - Soil

Project: 20-0399D Bus Connects Route 9

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		20-27524	20-27524	20-27524	20-27524	20-27524	20-27524
Quotation No.: Q20-21063			**Chemtest Sample ID.:**		1079222	1079225	1079227	1079230	1079232	1079240
			Sample Location:		TP04	TP05	TP06	TP09	TP09	TP11
			Sample Type:		SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Top Depth (m):		1.50	1.00	0.50	1.00	2.00	1.00
			Date Sampled:		08-Oct-2020	08-Oct-2020	08-Oct-2020	09-Oct-2020	09-Oct-2020	08-Oct-2020
			Asbestos Lab:		COVENTRY	COVENTRY	COVENTRY	DURHAM	COVENTRY	COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**						
ACM Type	U	2192		N/A	-	-	-	-	-	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
ACM Detection Stage	U	2192		N/A	-	-	-	-	-	-
Moisture	N	2030	%	0.020	10	13	9.5	10	23	13
pH	M	2010		4.0	8.7	8.6	8.5	8.8	8.3	8.7
Boron (Hot Water Soluble)	M	2120	mg/kg	0.40	0.67	0.44	0.48	0.72	1.5	0.84
Sulphate (2:1 Water Soluble) as SO4	M	2120	g/l	0.010	< 0.010		0.13		0.24	< 0.010
Sulphur (Elemental)	M	2180	mg/kg	1.0		3.7		7.3		
Cyanide (Total)	M	2300	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Sulphide (Easily Liberatable)	N	2325	mg/kg	0.50		13		9.9		
Sulphate (Total)	M	2430	%	0.010		0.071		0.13		
Arsenic	M	2450	mg/kg	1.0	14	18	35	25	86	21
Barium	M	2450	mg/kg	10		80		350		
Cadmium	M	2450	mg/kg	0.10	2.2	1.4	1.8	1.4	1.2	1.9
Chromium	M	2450	mg/kg	1.0	18	17	21	17	81	19
Molybdenum	M	2450	mg/kg	2.0		2.1		4.6		
Antimony	N	2450	mg/kg	2.0		< 2.0		3.8		
Copper	M	2450	mg/kg	0.50	25	30	38	61	280	47
Mercury	M	2450	mg/kg	0.10	< 0.10	0.20	0.25	0.43	0.51	0.37
Nickel	M	2450	mg/kg	0.50	40	37	46	44	120	43
Lead	M	2450	mg/kg	0.50	36	92	90	130	710	120
Selenium	M	2450	mg/kg	0.20		0.36		0.34		
Zinc	M	2450	mg/kg	0.50	95	85	280	340	570	120
Chromium (Trivalent)	N	2490	mg/kg	1.0		17		17		
Chromium (Hexavalent)	N	2490	mg/kg	0.50		< 0.50		< 0.50		
Organic Matter	M	2625	%	0.40	1.7		2.8		19	4.1
Total Organic Carbon	M	2625	%	0.20		1.9		3.3		
Mineral Oil	N	2670	mg/kg	10		< 10		24		
Total TPH >C6-C40	M	2670	mg/kg	10	< 10		55		860	62
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0		< 1.0		< 1.0		
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0		< 1.0		< 1.0		
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0		< 1.0		6.2		
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0		< 1.0		2.3		
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0		< 1.0		1.4		
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0		< 1.0		1.2		
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0		< 1.0		11		
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0		< 1.0		1.9		
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0		< 5.0		24		

Results - Soil

Project: 20-0399D Bus Connects Route 9

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		20-27524	20-27524	20-27524	20-27524	20-27524	20-27524
Quotation No.: Q20-21063			**Chemtest Sample ID.:**		1079222	1079225	1079227	1079230	1079232	1079240
			Sample Location:		TP04	TP05	TP06	TP09	TP09	TP11
			Sample Type:		SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Top Depth (m):		1.50	1.00	0.50	1.00	2.00	1.00
			Date Sampled:		08-Oct-2020	08-Oct-2020	08-Oct-2020	09-Oct-2020	09-Oct-2020	08-Oct-2020
			Asbestos Lab:		COVENTRY	COVENTRY	COVENTRY	DURHAM	COVENTRY	COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**						
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0		< 1.0		< 1.0		
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0		< 1.0		< 1.0		
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0		< 1.0		1.2		
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0		< 1.0		1.3		
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0		< 1.0		2.2		
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0		< 1.0		5.3		
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0		< 1.0		57		
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0		< 1.0		3.7		
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0		< 5.0		71		
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0		< 10		94		
Naphthalene	M	2700	mg/kg	0.10	< 0.10		0.32		< 0.10	< 0.10
Acenaphthylene	M	2700	mg/kg	0.10	< 0.10		0.33		< 0.10	< 0.10
Acenaphthene	M	2700	mg/kg	0.10	< 0.10		1.3		< 0.10	< 0.10
Fluorene	M	2700	mg/kg	0.10	< 0.10		1.4		< 0.10	< 0.10
Phenanthrene	M	2700	mg/kg	0.10	< 0.10		7.7		< 0.10	0.88
Anthracene	M	2700	mg/kg	0.10	< 0.10		2.7		< 0.10	0.17
Fluoranthene	M	2700	mg/kg	0.10	< 0.10		11		1.6	1.6
Pyrene	M	2700	mg/kg	0.10	< 0.10		10		2.8	1.9
Benzo[a]anthracene	M	2700	mg/kg	0.10	< 0.10		4.9		1.6	0.97
Chrysene	M	2700	mg/kg	0.10	< 0.10		4.3		1.5	0.87
Benzo[b]fluoranthene	M	2700	mg/kg	0.10	< 0.10		6.2		3.7	1.6
Benzo[k]fluoranthene	M	2700	mg/kg	0.10	< 0.10		2.8		1.8	0.71
Benzo[a]pyrene	M	2700	mg/kg	0.10	< 0.10		5.3		3.0	1.2
Indeno(1,2,3-c,d)Pyrene	M	2700	mg/kg	0.10	< 0.10		3.1		2.2	0.78
Dibenz(a,h)Anthracene	M	2700	mg/kg	0.10	< 0.10		1.9		1.9	0.50
Benzo[g,h,i]perylene	M	2700	mg/kg	0.10	< 0.10		3.1		2.6	0.81
Coronene	N	2700	mg/kg	0.10	< 0.10		< 0.10		< 0.10	< 0.10
Total Of 17 PAH's	N	2700	mg/kg	2.0	< 2.0		66		23	12
Benzene	M	2760	µg/kg	1.0		< 1.0		< 1.0		
Toluene	M	2760	µg/kg	1.0		< 1.0		< 1.0		
Ethylbenzene	M	2760	µg/kg	1.0		< 1.0		< 1.0		
m & p-Xylene	M	2760	µg/kg	1.0		< 1.0		< 1.0		
o-Xylene	M	2760	µg/kg	1.0		< 1.0		< 1.0		
Methyl Tert-Butyl Ether	M	2760	µg/kg	1.0		< 1.0		< 1.0		
Naphthalene	M	2800	mg/kg	0.10		< 0.10		0.16		
Acenaphthylene	N	2800	mg/kg	0.10		< 0.10		0.10		
Acenaphthene	M	2800	mg/kg	0.10		< 0.10		0.11		
Fluorene	M	2800	mg/kg	0.10		< 0.10		0.13		
Phenanthrene	M	2800	mg/kg	0.10		< 0.10		1.4		

Results - Soil

Project: 20-0399D Bus Connects Route 9

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		20-27524	20-27524	20-27524	20-27524	20-27524	20-27524
Quotation No.: Q20-21063			**Chemtest Sample ID.:**		1079222	1079225	1079227	1079230	1079232	1079240
			Sample Location:		TP04	TP05	TP06	TP09	TP09	TP11
			Sample Type:		SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Top Depth (m):		1.50	1.00	0.50	1.00	2.00	1.00
			Date Sampled:		08-Oct-2020	08-Oct-2020	08-Oct-2020	09-Oct-2020	09-Oct-2020	08-Oct-2020
			Asbestos Lab:		COVENTRY	COVENTRY	COVENTRY	DURHAM	COVENTRY	COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**						
Anthracene	M	2800	mg/kg	0.10		< 0.10		0.34		
Fluoranthene	M	2800	mg/kg	0.10		0.19		3.7		
Pyrene	M	2800	mg/kg	0.10		0.17		3.3		
Benzo[a]anthracene	M	2800	mg/kg	0.10		0.18		2.4		
Chrysene	M	2800	mg/kg	0.10		0.18		2.1		
Benzo[b]fluoranthene	M	2800	mg/kg	0.10		0.27		3.3		
Benzo[k]fluoranthene	M	2800	mg/kg	0.10		0.19		1.4		
Benzo[a]pyrene	M	2800	mg/kg	0.10		0.26		3.2		
Indeno(1,2,3-c,d)Pyrene	M	2800	mg/kg	0.10		0.43		3.2		
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10		0.41		0.67		
Benzo[g,h,i]perylene	M	2800	mg/kg	0.10		0.43		2.6		
Coronene	N	2800	mg/kg	0.10		< 0.10		< 0.10		
Total Of 17 PAH's	N	2800	mg/kg	2.0		2.7		28		
PCB 28	U	2815	mg/kg	0.010		< 0.010		< 0.010		
PCB 52	U	2815	mg/kg	0.010		< 0.010		< 0.010		
PCB 90+101	U	2815	mg/kg	0.010		< 0.010		< 0.010		
PCB 118	U	2815	mg/kg	0.010		< 0.010		< 0.010		
PCB 153	U	2815	mg/kg	0.010		< 0.010		< 0.010		
PCB 138	U	2815	mg/kg	0.010		< 0.010		< 0.010		
PCB 180	U	2815	mg/kg	0.010		< 0.010		< 0.010		
Total PCBs (7 Congeners)	U	2815	mg/kg	0.10		< 0.10		< 0.10		
Total Phenols	M	2920	mg/kg	0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30

Results - Single Stage WAC

Project: 20-0399D Bus Connects Route 9

					Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	20-27524						
Chemtest Sample ID:	1079225						
Sample Ref:							
Sample ID:							
Sample Location:	TP05						
Top Depth(m):	1.00						
Bottom Depth(m):							
Sampling Date:	08-Oct-2020						
Determinand	**SOP**	**Accred.**	**Units**		**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Total Organic Carbon	2625	M	%	1.9	3	5	6
Loss On Ignition	2610	M	%	5.3	--	--	10
Total BTEX	2760	M	mg/kg	< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	M	mg/kg	< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	M	mg/kg	< 10	500	--	--
Total (Of 17) PAH's	2800	N	mg/kg	2.7	100	--	--
pH	2010	M		8.6	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg	0.018	--	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	1450	U	< 0.0010	< 0.050	0.5	2	25
Barium	1450	U	0.0082	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.050	0.5	10	70
Copper	1450	U	0.0014	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.0021	< 0.050	0.5	10	30
Nickel	1450	U	< 0.0010	< 0.050	0.4	10	40
Lead	1450	U	< 0.0010	< 0.010	0.5	10	50
Antimony	1450	U	< 0.0010	< 0.010	0.06	0.7	5
Selenium	1450	U	< 0.0010	< 0.010	0.1	0.5	7
Zinc	1450	U	< 0.0010	< 0.50	4	50	200
Chloride	1220	U	< 1.0	< 10	800	15000	25000
Fluoride	1220	U	0.29	2.9	10	150	500
Sulphate	1220	U	3.1	31	1000	20000	50000
Total Dissolved Solids	1020	N	150	1500	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	6.2	62	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	13

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: 20-0399D Bus Connects Route 9

					Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	20-27524						
Chemtest Sample ID:	1079230						
Sample Ref:							
Sample ID:							
Sample Location:	TP09						
Top Depth(m):	1.00						
Bottom Depth(m):							
Sampling Date:	09-Oct-2020						
Determinand	**SOP**	**Accred.**	**Units**		**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Total Organic Carbon	2625	M	%	3.3	3	5	6
Loss On Ignition	2610	M	%	6.4	--	--	10
Total BTEX	2760	M	mg/kg	< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	M	mg/kg	< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	M	mg/kg	94	500	--	--
Total (Of 17) PAH's	2800	N	mg/kg	28	100	--	--
pH	2010	M		8.8	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg	0.012	--	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	1450	U	0.0010	< 0.050	0.5	2	25
Barium	1450	U	0.033	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.050	0.5	10	70
Copper	1450	U	0.0013	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.012	0.12	0.5	10	30
Nickel	1450	U	< 0.0010	< 0.050	0.4	10	40
Lead	1450	U	< 0.0010	< 0.010	0.5	10	50
Antimony	1450	U	0.0019	0.019	0.06	0.7	5
Selenium	1450	U	< 0.0010	< 0.010	0.1	0.5	7
Zinc	1450	U	0.0067	< 0.50	4	50	200
Chloride	1220	U	< 1.0	< 10	800	15000	25000
Fluoride	1220	U	0.28	2.8	10	150	500
Sulphate	1220	U	5.6	56	1000	20000	50000
Total Dissolved Solids	1020	N	150	1500	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	4.4	< 50	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	10

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
1010	pH Value of Waters	pH	pH Meter
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.
1450	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
2180	Sulphur (Elemental) in Soils by HPLC	Sulphur	Dichloromethane extraction / HPLC with UV detection
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.
2325	Sulphide in Soils	Sulphide	Steam distillation with sulphuric acid / analysis by 'Aquakem 600' Discrete Analyser, using N,N–dimethyl-p-phenylenediamine.
2430	Total Sulphate in soils	Total Sulphate	Acid digestion followed by determination of sulphate in extract by ICP-OES.
2450	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.
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

Test Methods

SOP	Title	Parameters included	Method summary
2700	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-FID	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-FID (GC-FID detection is non-selective and can be subject to interference from co-eluting compounds)
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
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"

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

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

Final Report

Report No.:	20-27739-1
Initial Date of Issue:	02-Nov-2020
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 Martin Gardiner Matthew Gilbert Neil Haggan Paul Dunlop Sean Ross Stephen Franey Stephen McCracken Stephen Watson Stuart Abraham Thomas McAllis
Project	20-0399D Bus Connects Route 9

Quotation No.:	Q20-21063	**Date Received:**	14-Oct-2020
Order No.:	R8765/0005	**Date Instructed:**	28-Oct-2020
No. of Samples:	1		
Turnaround (Wkdays):	5	**Results Due:**	03-Nov-2020
Date Approved:	02-Nov-2020		

Approved By:

Details: Glynn Harvey, Technical Manager

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

Results - Leachate

Project: 20-0399D Bus Connects Route 9

Client: Causeway Geotech Ltd				**Chemtest Job No.:**		20-27739
Quotation No.: Q20-21063				**Chemtest Sample ID.:**		1080543
				Sample Location:		R9-CP05
				Sample Type:		SOIL
				Top Depth (m):		1.50
				Date Sampled:		12-Oct-2020
Determinand	**Accred.**	**SOP**	**Type**	**Units**	**LOD**	
Ammonium	U	1220	10:1	mg/l	0.050	< 0.050
Ammonium	N	1220	10:1	mg/kg	0.10	0.41

Results - Soil

Project: 20-0399D Bus Connects Route 9

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		20-27739
Quotation No.: Q20-21063			**Chemtest Sample ID.:**		1080543
			Sample Location:		R9-CP05
			Sample Type:		SOIL
			Top Depth (m):		1.50
			Date Sampled:		12-Oct-2020
			Asbestos Lab:		COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
ACM Type	U	2192		N/A	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected
ACM Detection Stage	U	2192		N/A	-
Moisture	N	2030	%	0.020	11
pH	M	2010		4.0	9.3
Boron (Hot Water Soluble)	M	2120	mg/kg	0.40	0.42
Sulphur (Elemental)	M	2180	mg/kg	1.0	1.9
Cyanide (Total)	M	2300	mg/kg	0.50	[B] < 0.50
Sulphide (Easily Liberatable)	N	2325	mg/kg	0.50	7.9
Sulphate (Total)	M	2430	%	0.010	0.089
Arsenic	M	2450	mg/kg	1.0	20
Barium	M	2450	mg/kg	10	53
Cadmium	M	2450	mg/kg	0.10	1.9
Chromium	M	2450	mg/kg	1.0	15
Molybdenum	M	2450	mg/kg	2.0	3.6
Antimony	N	2450	mg/kg	2.0	< 2.0
Copper	M	2450	mg/kg	0.50	28
Mercury	M	2450	mg/kg	0.10	< 0.10
Nickel	M	2450	mg/kg	0.50	48
Lead	M	2450	mg/kg	0.50	19
Selenium	M	2450	mg/kg	0.20	0.41
Zinc	M	2450	mg/kg	0.50	76
Chromium (Trivalent)	N	2490	mg/kg	1.0	15
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50
Total Organic Carbon	M	2625	%	0.20	0.51
Mineral Oil	N	2670	mg/kg	10	< 10
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	[B] < 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	[B] < 1.0
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0	[B] < 1.0
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0	[B] < 1.0
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0	[B] < 1.0
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0	[B] < 1.0
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0	[B] < 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	[B] < 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	[B] < 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	[B] < 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	[B] < 1.0
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0	[B] < 1.0

Results - Soil

Project: 20-0399D Bus Connects Route 9

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		20-27739
Quotation No.: Q20-21063			**Chemtest Sample ID.:**		1080543
			Sample Location:		R9-CP05
			Sample Type:		SOIL
			Top Depth (m):		1.50
			Date Sampled:		12-Oct-2020
			Asbestos Lab:		COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0	[B] < 1.0
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0	[B] < 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	[B] < 1.0
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0	[B] < 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	[B] < 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	[B] < 5.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	[B] < 10
Benzene	M	2760	µg/kg	1.0	[B] < 1.0
Toluene	M	2760	µg/kg	1.0	[B] < 1.0
Ethylbenzene	M	2760	µg/kg	1.0	[B] < 1.0
m & p-Xylene	M	2760	µg/kg	1.0	[B] < 1.0
o-Xylene	M	2760	µg/kg	1.0	[B] < 1.0
Methyl Tert-Butyl Ether	M	2760	µg/kg	1.0	[B] < 1.0
Naphthalene	M	2800	mg/kg	0.10	< 0.10
Acenaphthylene	N	2800	mg/kg	0.10	< 0.10
Acenaphthene	M	2800	mg/kg	0.10	< 0.10
Fluorene	M	2800	mg/kg	0.10	< 0.10
Phenanthrene	M	2800	mg/kg	0.10	< 0.10
Anthracene	M	2800	mg/kg	0.10	< 0.10
Fluoranthene	M	2800	mg/kg	0.10	< 0.10
Pyrene	M	2800	mg/kg	0.10	< 0.10
Benzo[a]anthracene	M	2800	mg/kg	0.10	< 0.10
Chrysene	M	2800	mg/kg	0.10	< 0.10
Benzo[b]fluoranthene	M	2800	mg/kg	0.10	< 0.10
Benzo[k]fluoranthene	M	2800	mg/kg	0.10	< 0.10
Benzo[a]pyrene	M	2800	mg/kg	0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	M	2800	mg/kg	0.10	< 0.10
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	< 0.10
Benzo[g,h,i]perylene	M	2800	mg/kg	0.10	< 0.10
Coronene	N	2800	mg/kg	0.10	< 0.10
Total Of 17 PAH's	N	2800	mg/kg	2.0	< 2.0
PCB 28	U	2815	mg/kg	0.010	< 0.010
PCB 52	U	2815	mg/kg	0.010	< 0.010
PCB 90+101	U	2815	mg/kg	0.010	< 0.010
PCB 118	U	2815	mg/kg	0.010	< 0.010
PCB 153	U	2815	mg/kg	0.010	< 0.010
PCB 138	U	2815	mg/kg	0.010	< 0.010
PCB 180	U	2815	mg/kg	0.010	< 0.010
Total PCBs (7 Congeners)	U	2815	mg/kg	0.10	< 0.10

