Appendix E.3
Geotechnical Report – Ground Investigation

Bus Connects Route 6 Lucan to City Centre – Ground Investigation

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

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APPENDICES

Document Control Sheet

Report No.:		20-0399B			
Project Title:		Bus Connects Route 6 Lucan to City Centre			
Client:		National Transport Authority (NTA)			
Client's Representative:		AECOM/Mott MacDonald			
Revision:	A01	**Status:**	Final for Issue	**Issue Date:**	16th December 2020
Prepared by:		**Reviewed by:**		**Approved by:**	
 Stuart Abraham MEng MIEI		 Sean Ross BSc MSc MIEI		 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 6 Lucan 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, slit trenches, 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 on and alongside the N4 road from Junction 2 in the west to Ballyfermot Training Centre adjacent to the R148 (Chapilizod Bypass) in the east. The main land use in the area is residential and light commercial with Liffey Valley Shopping Centre located in the centre of the site. Large residential developments are found east through west.

4 SITE OPERATIONS

4.1 Summary of site works

Site operations, which were conducted between 24th September and 24th October 2020, comprised:

- six light cable percussion boreholes
- one borehole by combined percussion boring and rotary follow-on drilling
- six boreholes by dynamic (windowless) sampling methods
- a standpipe installation in one borehole
- one slit trench

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 thirteen 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 Dando Terrier rigs, light cable percussion boring by Dando 2000 rigs, and rotary drilling (by Hanjin D8 rotary drilling rigs).

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

Six boreholes (R6-CP01, R6-CP03 and R6-CP08 – R6-CP11) were put down to completion in minimum 200mm diameter using Dando 2000 light cable percussion boring rigs. All boreholes were terminated on encountering virtual refusal on obstructions.

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.

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 H.

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

Appendix B presents the borehole logs.

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

One borehole (R6-CP07) was put down by a combination of light percussion boring and rotary follow-on drilling techniques with core recovery in bedrock. Where the light percussion borehole had not been advanced onto bedrock, rotary percussive methods were employed to advance the borehole to completion/bedrock. Symmetrix cased full-hole drilling was used, with SPTs carried out at standard intervals as required.

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.

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 H.

Where coring was carried out within bedrock strata, 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

Six boreholes (R6-CP02, R6-CP04 – R6-CP06, R6-WS01 & R6-WS02) were put down to completion by light percussion boring techniques using a Dando Terrier dynamic sampling rig. The boreholes were put down initially in 150mm diameter, reducing in diameter with depth as required, down to 50mm by use of the smallest sampler.

Hand dug inspection pits were carried out between ground level and 1.20m depth to ensure boreholes were put down clear of services or subsurface obstructions. The boreholes were taken to depths ranging between 0.87m and 3.60m where they were terminated on encountering virtual refusal on obstructions.

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 H.

Disturbed (bulk and small bag) samples were taken within the encountered strata. Environmental samples were taken at standard intervals, as directed by the Client's Representative. Undisturbed (U100) samples were taken as appropriate within fine grained strata.

Any water strikes encountered during boring were recorded along with any changes in their levels as the borehole proceeded. Details of the water strikes are presented on the individual borehole logs.

Appendix B presents the borehole logs.

4.3 Dynamic probes

Two dynamic probes (R6-CP02DP and R6-CP07DP) were conducted as a follow on from the boreholes using the DPSHB method as described in BS EN ISO 22476-3:2005+A1:2011. The method entails a 63.5kg hammer falling 0.75m onto a 50.5mm diameter cone with an apex angle of 90°.

Appendix B provides the dynamic probe logs on the sheet following the relevant borehole log in the form of plots, against depth, of the number of blows per 100mm penetration.

4.4 Standpipe installations

A groundwater monitoring standpipe was installed in boreholes R6-CP07

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

4.5 Slit trenches

One slit trench (R6-TP01) was excavated by a combination of hand digging and mechanical excavation using a compact 3t tracked excavator fitted with a 600mm wide toothless bucket, to locate and identify buried services at the site. An attempt was also made to investigate foundations of existing bridge abutments at this location. A concrete projection was identified at 1.10mbgl however it was not possible to establish or confirm foundation makeup.

Drawing of the trenches and the locations of services encountered during excavation are shown along with the slit trench logs in Appendix D, with photographs presented in Appendix E.

4.6 Surveying

The as-built exploratory hole positions were surveyed following completion of site operations by a Site Engineer from Causeway Geotech. Surveying was carried out using a Trimble R6 GPS system employing VRS and real time kinetic (RTK) techniques.

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

4.7 Groundwater monitoring

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

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
- **soil chemistry:** pH and water soluble sulphate content

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

The test results are presented in Appendix F.

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 F.

5.3 Environmental laboratory testing of soils

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

Testing was carried out on a number of samples according to Engineer's Ireland Suite E and Suite H including 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

Results of environmental laboratory testing are presented in Appendix G.

6 GROUND CONDITIONS

6.1 General geology of the area

Published geological mapping indicate the superficial deposits underlying the site comprise mainly Glacial Till. These deposits are underlain by limestone and shale of the Lucan Formation. An area of gravels derived from limestone underlain by the Waulsortian Limestones was noted on the site's western boundary. East of the M50 on the Chapelizod Bypass is underlain by made ground, alluvium and glacial till.

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:** boreholes R6-CP10 & R6-CP11 encountered 0.3mm of macadam surfacing. In addition, R6-TP01 had concrete down to 100mm. Concrete was encountered at 4.0mbgl in borehole R6-CP10
- **Topsoil:** the remainder of the site encountered topsoil in 0.1m-0.3m thickness.
- **Made Ground (sub-base):** approximately 1.0m of aggregate fill beneath the paved surfaces.
- **Made Ground (fill):** reworked sandy gravelly clay fill occasionally with fragments of concrete extending to a maximum depth of 4.0m at bridge abutment locations.
- **Alluvium:** very soft clay encountered at depths ranging 3.0m-4.0m in borehole R6-CP09
- **Glacial Till:** sandy gravelly clay, typically firm or stiff in upper horizons, becoming very stiff with increasing depth.
- **Bedrock (Limestone):** Rockhead was encountered at a depth of 7.6m in R6-CP07.

6.3 Groundwater

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

Groundwater was encountered during percussion boring through soil as water strikes at 2.5m – 3.1m in boreholes R6-CP03 – R6-CP05 and R6-CP07. Groundwater was encountered in slit trench R6-TP02.

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

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

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

Table 1: Groundwater monitoring

Date	Water level (mbgl)
	R6-CP07
19/11/2020	6.35

Continued monitoring of the installed standpipe will give an indication of the seasonal variation in groundwater level which should be factored into design considerations.

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

EXPLORATORY HOLE LOCATION PLAN

PROJECT: Bus Connects Route 6 Lucan to City Centre

TITLE: Exploratory hole location plan

CLIENT: National Transport Authority (NTA)

KEY:
- Borehole
- Trial Pit

ENGINEER: AECOM/Mott MacDonald

CAUSEWAY GEOTECH

SCALE: NTS@A3

DATE: 16/12/2020

DRWN: BS

CHCK: CH

SERIES: 1 of 2

DWG No: 20-0399B-EHL-OW-001

PROJECT: Bus Connects Route 6 Lucan to City Centre

TITLE: Exploratory hole location plan (Overview)

CLIENT: National Transport Authority (NTA)