Results - Soil

Project: 20-0399D Bus Connects Route 9

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		20-27739
Quotation No.: Q20-21063			**Chemtest Sample ID.:**		1080543
			Sample Location:		R9-CP05
			Sample Type:		SOIL
			Top Depth (m):		1.50
			Date Sampled:		12-Oct-2020
			Asbestos Lab:		COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
Total Phenols	M	2920	mg/kg	0.30	< 0.30

Results - Single Stage WAC

Project: 20-0399D Bus Connects Route 9

					Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	20-27739						
Chemtest Sample ID:	1080543						
Sample Ref:							
Sample ID:							
Sample Location:	R9-CP05						
Top Depth(m):	1.50						
Bottom Depth(m):							
Sampling Date:	12-Oct-2020						
Determinand	**SOP**	**Accred.**	**Units**		**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Total Organic Carbon	2625	M	%	0.51	3	5	6
Loss On Ignition	2610	M	%	2.1	--	--	10
Total BTEX	2760	M	mg/kg	[B] < 0.010	6	--	--
Total PCBs (7 Congeners)	2815	M	mg/kg	< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	M	mg/kg	[B] < 10	500	--	--
Total (Of 17) PAH's	2800	N	mg/kg	< 2.0	100	--	--
pH	2010	M		9.3	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg	0.049	--	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	1450	U	< 0.0010	< 0.050	0.5	2	25
Barium	1450	U	0.0010	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.050	0.5	10	70
Copper	1450	U	< 0.0010	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.0057	0.057	0.5	10	30
Nickel	1450	U	< 0.0010	< 0.050	0.4	10	40
Lead	1450	U	< 0.0010	< 0.010	0.5	10	50
Antimony	1450	U	< 0.0010	< 0.010	0.06	0.7	5
Selenium	1450	U	< 0.0010	< 0.010	0.1	0.5	7
Zinc	1450	U	< 0.0010	< 0.50	4	50	200
Chloride	1220	U	< 1.0	< 10	800	15000	25000
Fluoride	1220	U	0.32	3.2	10	150	500
Sulphate	1220	U	11	110	1000	20000	50000
Total Dissolved Solids	1020	N	72	710	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	4.2	< 50	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	11

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.

Deviations

In accordance with UKAS Policy on Deviating Samples TPS 63. Chemtest have a procedure to ensure 'upon receipt of each sample a competent laboratory shall assess whether the sample is suitable with regard to the requested test(s)'. This policy and the respective holding times applied, can be supplied upon request.The reason a sample is declared as deviating is detailed below. Where applicable the analysis remains UKAS/MCERTs accredited but the results may be compromised.

Sample:	Sample Ref:	Sample ID:	Sample Location:	Sampled Date:	Deviation Code(s):	Containers Received:
1080543			R9-CP05	12-Oct-2020	B	Amber Glass 250ml
1080543			R9-CP05	12-Oct-2020	B	Amber Glass 60ml
1080543			R9-CP05	12-Oct-2020	B	Plastic Tub 500g

Test Methods

SOP	Title	Parameters included	Method summary
1010	pH Value of Waters	pH	pH Meter
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.
1450	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
2180	Sulphur (Elemental) in Soils by HPLC	Sulphur	Dichloromethane extraction / HPLC with UV detection
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.
2325	Sulphide in Soils	Sulphide	Steam distillation with sulphuric acid / analysis by 'Aquakem 600' Discrete Analyser, using N,N–dimethyl-p-phenylenediamine.
2430	Total Sulphate in soils	Total Sulphate	Acid digestion followed by determination of sulphate in extract by ICP-OES.
2450	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.
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

Test Methods

SOP	Title	Parameters included	Method summary
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
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

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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

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

Final Report

Report No.:	20-27893-1
Initial Date of Issue:	20-Oct-2020
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 Martin Gardiner Matthew Gilbert Neil Haggan Paul Dunlop Sean Ross Stephen Franey Stephen McCracken Stephen Watson Stuart Abraham Thomas McAllis
Project	20-0399D Bus Connects Route 9

Quotation No.:	Q20-21063	**Date Received:**	15-Oct-2020
Order No.:		**Date Instructed:**	15-Oct-2020
No. of Samples:	1		
Turnaround (Wkdays):	5	**Results Due:**	21-Oct-2020
Date Approved:	20-Oct-2020		

Approved By:

Details: Glynn Harvey, Technical Manager

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

Results - Soil

Project: 20-0399D Bus Connects Route 9

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		20-27893
Quotation No.: Q20-21063			**Chemtest Sample ID.:**		1081298
			Sample Location:		TP08
			Sample Type:		SOIL
			Top Depth (m):		0.50
			Date Sampled:		08-Oct-2020
			Asbestos Lab:		COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
ACM Type	U	2192		N/A	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected
ACM Detection Stage	U	2192		N/A	-
Moisture	N	2030	%	0.020	7.1
pH	U	2010		4.0	8.8
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	0.52
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	< 0.010
Cyanide (Total)	U	2300	mg/kg	0.50	< 0.50
Arsenic	U	2450	mg/kg	1.0	23
Cadmium	U	2450	mg/kg	0.10	1.3
Chromium	U	2450	mg/kg	1.0	30
Copper	U	2450	mg/kg	0.50	36
Mercury	U	2450	mg/kg	0.10	< 0.10
Nickel	U	2450	mg/kg	0.50	47
Lead	U	2450	mg/kg	0.50	51
Zinc	U	2450	mg/kg	0.50	110
Organic Matter	U	2625	%	0.40	1.0
Total TPH >C6-C40	U	2670	mg/kg	10	< 10
Naphthalene	U	2700	mg/kg	0.10	< 0.10
Acenaphthylene	U	2700	mg/kg	0.10	< 0.10
Acenaphthene	U	2700	mg/kg	0.10	< 0.10
Fluorene	U	2700	mg/kg	0.10	< 0.10
Phenanthrene	U	2700	mg/kg	0.10	< 0.10
Anthracene	U	2700	mg/kg	0.10	< 0.10
Fluoranthene	U	2700	mg/kg	0.10	0.28
Pyrene	U	2700	mg/kg	0.10	0.31
Benzo[a]anthracene	U	2700	mg/kg	0.10	< 0.10
Chrysene	U	2700	mg/kg	0.10	< 0.10
Benzo[b]fluoranthene	U	2700	mg/kg	0.10	< 0.10
Benzo[k]fluoranthene	U	2700	mg/kg	0.10	< 0.10
Benzo[a]pyrene	U	2700	mg/kg	0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	U	2700	mg/kg	0.10	< 0.10
Dibenz(a,h)Anthracene	U	2700	mg/kg	0.10	< 0.10
Benzo[g,h,i]perylene	U	2700	mg/kg	0.10	< 0.10
Coronene	N	2700	mg/kg	0.10	< 0.10
Total Of 17 PAH's	N	2700	mg/kg	2.0	< 2.0
Total Phenols	U	2920	mg/kg	0.30	< 0.30

Test Methods

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
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.
2450	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.
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
2700	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-FID	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-FID (GC-FID detection is non-selective and can be subject to interference from co-eluting compounds)
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.

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
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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

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

Final Report

Report No.:	20-29281-1
Initial Date of Issue:	04-Nov-2020
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 Martin Gardiner Matthew Gilbert Neil Haggan Paul Dunlop Sean Ross Stephen Franey Stephen McCracken Stephen Watson Stuart Abraham Thomas McAllis
Project	20-0399D Bus Connects Route 9

Quotation No.:	Q20-21063	**Date Received:**	29-Oct-2020
Order No.:		**Date Instructed:**	29-Oct-2020
No. of Samples:	1		
Turnaround (Wkdays):	5	**Results Due:**	04-Nov-2020
Date Approved:	04-Nov-2020		

Approved By:

Details: Glynn Harvey, Technical Manager

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

Results - Leachate

Project: 20-0399D Bus Connects Route 9

Client: Causeway Geotech Ltd				**Chemtest Job No.:**		20-29281
Quotation No.: Q20-21063				**Chemtest Sample ID.:**		1088392
				Sample Location:		TP07
				Sample Type:		SOIL
				Top Depth (m):		0.50
				Date Sampled:		26-Oct-2020
Determinand	**Accred.**	**SOP**	**Type**	**Units**	**LOD**	
Ammonium	U	1220	10:1	mg/l	0.050	0.051
Ammonium	N	1220	10:1	mg/kg	0.10	0.65

Results - Soil

Project: 20-0399D Bus Connects Route 9

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		20-29281
Quotation No.: Q20-21063			**Chemtest Sample ID.:**		1088392
			Sample Location:		TP07
			Sample Type:		SOIL
			Top Depth (m):		0.50
			Date Sampled:		26-Oct-2020
			Asbestos Lab:		COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
ACM Type	U	2192		N/A	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected
ACM Detection Stage	U	2192		N/A	-
Moisture	N	2030	%	0.020	8.5
pH	M	2010		4.0	8.9
Boron (Hot Water Soluble)	M	2120	mg/kg	0.40	0.62
Sulphur (Elemental)	M	2180	mg/kg	1.0	6.0
Cyanide (Total)	M	2300	mg/kg	0.50	< 0.50
Sulphide (Easily Liberatable)	N	2325	mg/kg	0.50	12
Sulphate (Total)	M	2430	%	0.010	0.22
Arsenic	M	2450	mg/kg	1.0	19
Barium	M	2450	mg/kg	10	88
Cadmium	M	2450	mg/kg	0.10	1.4
Chromium	M	2450	mg/kg	1.0	16
Molybdenum	M	2450	mg/kg	2.0	3.4
Antimony	N	2450	mg/kg	2.0	2.4
Copper	M	2450	mg/kg	0.50	44
Mercury	M	2450	mg/kg	0.10	0.27
Nickel	M	2450	mg/kg	0.50	38
Lead	M	2450	mg/kg	0.50	110
Selenium	M	2450	mg/kg	0.20	0.54
Zinc	M	2450	mg/kg	0.50	120
Chromium (Trivalent)	N	2490	mg/kg	1.0	16
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50
Total Organic Carbon	M	2625	%	0.20	1.6
Mineral Oil	N	2670	mg/kg	10	< 10
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0

Results - Soil

Project: 20-0399D Bus Connects Route 9

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		20-29281
Quotation No.: Q20-21063			**Chemtest Sample ID.:**		1088392
			Sample Location:		TP07
			Sample Type:		SOIL
			Top Depth (m):		0.50
			Date Sampled:		26-Oct-2020
			Asbestos Lab:		COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	< 10
Benzene	M	2760	µg/kg	1.0	< 1.0
Toluene	M	2760	µg/kg	1.0	< 1.0
Ethylbenzene	M	2760	µg/kg	1.0	< 1.0
m & p-Xylene	M	2760	µg/kg	1.0	< 1.0
o-Xylene	M	2760	µg/kg	1.0	< 1.0
Methyl Tert-Butyl Ether	M	2760	µg/kg	1.0	< 1.0
Naphthalene	M	2800	mg/kg	0.10	< 0.10
Acenaphthylene	N	2800	mg/kg	0.10	< 0.10
Acenaphthene	M	2800	mg/kg	0.10	< 0.10
Fluorene	M	2800	mg/kg	0.10	< 0.10
Phenanthrene	M	2800	mg/kg	0.10	0.64
Anthracene	M	2800	mg/kg	0.10	0.13
Fluoranthene	M	2800	mg/kg	0.10	1.5
Pyrene	M	2800	mg/kg	0.10	1.3
Benzo[a]anthracene	M	2800	mg/kg	0.10	< 0.10
Chrysene	M	2800	mg/kg	0.10	< 0.10
Benzo[b]fluoranthene	M	2800	mg/kg	0.10	< 0.10
Benzo[k]fluoranthene	M	2800	mg/kg	0.10	< 0.10
Benzo[a]pyrene	M	2800	mg/kg	0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	M	2800	mg/kg	0.10	< 0.10
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	< 0.10
Benzo[g,h,i]perylene	M	2800	mg/kg	0.10	< 0.10
Coronene	N	2800	mg/kg	0.10	< 0.10
Total Of 17 PAH's	N	2800	mg/kg	2.0	3.6
PCB 28	U	2815	mg/kg	0.010	< 0.010
PCB 52	U	2815	mg/kg	0.010	< 0.010
PCB 90+101	U	2815	mg/kg	0.010	< 0.010
PCB 118	U	2815	mg/kg	0.010	< 0.010
PCB 153	U	2815	mg/kg	0.010	< 0.010
PCB 138	U	2815	mg/kg	0.010	< 0.010
PCB 180	U	2815	mg/kg	0.010	< 0.010
Total PCBs (7 Congeners)	U	2815	mg/kg	0.10	< 0.10

Results - Soil

Project: 20-0399D Bus Connects Route 9

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		20-29281
Quotation No.: Q20-21063			**Chemtest Sample ID.:**		1088392
			Sample Location:		TP07
			Sample Type:		SOIL
			Top Depth (m):		0.50
			Date Sampled:		26-Oct-2020
			Asbestos Lab:		COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
Total Phenols	M	2920	mg/kg	0.30	< 0.30

Results - Single Stage WAC

Project: 20-0399D Bus Connects Route 9

					Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	20-29281						
Chemtest Sample ID:	1088392						
Sample Ref:							
Sample ID:							
Sample Location:	TP07						
Top Depth(m):	0.50						
Bottom Depth(m):							
Sampling Date:	26-Oct-2020						
Determinand	**SOP**	**Accred.**	**Units**		**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Total Organic Carbon	2625	M	%	1.6	3	5	6
Loss On Ignition	2610	M	%	3.9	--	--	10
Total BTEX	2760	M	mg/kg	< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	M	mg/kg	< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	M	mg/kg	< 10	500	--	--
Total (Of 17) PAH's	2800	N	mg/kg	3.6	100	--	--
pH	2010	M		8.9	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg	0.042	--	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	1450	U	< 0.0010	< 0.050	0.5	2	25
Barium	1450	U	0.010	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.050	0.5	10	70
Copper	1450	U	< 0.0010	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.010	0.10	0.5	10	30
Nickel	1450	U	< 0.0010	< 0.050	0.4	10	40
Lead	1450	U	< 0.0010	< 0.010	0.5	10	50
Antimony	1450	U	< 0.0010	< 0.010	0.06	0.7	5
Selenium	1450	U	< 0.0010	< 0.010	0.1	0.5	7
Zinc	1450	U	< 0.0010	< 0.50	4	50	200
Chloride	1220	U	< 1.0	< 10	800	15000	25000
Fluoride	1220	U	0.34	3.4	10	150	500
Sulphate	1220	U	3.9	39	1000	20000	50000
Total Dissolved Solids	1020	N	91	910	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	5.5	55	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	8.5

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
1010	pH Value of Waters	pH	pH Meter
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.
1450	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
2180	Sulphur (Elemental) in Soils by HPLC	Sulphur	Dichloromethane extraction / HPLC with UV detection
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.
2325	Sulphide in Soils	Sulphide	Steam distillation with sulphuric acid / analysis by 'Aquakem 600' Discrete Analyser, using N,N–dimethyl-p-phenylenediamine.
2430	Total Sulphate in soils	Total Sulphate	Acid digestion followed by determination of sulphate in extract by ICP-OES.
2450	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.
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

Test Methods

SOP	Title	Parameters included	Method summary
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
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

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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

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

Final Report

Report No.:	20-29604-1
Initial Date of Issue:	06-Nov-2020
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 Martin Gardiner Matthew Gilbert Neil Haggan Paul Dunlop Sean Ross Stephen Franey Stephen McCracken Stephen Watson Stuart Abraham Thomas McAllis

Project

Quotation No.:	Q20-21063	**Date Received:**	02-Nov-2020
Order No.:	20-0399D Bus Connects Route 9	**Date Instructed:**	02-Nov-2020
No. of Samples:	1		
Turnaround (Wkdays):	5	**Results Due:**	06-Nov-2020
Date Approved:	06-Nov-2020		

Approved By:

Details: Glynn Harvey, Technical Manager

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

Results - Soil

Project:

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		20-29604
Quotation No.: Q20-21063			**Chemtest Sample ID.:**		1090019
			Sample Location:		R9-CP06
			Sample Type:		SOIL
			Top Depth (m):		1.00
			Date Sampled:		29-Oct-2020
			Asbestos Lab:		LIVERPOOL
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
ACM Type	U	2192		N/A	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected
ACM Detection Stage	U	2192		N/A	-
Moisture	N	2030	%	0.020	6.5
pH	U	2010		4.0	8.2
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	< 0.40
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	1.2
Cyanide (Total)	U	2300	mg/kg	0.50	< 0.50
Arsenic	U	2450	mg/kg	1.0	20
Cadmium	U	2450	mg/kg	0.10	0.68
Chromium	U	2450	mg/kg	1.0	6.8
Copper	U	2450	mg/kg	0.50	17
Mercury	U	2450	mg/kg	0.10	< 0.10
Nickel	U	2450	mg/kg	0.50	27
Lead	U	2450	mg/kg	0.50	24
Zinc	U	2450	mg/kg	0.50	49
Organic Matter	U	2625	%	0.40	2.4
Total TPH >C6-C40	U	2670	mg/kg	10	< 10
Naphthalene	U	2700	mg/kg	0.10	< 0.10
Acenaphthylene	U	2700	mg/kg	0.10	< 0.10
Acenaphthene	U	2700	mg/kg	0.10	< 0.10
Fluorene	U	2700	mg/kg	0.10	< 0.10
Phenanthrene	U	2700	mg/kg	0.10	< 0.10
Anthracene	U	2700	mg/kg	0.10	< 0.10
Fluoranthene	U	2700	mg/kg	0.10	< 0.10
Pyrene	U	2700	mg/kg	0.10	< 0.10
Benzo[a]anthracene	U	2700	mg/kg	0.10	< 0.10
Chrysene	U	2700	mg/kg	0.10	< 0.10
Benzo[b]fluoranthene	U	2700	mg/kg	0.10	< 0.10
Benzo[k]fluoranthene	U	2700	mg/kg	0.10	< 0.10
Benzo[a]pyrene	U	2700	mg/kg	0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	U	2700	mg/kg	0.10	< 0.10
Dibenz(a,h)Anthracene	U	2700	mg/kg	0.10	< 0.10
Benzo[g,h,i]perylene	U	2700	mg/kg	0.10	< 0.10
Coronene	N	2700	mg/kg	0.10	< 0.10
Total Of 17 PAH's	N	2700	mg/kg	2.0	< 2.0
Total Phenols	U	2920	mg/kg	0.30	< 0.30

Test Methods

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
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.
2450	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.
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
2700	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-FID	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-FID (GC-FID detection is non-selective and can be subject to interference from co-eluting compounds)
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.

Report Information

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U	UKAS accredited
M	MCERTS and UKAS accredited
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S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
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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

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

Final Report

Report No.:	20-31991-1
Initial Date of Issue:	30-Nov-2020
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 Martin Gardiner Matthew Gilbert Neil Haggan Paul Dunlop Sean Ross Stephen Franey Stephen McCracken Stephen Watson Stuart Abraham Thomas McAllis
Project	20-0399D Bus Connects Route 9

Quotation No.:	Q20-21063	**Date Received:**	23-Nov-2020
Order No.:		**Date Instructed:**	24-Nov-2020
No. of Samples:	5		
Turnaround (Wkdays):	5	**Results Due:**	30-Nov-2020
Date Approved:	30-Nov-2020		

Approved By:

Details: Glynn Harvey, Technical Manager

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

Results - Water

Project: 20-0399D Bus Connects Route 9

Client: Causeway Geotech Ltd		**Chemtest Job No.:**			20-31991	20-31991	20-31991	20-31991	20-31991
Quotation No.: Q20-21063		**Chemtest Sample ID.:**			1101918	1101919	1101920	1101921	1101922
			Sample Location:		R9-CP02	R9-CP08	R9-CP11	R9-CPGS01	R9-CPGS04
			Sample Type:		WATER	WATER	WATER	WATER	WATER
			Date Sampled:		19-Nov-2020	19-Nov-2020	19-Nov-2020	19-Nov-2020	19-Nov-2020
Determinand	**Accred.**	**SOP**	**Units**	**LOD**					
pH	U	1010		N/A	8.2	7.6	7.7	7.6	7.7
Electrical Conductivity	U	1020	µS/cm	1.0	640	1200	720	960	880
Ammonia (Free) as N	U	1220	mg/l	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Nitrite as N	U	1220	mg/l	0.010	< 0.010	0.028	0.025	0.30	0.016
Nitrate as N	U	1220	mg/l	0.50	< 0.50	8.3	< 0.50	3.3	3.6
Phosphorus (Total)	N	1220	mg/l	0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Phosphate as P	U	1220	mg/l	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Nitrogen (Total)	N	1340	mg/l	5.0	< 5.0	16	< 5.0	9.0	6.8
Calcium	U	1415	mg/l	5.0	73	160	83	120	110
Magnesium	U	1415	mg/l	0.50	17	29	7.7	19	9.4
Sodium	U	1415	mg/l	0.50	33	34	25	56	37
Total Hardness as CaCO3	U	1270	mg/l	15	250	520	240	370	310
Arsenic (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Boron (Dissolved)	U	1450	µg/l	20	23	170	29	69	27
Barium (Dissolved)	U	1450	µg/l	5.0	73	64	66	68	61
Cadmium (Dissolved)	U	1450	µg/l	0.080	< 0.080	< 0.080	0.32	< 0.080	0.13
Copper (Dissolved)	U	1450	µg/l	1.0	1.4	1.9	2.3	< 1.0	1.0
Iron (Dissolved)	N	1450	µg/l	20	310	500	340	290	330
Mercury (Dissolved)	U	1450	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Manganese (Dissolved)	U	1450	µg/l	1.0	24	18	170	300	9.4
Molybdenum (Dissolved)	U	1450	µg/l	1.0	1.2	1.1	2.6	3.6	1.8
Nickel (Dissolved)	U	1450	µg/l	1.0	< 1.0	6.3	14	6.1	2.1
Lead (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Antimony (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Selenium (Dissolved)	U	1450	µg/l	1.0	11	6.1	< 1.0	3.7	4.3
Zinc (Dissolved)	U	1450	µg/l	1.0	2.3	5.8	7.4	8.1	4.7
Chromium (Trivalent)	N	1490	µg/l	20	[B] < 20	[B] < 20	[B] < 20	[B] < 20	[B] < 20
Chromium (Hexavalent)	U	1490	µg/l	20	[B] < 20	[B] < 20	[B] < 20	[B] < 20	[B] < 20
Total Organic Carbon	U	1610	mg/l	2.0	85	120	89	94	88
Mineral Oil	N	1670	µg/l	10	< 10	< 10	< 10	< 10	< 10
Total TPH >C6-C40	U	1670	µg/l	10	< 10	< 10	< 10	< 10	< 10
Naphthalene	U	1800	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthylene	U	1800	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthene	U	1800	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluorene	U	1800	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Phenanthrene	U	1800	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Anthracene	U	1800	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluoranthene	U	1800	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Pyrene	U	1800	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[a]anthracene	U	1800	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Chrysene	U	1800	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10

Results - Water

Project: 20-0399D Bus Connects Route 9

Client: Causeway Geotech Ltd		**Chemtest Job No.:**			20-31991	20-31991	20-31991	20-31991	20-31991
Quotation No.: Q20-21063		**Chemtest Sample ID.:**			1101918	1101919	1101920	1101921	1101922
			Sample Location:		R9-CP02	R9-CP08	R9-CP11	R9-CPGS01	R9-CPGS04
			Sample Type:		WATER	WATER	WATER	WATER	WATER
			Date Sampled:		19-Nov-2020	19-Nov-2020	19-Nov-2020	19-Nov-2020	19-Nov-2020
Determinand	**Accred.**	**SOP**	**Units**	**LOD**					
Benzo[b]fluoranthene	U	1800	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[k]fluoranthene	U	1800	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[a]pyrene	U	1800	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	U	1800	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene	U	1800	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[g,h,i]perylene	U	1800	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Of 16 PAH's	U	1800	µg/l	2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0

Deviations

In accordance with UKAS Policy on Deviating Samples TPS 63. Chemtest have a procedure to ensure 'upon receipt of each sample a competent laboratory shall assess whether the sample is suitable with regard to the requested test(s)'. This policy and the respective holding times applied, can be supplied upon request.The reason a sample is declared as deviating is detailed below. Where applicable the analysis remains UKAS/MCERTs accredited but the results may be compromised.

Sample:	Sample Ref:	Sample ID:	Sample Location:	Sampled Date:	Deviation Code(s):	Containers Received:
1101918			R9-CP02	19-Nov-2020	B	Coloured Winchester 1000ml
1101918			R9-CP02	19-Nov-2020	B	EPA Vial 40ml
1101918			R9-CP02	19-Nov-2020	B	Plastic Bottle 1000ml
1101919			R9-CP08	19-Nov-2020	B	Coloured Winchester 1000ml
1101919			R9-CP08	19-Nov-2020	B	EPA Vial 40ml
1101919			R9-CP08	19-Nov-2020	B	Plastic Bottle 1000ml
1101920			R9-CP11	19-Nov-2020	B	Coloured Winchester 1000ml
1101920			R9-CP11	19-Nov-2020	B	EPA Vial 40ml
1101920			R9-CP11	19-Nov-2020	B	Plastic Bottle 1000ml
1101921			R9-CPGS01	19-Nov-2020	B	Coloured Winchester 1000ml
1101921			R9-CPGS01	19-Nov-2020	B	EPA Vial 40ml
1101921			R9-CPGS01	19-Nov-2020	B	Plastic Bottle 1000ml
1101922			R9-CPGS04	19-Nov-2020	B	Coloured Winchester 1000ml
1101922			R9-CPGS04	19-Nov-2020	B	EPA Vial 40ml
1101922			R9-CPGS04	19-Nov-2020	B	Plastic Bottle 1000ml

Test Methods

SOP	Title	Parameters included	Method summary
1010	pH Value of Waters	pH	pH Meter
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.
1270	Total Hardness of Waters	Total hardness	Calculation applied to calcium and magnesium results, expressed as mg l-1 CaCO3 equivalent.
1340	Total Nitrogen in Waters	Total Nitrogen and organic Nitrogen	Persulphate digestion followed by colorimetry.
1415	Cations in Waters by ICP-MS	Sodium; Potassium; Calcium; Magnesium	Direct determination by inductively coupled plasma - mass spectrometry (ICP-MS).
1450	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).
1490	Hexavalent Chromium in Waters	Chromium [VI]	Automated colorimetric analysis by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazide.
1610	Total/Dissolved Organic Carbon in Waters	Organic Carbon	TOC Analyser using Catalytic Oxidation
1670	Total Petroleum Hydrocarbons (TPH) in Waters by GC-FID	TPH (C6–C40); optional carbon banding, e.g. 3-band – GRO, DRO & LRO	Pentane extraction / GC FID detection
1800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Waters 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	Pentane extraction / GCMS detection

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

CAUSEWAY GEOTECH

APPENDIX I

SPT HAMMER ENERGY MEASUREMENT REPORT

Southern Testing
Environmental & Geotechnical

SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

Southern Testing
Keeble House
Stuart Way
East Grinstead
West Sussex
RH19 4QA

SPT Hammer Ref: .0643
Test Date: 22/02/2020
Report Date: 03/03/2020
File Name: .0643.spt
Test Operator: NPB

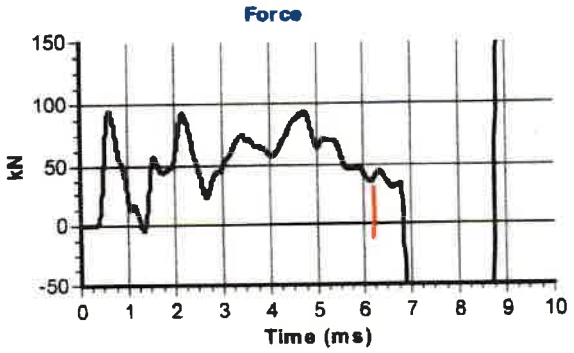
Instrumented Rod Data

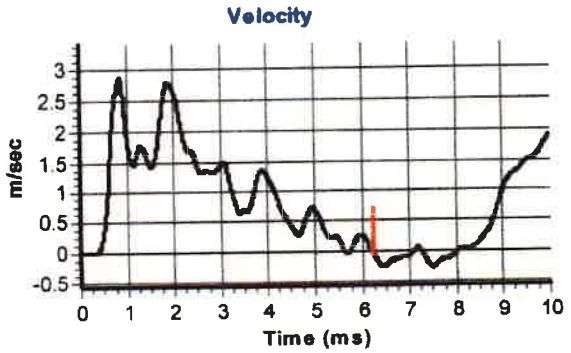
Diameter d_r (mm):	54
Wall Thickness t_r (mm):	6.0
Assumed Modulus E_a (GPa):	200
Accelerometer No.1:	6458
Accelerometer No.2:	9607

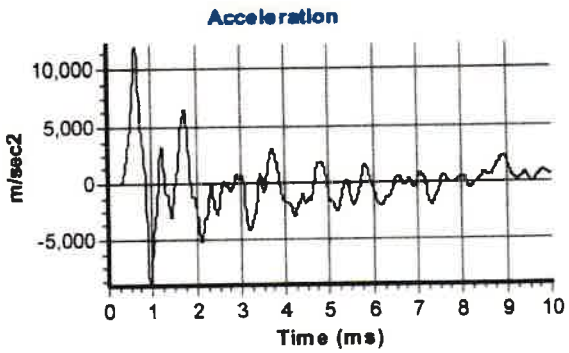
SPT Hammer Information

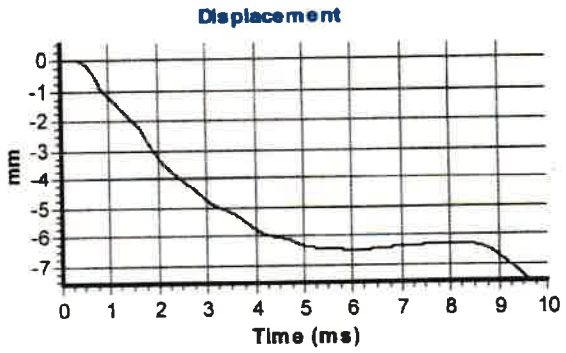
Hammer Mass m (kg):	63.5
Falling Height h (mm):	760
SPT String Length L (m):	10.0

Comments / Location
BALLEYMONEY









Calculations

Area of Rod A (mm2):	905
Theoretical Energy E_{theor} (J):	473
Measured Energy E_{meas} (J):	400

Energy Ratio E_r (%): **85**

NPBurrows

Signed: Neil Burrows
Title: Field Operations Manager

The recommended calibration interval is 12 months

Southern Testing
Environmental & Geotechnical

SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

Southern Testing
Keeble House
Stuart Way
East Grinstead
West Sussex
RH19 4QA

SPT Hammer Ref: .T7
Test Date: 22/02/2020
Report Date: 03/03/2020
File Name: .T7.spt
Test Operator: NPB

Instrumented Rod Data

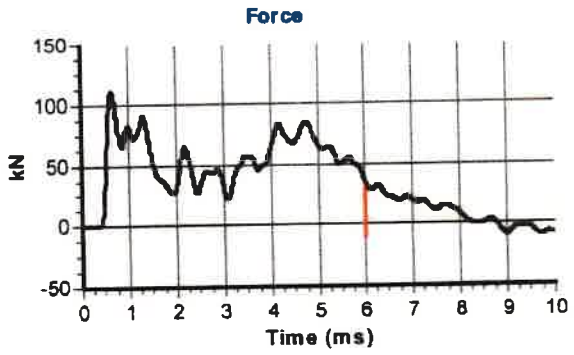
Diameter d_r (mm): 54
Wall Thickness t_r (mm): 6.0
Assumed Modulus E_a (GPa): 200
Accelerometer No.1: 6458
Accelerometer No.2: 9607

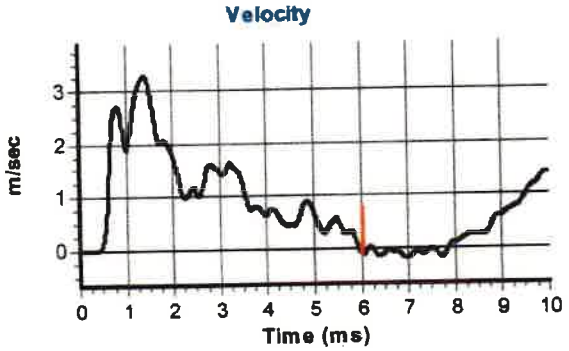
SPT Hammer Information

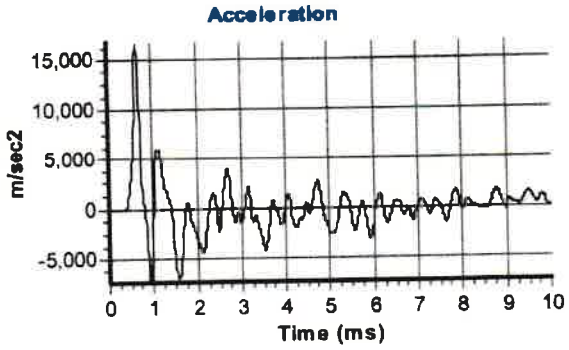
Hammer Mass m (kg): 63.5
Falling Height h (mm): 760
SPT String Length L (m): 10.0

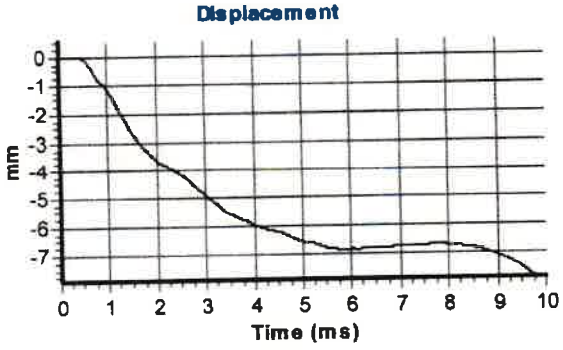
Comments / Location

BALLEYMONEY









Calculations

Area of Rod A (mm2): 905
Theoretical Energy E_{theor} (J): 473
Measured Energy E_{meas} (J): 399

Energy Ratio E_r (%): 84

Signed: Neil Burrows
Title: Field Operations Manager

The recommended calibration interval is 12 months

CAUSEWAY GEOTECH

APPENDIX J

ARCHAEOLGY REPORT

Report on Archaeological Monitoring

BusConnects Infrastructure Dublin Detailed Ground Investigation Stage 1

Licence No. 20E0622

Client:	Causeway Geotech Limited
Issue date:	December 2020
Licensee:	Grace Fegan
Prepared by:	Thaddeus Breen, Marion Sutton and Grace Fegan, Shanarc Archaeology Ltd.

shanarc archaeology

Contents

Figures

Plates

Executive Summary

Archaeological monitoring of Stage 1 detailed ground investigations relating to the National Transport Authority's BusConnects Infrastructure Dublin project was carried out by Shanarc Archaeology Ltd. under licence 20E0622.

The works, carried out in September and October 2020, were split over three routes, namely Route 02: Swords to City Centre, Route 09: Greenhills to City Centre and Route 13: Bray to City Centre.

A total of 22 ground investigation locations were subject to archaeological monitoring, due to their proximity to either a Recorded Monument and Place, other area of archaeological or cultural heritage potential, or as requested by Causeway Geotech Limited.

The works generally comprised the excavation of trial pits that ranged from 1.60m to 2.40m long x 0.60m wide and 1.0m to 4.2m deep, and cable percussion cores that ranged from 0.23m to 8m deep.

No archaeological features or deposits were identified during monitoring. An Irish halfpenny of George II, dated 1742, was recovered during monitoring on Route 13: Bray to City Centre, in Bray, Co. Wicklow.

1. Introduction

This report describes the results of archaeological monitoring of Stage 1 detailed ground investigations relating to the National Transport Authority's BusConnects Infrastructure Dublin project. The planning stage/Stage 1 detailed ground/geotechnical investigations were carried out on five routes, namely Route 02: Swords to City Centre Route, 06: Lucan to City Centre, Route 08: Clondalkin to Drimnagh, Route 09: Greenhills to City Centre and Route 13: Bray to City Centre (Figure 1).