KEY:
- Borehole
- Trial Pit

ENGINEER: AECOM/Mott MacDonald

CAUSEWAY GEOTECH

SCALE: NTS@A3

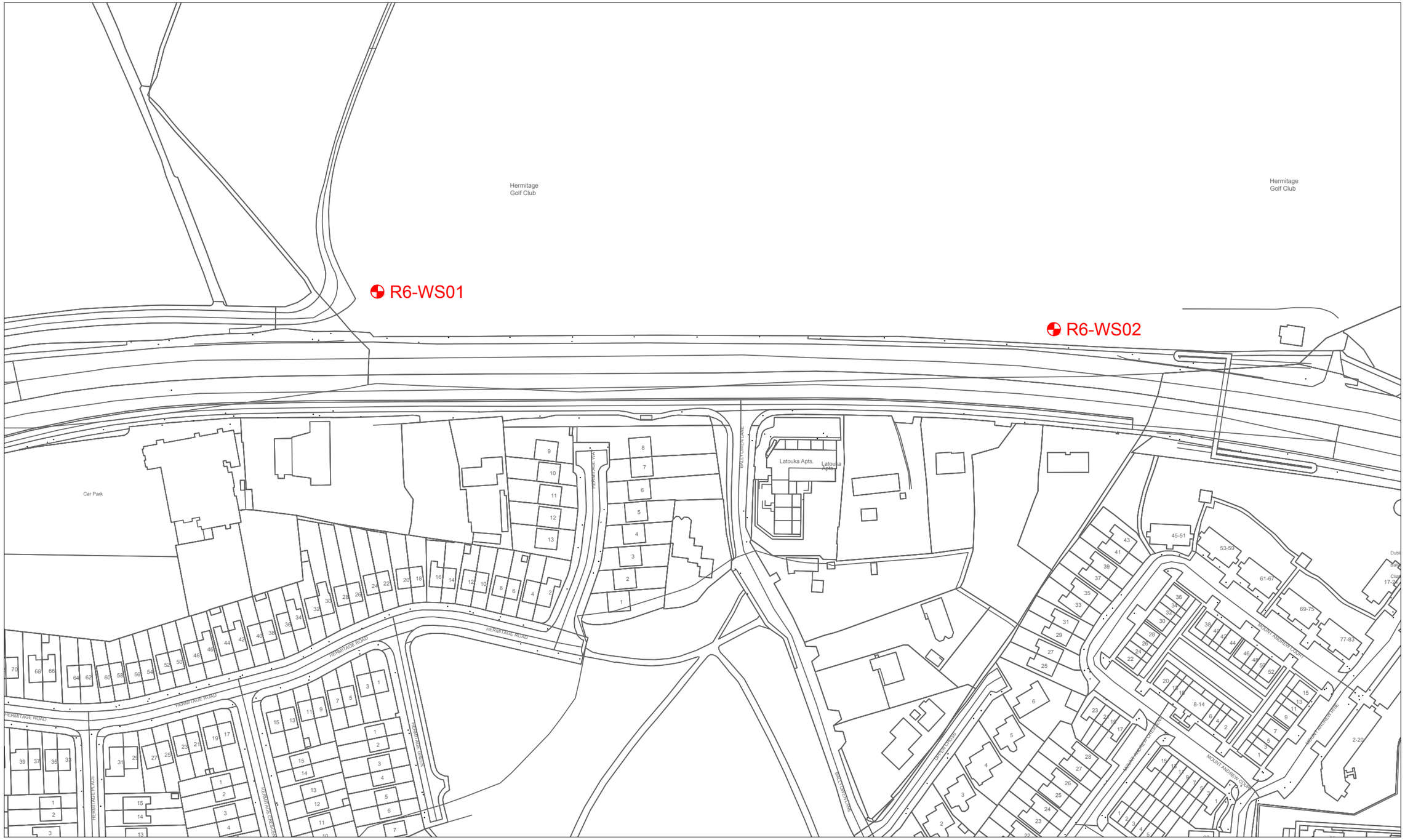
DATE: 16/12/2020

DRWN: BS

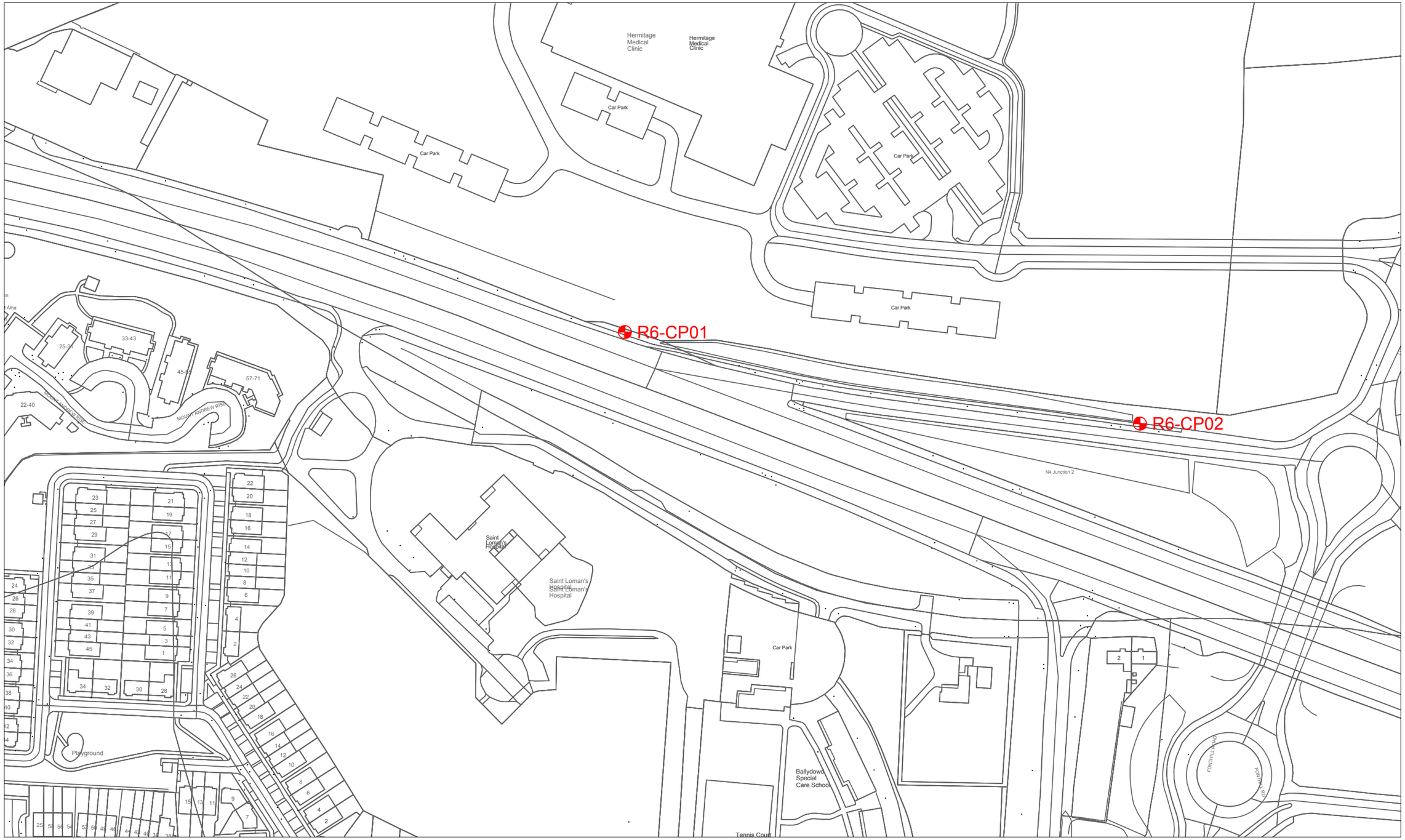
CHCK: CH

SERIES: 2 of 2

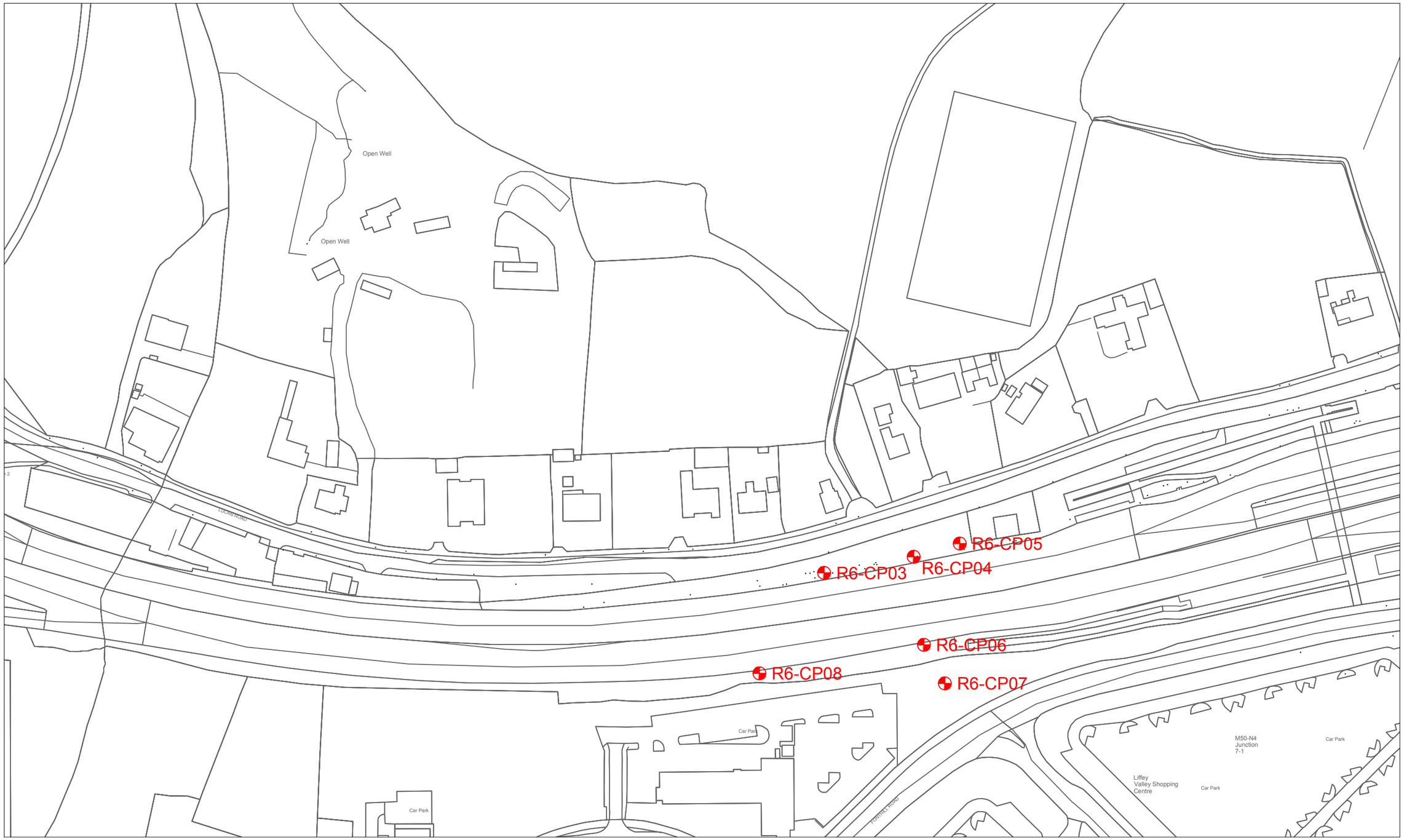
DWG No: 20-0399B-EHL-OW-002



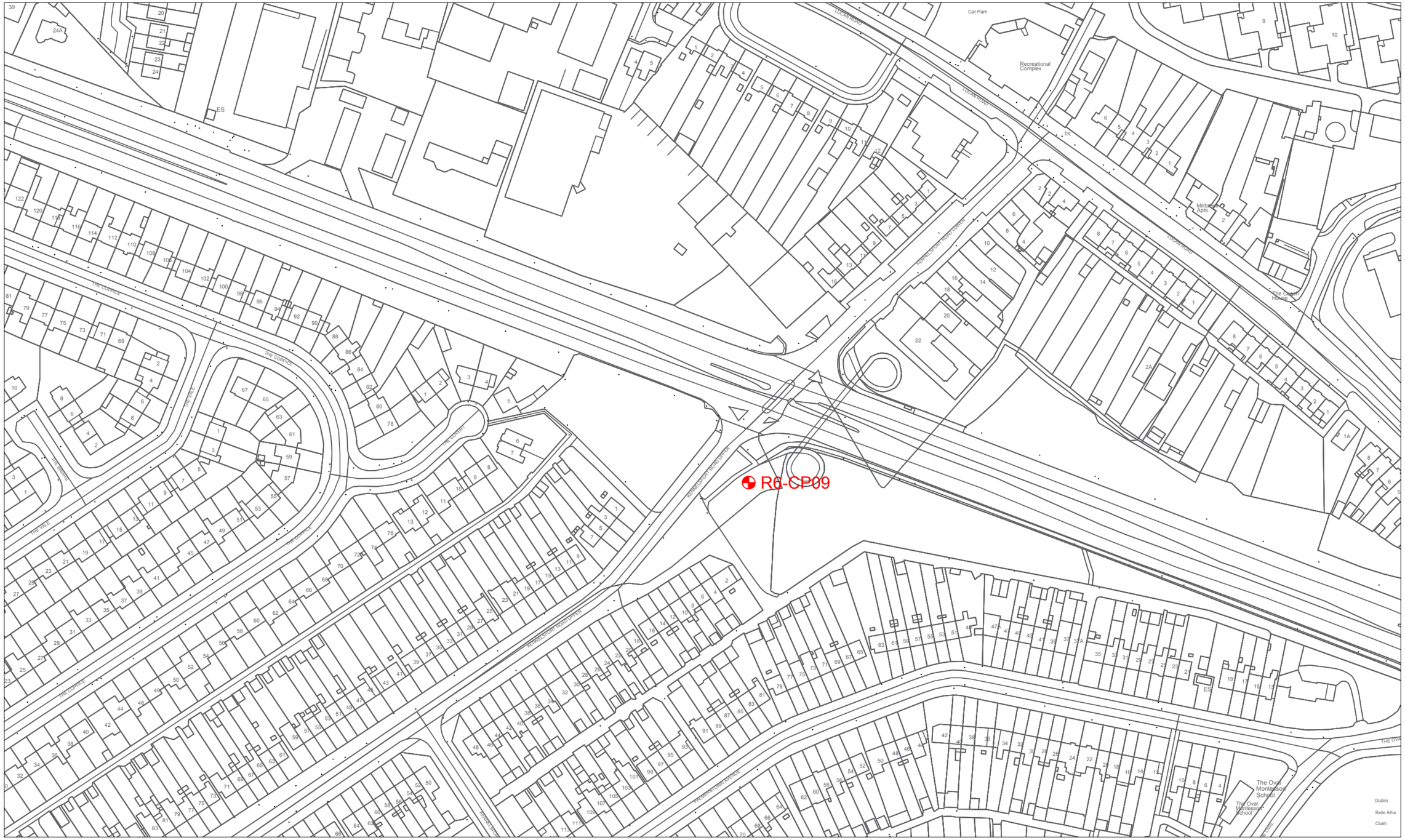
PROJECT: Bus Connects Route 6 Lucan to City Centre		TITLE: Exploratory hole location plan			
CLIENT: National Transport Authority (NTA)	KEY: Borehole, Trial Pit	CAUSEWAY GEOTECH	SCALE: NTS@A3	DATE: 16/12/2020	
ENGINEER: AECOM/Mott MacDonald			DRWN: BS CHCK: CH	SERIES: 1 of 5	DWG No: 20-0399B-EHL-001



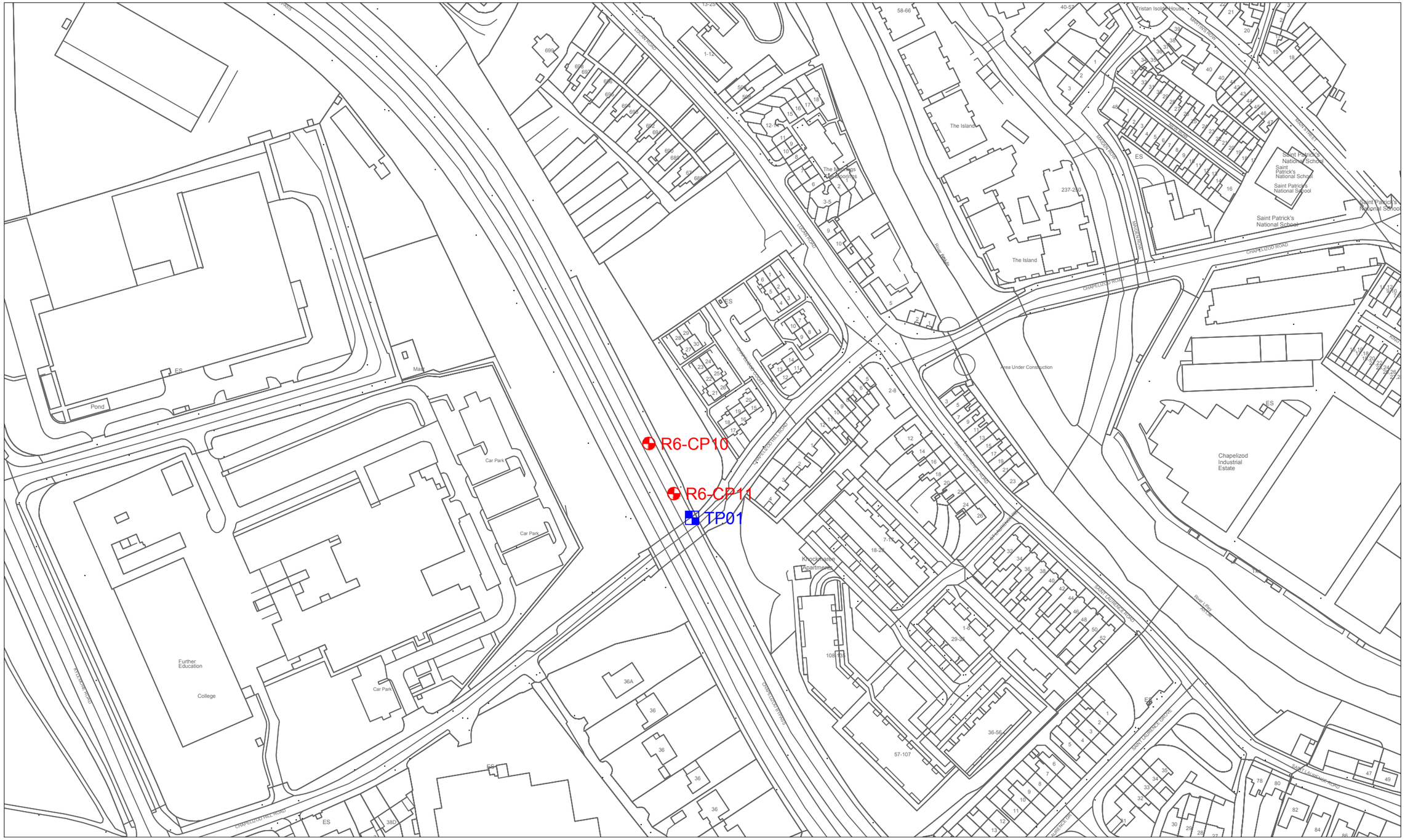
PROJECT: Bus Connects Route 6 Lucan to City Centre		TITLE: Exploratory hole location plan			
CLIENT: National Transport Authority (NTA)	KEY: Borehole, Trial Pit	CAUSEWAY GEOTECH	SCALE: NTS@A3	DATE: 16/12/2020	
ENGINEER: AECOM/Mott MacDonald			DRWN: BS CHCK: CH	SERIES: 2 of 5	DWG No: 20-0399B-EHL-002



PROJECT: Bus Connects Route 6 Lucan to City Centre		TITLE: Exploratory hole location plan			
CLIENT: National Transport Authority (NTA)	KEY: Borehole, Trial Pit	CAUSEWAY GEOTECH	SCALE: NTS@A3	DATE: 16/12/2020	
ENGINEER: AECOM/Mott MacDonald			DRWN: BS	SERIES: 3 of 5	DWG No: 20-0399B-EHL-003
			CHCK: CH		



PROJECT: Bus Connects Route 6 Lucan to City Centre		TITLE: Exploratory hole location plan			
CLIENT: National Transport Authority (NTA)	KEY: Borehole, Trial Pit	CAUSEWAY GEOTECH	SCALE: NTS@A3	DATE: 16/12/2020	
ENGINEER: AECOM/Mott MacDonald			DRWN: BS CHCK: CH	SERIES: 4 of 5	DWG No: 20-0399B-EHL-004



PROJECT: Bus Connects Route 6 Lucan to City Centre		TITLE: Exploratory hole location plan			
CLIENT: National Transport Authority (NTA)	KEY: Borehole, Trial Pit	CAUSEWAY GEOTECH	SCALE: NTS@A3	DATE: 16/12/2020	
ENGINEER: AECOM/Mott MacDonald			DRWN: BS CHCK: CH	SERIES: 5 of 5	DWG No: 20-0399B-EHL-005

CAUSEWAY GEOTECH

APPENDIX B

BOREHOLE LOGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
20-0399B	Bus Connects Route 6 Lucan to City Centre	R6-CP01
	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	706072.26 E 735381.46 N

Final Depth:	Start Date:	Driller:	Sheet 1 of 1
5.00 m	19/10/2020	BM	Scale: 1:40
Elevation: 60.62 mOD	**End Date:** 19/10/2020	**Logger:** CH	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
					60.52	0.10		TOPSOIL		
0.50	B5							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	ES1									
1.00	B6				59.62	1.00		Firm brown slightly gravelly sandy silty CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium of mixed lithologies.		
1.00	ES2									
1.20	D10									
1.20 - 1.65	SPT (S)	N=8 (2,2/2,2,2,2) Hammer SN = 0643	1.20	Dry						
2.00	B7									
2.00	D11									
2.00	ES3									
2.00 - 2.45	SPT (S)	N=9 (4,2/2,2,2,3) Hammer SN = 0643	1.50	Dry						
3.00	B8									
3.00	ES4									
3.00 - 3.45	U14	Ublow=30 80%	1.50	Dry						
4.00	B9				56.62	4.00		Firm brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.		
4.00	D12									
4.00 - 4.45	SPT (S)	N=33 (5,5/7,8,8,10) Hammer SN = 0643	1.50	Dry						
					55.92	4.70		Grey sandy angular coarse GRAVEL of limestone. Sand is fine to coarse. (Possible bedrock)		
5.00	D13				55.62	5.00		End of Borehole at 5.00m		
5.00 - 5.10	SPT (S)	N=50 (25 for 50mm/50 for 50mm) Hammer SN = 0643	1.50	Dry						