Detailed ground investigation is being carried out in accordance with the *BusConnects Detailed Ground Investigation Contract: Stage 1* tendered by the National Transport Authority.

Only specified investigations on identified sections of the Stage 1 routes were subject to archaeological monitoring; the specified investigations were identified following a review by Shanarc Archaeology Ltd. of the proposed investigation locations.

Proposed investigation locations were reviewed by Shanarc Archaeology Ltd. to identify (1) whether proposed works fall with the historic core of Dublin (DU019-020), (2) whether proposed works fall within the Zone of Archaeological Potential associated with an individual recorded monument and (3) whether proposed works fall within an area of identified archaeological or cultural heritage potential.

21 no. ground investigation locations were identified for archaeological monitoring, on three routes, Route 02: Swords to City Centre, Route 09: Greenhills to City Centre and Route 13: Bray to City Centre, with Route 09: Greenhills to City Centre investigations forming the focus of archaeological monitoring. The identified locations are listed in Appendix 1.

Following modifications to Stage 1 detailed ground/geotechnical investigations at the construction stage, a total of 22 ground investigations locations were subject to archaeological monitoring. The monitored locations are listed in Appendix 2.

1.1 Location Description

The BusConnect routes are on existing main commuter routes into Dublin City Centre. Although some of the routes are partly within the Zone of Archaeological Potential of Dublin city (DU018-020), the areas covered by the *BusConnects Detailed Ground Investigation Contract: Stage 1* are not.

The Route 02: Swords to City Centre bus corridor commences on the Swords Road at the Pinnock Hill junction and is routed along Swords Road, Drumcondra Road Upper & Lower and Dorset Street to the junction with North Frederick Street. The ground investigation location monitored on Route 02 was located to the south side of the Tolka River at Drumcondra Bridge, on the R132 (Drumcondra Road Upper and Lower).

The Route 09: Greenhills core bus corridor commences on Belgard Square West, at the junction with Cookstown Way, Tallaght, routed along Belgard Square North and Belgard Square East towards the Blessington Road, continuing to Greenhills Road (R819), and along Ballymount Avenue, Calmount Road and Walkinstown Road (R819) to the junction with the Long Mile Road (R110). 20 ground investigation locations were monitored on this section of Route 09, beginning on Belgard Square North and located on, or in proximity of Greenhills Road (R819) to both sides of the M50 as far as Walkinstown.

Figure 1 BusConnects Corridor Map.

The Route 13: Bray to City Centre bus corridor commences at the Dargle River crossing, in Bray town, and is routed northwards along the Dublin Road (R119) to Loughlinstown roundabout, along Bray Road and Stillorgan Road (N11, R138), and via Donnybrook Road and Morehampton Road toward Dublin city centre, to the junction of Leeson Street Lower and St. Stephen's Green. One ground investigation location was monitored on Route 13, to the north of Bray town.

1.1 Project Description

BusConnects is the National Transport Authority's programme to greatly improve bus services in Dublin city. The ground/geotechnical investigation works will be variously in public areas, on land under control of a Local Authority and on private land, and are required to determine the condition and properties of the ground to inform the planning stage design of BusConnects core bus corridors. The investigation works provides for trial pits, slit trenches, cable percussion drilling (minimum diameter 200mm) and window samples, which may be associated with pitting and trenching up to 1.2m below the surface to locate and avoid underground services.

2. Receiving Environment

2.1 Route 2: Swords to City Centre

The ground investigation location, R2-SLT02, monitored on Route 02 was located to the south side of the Tolka River at Drumcondra Bridge, west of the R123, in Clonliffe West townland, within 380m of DU018-012001, the site of a 16th-17th century house incorporated into St. Patrick's Teacher Training College, 480m of DU018-011, a holy well, and 480m of DU018-013001 and DU018-013002, the church of St. John the Baptist (1734) and associated graveyard on the grounds of All Hallows College, which was built on a medieval foundation associated with the Prior of All Saints (Figure 2). In 1756, John Rocque records a terrace of buildings facing south onto Botanic Avenue, now the site of our Lady's Park. A terrace of buildings were still present on the first edition 6-inch Ordnance Survey map (1837-1843; Figure 3), known as Tolka Cottages, which appear to have been removed at some point in the 20th century. While no stray finds are provenance to Clonliffe West townland, the Topographical files at the National Museum of Ireland record a number of stray finds to Drisoge (1 x copper alloy coin) and Drumcondra (3 x flint scrapers; 1 x bone ring) townlands to the north of the Tolka River, highlighting the settlement potential in the catchment of the Tolka River.

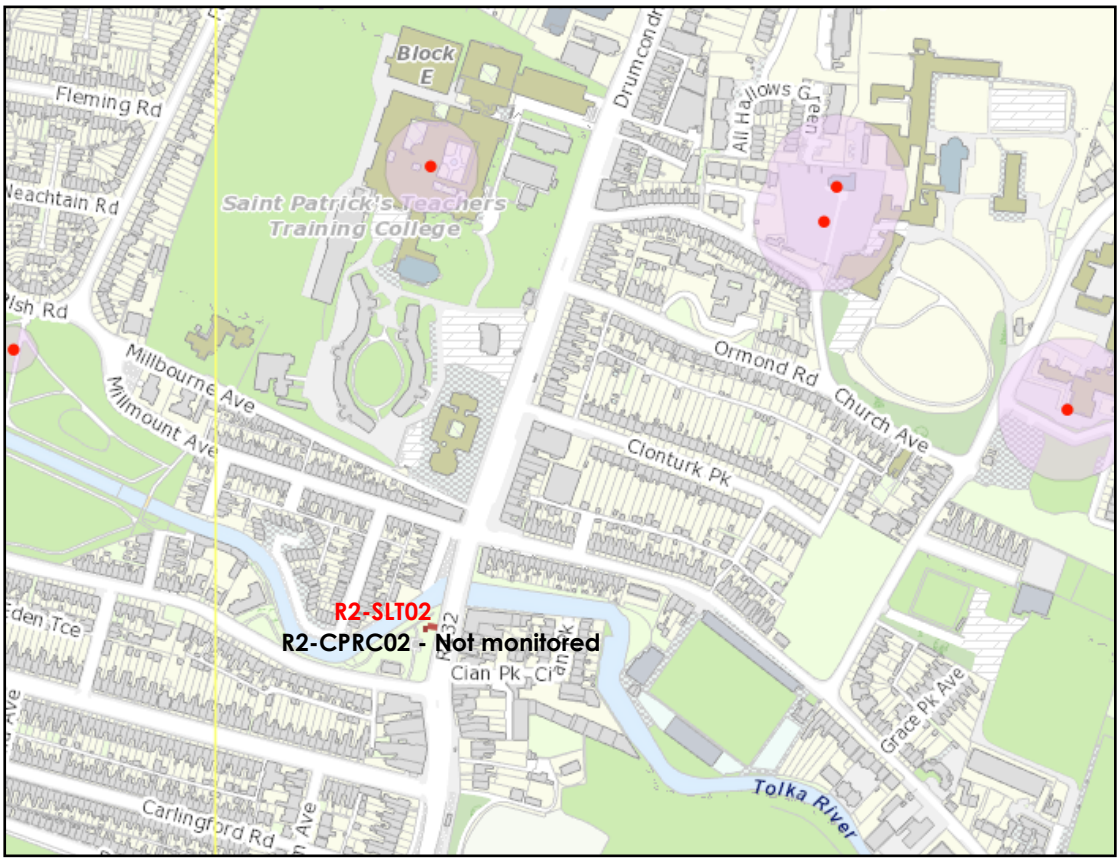


Figure 2 Location of R2-SLT02 (*in red*) next to R2-CPRC02, in relation to RMP sites (*red dots*) and Zones of Archaeological Potential (*shaded pink*) (OSi Licence No. EN 0077920).

Figure 3 Location of R2-SLT02 (*in red*) next to R2-CPRC02 on the first edition 6-inch OS map, 1837-1843 (OSi Licence No. EN 0077920).

2.2 Route 9: Greenhills to City Centre

The majority of ground investigation locations were monitored on Route 09, 20 sites in total, in Tallaght, Tymon North, Kilnamanagh and Greenhills townlands. The Greenhills route is situated in a landscape in which archaeological remains are well represented, which include Bronze Age (c. 2400-500 BC) burials in Greenhills townland, stray finds indicating early occupation from the Bancroft and Dodder River areas at Tallaght Village (Bolger 2010; NMI Topographical Files), which include a number of bronze axeheads from a sandpit in Tallaght, and well represented early and later medieval remains, the monastery at Tallaght being founded in the mid-8th century. With the arrival of the Anglo-Normans in 1169, the monastery passed to the control of the archbishop of Dublin, becoming a manor with borough status.

R9-TP01 and R9-TP02 are sited to the north side of Belgrade Square North, a short distance east of the entry to Tallaght General Hospital, 500m from the historic town and ecclesiastical manor at Tallaght (DU021-037) (Figure 4), on land that was formerly within the grounds of the Glebe House, later St. Maelruen's. The Glebe grounds were located within the wider Tallaght townland (Figure 5). R9-TP03, on the Greenhills Road (R819), is sited approximately 540m to the north-north-east of the historic town, which in addition to DU021-037003 and DU021-037004, Tallaght church and graveyard, comprises DU021-037012, a holy well, and two castles, DU021-037020 and DU022-018001 (Figure 6).

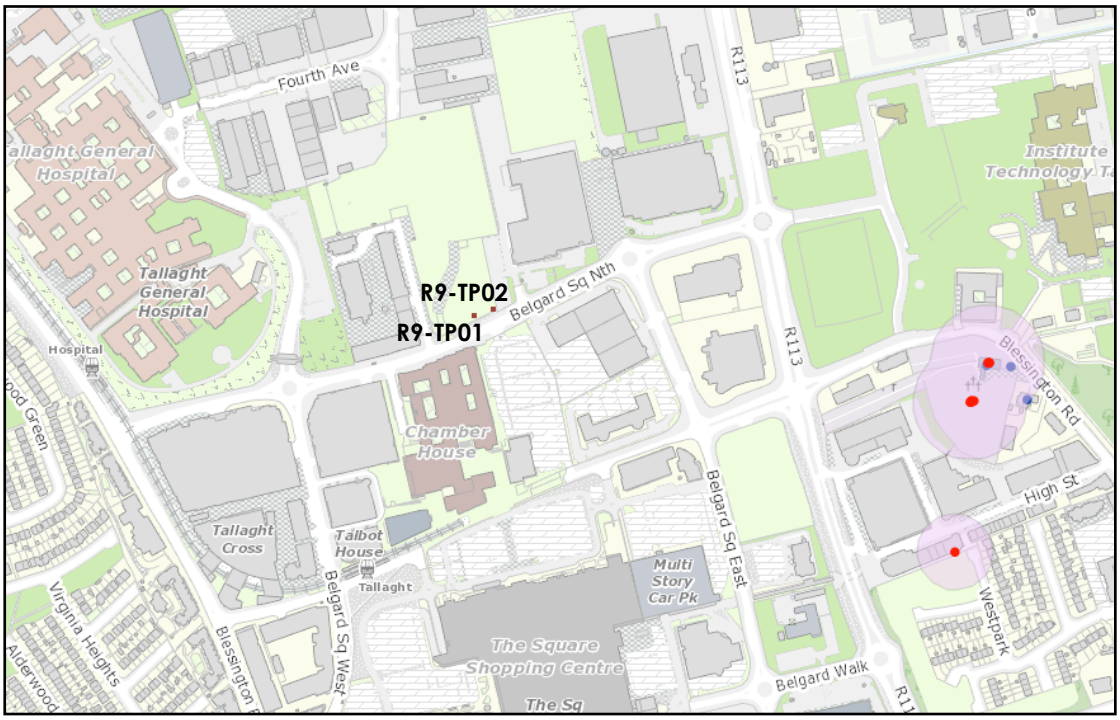


Figure 4 Locations of R9-TP01 and R9-TP02 in relation to RMP sites (*red dots*) and Zones of Archaeological Potential (*shaded pink*) (OSi Licence No. EN 0077920).

Figure 5 Locations of R9-TP01 and R9-TP02 on the first edition 6-inch OS map, 1837-1843 (OSi Licence No. EN 0077920).

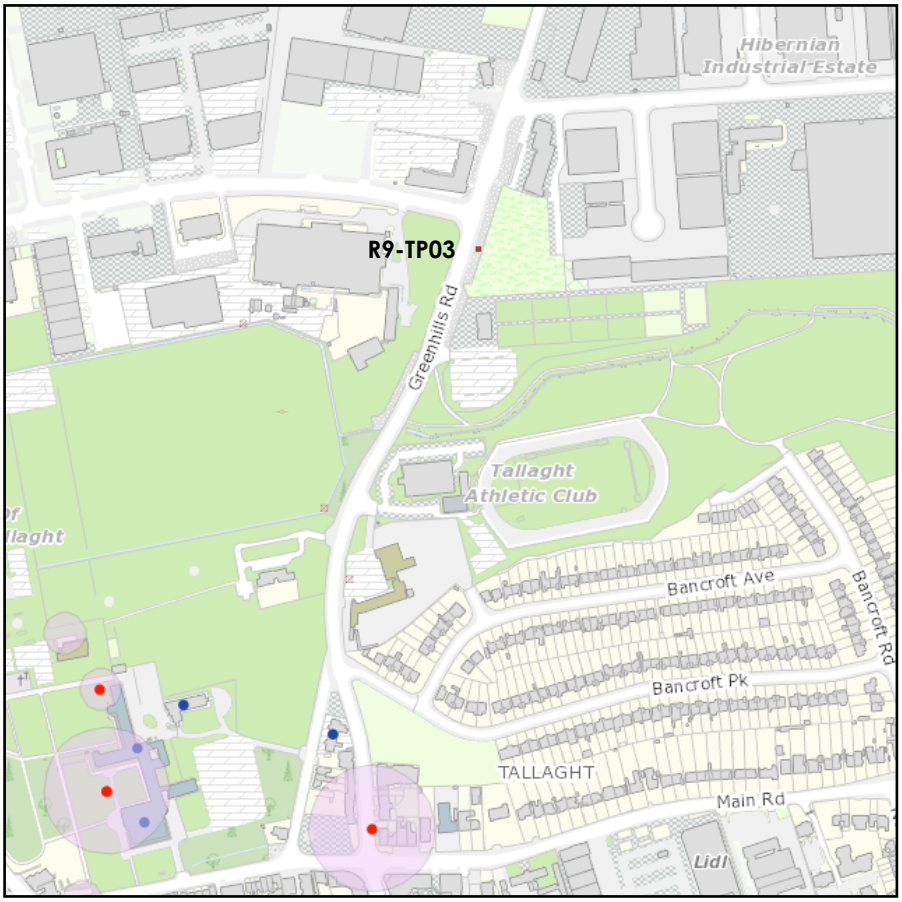


Figure 6 Location of R9-TP03 in relation to RMP sites (*red dots*) and Zones of Archaeological Potential (*shaded pink*) (OSi Licence No. EN 0077920).

A programme of archaeological monitoring of utility trenches along the route of Metro West in the vicinity of Tallaght was carried out in October 2010 in accordance with licence numbers 10E0309, 10E0415, 10E0416 and 10E0417. No archaeological features or deposits were found (Bolger 2010). John Rocque's 1760 map presents a rural landscape in the hinterland of the historic Tallaght village, with enclosed fields and sporadic dwellings largely fronting the mid-18th century road network, which included the precursors of the Old Blessington Road and the Greenhills Road. R9-TP03 is depicted positioned on the Greenhills Road on the first edition 6-inch Ordnance Survey map (Figure 7).

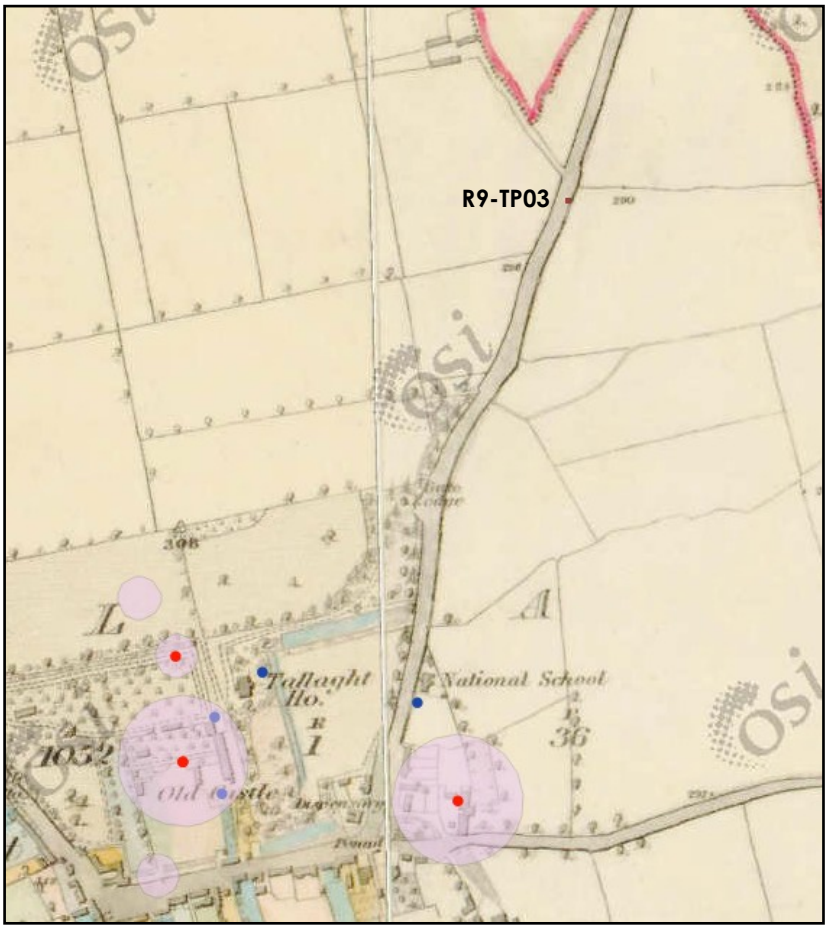


Figure 7 Location of R9-TP03 on the first edition 6-inch OS map, 1837-1843 (OSi Licence No. EN 0077920).