Water Strikes

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

Casing Details

To (m)	Diameter
1.50	200

Water Added

From (m)	To (m)

Chiselling Details

From (m)	To (m)	Time (hh:mm)
4.70	5.00	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
20-0399B	Bus Connects Route 6 Lucan to City Centre	R6-CP02
	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 1 of 1
Light Percussion	Dando Terrier	0.00	1.90	706305.22 E 735340.10 N	1.90 m	22/10/2020	JC	Scale: 1:50
					Elevation: 52.79 mOD	End Date: 22/10/2020	Logger: CH	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
0.20 - 0.70	B1				52.59	0.20		TOPSOIL		
								MADE GROUND: Grey angular to subangular fine to coarse GRAVEL of mixed lithologies. Sand is fine to coarse.		
0.70 - 1.20	B2				52.09	0.70		Stiff brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.		
1.00	ES3									
1.20 - 1.90	B4				51.59	1.20		Stiff brown slightly gravelly sandy silty CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium of mixed lithologies.		
1.20 - 1.65	SPT (C)	N=29 (5,7/6,7,8,8) Hammer SN = 0696	0.00	Dry						
1.90	ES5				50.89	1.90		End of Borehole at 1.90m		
1.90 - 2.35	SPT (S)	N=38 (6,9/9,11,11,7) Hammer SN = 0696	0.00	Dry						

Water Strikes				Casing Details	
Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	To (m)	Diameter

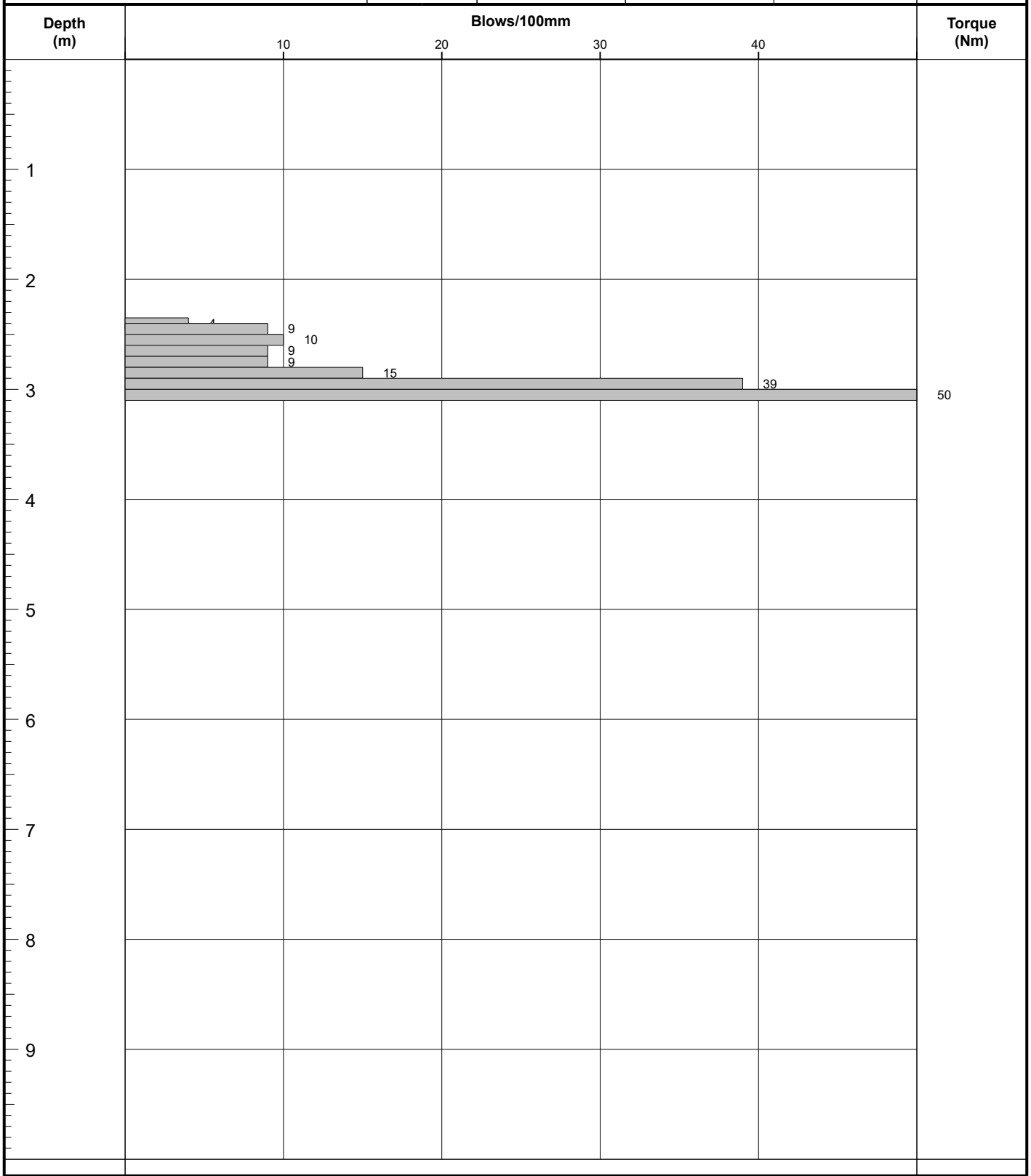
Remarks

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

Termination Reason	Last Updated
Terminated due to sampler refusal, continued by dynamic probing.	16/12/2020

AGS

CAUSEWAY GEOTECH	**Project No.** 20-0399B	**Project Name:** Bus Connects Route 6 Lucan to City Centre			**Probe ID** R6-CP02DP
	Coordinates 706305.22 E 735340.10 N	**Client:** National Transport Authority (NTA)			
Method: Dynamic Probing		**Client's Representative:** AECOM/Mott MacDonald			Sheet 1 of 1 Scale: 1:50
Probe Type: DPSH-B	**Elevation** 52.79 mOD	**Final Depth:** 3.05	**Date:**	**Operator:** JC	FINAL



Fall Height: 750 mm	**Remarks:** Follow on from R6-CP02.
Hammer Mass: 64 kg	
Cone Diameter: 51 mm	

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
20-0399B	Bus Connects Route 6 Lucan to City Centre	R6-CP03
	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	4.00	706928.72 E 735171.78 N

Final Depth:	4.00 m	Start Date:	20/10/2020	Driller:	BM	Sheet 1 of 1 Scale: 1:40
Elevation:	50.87 mOD	End Date:	20/10/2020	Logger:	CH	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
					50.76	0.10		TOPSOIL		
								MADE GROUND: Soft brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.		
					50.46	0.40				
0.50	B5							MADE GROUND: Grey sandy subrounded GRAVEL of mixed lithologies. Sand is fine to coarse.		
0.50	ES1				50.26	0.60				
								MADE GROUND: Soft brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.		
1.00	B6				49.86	1.00				
1.00	ES2							Brown fine to coarse SAND.		
1.20 - 1.65	U12	Ublow=50 90%	1.00	Dry	49.66	1.20		Soft becoming firm brown slightly gravelly sandy silty CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium of mixed lithologies.		
2.00	B7									
2.00	D10									
2.00	ES10									
2.00	ES3									
2.00 - 2.45	SPT (S)	N=10 (2,2/2,2,2,4) Hammer SN = 0643	1.50	Dry						
3.00	B8								▼	
3.00	D11									
3.00	ES4									
3.00 - 3.45	SPT (S)	N=10 (2,3/2,3,2,3) Hammer SN = 0643 Water strike at 3.00m	1.50	3.00						
					47.16	3.70		Grey angular to subangular COBBLES of medium strong limestone with much subangular coarse gravel. (Possible bedrock)		
4.00	B9				46.86	4.00		End of Borehole at 4.00m		
4.00 - 4.08	SPT (S)	N=50 (25 for 25mm/50 for 50mm) Hammer SN = 0643	1.50	3.00						

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

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
3.00	3.00		

Chiselling Details

From (m)	To (m)	Time (hh:mm)
3.70	4.00	01:00

Casing Details

To (m)	Diameter

Water Added

From (m)	To (m)

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
20-0399B	Bus Connects Route 6 Lucan to City Centre	R6-CP04
	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	3.60	706969.62 E 735179.08 N

Final Depth:	Start Date:	Driller:	Sheet 1 of 1
3.60 m	21/10/2020	JC	Scale: 1:50
Elevation: 51.36 mOD	**End Date:** 21/10/2020	**Logger:** SF	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
0.10	ES1				51.26	0.10		TOPSOIL		
0.10 - 1.20	B1							MADE GROUND: Stiff brown sandy gravelly CLAY with high cobble content and concrete fragments. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.		
0.50	ES2									
1.00	ES3									
1.20 - 1.70	B4									
1.20 - 1.65	SPT (S)	N=36 (8,12/13,7,7,9) Hammer SN = 0696	0.00	Dry						
1.70	ES5				49.66	1.70		Stiff brown sandy gravelly SILT. Sand is fine to medium. Gravel is subrounded to subangular fine to coarse of mixed lithologies.		
1.70 - 2.00	B5									
2.00	U6	Ublow=127 80%	0.00	Dry						
2.50	D7									
3.00	ES8				48.36	3.00		Soft brown sandy gravelly SILT with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.		
3.00 - 3.60	B9									
3.00 - 3.45	SPT (C)	N=4 (2,1/1,1,1,1) Hammer SN = 0696	0.00	3.30						
		Water strike at 3.00m			47.76	3.60		End of Borehole at 3.60m		
3.60 - 3.78	SPT (C)	N=50 (19,25/50 for 30mm) Hammer SN = 0696	0.00	Dry						

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
3.00	3.00	20	2.70

Casing Details

To (m)	Diameter

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
20-0399B	Bus Connects Route 6 Lucan to City Centre	R6-CP05
	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	3.52	706990.65 E 735185.16 N

Final Depth:	Start Date:	Driller:	Sheet 1 of 1
3.52 m	20/10/2020	JC	Scale: 1:50
Elevation: 51.55 mOD	**End Date:** 20/10/2020	**Logger:** CH	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
0.10 - 1.20	B1				51.45	0.10		TOPSOIL		
0.50	ES2							MADE GROUND: Firm becoming stiff brown sandy gravelly CLAY with high cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies. Cobbles are subrounded of mixed lithologies.		
1.00	ES3									
1.20	D4									
1.20 - 1.65	SPT (S)	N=15 (3,3/2,4,5,4) Hammer SN = 0696	0.00	Dry						
2.00	U5	Ublow=86 100%	0.00	Dry	49.65	1.90		Stiff becoming very stiff brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.		
2.50	D6									
2.50	ES6									
2.60 - 3.52	B7									
3.00	D9									
3.00	ES8									
3.00 - 3.45	SPT (S)	N=30 (4,6/5,4,9,12) Hammer SN = 0696 Water strike at 3.10m	0.00	Dry						
					48.03	3.52		End of Borehole at 3.52m		
3.52 - 3.73	SPT (C)	N=50 (20,37/50 for 60mm) Hammer SN = 0696	0.00	3.20						

Water Strikes				Casing Details	
Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	To (m)	Diameter
3.10	3.10	20	2.90		

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
20-0399B	Bus Connects Route 6 Lucan to City Centre	R6-CP06
	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	2.60	706974.30 E 735138.90 N

Final Depth:	Start Date:	Driller:	Sheet 1 of 1
2.60 m	21/10/2020	JC	Scale: 1:50
Elevation: 51.61 mOD	**End Date:** 21/10/2020	**Logger:** CH	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
0.10 - 0.40	B1				51.51	0.10		TOPSOIL		
								MADE GROUND: Grey sandy angular to subangular fine to coarse GRAVEL of mixed lithologie. Sand is fine to coarse.		
0.50	ES2									
0.60 - 1.20	B3				51.01	0.60		MADE GROUND: Light grey angular to subangular fine to coarse GRAVEL of mixed lithologies.		
1.00	ES4									
1.20 - 1.80	B5				50.41	1.20		MADE GROUND: Loose light grey angular to subangular fine to coarse GRAVEL of mixed lithologies.		
1.20 - 1.65	SPT (S)	N=6 (1,1/2,1,2,1) Hammer SN = 0696	0.00	Dry						
					49.81	1.80		Very stiff brown sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies. Cobbles are subangular to subrounded of mixed lithologies.		
1.90	D6									
1.90	ES6									
2.00	U7									
2.00	U9	Ublow=140 100%	0.00	Dry						
2.50	D8									
2.60 - 2.85	SPT (C)	N=50 (6,14/50 for 100mm) Hammer SN = 0696	0.00	Dry	49.01	2.60		End of Borehole at 2.60m		

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.
No groundwater encountered.

Termination Reason

Terminated on refusal.

Last Updated

16/12/2020

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
20-0399B	Bus Connects Route 6 Lucan to City Centre	R6-CP07
	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	4.00	
Rotary Drilling	Hanjin D8	4.00	5.20	706983.83 E
Rotary Coring	Hanjin D8	5.20	10.70	735121.30 N

Final Depth:	10.70 m	Start Date:	24/09/2020	Driller:	JC+KW	Sheet 1 of 2
						Scale: 1:50
Elevation:	56.05 mOD	End Date:	23/10/2020	Logger:	CH+NP	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
								TOPSOIL		
0.20 - 1.00	B5				55.85	0.20		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	ES									
0.50	ES6									
1.00	ES1				55.05	1.00		Soft brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.		
1.00	ES7									
1.00 - 2.00	B7									
1.20 - 1.65	SPT (S)	N=5 (2,1/1,1,1,2) Hammer SN = 0696	0.00	Dry						
2.00	ES2									
2.00	U8	Ublow=38 0%	0.00	Dry						
2.00 - 2.50	B9									
2.50 - 3.20	B10	Seepage at 2.50m			53.55	2.50		Stiff grey slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.	▼	
3.00	D11									
3.00	ES3				52.85	3.20		Stiff light brown silty slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.		
3.00 - 3.45	SPT (S)	N=22 (3,3/5,6,5,6) Hammer SN = 0696	0.00	Dry						
3.20	ES12									
3.20 - 4.00	B12									
4.00	ES4				52.05	4.00		Very stiff brown very sandy gravelly CLAY with high cobble content. (Driller's description)		
5.20	C11				50.85	5.20 (0.30)		Brown slightly silty andy subangular fine to coarse GRAVEL of limestone. Sand is fine to coarse.		
5.20	ES				50.55	5.50		Firm brown sandy gravelly SILT. Sand is fine to coarse. Gavel is subangular fine to coarse of limestone.		
		TCR: 100				(0.70)				
6.20					49.85	6.20		Brown and grey sandy silty subangular fine to coarse GRAVEL of mixed lithologies with medium cobble content. Sand is fine to coarse. Cobbles are subangular of limestone.		
6.20	C11					(0.65)				
6.85	C	SCR: 100, RQD: 23, FI: 7			49.20	6.85 (0.25)		Medium strong (locally weak) dark grey LIMESTONE. Partially weathered: slightly reduced strength, closer fracture spacing with silty gravelly sand deposits. Discontinuities: 1. 0 to 10 degree bedding fractures, closely spaced (50/80/110), undulating, rough with brown silty gravelly sand up to 28mm between fracture surfaces.		
					48.95	7.10		Brown silty gravelly fine to coarse SAND. Gravel is subangular of limestone.		
						(0.50)				
7.60	C				48.45	7.60		Medium strong thinly bedded dark grey LIMESTONE. Largely unweathered: closer fracture spacing. Discontinuities: 1. 0 to 10 degree bedding fractures, closely spaced (40/180/280), planar and slightly undulating, smooth, clean.		
7.70										
7.80	C									
		TCR: 93, SCR: 93, RQD: 75, FI: 5				(1.45)				
8.50	C									
8.85 - 9.05	C									
9.20					47.00	9.05		Medium strong thinly bedded grey LIMESTONE. Partially weathered:		

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
2.50	2.50		

Casing Details

To (m)	Diam (mm)
5.20	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.
WS section extended by dynamic probing.

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
20-0399B	Bus Connects Route 6 Lucan to City Centre	R6-CP07
	Client: National Transport Authority (NTA)	
	Client's Rep: AECOM/Mott MacDonald	

Method	Plant Used	Top (m)	Base (m)
Light Percussion	Dando Terrier	0.00	4.00
Rotary Drilling	Hanjin D8	4.00	5.20
Rotary Coring	Hanjin D8	5.20	10.70

Coordinates: 706983.83 E, 735121.30 N

Final Depth: 10.70 m | Start Date: 24/09/2020 | Driller: JC+KW | Sheet 2 of 2 | Scale: 1:50

Elevation: 56.05 mOD | End Date: 23/10/2020 | Logger: CH+NP | FINAL

Depth (m)	Samples / Field Records	TCR	SCR	RQD	FI	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
9.40	C	100	100	0	10				(1.65)		Medium strong thinly bedded grey LIMESTONE. Partially weathered: slightly reduced strength, closer fracture spacing with localised ge sandy silt deposits. Discontinuities: 1. 0 to 10 degree bedding fractures, closely spaced (30/150/390), planar and undulating, smooth with grey sandy silt deposits on some joint surfaces. 2. At 10.35m to 10.45m: 25 to 75 degree joint, undulating, smooth, clean. 3. At 9.05m to 10.35m: 80 to 90 degree joint, undulating, smooth with localised grey sandy silt deposits on joint surface at 9.20m to 9.45m.		
10.60	C												
10.70								45.35	10.70		End of Borehole at 10.70m		

TCR	SCR	RQD	FI

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
2.50	2.50		

Casing Details

To (m)	Diam (mm)
5.20	200

Water Added

From (m)	To (m)

Chiselling Details

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

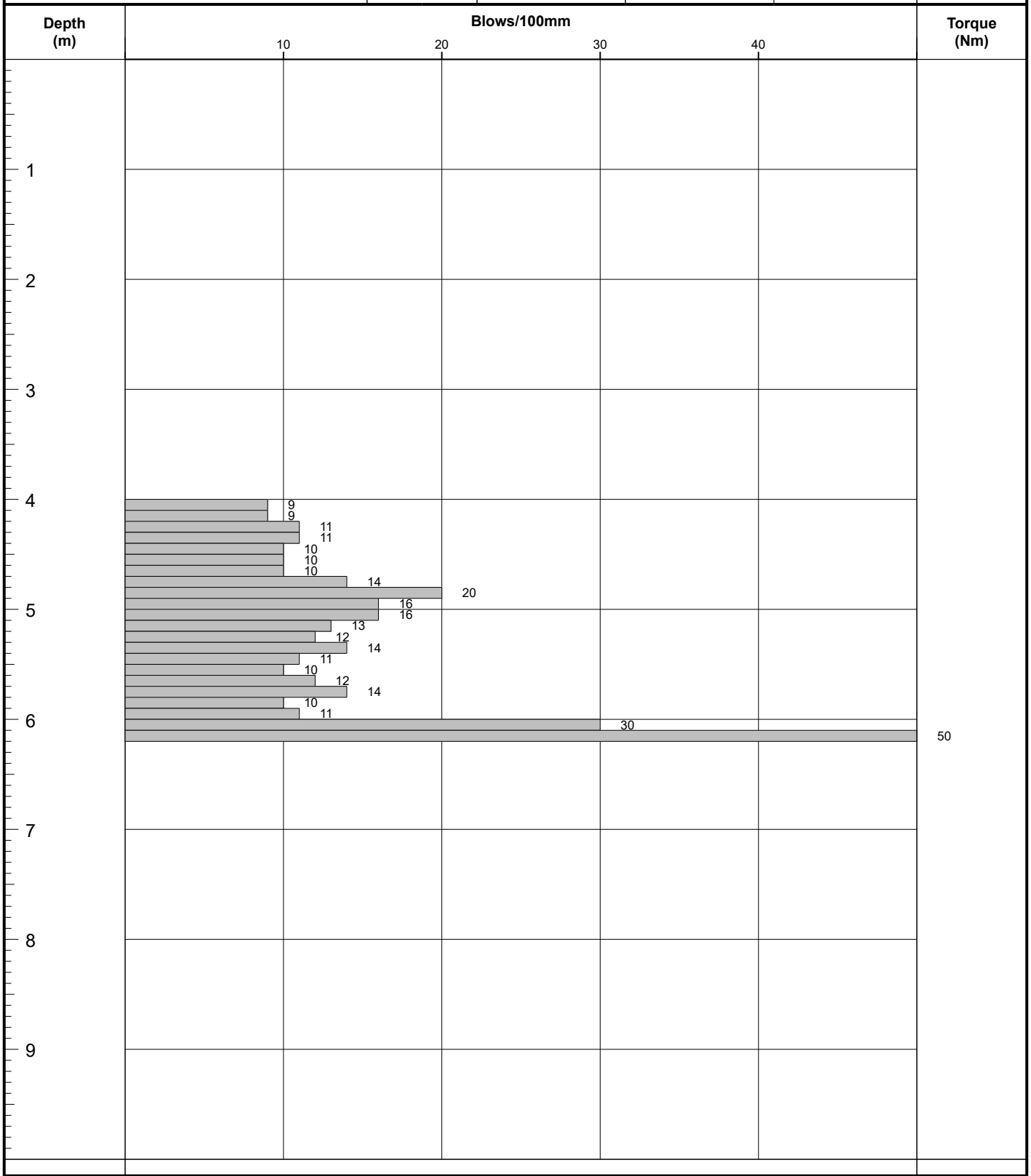
Remarks

Hand dug inspection pit excavated to 1.20m.
No groundwater encountered.
WS section extended by dynamic probing.

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

AGS

CAUSEWAY GEOTECH	**Project No.** 20-0399B	**Project Name:** Bus Connects Route 6 Lucan to City Centre			**Probe ID** R6-CP07DP
	Coordinates 706983.83 E 735121.30 N	**Client:** National Transport Authority (NTA)			
Method: Dynamic Probing		**Client's Representative:** AECOM/Mott MacDonald			Sheet 1 of 1 Scale: 1:50
Probe Type: DPSH-B	**Elevation** 56.05 mOD	**Final Depth:** 6.20	**Date:**	**Operator:** JC	FINAL



Fall Height: 750 mm	**Remarks:** Follow on from R6-CP07 WS Section.
Hammer Mass: 64 kg	
Cone Diameter: 51 mm	

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
20-0399B	Bus Connects Route 6 Lucan to City Centre	R6-CP08
	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	4.20	706899.18 E 735125.89 N

Final Depth:	4.20 m	Start Date:	21/10/2020	Driller:	BM	Sheet 1 of 1 Scale: 1:40
Elevation:	52.30 mOD	End Date:	21/10/2020	Logger:	CH	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
					51.90	0.40		MADE GROUND: Soft brown sandy gravelly CLAY. Sand is fine to coarse. Gravel i subangular to subrounded fine to coarse of mixed lithologies.		
0.50	B5							Loose brown gravelly silty fine to coarse SAND. Gravel is subrounded fine to medium of mixed lithologies.		
0.50	ES1									
1.00	B6									
1.00	ES2				51.20	1.10		Stiff brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.		
1.20	D10									
1.20 - 1.65	SPT (S)	N=16 (2,3/2,3,4,7) Hammer SN = 0643	0.00	Dry						
2.00	B7				50.30	2.00		Stiff greyish brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.		
2.00	ES3									
2.00	ES7									
2.00 - 2.45	U13	Ublow=50 100%	0.00	Dry						
3.00	B8									
3.00	D11									
3.00	ES4									
3.00 - 3.45	SPT (S)	N=23 (4,5/5,5,6,7) Hammer SN = 0643	0.00	Dry						
4.00	B9				48.30	4.00		Grey sandy silty subangular coarse GRAVEL of limestone. Sand is fine to coarse. (Possible bedrock)		
4.00	D12									
4.00 - 4.15	SPT (S)	N=50 (40 for 125mm/50 for 25mm) Hammer SN = 0643	0.00	Dry	48.10	4.20		End of Borehole at 4.20m		

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)
4.00	4.20	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
20-0399B	Bus Connects Route 6 Lucan to City Centre	R6-CP09
	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	708336.68 E 735065.33 N

Final Depth:	5.10 m	Start Date:	23/10/2020	Driller:	BM	Sheet 1 of 1 Scale: 1:40
Elevation:	45.94 mOD	End Date:	23/10/2020	Logger:	CH	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
					45.64	0.30		TOPSOIL		
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	ES									
1.00	ES2				44.74	1.20		MADE GROUND: Very soft brownish grey sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.		
1.20	D11									
1.20	ES11									
1.20 - 1.65	SPT (S)	N=2 (3,0/0,1,0,1) Hammer SN = 0696	0.00	Dry						
2.00	B7									
2.00	D12									
2.00	ES3									
2.00 - 2.45	SPT (S)	N=2 (0,1/0,1,0,1) Hammer SN = 0696	0.00	Dry						
3.00	B8				42.94	3.00		Very soft brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.		
3.00	ES4									
3.00	ES8									
3.00 - 3.45	U15	Ublow=15 80%	0.00	Dry						
4.00	B9				41.94	4.00		Stiff brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.		
4.00	D13									
4.00 - 4.45	SPT (S)	N=25 (4,4/5,6,7,7) Hammer SN = 0696	0.00	Dry						
					41.14	4.80		Grey sandy angular coarse GRAVEL of limestone. Sand is fine to coarse. (Possible bedrock)		
5.00	B10									
5.00	D14				40.84	5.10		End of Borehole at 5.10m		
5.00 - 5.15	SPT (S)	N=50 (34 for 125mm/50 for 21mm) Hammer SN = 0696	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)
4.90	5.10	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
20-0399B	Bus Connects Route 6 Lucan to City Centre	R6-CP10
	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	4.10	709996.96 E 734297.36 N

Final Depth:	Start Date:	Driller:	Sheet 1 of 1
4.10 m	24/10/2020	BM	Scale: 1:40
Elevation: 25.45 mOD	**End Date:** 24/10/2020	**Logger:** GH	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
								BITMAC		
					25.15	0.30				
0.50	B1							MADE GROUND: Black slightly sandy angular fine to coarse GRAVEL of limestone. Sand is fine to coarse.		
0.50	ES2									
1.00	B4				24.45	1.00				
1.00	ES							MADE GROUND: Firm becoming stiff brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium of mixed lithologies.		
1.00	ES5									
1.20	D3									
1.20	ES3									
1.20 - 1.65	SPT (C)	N=9 (6,4/2,2,2,3) Hammer SN = 0643	1.00	Dry						
2.00	B7									
2.00	D6									
2.00	ES8									
2.00 - 2.45	SPT (C)	N=20 (4,4/5,4,5,6) Hammer SN = 0643	1.50	Dry						
3.00	B10				22.45	3.00				
3.00	D9							MADE GROUND: Very stiff brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.		
3.00	ES11									
3.00 - 3.45	SPT (C)	N=39 (6,7/9,9,10,11) Hammer SN = 0643	1.50	Dry						
4.00	B12				21.45	4.00				
4.00 - 4.08	SPT (C)	N=50 (25 for 50mm/50 for 25mm) Hammer SN = 0643	1.50	Dry	21.35	4.10		CONCRETE		
								End of Borehole at 4.10m		

Water Strikes

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

Chiselling Details

From (m)	To (m)	Time (hh:mm)
3.90	4.10	01:00

Casing Details

To (m)	Diameter
1.50	200

Water Added

From (m)	To (m)

Remarks

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

Termination Reason

Terminated on concrete.

Last Updated

16/12/2020

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
20-0399B	Bus Connects Route 6 Lucan to City Centre	R6-CP11
	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 1 of 1
Cable Percussion	Dando 2000	0.00	4.20	710008.77 E 734273.64 N	4.20 m	24/10/2020	BM	Scale: 1:40
					Elevation: 25.13 mOD	End Date: 24/10/2020	Logger: GH	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
					24.83	0.30		BITMAC		
0.50	B2							MADE GROUND: Black sandy angular fine to coarse GRAVEL of limestone. Sand is fine to coarse.		
0.50	ES1									
1.00	B5									
1.00	ES4				24.03	1.10				
1.20	D3							MADE GROUND: Firm becoming stiff brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium of mixed lithologies.		
1.20	ES3									
1.20 - 1.65	SPT (S)	N=10 (4,3/2,3,2,3) Hammer SN = 0643	1.00	Dry						
2.00	B8									
2.00	D6									
2.00	ES7									
2.00 - 2.45	SPT (S)	N=21 (4,4/5,5,5,6) Hammer SN = 0643	1.50	Dry						
3.00	B10				22.13	3.00		Possible MADE GROUND: Very stiff brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.		
3.00	D11									
3.00	ES11									
3.00	ES9									
3.00 - 3.45	SPT (S)	N=45 (7,8/10,10,12,13) Hammer SN = 0643	1.50	Dry						
4.00	B12									
4.00 - 4.12	SPT (S)	N=50 (41 for 100mm/50 for 25mm) Hammer SN = 0643	1.50	Dry	20.93	4.20		End of Borehole at 4.20m		

Water Strikes

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

Chiselling Details

From (m)	To (m)	Time (hh:mm)
4.10	4.20	01:00

Casing Details

To (m)	Diameter
1.50	200

Water Added

From (m)	To (m)

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
20-0399B	Bus Connects Route 6 Lucan to City Centre	R6-WS01
	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 / Scale
Light Percussion	Dando Terrier	0.00	1.40	705329.45 E 735516.12 N	1.40 m	24/09/2020	JC	Sheet 1 of 1 Scale: 1:50
					Elevation: 53.45 mOD	End Date: 24/09/2020	Logger: CH	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
0.20	D1							TOPSOIL		
0.40	ES2				53.05	0.40		Very dense brown very sandy silty subangular to subrounded fine to coarse GRAVEL of mixed lithologies. Sand is fine to coarse.		
0.40 - 1.40	B2									
0.50	ES4									
1.00	ES5									
1.20	D3									
1.20 - 1.58	SPT (S)	N=50 (8,11/50 for 235mm) Hammer SN = 0696	0.00	Dry	52.05	1.40		End of Borehole at 1.40m		

Water Strikes				Casing Details	
Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	To (m)	Diameter

Remarks

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

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

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
20-0399B	Bus Connects Route 6 Lucan to City Centre	R6-WS02
	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 1 of 1
Light Percussion	Dando Terrier	0.00	0.87	705635.37 E 735499.12 N	0.87 m	24/09/2020	JC	Scale: 1:50
					Elevation: 64.42 mOD	End Date: 24/09/2020	Logger: CH	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
0.30	ES1				64.12	0.30		TOPSOIL		
0.30 - 0.87	B1							Very dense brown very sandy very silty subangular to subrounded fine to coarse GRAVEL of mixed lithologies. Sand is fine to coarse.		
0.50	ES2									
0.87 - 1.28	SPT (C)	N=50 (11,10/50 for 265mm) Hammer SN = 0696	0.00	Dry	63.55	0.87		End of Borehole at 0.87m		

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				Casing Details	
Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	To (m)	Diameter

Remarks

Hand dug inspection pit excavated to 0.87m.
No groundwater encountered.