R9-CP03, R9-TP04, R9-TP05, R9-CP04 and R9-TP06 are all situated within 380m of a complex of medieval monuments at Kilnamanagh, a developed area with no visible surface remains (Figure 8). The complex incorporates DU022-005005, an ecclesiastical enclosure, bi-sected by Treepark Road - R9-TP05 is sited within the Zone of Archaeological Potential of the enclosure. The complex also includes DU022-005002, a church, DU022-005003, a graveyard, DU022-005004, a holy well, and DU022-005009 and DU022-005008, an earthwork and bawn enclosing Kilnamanagh Castle, DU022-005001.

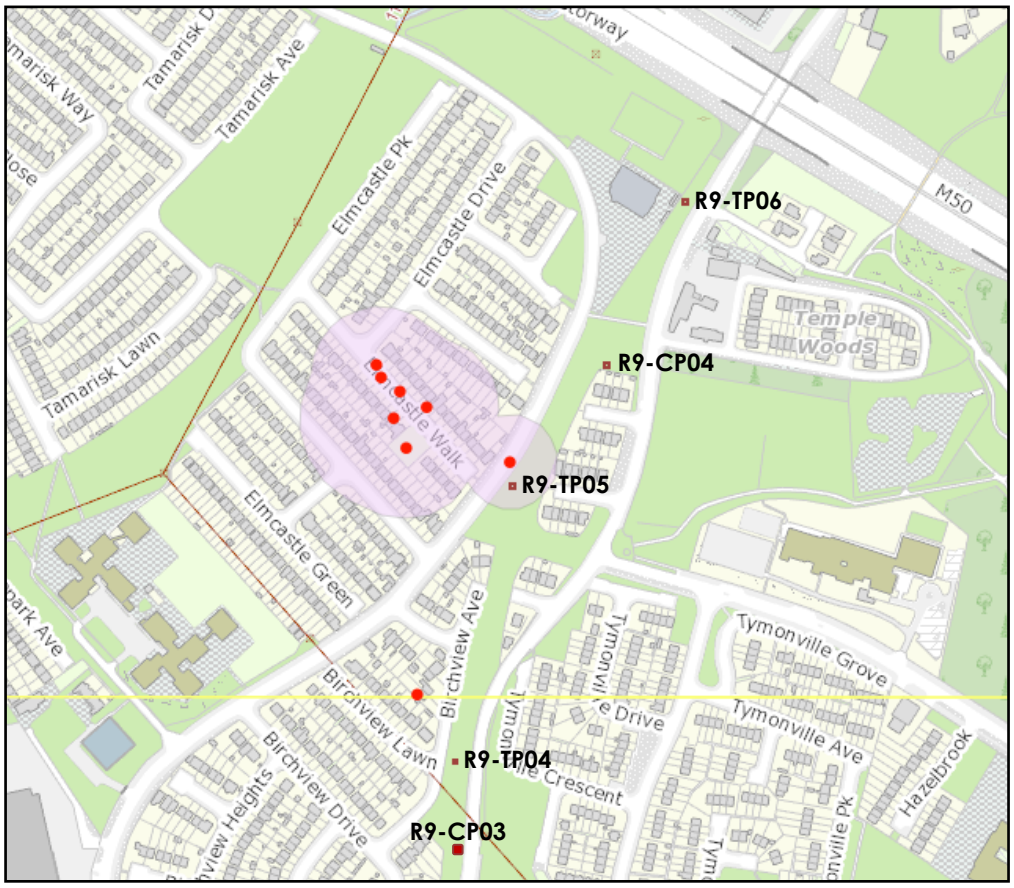


Figure 8 Locations of R9-CP03, R9-TP04, R9-TP05, R9-CP04 and R9-TP06 in relation to RMP sites (*red dots*) and Zones of Archaeological Potential (*shaded pink*) (OSi Licence No. EN 0077920).

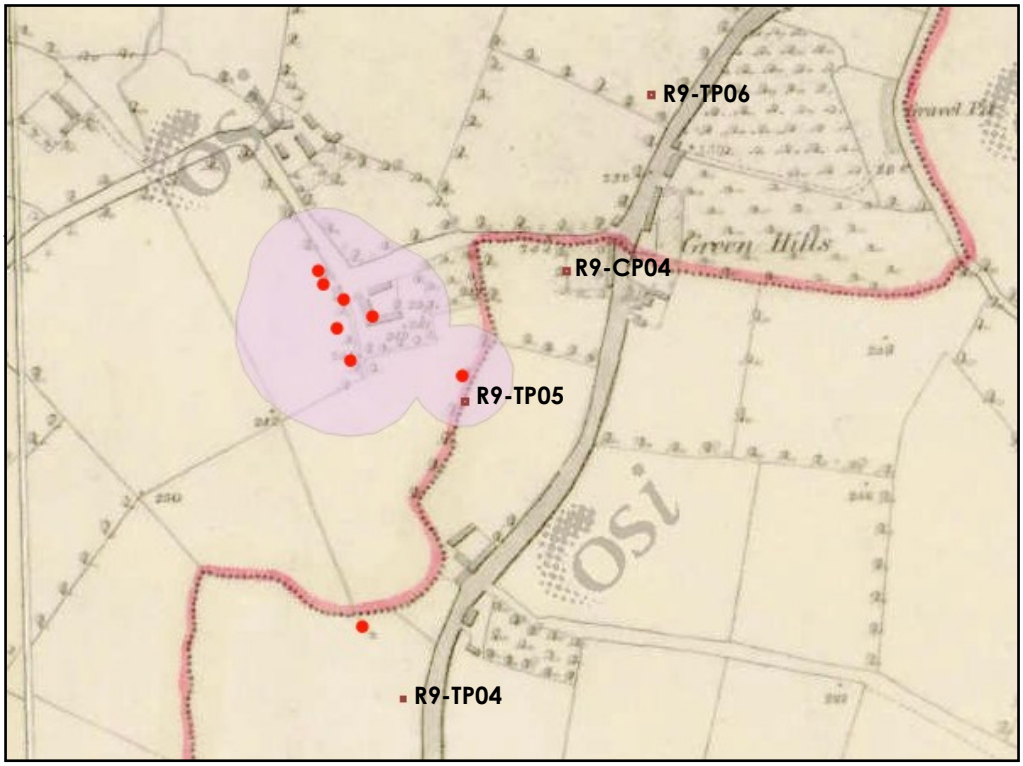


Figure 9 Locations of R9-TP04, R9-TP05, R9-CP04 and R9-TP06 on the first edition 6-inch OS map, 1837-1843 (OSi Licence No. EN 0077920).

Both Rocque, in 1760, and the Ordnance Survey (1837-1843) show the rural nature of the Kilnamanagh area, with a number of structures concentrated on the Greenhills Road in this area (Figure 9); with Rocque showing a spring to the east side of the precursor of the Greenhills Road. The National Museum of Ireland provenance a large number of stray finds to Kilnamanagh and Greenhills townlands, reflecting settlement in this area in prehistory and during the medieval and post medieval periods.

R9-CP05, R9-TP08, R9-WS01 and R9-TP09 are ground investigation locations situated peripheral to the medieval Kilnamanagh complex (Figure 10 and Figure 11).

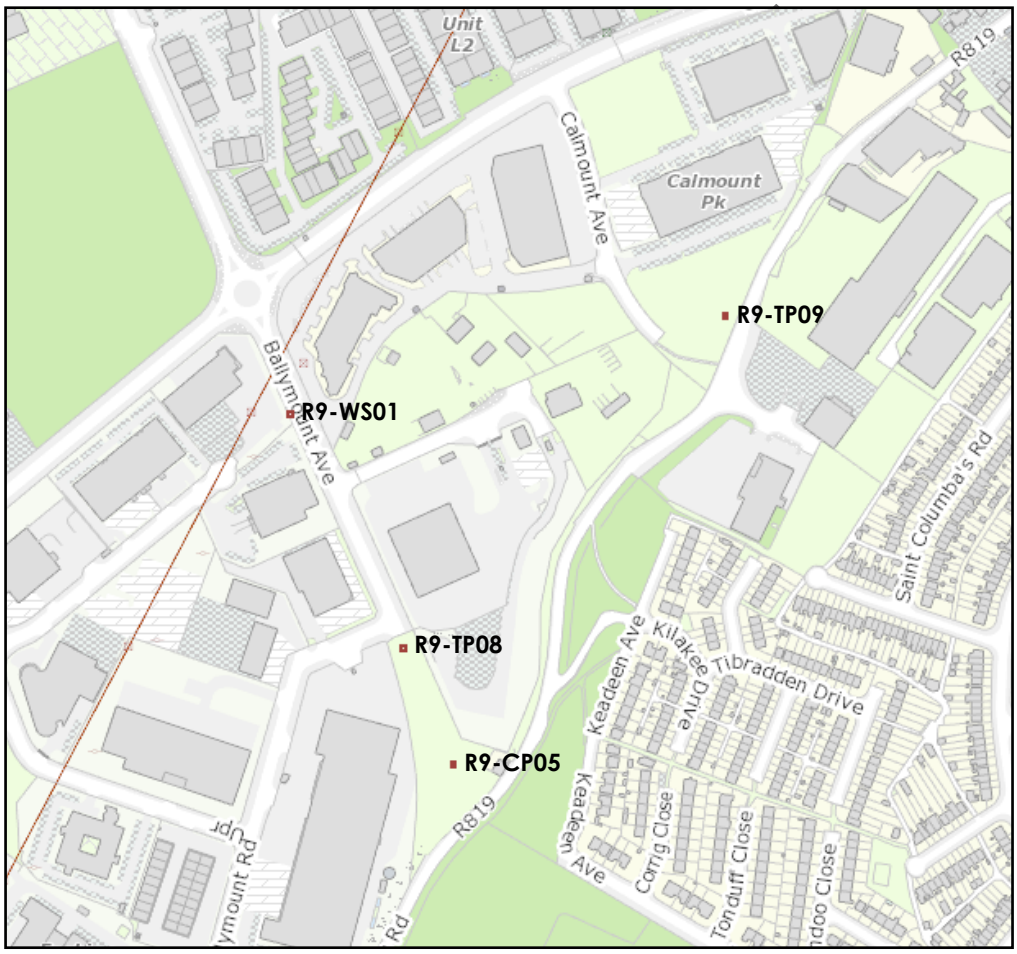


Figure 10 Locations of R9-CP05, R9-TP08, R9-WS01 and R9-TP02 (OSi Licence No. EN 0077920).

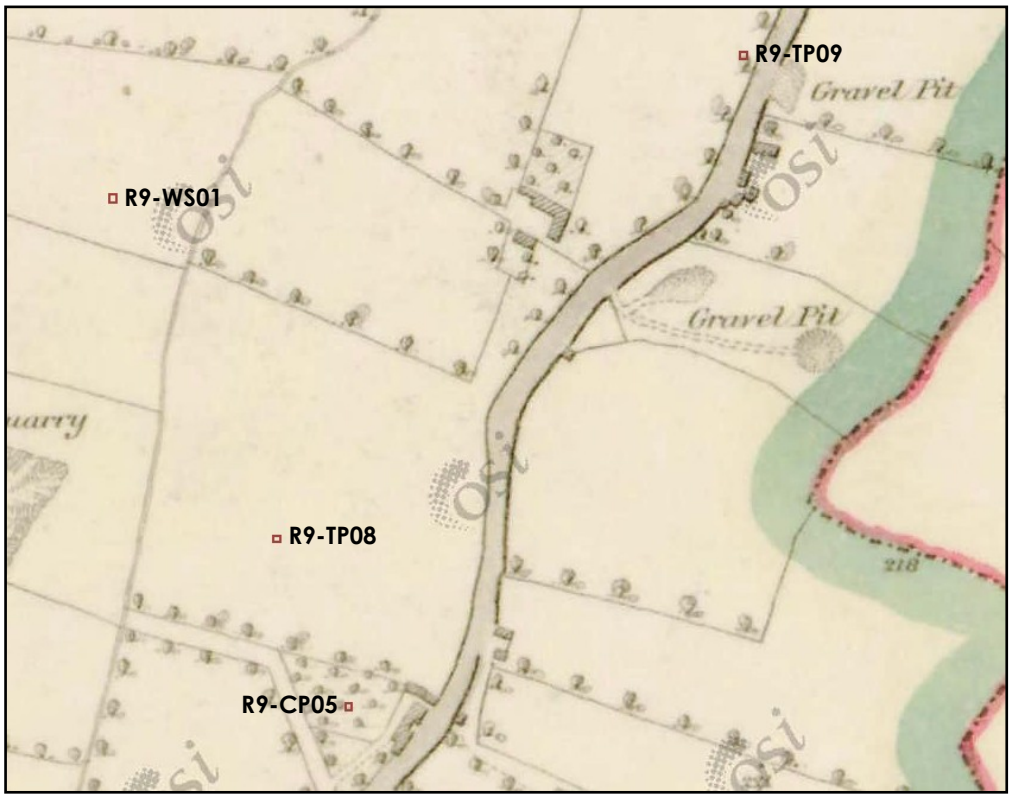


Figure 11 Locations of R9-CP05, R9-TP08, R9-WS01 and R9-TP02 on the first edition 6-inch OS map, 1837-1843 (OSi Licence No. EN 0077920).

R9-CP08, R9-TP10, R9-TP11, R9-CP10, R9-CP07, R9-CP09, R9-CP12 and R9-CP13 are sited on, or in proximity of Greenhills Road (R819) near Walkinstown, between Greenhills Industrial Estate and Ballymount Court Business Centre (Figure 12). The investigation locations are within 95m-400m of DU022-002, a Bronze Age flat cemetery, and 330m-480m of DU022-001, a holy well. R9-CP12 is sited closest to the DU022-002, flat cemetery, just west of the designated Zone of Archaeological Potential. This area, to either side of the Greenhills Road was the focus of gravel extraction, at least from the 19th century, and the flat cemetery was first uncovered during the quarrying of a sand and gravel ridge in 1892. A spot height shown on the first edition 6-inch Ordnance Survey map (1837-1943) to the south-west of the cemetery site overlooked the locations of R9-CP09, R9-CP12 and R9-CP13.

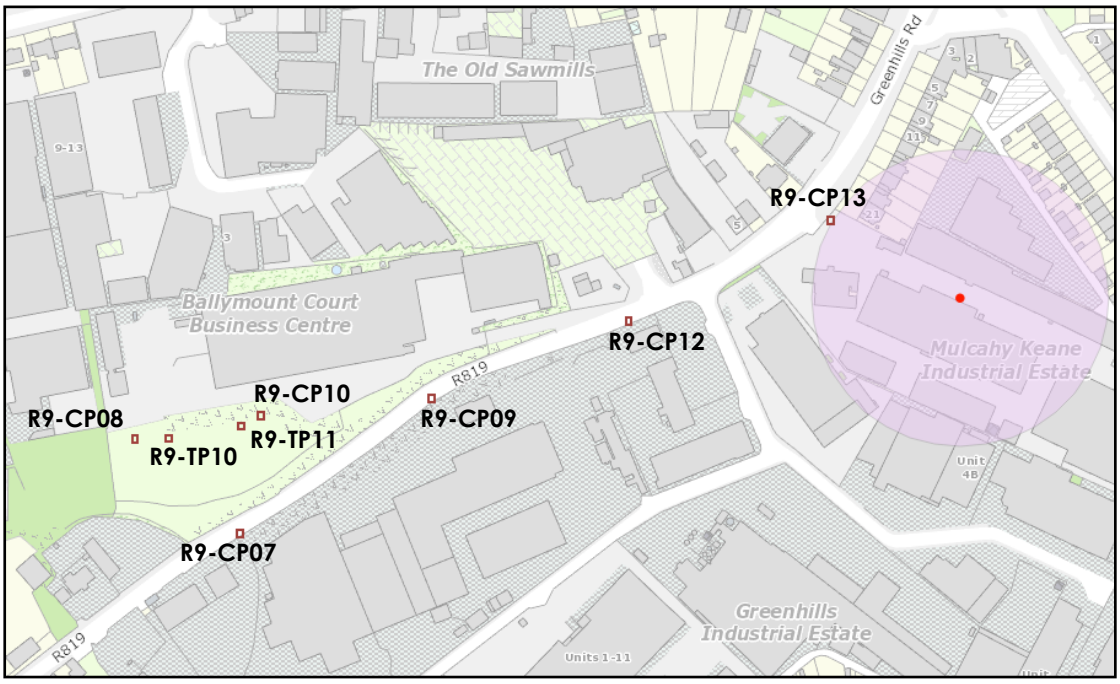


Figure 12 Locations of R9-CP08, R9-TP10, R9-TP11, R9-CP10, R9-CP07, R9-CP09, R9-CP12 and R9-CP13 in relation to RMP sites (*red dots*) and Zones of Archaeological Potential (*shaded pink*) (OSi Licence No. EN 0077920).

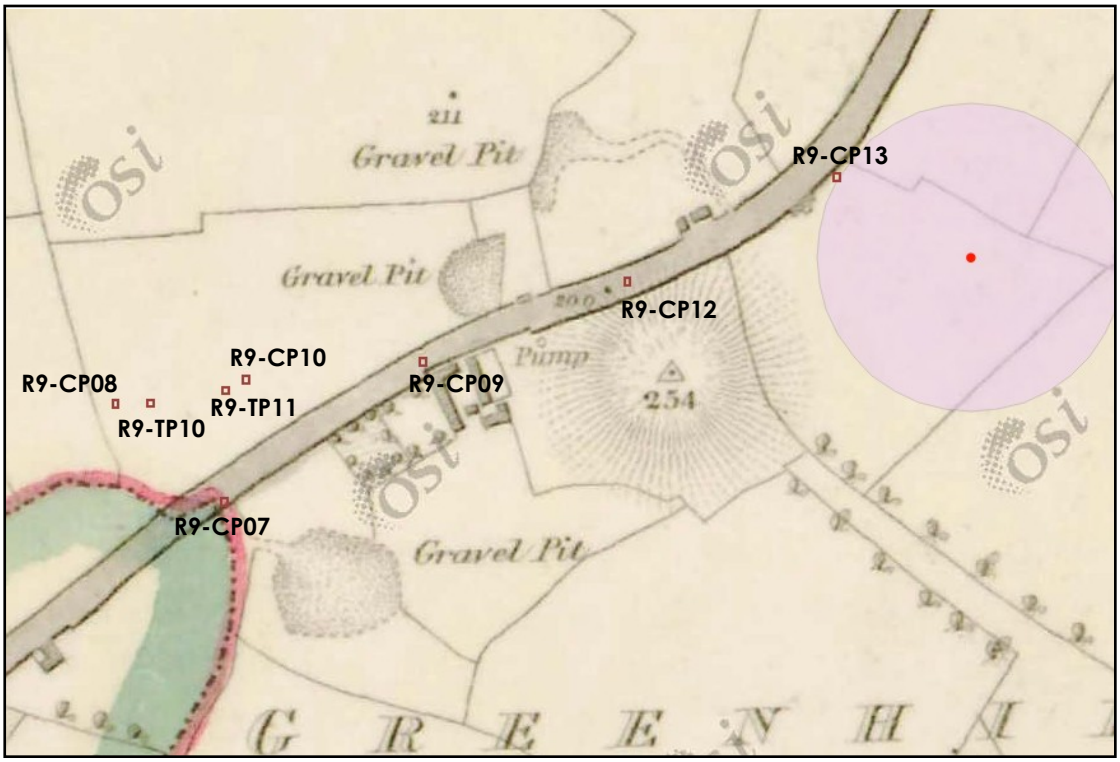


Figure 13 Locations of R9-CP08, R9-TP10, R9-TP11, R9-CP10, R9-CP07, R9-CP09, R9-CP12 and R9-CP13 on the first edition 6-inch OS map, 1837-1843 (OSi Licence No. EN 0077920).

2.3 Route 13: Bray to City Centre

The ground investigation location, R13-WS01, monitored on Route 13 was located in Ravenswell townland, to the east of the Dublin Road (R716) in the grounds of Saint Philomena's Primary School, situated outside, and to the north of the Zone of Archaeological Potential for the historic town at Bray (WI004-001). The window sample, approximately 120m north-west of the historic town, was sited 95m from WI004-001006, the findspot of a cross-slab, and 185m of WI004-001006, a castle site forming a sub-element of the historic town (Figure 14). A timber pier excavated on the Dargle River (WI004-006; Excavation Licence No. 95E0004), in Killarney townland, upriver of the town, has been radiocarbon dated to 4661-4360 BC, indicating Neolithic activity in the Dargle River and Bray area.

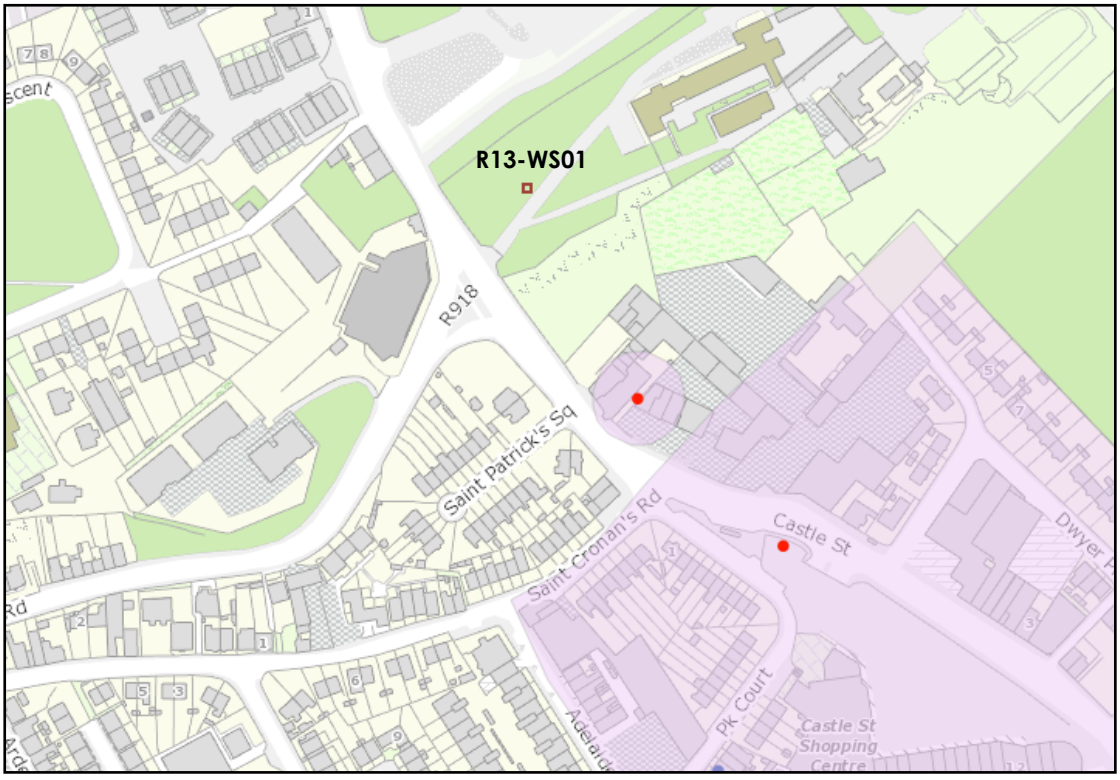


Figure 14 Location of R13-WS01 outside Bray (OSi Licence No. EN 0077920).

The first edition 6-inch Ordnance Survey map (1837-1843; Figure 15) shows the location of the window sample sited to the townland boundary between Ravenswell and Cork Great, to the north of Little Bray and the Dargle River. A grant of lands in the town of Little Bray in 1636 mentioned the castle, sited on Castle Street, along with six houses and gardens, orchards, the commons and fishing in the Dargle. The grounds of Ravenswell House, the residence of de Butt Esq., are now substantially developed as part of the Bray Golf Club, which has operated a course at Ravenswell since 1897.

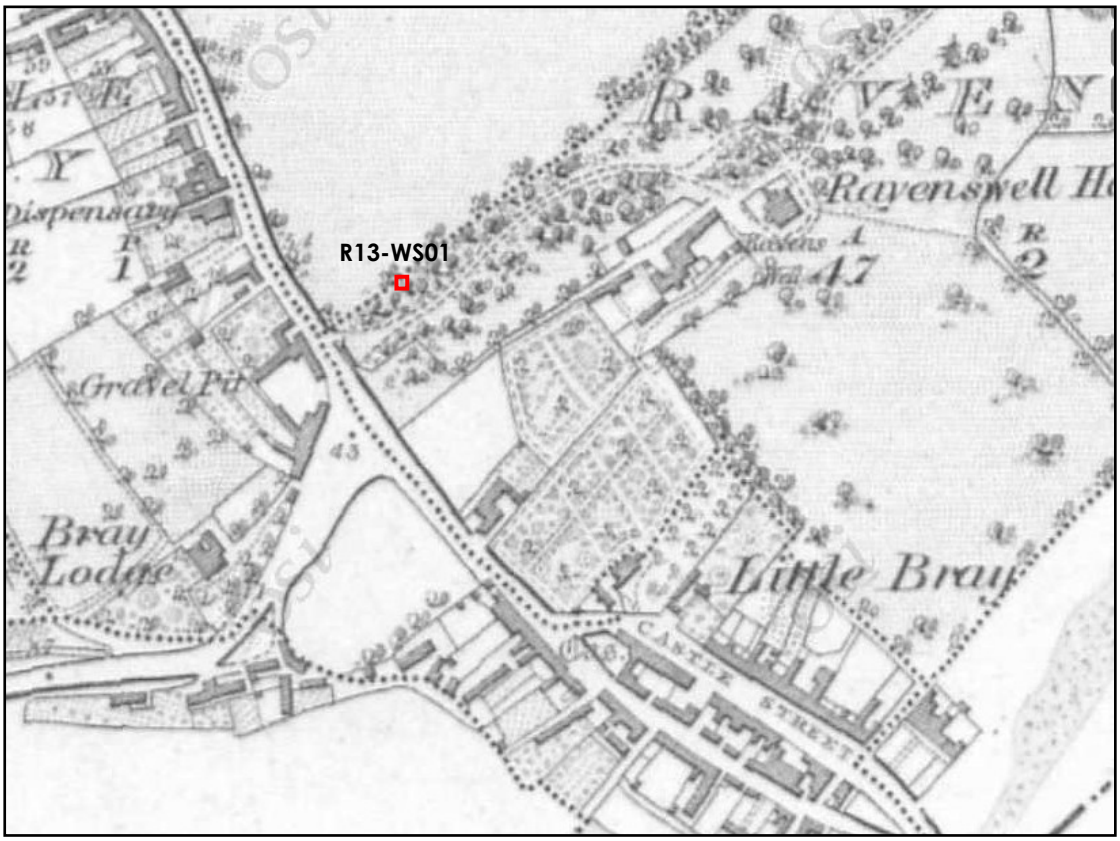


Figure 15 Location of R13-WS01, outside Bray, on the first edition 6-inch OS map, 1837-1843 (OSi Licence No. EN 0077920).

3. Methodology

The objective of the programme of archaeological monitoring was to provide a watching brief of excavation and drilling associated with the of ground/geotechnical investigations for the purpose of identifying any archaeological features, deposits or finds that might be present and subject to potential development impacts.

Ground/geotechnical investigations comprised a combination of trial pits (TP), cable percussion cores (CP), slit trenches (SLT), and window samples (WS).

It was originally proposed that archaeological monitoring would occur at 21 locations (listed in Appendix 1). However, as a result of changes at the construction phase, investigation locations were subject to name changes, with some cancellations (i.e. R2-CPRC01) and with some additions (e.g. R2-SLT02). Changes to the construction programme also resulted in a number of investigation locations being excavated in the absence of an archaeologist i.e. R2-CPRC02, R13-CP01, R13-CP02 and R13-CP03. Although in the case of R2-CPRC02, an added slit trench R2-SLT02 in very close proximity was monitored, while R13-WS01 was monitored in the general proximity of R13-CP03. Ultimately, 22 locations were monitored (listed in Appendix 2), including a number of locations more peripheral to identified areas of archaeological potential that were monitored at the request of Causeway Geotech Limited.

4. Results of monitoring

The following tables provide details of the location and stratigraphy of each of the Stage I archaeologically monitored ground/geotechnical investigation locations. Relevant plates are provided in Section 7.

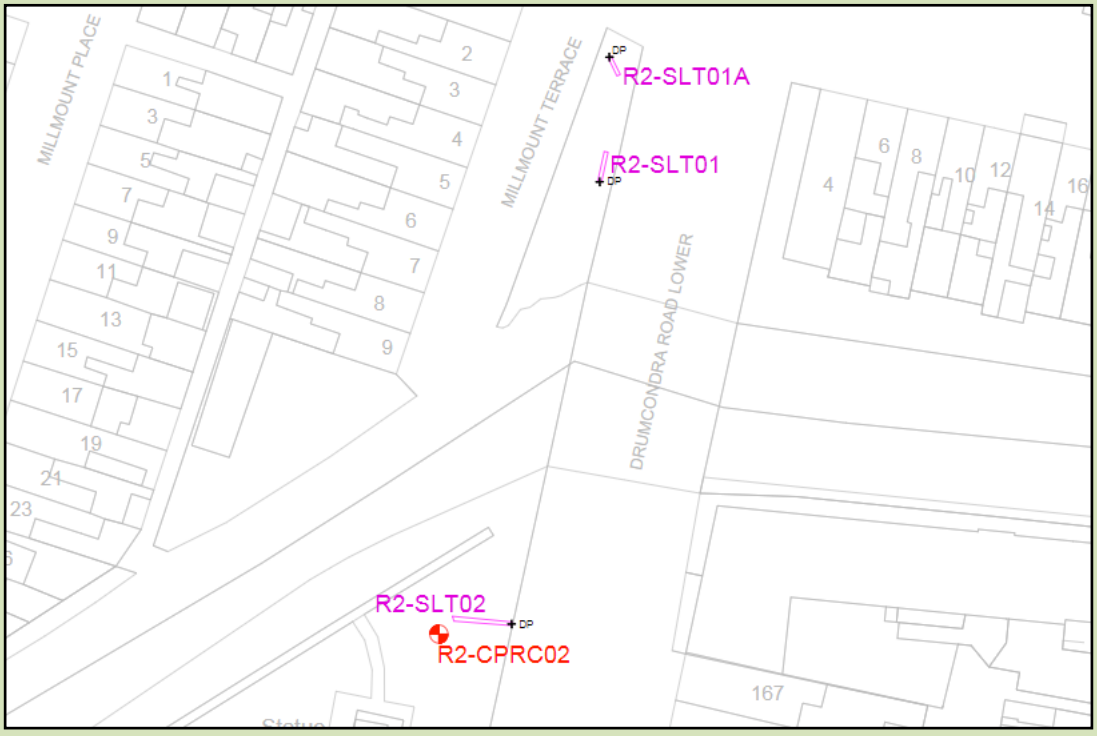
4.1 Results of Monitoring

Route 2: Swords to City Centre

Slit Trench	R2-SLT02
Location	Drumcondra, in a small park, Our Lady's Park, immediately south of the River Tolka
Date	29 September 2020
Type	Slit trench, 7m long, 0.40m wide
Depth	**Description**
0m-0.20m	Mid-brown loose topsoil with roots
0.20m-0.50m	Mid-brown stony soil with modern potsherds, F#'s 1-8 listed in Appendix 3
0.50m-1.30m	Very hard, compact, stony soil with brick and roof-tile fragments
1.30m-1.60m+	Some pea gravel present at 1.13m, then mid-brown gravelly clay continuing, still with fragments of brick, ceramic, glass and even plastic

Comments: Modern disturbance throughout the trench. Natural not reached. No archaeological significance. **Plate 1**

Location Plan showing R2-SLT02:

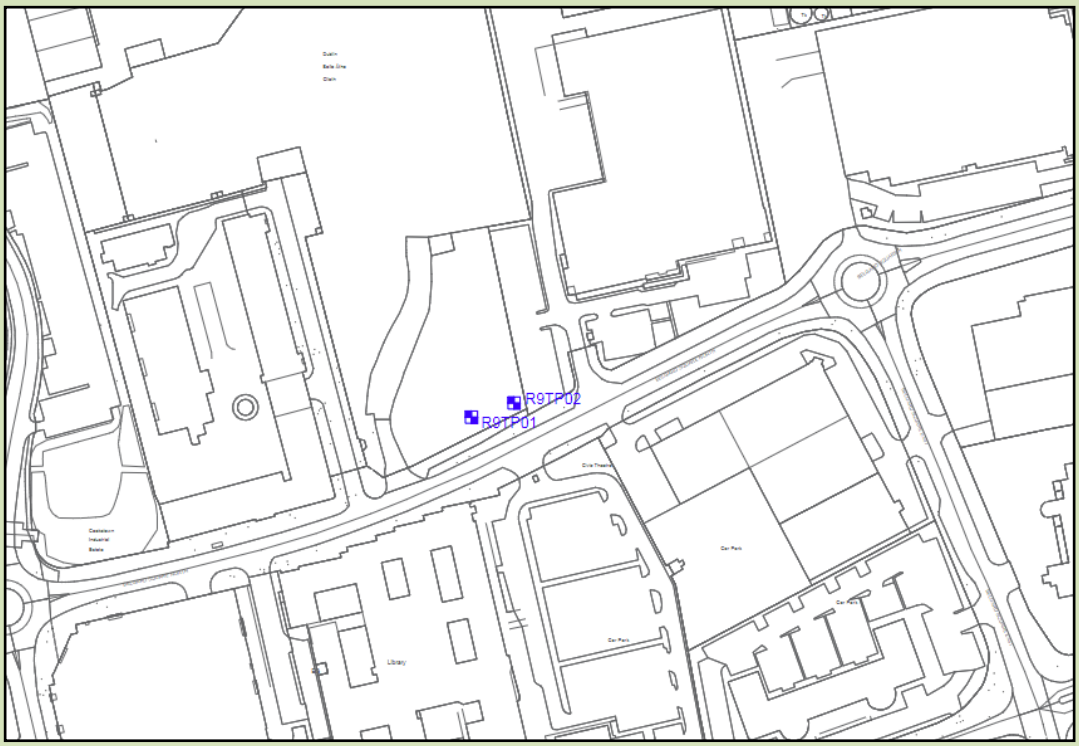


Route 9: Greenhills to City Centre

Trial Pit	R9-TP01
Location	Tallaght, on waste ground near centre
Date	8 October 2020
Type	Machine-dug trial pit, 2.30m x 0.60m
Depth	**Description**
0m-0.30m	Mid-grey-brown topsoil
0.30m-2.00m+	Stiff greyish-brown sandy gravelly clay

Comments: Former agricultural field. No archaeological significance. **Plate 2**

Location Plan showing R9-TP01 and R9-TP02:



Trial Pit	R9-TP02
Location	Tallaght, waste ground near centre
Date	8 October 2020
Type	Machine-dug trial pit, 2.30m x 0.60m
Depth	**Description**
0m-0.10m	Dark brown topsoil
0.10m-0.23m	Very stony, gravelly soil, dark brown
0.30m-0.65m	Lighter mid-brown material
1.50m-2.40m+	Similar to above but more stony

Comments: Former agricultural field. No archaeological significance. **Plate 3**

Location Plan showing R9-TP02:

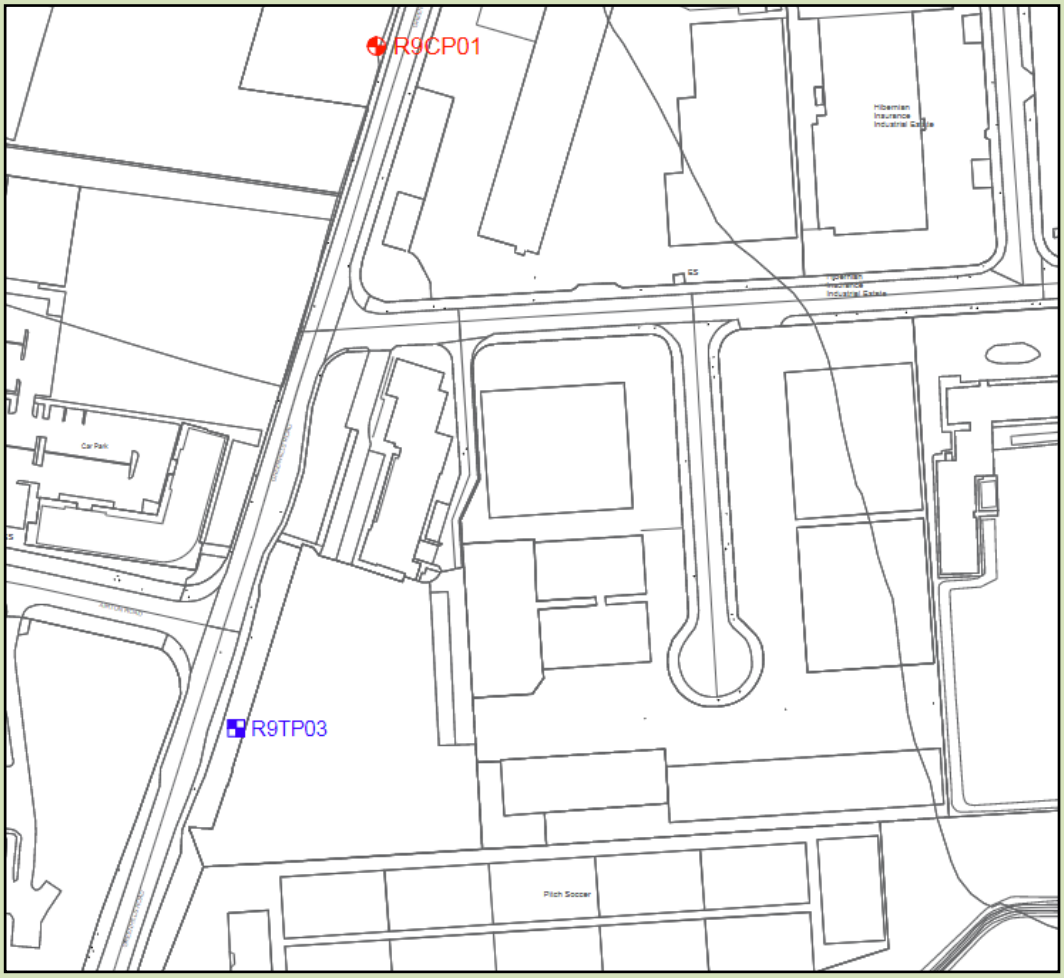
See R9-TP01 above.