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

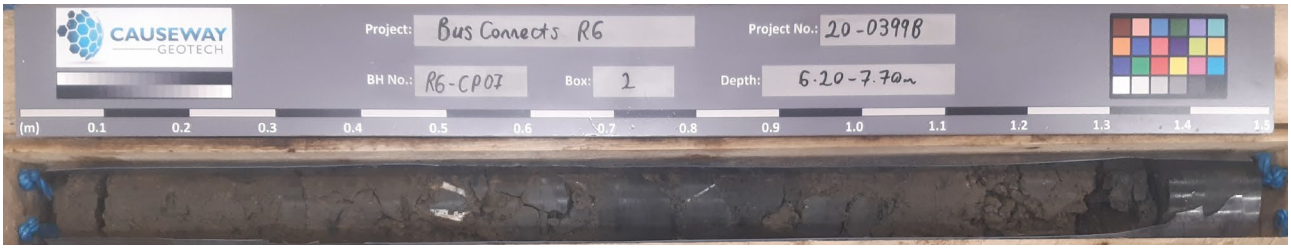
AGS

CAUSEWAY GEOTECH

APPENDIX C

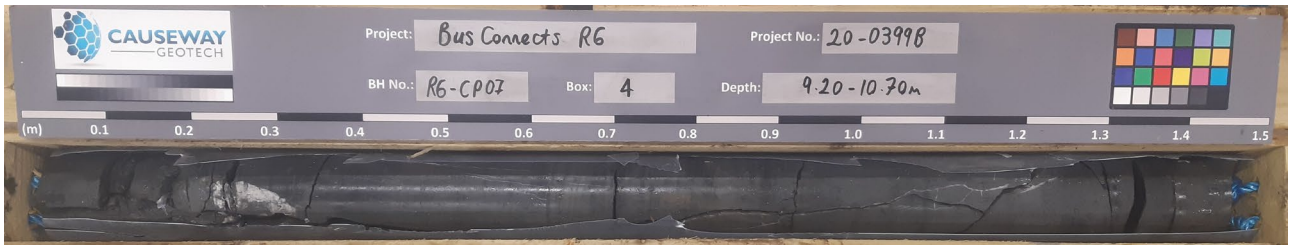
CORE PHOTOGRAPHS

R6-CP07 Box 1 (5.20-6.20m)



R6-CP07 Box 2 (6.20-7.70m)

R6-CP07 Box 3 (7.70-9.20m)



R6-CP07 Box 4 (9.20-10.70m)

CAUSEWAY GEOTECH

APPENDIX D

SLIT TRENCH LOGS AND SKETCHES

CAUSEWAY GEOTECH

Project No.	Project Name:	Trial Pit ID
20-0399B	Bus Connects Route 6 Lucan to City Centre	R6-TP01
Coordinates 710019.80 E 734262.84 N	**Client:** National Transport Authority (NTA)	
Method: Slit Trenching	**Client's Representative:** AECOM/Mott MacDonald	Sheet 1 of 1 Scale: 1:25
Plant: 3t Tracked Excavator	**Elevation** 19.45 mOD / **Date:** 26/10/2020 / **Logger:** GH	FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
			19.35	0.10		CONCRETE	
			19.27	0.18		MADE GROUND: Grey slightly sandy angular fine to coarse GRAVEL of limestone. Sand is fine to coarse.	
						MADE GROUND: Dark grey slightly sandy angular fine to coarse GRAVEL of limestone. Sand is fine to coarse.	
0.50	B1	Slow seepage at 0.65m.	18.97	0.48		MADE GROUND: Brown slightly sandy clayey angular fine to coarse GRAVEL of limestone. Sand is fine to coarse.	▼
			18.35	1.10		End of trial pit at 1.10m	

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5

Water Strikes	
Struck at (m)	Remarks
0.65	Slow seepage at 0.65m.

Depth: 1.10
Width: 0.60
Length: 1.55

Remarks:
Base of foundation unable to be determined to presences of services.

Stability: Stable

Termination Reason: Terminated at scheduled depth.

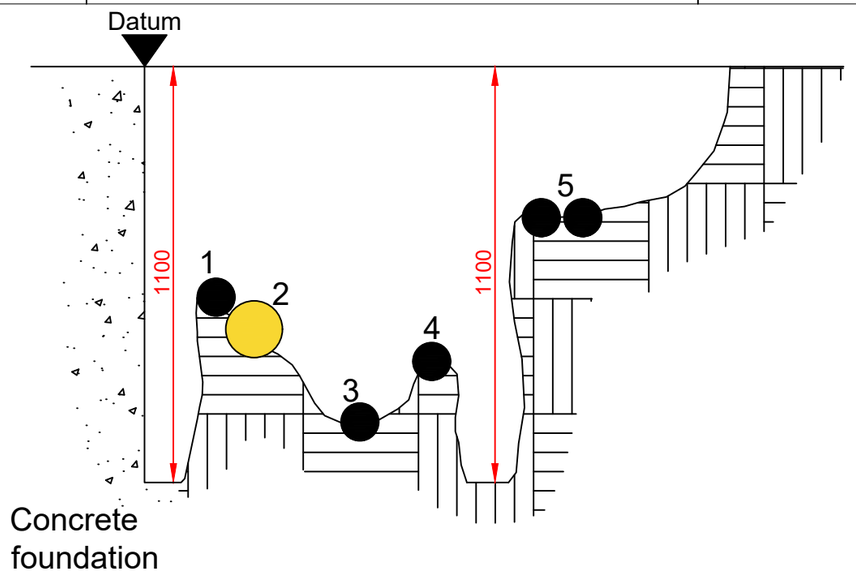
Last Updated 16/12/2020

AGS

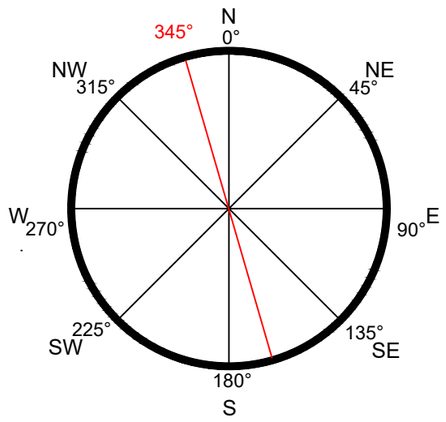
JOB NUMBER: 20-0399B	JOB NAME: Bus Connects Lucan to City Centre	LOCATION: R6 - TP01

CLIENT: National Transport authority (NTA)	CLIENTS REPRESENTATIVE: AECOM	CREW: GH	PLANT & EQUIPMENT: 3 Tonne Excavator & Hand Tools

TRENCH: (SECTION & PLAN)



TRENCH - ORIENTATION



TRENCH ORIENTATED : 345° FROM NORTH

COORDINATES: DATUM WALL

EASTING: 710019.80

NORTHING: 734262.84

ELEVATION: 19.45mOD

No:	Type of Service:	Diameter (in mm)	Depth to Top of Service (m)	Distance to Centre of Service (m)	Details/Comments
01	Unknown	100	0.56	0.21	100mm Black Duct Unknown
02	Unknown	152	0.62	0.29	152mm Yellow Duct Unknown
03	Unknown	100	0.89	0.57	100mm Black Duct Unknown
04	Unknown	100	0.73	0.76	100mm Black Duct Unknown
05	Unknown	100	0.35	1.05 - 1.16	2x100mm Black Duct Unknown
06					
07					
08					
09					
10					
11					
12					
13					
14					
15					

TRENCH LENGTH (m) : 1.55

TRENCH DEPTH (m) : 1.10

TRENCH WIDTH (m) : 0.60

STABILITY: Stable

GROUNDWATER: Slow flow at 0.65

SCALE: NTS@A3

DRAWN: BS

CHECKED: CH

DATE EXCAVATED: 26-10-2020

CAUSEWAY GEOTECH

CAUSEWAY GEOTECH

APPENDIX E

SLIT TRENCH PHOTOGRAPHS

R6-TP01

R6-TP01

R6-TP01

R6-TP01

R6-TP01

CAUSEWAY GEOTECH

APPENDIX F

GEOTECHNICAL LABORATORY TEST RESULTS

CAUSEWAY GEOTECH

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SOIL AND ROCK SAMPLE ANALYSIS
LABORATORY TEST REPORT

19 November 2020

Project Name:	Bus Connects - Route 6 - Lucan to City Centre
Project No.:	20-0399B
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 6 - Lucan to City Centre

Report Reference: Schedule 1

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

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

Material tested	Type of test/Properties measured/Range of measurement	Standard specifications	No. of results included in the report
SOIL	Moisture Content of Soil	BS 1377-2: 1990: Cl 3.2	37
SOIL	Liquid and Plastic Limits of soil-1 point cone penetrometer method	BS 1377-2: 1990: Cl 4.4, 5.3 & 5.4	12
SOIL	Particle size distribution - wet sieving	BS 1377-2: 1990: Cl 9.2	14
SOIL	Particle size distribution - sedimentation hydrometer method	BS 1377-2: 1990: Cl 9.5	11
SOIL	Moisture Condition Value at natural moisture content	BS 1377-4: 1990: Cl 5.4	1
SOIL	Undrained shear strength – triaxial compression without measurement of pore pressure (loads from 0.12 to 24 kN)	BS 1377-7: 1990: Cl 8	1
ROCK	Point load index	ISRM Commission on Testing Methods. Suggested Method for Determining Point Load Strength 1985	6
ROCK	Uniaxial Compressive Strength (UCS)*	ISRM Suggested Methods -Rock Characterization Testing and Monitoring, Ed. E T Brown - 1981	1

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		17
SOIL – Subcontracted to Eurofins Chemtest Ltd *(UKAS 2183)*	Sulphate Content water extract		17

Summary of Classification Test Results

Project No.	Project Name
20-0399B	Bus Connects Route 6 - Lucan 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	
R6-CP01	6	1.00		B	Brown slightly sandy silty CLAY.			12.0						
R6-CP01	7	2.00		B	Brown slightly sandy slightly gravelly silty CLAY.			15.0	70	28 -1pt	19	9		CL
R6-CP01	14	3.00		U	Brown slightly sandy silty CLAY.			15.0						
R6-CP01	12	4.00		D	Brown slightly sandy silty CLAY.			16.0						
R6-CP01	13	5.00		D	Brown slightly sandy silty CLAY.			9.0						
R6-CP02	2	0.70		B	Brown slightly sandy silty CLAY.			24.0						
R6-CP02	4	1.20		B	Brown sandy slightly gravelly silty CLAY.			17.0	83	37 -1pt	21	16		CI
R6-CP03	12	1.20		U	Brown sandy gravelly silty CLAY.			33.0						
R6-CP03	7	2.00		B	Brown sandy gravelly silty CLAY.			16.0	60	30 -1pt	20	10		CL
R6-CP03	11	3.00		D	Brown sandy slightly gravelly silty CLAY.			15.0						
R6-CP04	4	1.20		B	Brown sandy slightly gravelly silty CLAY.			15.0						
R6-CP04	6	2.00		U	Brown sandy slightly gravelly silty CLAY.			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

19/11/2020

Approved By

Stephen.Watson

UKAS TESTING

10122

Summary of Classification Test Results

Project No.	Project Name
20-0399B	Bus Connects Route 6 - Lucan 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										
R6-CP04	9	3.00		B	Brown sandy slightly gravelly silty CLAY.			17.0						
R6-CP05	4	1.20		D	Brown sandy slightly gravelly silty CLAY.			16.0						
R6-CP05	5	2.00		U	Brown sandy gravelly silty CLAY.			14.0						
R6-CP05	6	2.50		D	Brown sandy gravelly silty CLAY.			12.0						
R6-CP05	7	2.60		B	Brown sandy gravelly silty CLAY.			9.6	47	28 -1pt	18	10		CL
R6-CP06	9	2.00		U	Brown sandy gravelly silty CLAY.			12.0						
R6-CP07	5	0.20		B	Brown sandy slightly gravelly silty CLAY.			18.0	72	41 -1pt	23	18		CI
R6-CP07	7	1.00		B	Brown sandy slightly gravelly silty CLAY.			18.0	63	40 -1pt	25	15		MI/CI
R6-CP07	11	3.00		D	Brown sandy slightly gravelly silty CLAY.			22.0						
R6-CP07	11	5.20		C	Brown sandy gravelly silty CLAY.			13.0	48	28 -1pt	13	15		CL
R6-CP07	11	6.20		C	Brown sandy very gravelly silty CLAY with coobles.			8.5						
R6-CP08	10	1.20		D	Brown sandy slightly 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

19/11/2020

Approved By

Stephen.Watson

UKAS TESTING

10122

Summary of Classification Test Results

Project No.	Project Name
20-0399B	Bus Connects Route 6 - Lucan 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	
R6-CP08	7	2.00		B	Brown sandy slightly gravelly silty CLAY.			16.0	59	29 -1pt	19	10		CL
R6-CP08	11	3.00		D	Brown sandy gravelly silty CLAY.			17.0						
R6-CP08	12	4.00		D	Greyish brown sandy very gravelly silty CLAY.			7.9						
R6-CP09	11	1.20		D	Greyish brown sandy slightly gravelly silty CLAY.			25.0						
R6-CP09	12	2.00		D	Greyish brown sandy silty CLAY.			26.0						
R6-CP09	7	2.00		B	Greyish brown sandy silty CLAY.			26.0	50	32 -1pt	16	16		CL
R6-CP09	15	3.00		U	Greyish brown sandy silty CLAY.			27.0						
R6-CP10	4	1.00		B	Greyish brown sandy gravelly silty CLAY.			12.0	48	31 -1pt	17	14		CL
R6-CP10	6	2.00		D	Greyish brown sandy gravelly silty CLAY.			10.0						
R6-CP10	10	3.00		B	Greyish brown sandy gravelly silty CLAY.			12.0	50	28 -1pt	17	11		CL
R6-CP11	3	1.20		D	Greyish brown sandy slightly gravelly silty CLAY.			15.0						
R6-CP11	8	2.00		B	Greyish brown sandy slightly gravelly silty CLAY.			14.0	60	30 -1pt	15	15		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

19/11/2020

Approved By

Stephen.Watson

UKAS TESTING

10122

Summary of Classification Test Results

Project No.	Project Name
20-0399B	Bus Connects Route 6 - Lucan to City Centre

Hole No.	Sample				Soil Description	Density bulk / dry		*w*	Passing 425µm	LL	PL	PI	Particle density	Casagrande Classification
	Ref	Top	Base	Type		Mg/m3		%	%	%	%	%	Mg/m3	
R6-CP11	11	3.00		D	Greyish brown sandy slightly gravelly silty CLAY.			11.0						

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

LAB 01R Version 4

Key

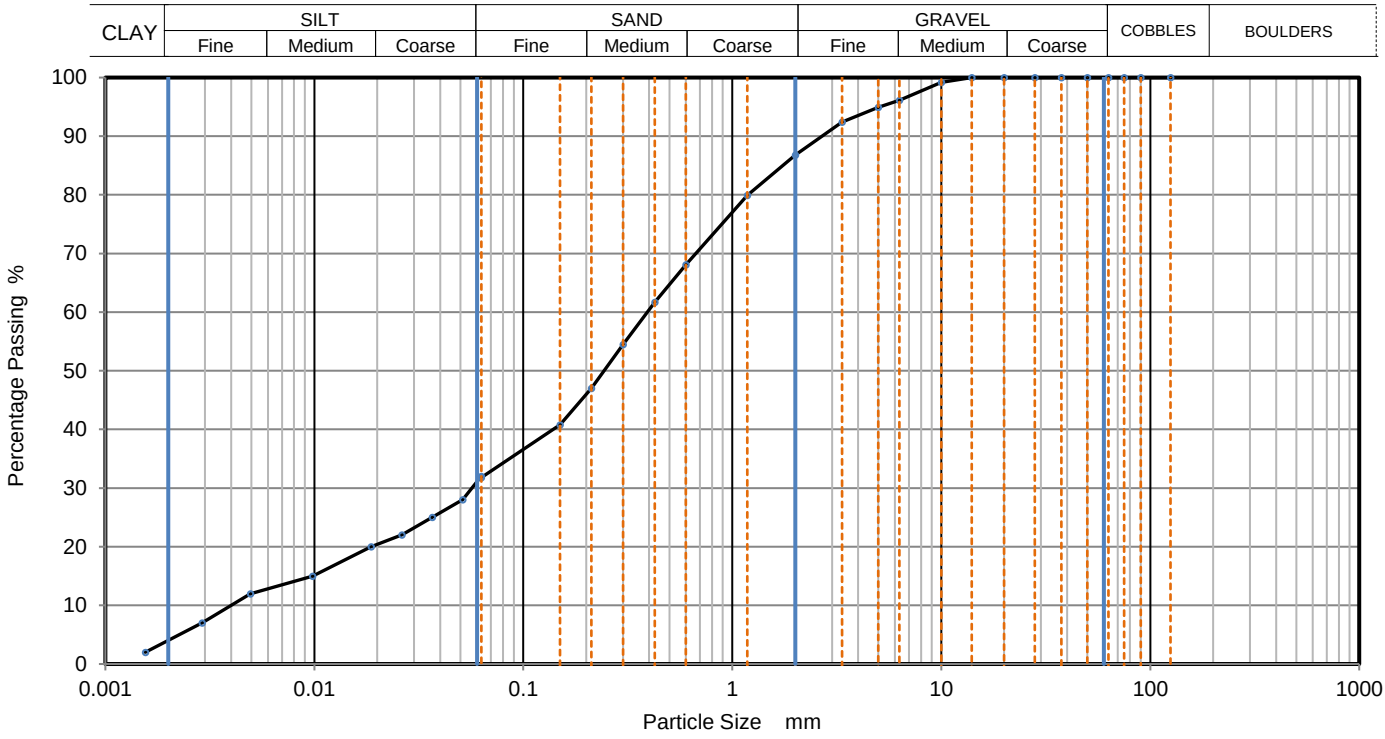
Density test	Liquid Limit	Particle density
Linear measurement unless :	4pt cone unless :	sp - small pyknometer
wd - water displacement	cas - Casagrande method	gj - gas jar
wi - immersion in water	1pt - single point test	

Date Printed: 19/11/2020

Approved By: Stephen.Watson

UKAS TESTING 10122

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION				Job Ref	20-0399B
					Borehole/Pit No.	R6-CP01
Site Name	Bus Connects Route 6 - Lucan to City Centre				Sample No.	7
Soil Description	Brown slightly sandy slightly gravelly silty CLAY.				Depth, m	2.00
Specimen Reference	9	Specimen Depth	2	m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5				KeyLAB ID	Caus202010301



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	32
90	100	0.05127	28
75	100	0.03668	25
63	100	0.02624	22
50	100	0.01866	20
37.5	100	0.00980	15
28	100	0.00495	12
20	100	0.00290	7
14	100	0.00155	2
10	99		
6.3	96		
5	95		
3.35	92		
2	87		
1.18	80		
0.6	68	Particle density	(assumed)
0.425	62	2.65	Mg/m3
0.3	55		
0.212	47		
0.15	41		
0.063	32		

Dry Mass of sample, g	449

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	13.2
Sand	55.0
Silt	28.1
Clay	3.7

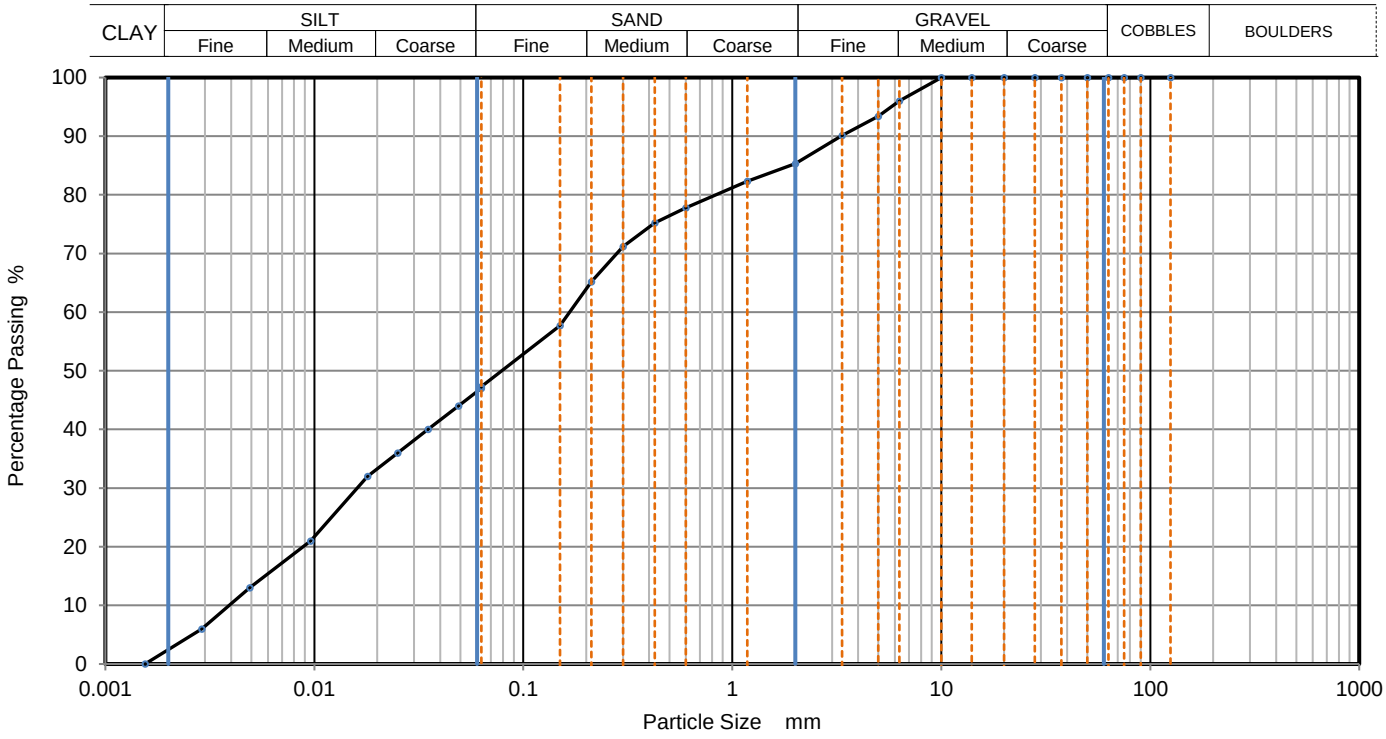
Grading Analysis		
D100	mm	
D60	mm	0.392
D30	mm	0.0564
D10	mm	0.00413
Uniformity Coefficient		95
Curvature Coefficient		2

Remarks

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

Approved
Stephen.Watson

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION				Job Ref	20-0399B
					Borehole/Pit No.	R6-CP02
Site Name	Bus Connects Route 6 - Lucan to City Centre				Sample No.	4
Soil Description	Brown sandy slightly gravelly silty CLAY.				Depth, m	1.20
Specimen Reference	9	Specimen Depth	1.2	m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5				KeyLAB ID	Caus202010306



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	47
90	100	0.04889	44
75	100	0.03502	40
63	100	0.02508	36
50	100	0.01795	32
37.5	100	0.00960	21
28	100	0.00491	13
20	100	0.00290	6
14	100	0.00155	0
10	100		
6.3	96		
5	93		
3.35	90		
2	85		
1.18	82		
0.6	78	Particle density	(assumed)
0.425	75	2.65	Mg/m3
0.3	71		
0.212	65		
0.15	58		
0.063	47		

Dry Mass of sample, g	362

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	14.7
Sand	38.0
Silt	45.0
Clay	2.3

Grading Analysis		
D100	mm	
D60	mm	0.167
D30	mm	0.0159
D10	mm	0.00392
Uniformity Coefficient		43
Curvature Coefficient		0.39

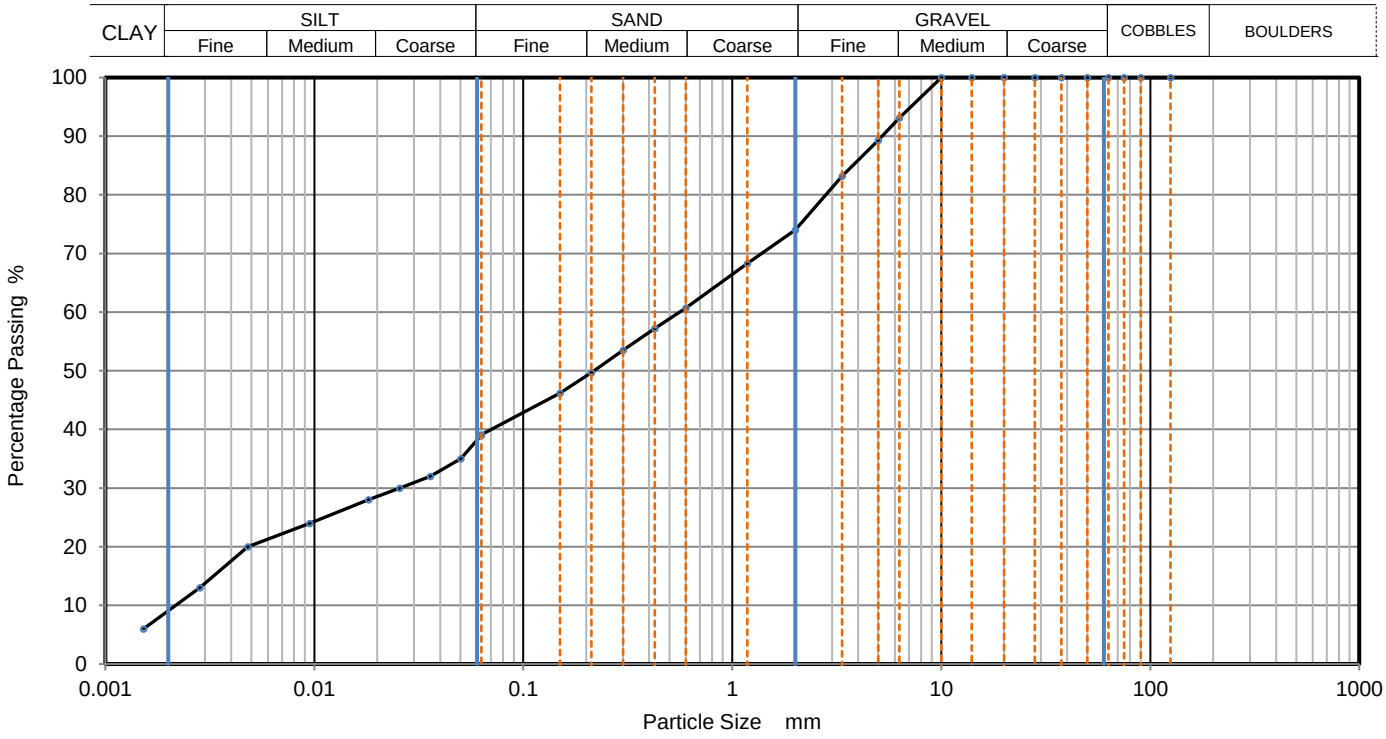
Remarks

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	**20-0399B**
				Borehole/Pit No.	R6-CP03
Site Name	Bus Connects Route 6 - Lucan to City Centre			Sample No.	7
Soil Description	Brown sandy gravelly silty CLAY.			Depth, m	2.00
Specimen Reference	9	Specimen Depth	2 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus202010308



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	39
90	100	0.05016	35
75	100	0.03591	32
63	100	0.02554	30
50	100	0.01817	28
37.5	100	0.00949	24
28	100	0.00480	20
20	100	0.00283	13
14	100	0.00152	6
10	100		
6.3	93		
5	89		
3.35	83		
2	74		
1.18	68		
0.6	61	Particle density	(assumed)
0.425	57	2.65	Mg/m3
0.3	54		
0.212	50		
0.15	46		
0.063	39		

Dry Mass of sample, g	436

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	26.0
Sand	34.9
Silt	30.3
Clay	8.8

Grading Analysis		
D100	mm	
D60	mm	0.558
D30	mm	0.0265
D10	mm	0.0022
Uniformity Coefficient		250
Curvature Coefficient		0.57