Trial Pit	R9-TP03
Location	Greenhills Road: gravelled margin beside main road
Date	9 Oct 2020
Type	Machine-dug trial pit, 1.50m x 0.60m

Depth	Description
0m-0.20m	Compacted gravel laid on geotextile
0.20m-0.85m	Hardcore
0.85m+	Leanmix, probably protecting services

Comments: Pit abandoned because of probable services. No archaeological significance. **Plate 4**

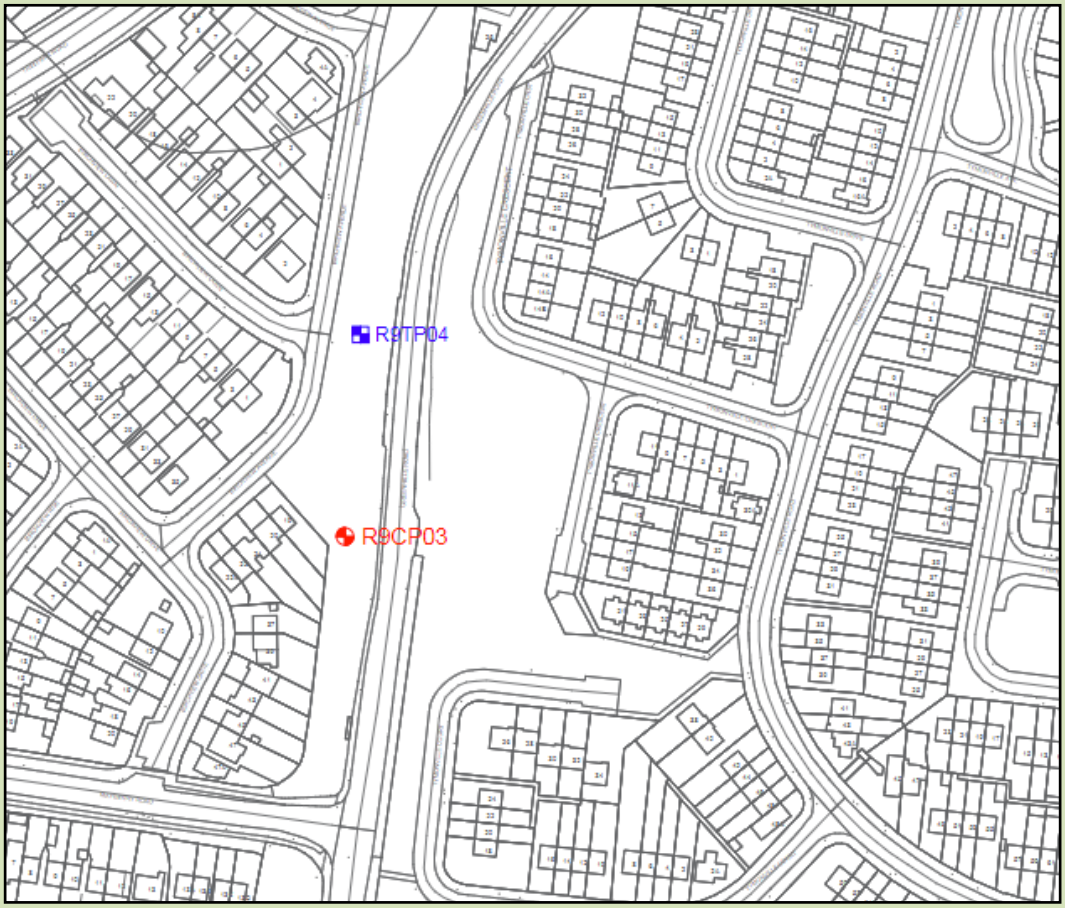
Location Plan showing R9-TP03:



Cable Percussion	R9-CP03
Location	Kilnamanagh, on ornamental grassland in a housing estate
Date	6 October 2020
Type	Cable percussion, no hand-digging
Depth	**Description**
0m-1.00m	Mid-brown topsoil; sherd of sewer pipe
1.00m-1.50m	Similar material, but somewhat lighter in colour
1.50m-8.00m	Light yellow-brown natural
8.00m	Hard boulder clay; refusal

Comments: Made ground to a depth of 1.50m. No archaeological significance. **Plate 5**

Location Plan showing R9-CP03 and R9-TP04 :

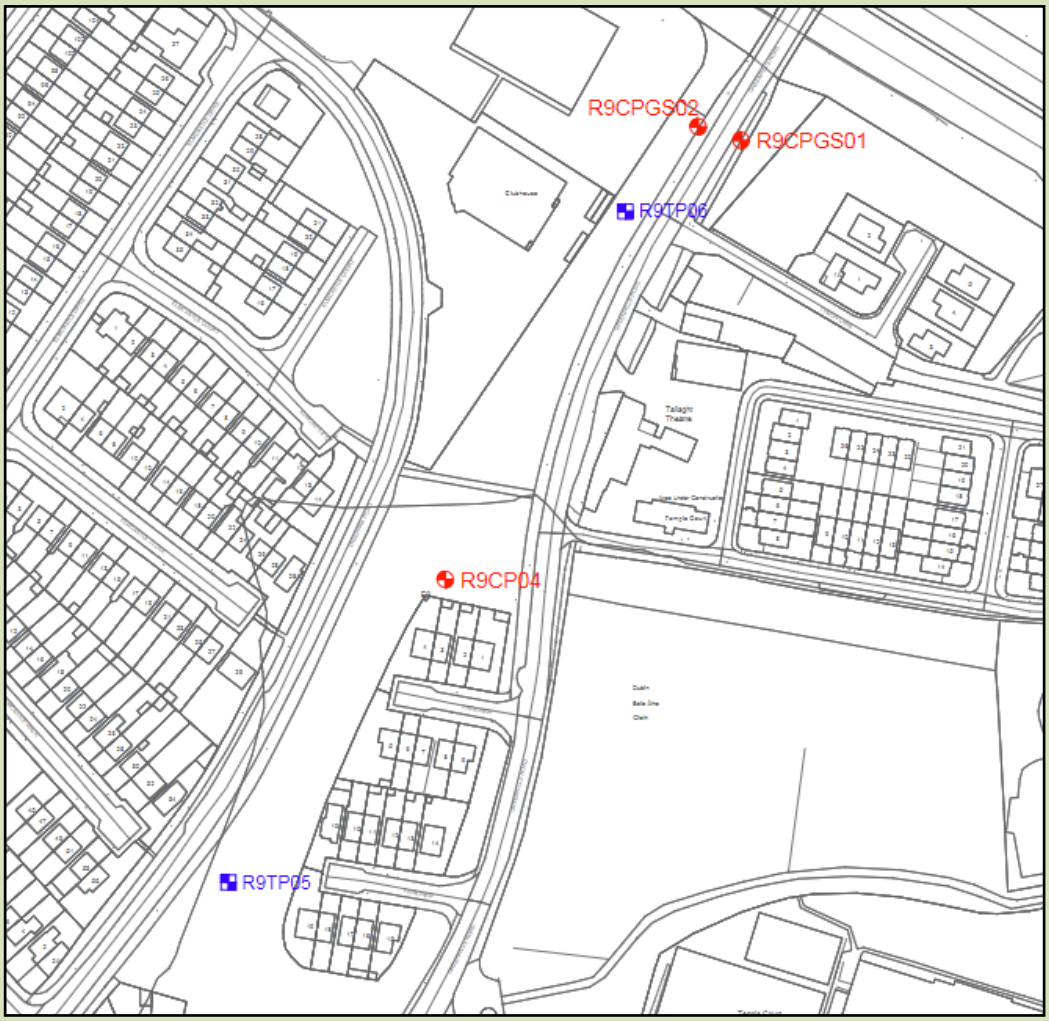


Trial Pit	R9-TP04
Location	Kilnamanagh, on ornamental grassland in a housing estate
Date	8 Oct 2020
Type	Machine-dug trial pit, 2.40m x 0.60m
Depth	**Description**
0m-0.20m	Loose dark brown topsoil with plastic and other modern refuse; modern potsherds and a clay pipe stem mixed in, F#'s 9-11 listed in Appendix 3
0.20m-0.80m	Mid-brown clayey soil
0.80m-2.00m+	Darker brown stony soil
Comments: Ornamental grassland in a housing estate. No archaeological significance. **Plate 6** **Location Plan showing R9-TP04:** See R9-CP03 above.	

Trial Pit	R9-TP05
Location	Kilnamanagh, on ornamental grassland in a housing estate
Date	8 Oct 2020
Type	Machine-dug trial pit, 2.40m x 0.60m
Depth	**Description**
0m-0.15m	Loose mid-brown sod layer
0.15m-2.00m+	Loose mid-brown soil with concrete blocks, fabric, plastic; larger stones at about 1.80m, and water coming in.

Comments: Higher than the level of the surrounding roads. Evidently used as a dump before being grassed over. No archaeological significance. **Plate 7**

Location Plan showing R9-TP05, R9-CP04 and R9-TP06:



Pit/Cable Percussion	R9-CP04
Location	Kilnamanagh, on ornamental grassland in a housing estate
Date	5 October 2020
Type	Hand-dug inspection pit followed by cable percussion
Depth	**Description**
0m-2.00m	Mid-brown soil with stones and coarse modern refuse including a carpet
2.00m-3.00m	Gravelly brown natural; refusal at about 3.00m: probably boulder clay

Comments: Higher than the level of the surrounding roads. Evidently used as a dump before being grassed over. No archaeological significance. **Plate 8**

Location Plan showing R9-CP04:

See R9-TP05 above.

Trial pit	R9-TP06
Location	Greenhills Road, on ornamental grassland beside main road
Date	8 Oct 2020
Type	Machine-dug trial pit, 2.00m x 0.60m
Depth	**Description**
0m-0.30m	Mid-brown sod layer
0.30m-0.40m	Gravelly soil with beer cans
0.40m-0.95m	Hard stony clay with some brick fragments, wire, metal debris
0.95m-1.00m+	Similar material, but with boulders

Comments: Used as a dump before landscaping. No archaeological significance.
Plate 9

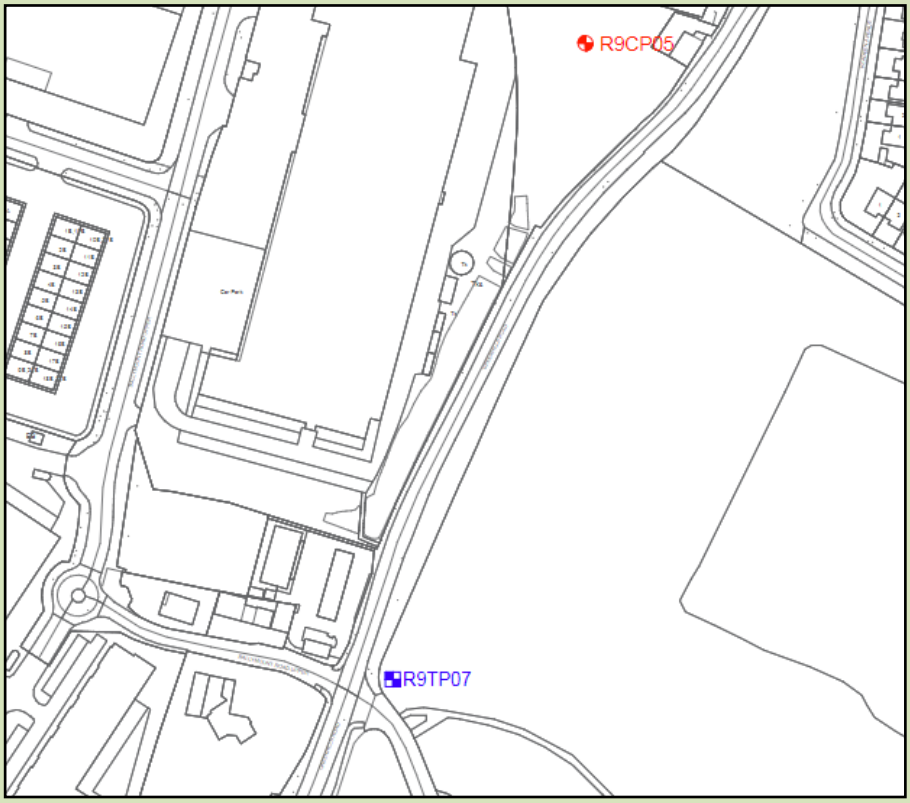
Location Plan showing R9-TP06:

See R9-TP05 above.

Cable Percussion	R9-CP05
Location	Narrow strip of waste land in an industrial estate/business park
Date	12 Oct 2020
Type	Cable percussion, no hand-digging
Depth	**Description**
0m-0.20m	Loose mid grey-brown soil with some fabric and plastic
0.20m-1.50m	Mid-grey-brown soil mixed with rubbish
1.50m-4.80m	Very clayey, but still with rubbish and stones; roofing felt at 4.00m
4.80m-5.00+	Natural gravel

Comments: Worked-out gravel pit used as a dump. No archaeological significance.
Plate 10

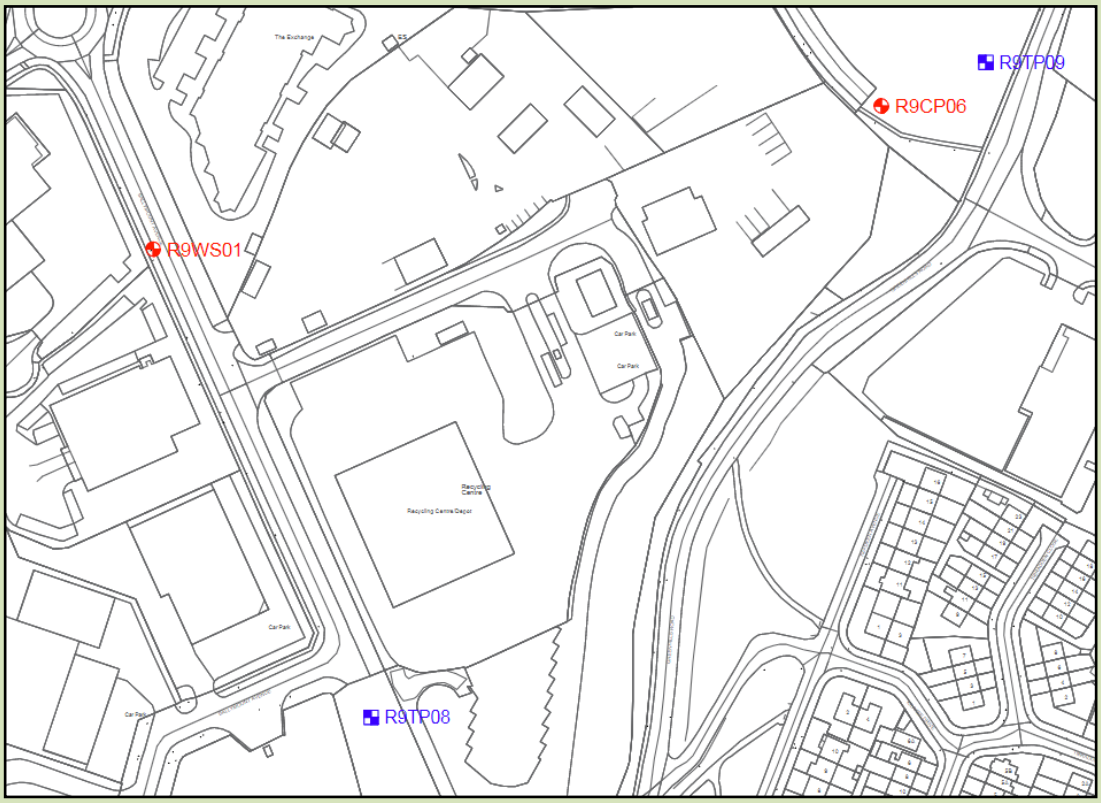
Location Plan showing R9-CP05:



Trial Pit	R9-TP08
Location	Narrow strip of waste land in an industrial estate/business park
Date	8 October 2020
Type	Machine-dug trial pit, 1.70m x 0.50m
Depth	**Description**
0-0.55m	Loose mid-brown topsoil
0.55-1.00m	Gravel
1.00m+	Clayey gravel, boulders by 1.30m

Comments: Formerly in the middle of a field. Cartographic sources suggest that, unlike much of the land adjoining Greenhills Road, it was never quarried for gravel. Nothing of archaeological significance. **Plate 11**

Location Plan showing R9-TP08, R9-WS01 and R9-TP09:



Window Sample	R9-WS01
Location	Grass verge beside road in an industrial estate/business park
Date	19 Oct 2020
Type	Hand-dug inspection pit to 1.20m, then window sample drill
Depth	**Description**
0m-1.00m	Mid-brown gravelly soil, a lot of roots from adjoining tree
c. 1.10m	Electricity cable

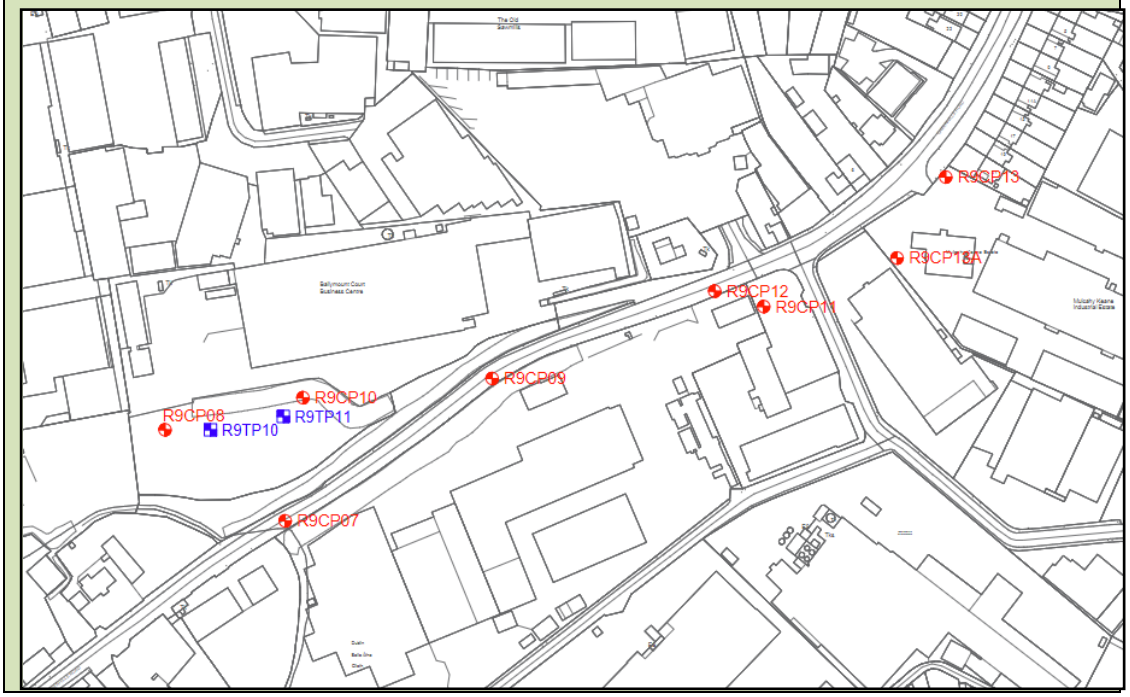
Comments: Pit abandoned after electric cable cut. **Plate 12**

Location Plan showing R9-WS01:

See R9-TP08 above.