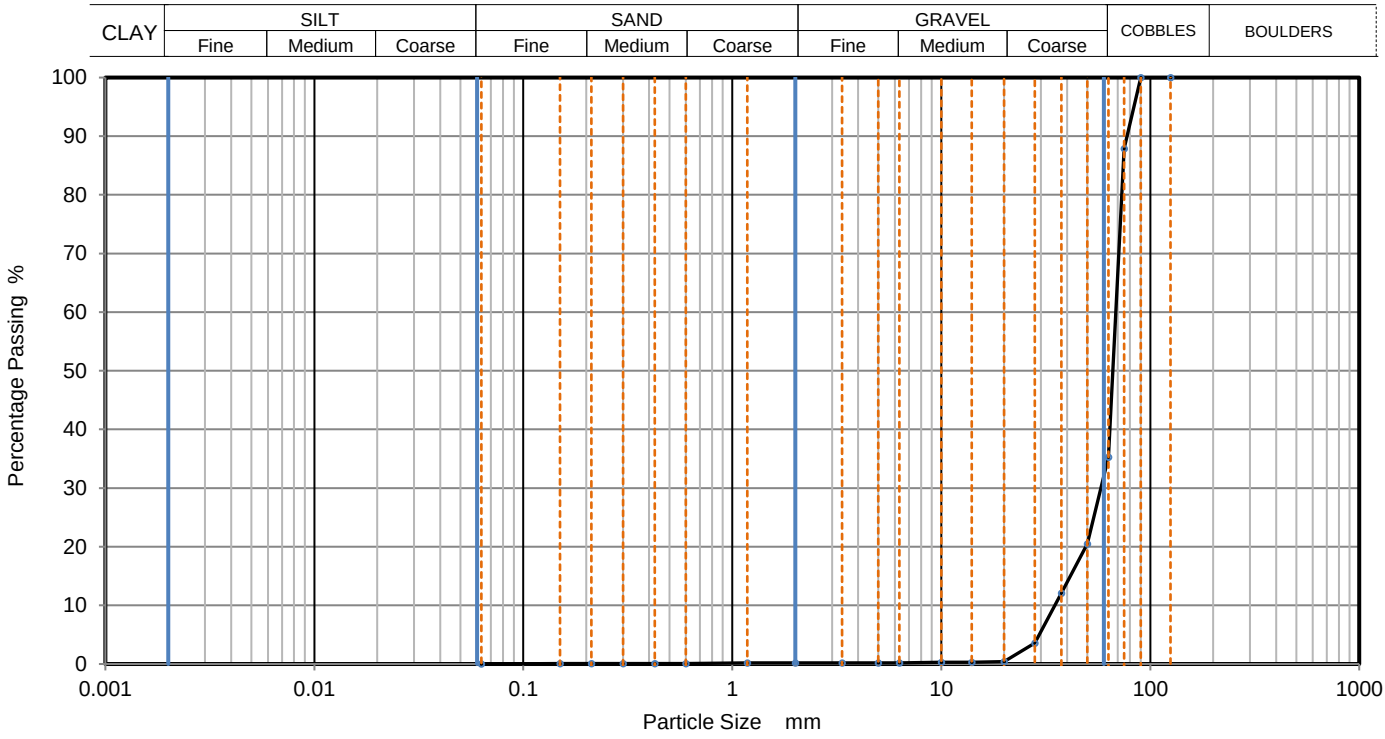
Remarks

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	**20-0399B**
				Borehole/Pit No.	R6-CP03
Site Name	Bus Connects Route 6 - Lucan to City Centre			Sample No.	9
Soil Description	Brown subangular medium coarse GRAVEL with high cobble content.			Depth, m	4.00
Specimen Reference	3	Specimen Depth	4 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clause 9.2			KeyLAB ID	Caus2020103010



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	88		
63	35		
50	21		
37.5	12		
28	4		
20	0		
14	0		
10	0		
6.3	0		
5	0		
3.35	0		
2	0		
1.18	0		
0.6	0		
0.425	0		
0.3	0		
0.212	0		
0.15	0		
0.063	0		

Dry Mass of sample, g	4669

Sample Proportions	% dry mass
Cobbles	64.7
Gravel	35.1
Sand	0.2
Fines <0.063mm	0.0

Grading Analysis		
D100	mm	
D60	mm	68.4
D30	mm	58
D10	mm	34.9
Uniformity Coefficient		2
Curvature Coefficient		1.4

Remarks

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

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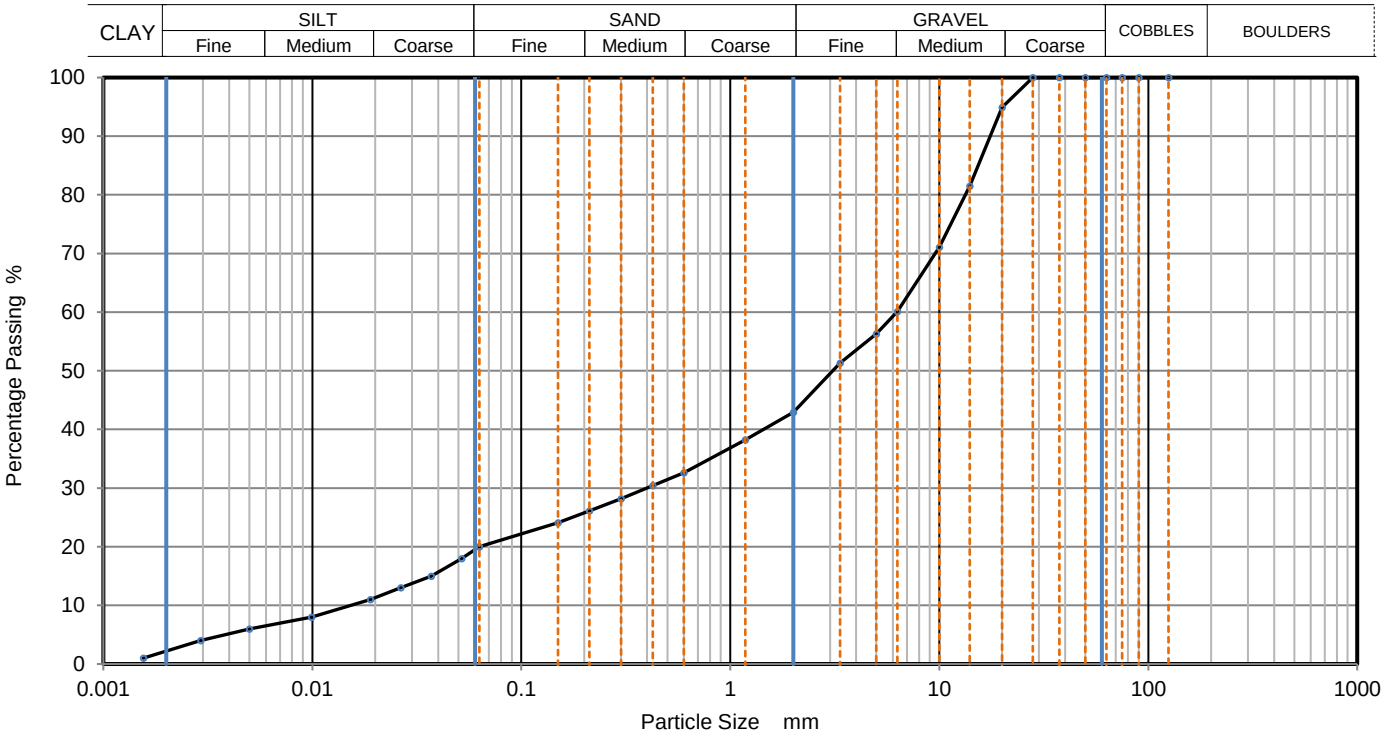
Stephen.Watson

UKAS TESTING 10122

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION				Job Ref	20-0399B
					Borehole/Pit No.	R6-CP05
Site Name	Bus Connects Route 6 - Lucan to City Centre				Sample No.	7
Soil Description	Brown sandy gravelly silty CLAY.				Depth, m	2.60
Specimen Reference	9	Specimen Depth	2.6	m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5				KeyLAB ID	Caus2020103017



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	20
90	100	0.05188	18
75	100	0.03711	15
63	100	0.02654	13
50	100	0.01897	11
37.5	100	0.00990	8
28	100	0.00501	6
20	95	0.00292	4
14	82	0.00155	1
10	71		
6.3	60		
5	56		
3.35	51		
2	43		
1.18	38		
0.6	33	Particle density	(assumed)
0.425	30	2.65	Mg/m3
0.3	28		
0.212	26		
0.15	24		
0.063	20		

Dry Mass of sample, g	2250

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	57.1
Sand	23.0
Silt	17.8
Clay	2.1

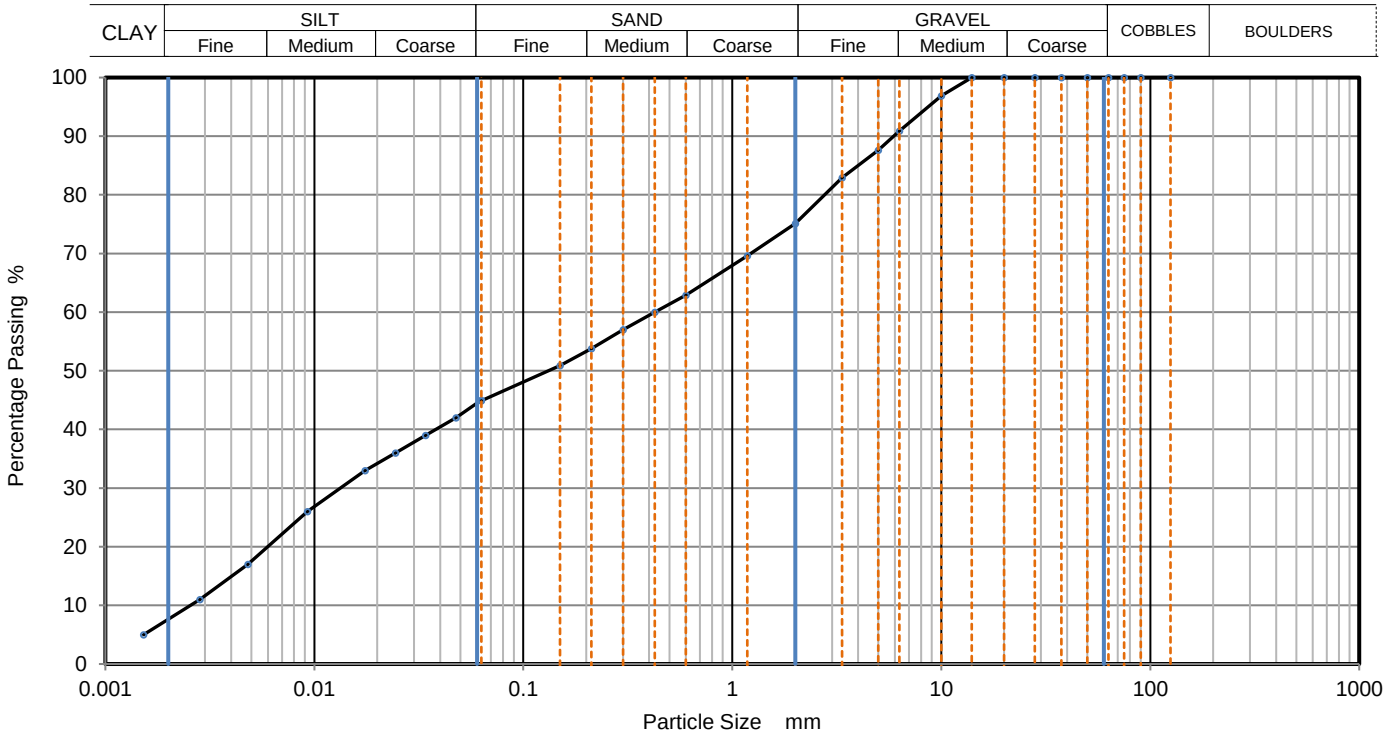
Grading Analysis		
D100	mm	
D60	mm	6.25
D30	mm	0.398
D10	mm	0.0161
Uniformity Coefficient		390
Curvature Coefficient		1.6

Remarks

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

Approved
Stephen.Watson

CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**20-0399B**
				Borehole/Pit No.	R6-CP07
Site Name	Bus Connects Route 6 - Lucan to City Centre			Sample No.	9
Soil Description	Brown sandy gravelly silty CLAY.			Depth, m	2.00
Specimen Reference	3	Specimen Depth	2 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2020103021



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	45
90	100	0.04758	42
75	100	0.03411	39
63	100	0.02444	36
50	100	0.01751	33
37.5	100	0.00927	26
28	100	0.00480	17
20	100	0.00283	11
14	100	0.00152	5
10	97		
6.3	91		
5	88		
3.35	83		
2	75		
1.18	70		
0.6	63	Particle density	(assumed)
0.425	60	2.65	Mg/m3
0.3	57		
0.212	54		
0.15	51		
0.063	45		

Dry Mass of sample, g	537

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	24.9
Sand	30.2
Silt	37.5
Clay	7.4

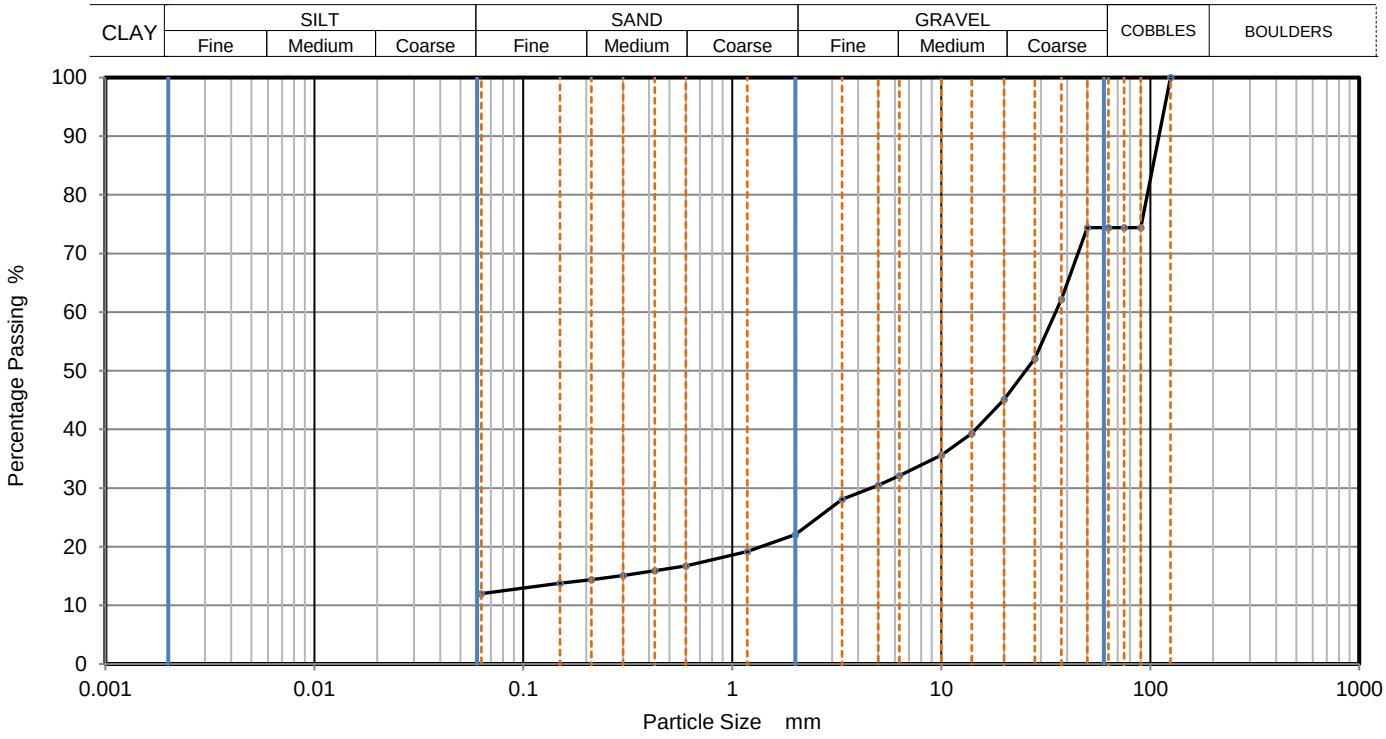
Grading Analysis		
D100	mm	
D60	mm	0.425
D30	mm	0.0135
D10	mm	0.00261
Uniformity Coefficient		160
Curvature Coefficient		0.16