Trial Pit	R9-TP09
Location	Waste ground on the edge of an industrial estate
Date	9 Oct 2020
Type	Machine-dug trial pit 1.60m x 0.60m
Depth	**Description**
0m-0.30m	Hardcore
0.30m-0.48m	Clay with lumps of concrete
0.48m-0.53m	Loose dark-brown soil
0.53m-1.00m	Black burnt layer
1.00m-2.5mm	Stony loose soil with rubble and domestic refuse (bottles, etc.)
2.50m-2.75m+	Gravel mixed with refuse and rubble
Comments: Worked-out gravel pit used as a dump. Nothing of archaeological significance. **Plate 13** **Location Plan showing R9-TP09:** See R9-TP08 above.	

Cable Percussion	R9-CP08
Location	Grounds of DPD premises, Greenhills. Raised area near car park.
Date	7 October 2020
Type	Cable percussion; no hand-digging
Depth	**Description**
0-0.20m	Gravel
0.20-0.50m	Light reddish-brown soil
0.50-2.00m	Stony/gravelly soil, lighter in colour but less red: tending to grey
2.00m+	Sticky clay with natural banding.
Comments: This is the edge of a worked-out gravel pit. Nothing of archaeological significance. **Plate 14** **Location Plan showing R9-CP08, R9-TP10, R9-TP11, R9-CP10, R9-CP07, R9-CP09, R9-CP12 and R9-CP13 :**	



Trial Pit	R9-TP10
Location	Grounds of DPD premises, Greenhills; cut into bank next to raised area.
Date	8 Oct 2020
Type	Machine-dug trial trench, 2.00m x 0.60m
Depth	**Description**
0m-0.30m	Loose mid-brown sod layer
0.30m-0.55m	Silty yellow-brown clayey layer
0.55m-0.80m	Soft yellow-brown sandy gravelly clay
0.80m-2.20m	Yellow-brown clayey gravelly sand
2.20m-4.20m+	Silt, banded
Comments: Cutting into glacial deposits at the edge of a worked-out gravel pit. Nothing of archaeological significance. **Plate 15** **Location Plan showing R9-TP10:** See R9-CP08 above.	

Trial Pit	R9-TP11
Location	Grounds of DPD premises, Greenhills; cut into bank next to raised area
Date	8 Oct 2020
Type	Machine-dug trial trench, 2.00m x 0.60m
Depth	**Description**
0m-0.90m	Loose dark-brown topsoil
0.90m-1.60m	Lighter yellow-brown silty soil
1.60m-3.00m	Very mixed silty material
3.00m-3.60m+	Silt
Comments: Cutting into glacial deposits at the edge of a worked-out gravel pit. Nothing of archaeological significance. **Plate 16** **Location Plan showing R9-TP11:** See R9-CP08 above.	

Cable Percussion	R9-CP10
Location	Grounds of DPD premises, Greenhills. Raised area near car park.
Date	7 October 2020
Type	Cable percussion, no hand-digging
Depth	**Description**
0m-0.20m	Gravel
0.20m-0.50m	Very stony soil
0.50m-2.00m	Silt, very fine; apparently water-deposited
2.00m+	Very sticky clay
Comments: This is the edge of a worked-out gravel pit. Nothing of archaeological significance. **Plate 17** **Location Plan showing R9-CP10:** See R9-CP08 above.	

Cable Percussion	R9-CP07
Location	Greenhills Road; road surface
Date	10 Oct 2020
Type	Cable percussion, no hand-digging

Depth	Description
0m-0.02m	Tarmacadam
0.02m-0.05m	Dense stone fill
0.05m-6.00m+	Dense brown gravel
Comments: Modern road surface overlying natural. No archaeological significance. **Location Plan showing R9-CP07:** See R9-CP08 above.	

Cable Percussion	R9-CP09
Location	Greenhills Road; road surface
Date	10 Oct 2020
Type	Cable percussion, no hand-digging
Depth	**Description**
0m-0.02m	Tarmacadam
0.02m-0.04m	Dense stone fill
0.04m-0.23m	Dense brown sand and gravel
Comments: Modern road surface. No archaeological significance. **Location Plan showing R9-CP09:** See R9-CP08 above.	

Cable Percussion	R9-CP12
Location	Greenhills Road; road surface
Date	10 Oct 2020
Type	Cable percussion, no hand-digging
Depth	**Description**
0m-0.02m	Tarmacadam
0.02m-0.05m	Dense stone fill
0.05m-0.4.70m	Dense brown gravel
4.70m-5.50m	Soft brown silty clay
5.50m-6.00m	Dark brown boulder clay
Comments: Modern road surface overlying natural. No archaeological significance. **Location Plan showing R9-CP12:** See R9-CP08 above.	

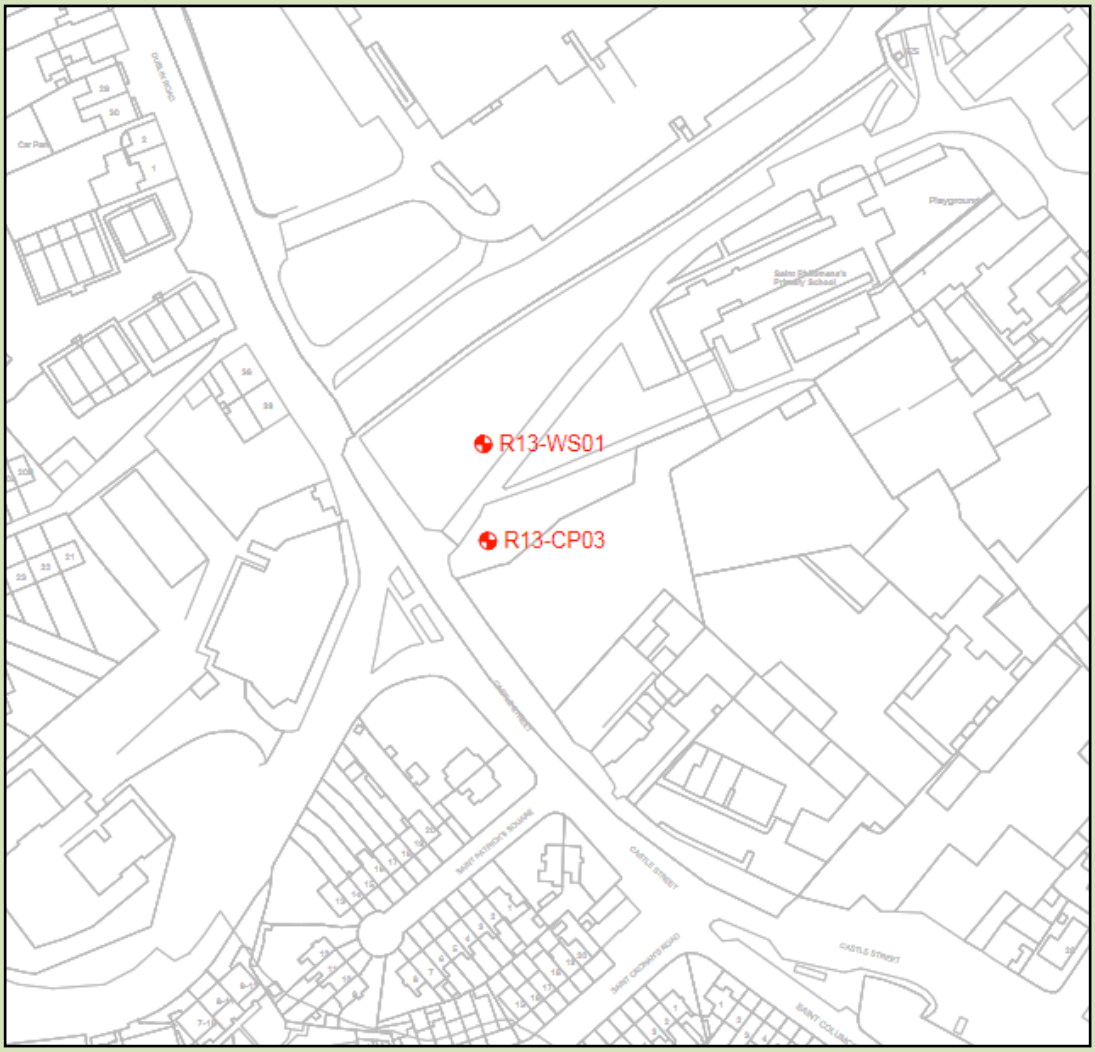
Cable Percussion	R9-CP13
Location	Mulcahy Keane industrial estate, Greenhills; corner of car park
Date	8 October 2020
Type	Cable percussion, no hand-digging.
Depth	**Description**
0m-0.08m	Tarmacadam
0.08m-0.50m	Very stony dark brown gritty soil
0.50m-0.80m	Grey-brown sandy soil with few stones, sherd of flowerpot
0.80m+	Yellow-brown silty soil
Comments: Former garden soil to about 0.80m. Nothing of archaeological significance. **Plate 18** **Location Plan showing R9-CP13:** See R9-CP08 above.	

Route 13: Bray to City Centre

Window Sample	R13-WS01
Location	Bray, in ornamental grassland beside a driveway
Date	19 Oct 2020
Type	Hand-dug inspection pit to 1.20m, then window sample drill
Depth	**Description**
0m-0.40m	Mid-brown garden soil with roots of nearby shrubs
0.40m-1.50m	Lighter brown soil; 1742 coin found in this layer, F#12 listed in Appendix 3
1.50m+	Lighter still, natural

Comments: Irish halfpenny of George II, 1742, recovered.

Location Plan showing R13-WS01:



4.2 Review of Finds

Artefacts were recovered from R2-SL02, R9-TP04 and R13-WS01.

The finds recovered from R2-SL02 consist of potsherds (F#'s 1-8 listed in Appendix 3), and include transfer-printed ware, polychrome ware, Willow Pattern, part of the handle of a white stoneware vessel and part of a whisky jar with the inscription:

...t Blak..

[Spir]it Merch[ant]

[Du]blin

There was also a piece of fairly coarse red ware with a pale green glaze, of possible 16th-17th century date.

This assemblage, from a slit trench beside the River Tolka, suggests that either the area behind the wall alongside the river was used as a dump, or that material dredged from the river could have been deposited there. The area is also sited in proximity of a terrace of cottages, Tolka Cottages, recorded in the mid-18th century but now demolished.

The finds from R9-TP04 comprised part of a pipe stem with spur and two potsherds, one of them with a gilt shamrock of fairly modern appearance (F#'s 9-11 listed in Appendix 3). These were mixed with undoubtedly modern refuse, but the clay pipe fragment shows that residual material from the agricultural soil was mixed in.

A copper coin from R13-WS01 was recovered from garden soil beside the driveway into Ravenswell House (F# 12 listed in Appendix 3). The coin comprises an Irish halfpenny depicted on the obverse side with the head of George II and on the reverse with Hibernia 1742 (Plate 20).

5. Conclusions

The stratigraphy revealed in the detailed ground/geotechnical investigations reflected mostly a landscape changed by modern industrial activities and development. A number of the sites in Greenhills were on the edges of worked-out sandpits, once a common feature of the area – the 'green hills' which gave the area its name were long ago removed in the course of sand-winning.

Other sites showed how ornamental grassland around housing developments were often used as a dump for building waste and general refuse before being landscaped.

No trace was found of any archaeological stratigraphy, even in Kilnamanagh, where there had been a group of medieval sites.

Finds retrieved during archaeological monitoring were mostly relatively recent, and reflected disposal of refuse. An 18th-century coin found during window sampling at Bray was a fortuitous find from garden soil.

6. References

Bolger, T., 2010. *Archaeological Monitoring of utility slit trenching along the proposed route of Metro West, Co. Dublin.* Unpublished report.

National Museum of Ireland Topographical Files

Cartographic Sources

John Rocque's map of Dublin city, 1757

John Rocque's map of County Dublin, 1760

1837-43, first edition 6-inch OS map

1908-13, 25" edition OS map

Cassini c. 1940s edition OS map

Electronic sources

www.excavations.ie	Summary accounts of archaeological investigations
www.archaeology.ie	Website listing RMP and NIAH sites
www.heritagemaps.ie	Heritage Council website
http://digital.ucd.ie	Historic OS maps
www.dublinhistoric maps.ie	17th and 18th century historic maps of Dublin
www.stpetersparishbray.com	Bray history

7. Monitoring Plates

Plate 1 Slit trench R2-SLT02

Plate 2 Trial pit R9-TP01

Plate 3 Trial pit R9-TP02

Plate 4 Trial pit R9-TP03

Plate 5 Cable percussion R9-CP03

Plate 6 Trial pit R9-TP04

Plate 7 Trial pit R9-TP05

Plate 8 Cable percussion R9-CP04

Plate 9 Trial pit R9-TP06

Plate 10 Cable percussion, R9-CP05

Plate 11 Trial pit R9-TP08

Plate 12 Window sample R9-WS01

Plate 13 Trial pit R9-TP09

Plate 14 Cable percussion R9-CP08

Plate 15 Trial pit R9-TP10

Plate 16 Trial pit R9-TP11

Plate 17 Cable percussion R9-CP10

Plate 18 Cable percussion R9-CP13

Plate 19 Window sample R13-WS01

Plate 20 R13-WS01, Irish halfpenny of George II, 1742

8. Appendix 1 Identified Investigation Locations

Route	Investigation Ref.	Townland, County	Monitoring proposed
CBC02 – Swords to City Centre	R2-CPRC01	Drishoge, Dublin	Yes
CBC02 – Swords to City Centre	R2-CPRC02	Clonliff West, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-M09-BH-01	Tymon North, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-M10-BH-01	Tymon North, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-M16-BH-04	Greenhills, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-M16-BH-05	Greenhills, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-M17-BH-01	Greenhills, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-M17-BH-02	Greenhills, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-M17-BH-04	Greenhills, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-M17-BH-06	Greenhills, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-M17-BH-07	Greenhills, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-M17-BH-08	Greenhills, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-M03-TP-01	Tallaght, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-M03-TP-02	Tallaght, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-M09-TP-03	Tymon North, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-M10-TP-01	Tymon North, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-M10-TP-04	Kilnamanagh, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-M11-TP-02	Kilmnamanagh, Dublin	Yes
CBC13 – Bray to City Centre	R13-CP01 unmonitored	Woodland, Dublin	Yes
CBC13 – Bray to City Centre	R13-CP02 unmonitored	Foxrock, Dublin	Yes
CBC13 – Bray to City Centre	R13-CP03	Ravenswell, Wicklow	Yes

9. Appendix 2 Monitored Investigation Locations

Route	Borehole Ref.	Townland, County	Archaeological Monitoring Completed
CBC02 – Swords to City Centre	R2-SLT02	Clonliff West, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-TP01	Tallaght, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-TP02	Tallaght, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-TP03	Tallaght, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-CP03	Tymon North, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-TP04	Tymon North, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-TP05	Tymon North, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-CP04	Tymon North, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-TP06	Kilnamanagh, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-CP05	Kilnamanagh, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-TP08	Kilnamanagh, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-WS01	Kilnamanagh, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-TP09	Kilnamanagh, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-CP08	Greenhills, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-TP10	Greenhills, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-TP11	Greenhills, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-CP10	Greenhills, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-CP07	Greenhills, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-CP09	Greenhills, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-CP12	Greenhills, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-CP13	Greenhills, Dublin	Yes
CBC13 – Bray to City Centre	R13-WS01	Ravenswell, Bray, Wicklow	Yes

10. Appendix 3 Register of Finds

Licence #	Find#	Type	Description	Date	Investigation Location	Townland
20E0622	1	Potsherd	Rim of large transfer-printed plate	29-Sep-20	R02-SLT02	Clonliff West
20E0622	2	Potsherd	Handle of white stoneware vessel	29-Sep-20	R02-SLT02	Clonliff West
20E0622	3	Potsherd	Fragment of transfer-printed plate	29-Sep-20	R02-SLT02	Clonliff West
20E0622	4	Potsherd	Rim of transfer-printed cup	29-Sep-20	R02-SLT02	Clonliff West
20E0622	5	Potsherd	Base of hand-painted cup	29-Sep-20	R02-SLT02	Clonliff West
20E0622	6	Potsherd	Base of Willow Pattern plate '[S]TONE W[...]'	29-Sep-20	R02-SLT02	Clonliff West
20E0622	7	Potsherd	Part of plate with red fabric and light green glaze	29-Sep-20	R02-SLT02	Clonliff West
20E0622	8	Potsherd	Part of stoneware vessel with brown glaze. '...t Blak[e, Spir]it Merch[ant..... Du]blin'	29-Sep-20	R02-SLT02	Clonliff West
20E0622	9	Potsherd	Part of cup with shamrock decoration	08-Oct-20	R09-TP04	Kilnamanagh
20E0622	10	Potsherd	Piece of transfer-printed ware	08-Oct-20	R09-TP04	Kilnamanagh
20E0622	11	Clay-pipe	Part of stem with spur	08-Oct-20	R09-TP04	Kilnamanagh
20E0622	12	Coin	Irish halfpenny of George II, 1742	19-Oct-20	R13-WS01	Ravenswell