Remarks

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

Approved
Stephen.Watson

CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**20-0399B**
				Borehole/Pit No.	R6-CP07
Site Name	Bus Connects Route 6 - Lucan to City Centre			Sample No.	11
Soil Description	Brown sandy very gravelly silty CLAY with coobles.			Depth, m	6.20
Specimen Reference	8	Specimen Depth	6.2 m	Sample Type	C
Test Method	BS1377:Part 2:1990, clause 9.2			KeyLAB ID	Caus2020103024



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	74		
75	74		
63	74		
50	74		
37.5	62		
28	52		
20	45		
14	39		
10	36		
6.3	32		
5	31		
3.35	28		
2	22		
1.18	19		
0.6	17		
0.425	16		
0.3	15		
0.212	14		
0.15	14		
0.063	12		

Dry Mass of sample, g	9944

Sample Proportions	% dry mass
Cobbles	25.6
Gravel	52.4
Sand	10.1
Fines <0.063mm	12.0

Grading Analysis		
D100	mm	125
D60	mm	35.2
D30	mm	4.59
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

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

Approved
Stephen.Watson

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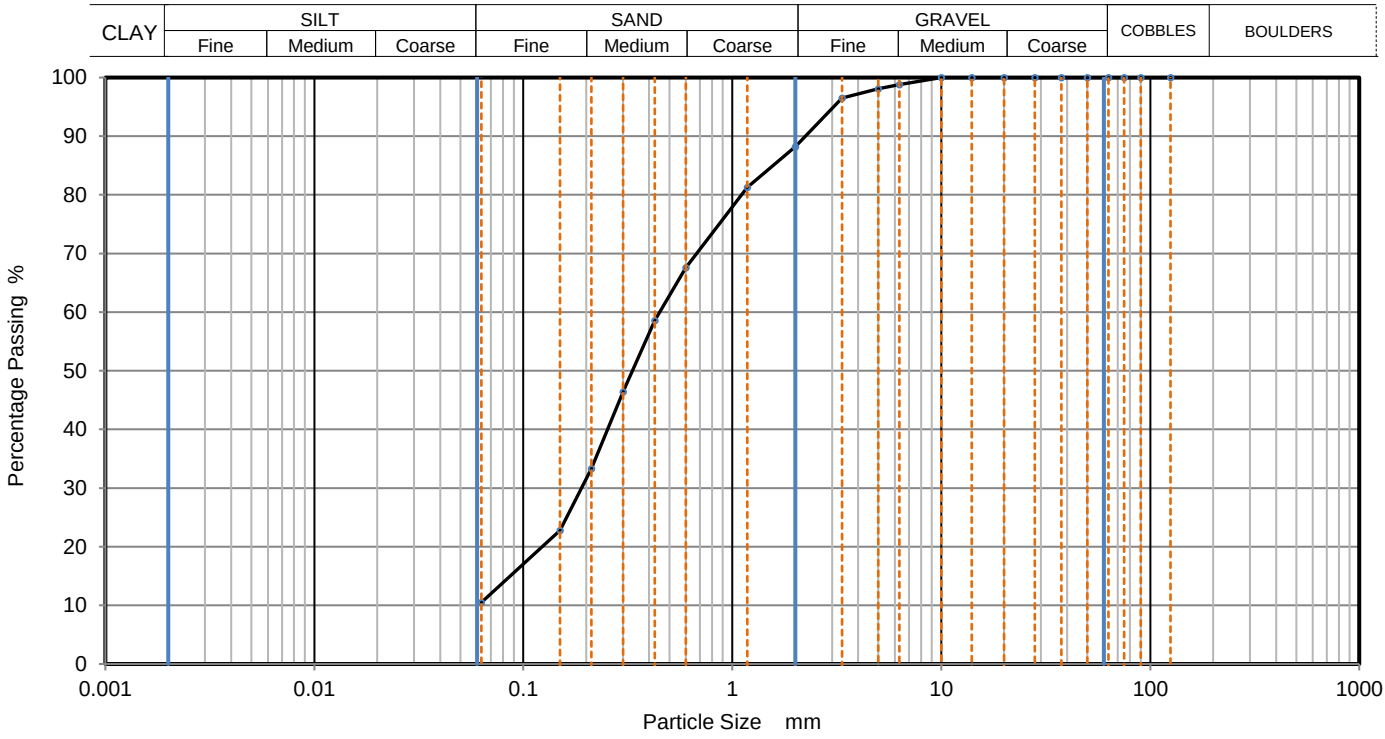
10122

CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**20-0399B**
				Borehole/Pit No.	R6-CP08
Site Name	Bus Connects Route 6 - Lucan to City Centre			Sample No.	5
Soil Description	Brown slightly gravelly silty fine to coarse SAND.			Depth, m	0.50
Specimen Reference	3	Specimen Depth	0.5 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clause 9.2			KeyLAB ID	Caus2020103025



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	100		
6.3	99		
5	98		
3.35	97		
2	88		
1.18	81		
0.6	68		
0.425	59		
0.3	46		
0.212	33		
0.15	23		
0.063	11		

Dry Mass of sample, g	358

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	11.8
Sand	77.7
Fines <0.063mm	11.0

Grading Analysis		
D100	mm	
D60	mm	0.448
D30	mm	0.19
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

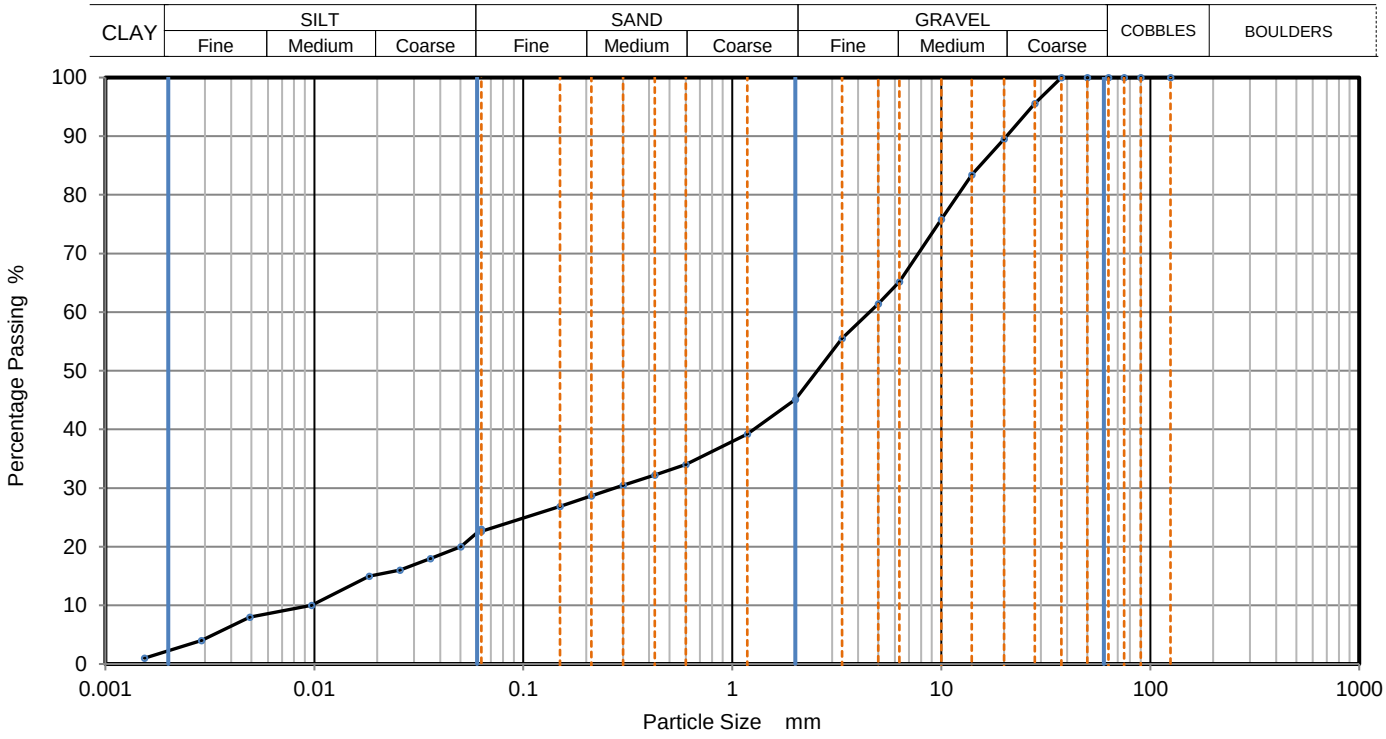
Remarks

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	20-0399B
					Borehole/Pit No.	R6-CP08
Site Name	Bus Connects Route 6 - Lucan to City Centre				Sample No.	8
Soil Description	Brown sandy slightly gravelly silty CLAY.				Depth, m	3.00
Specimen Reference	3	Specimen Depth	3	m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5				KeyLAB ID	Caus2020103029



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	23
90	100	0.05016	20
75	100	0.03591	18
63	100	0.02570	16
50	100	0.01828	15
37.5	100	0.00971	10
28	96	0.00491	8
20	90	0.00288	4
14	83	0.00154	1
10	76		
6.3	65		
5	61		
3.35	56		
2	45		
1.18	39		
0.6	34	Particle density	(assumed)
0.425	32	2.65	Mg/m3
0.3	31		
0.212	29		
0.15	27		
0.063	23		

Dry Mass of sample, g	2219

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	54.9
Sand	22.5
Silt	20.2
Clay	2.4

Grading Analysis		
D100	mm	
D60	mm	4.56
D30	mm	0.271
D10	mm	0.0101
Uniformity Coefficient		450
Curvature Coefficient		1.6

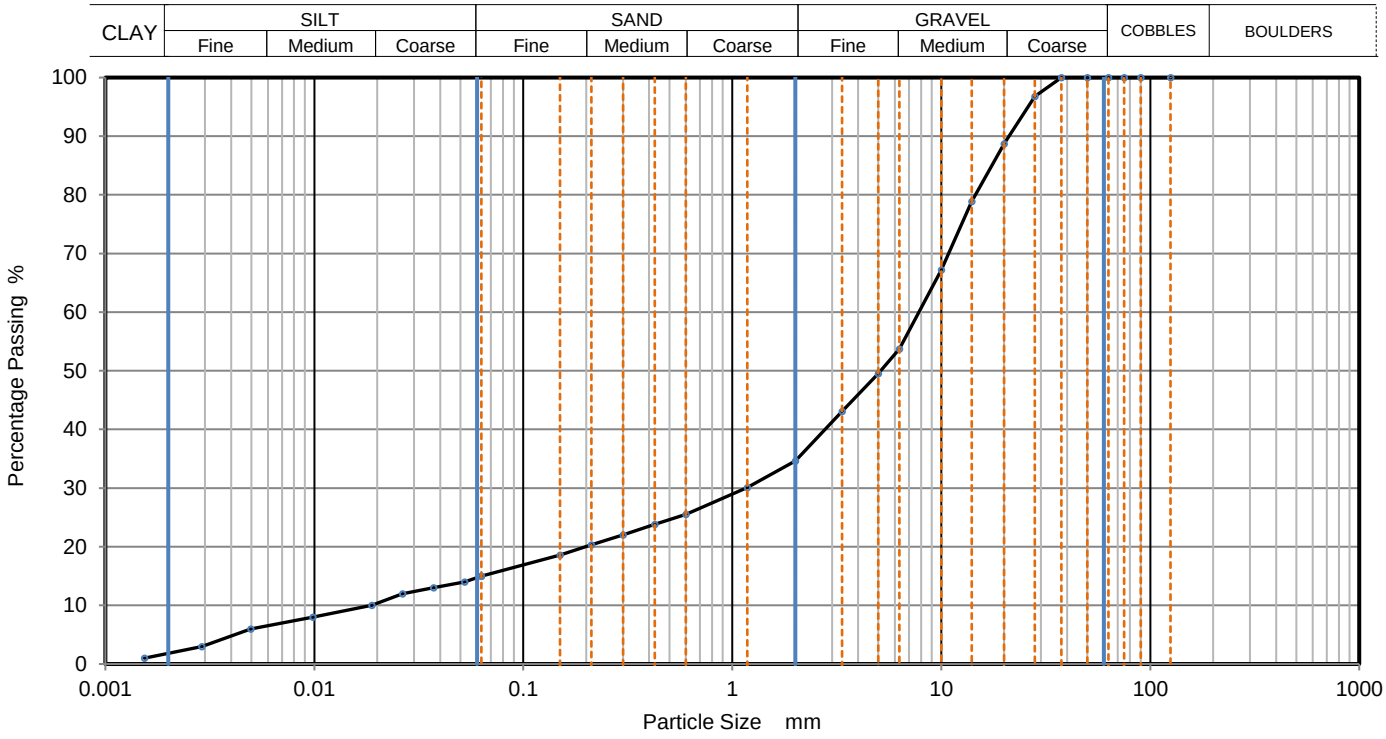
Remarks

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	**20-0399B**
				Borehole/Pit No.	R6-CP08
Site Name	Bus Connects Route 6 - Lucan to City Centre			Sample No.	9
Soil Description	Greyish brown sandy very gravelly silty CLAY.			Depth, m	4.00
Specimen Reference	3	Specimen Depth	4 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2020103032



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	15
90	100	0.05231	14
75	100	0.03720	13
63	100	0.02645	12
50	100	0.01881	10
37.5	100	0.00982	8
28	97	0.00496	6
20	89	0.00290	3
14	79	0.00154	1
10	67		
6.3	54		
5	50		
3.35	43		
2	35		
1.18	30		
0.6	26	Particle density	(assumed)
0.425	24	2.65	Mg/m3
0.3	22		
0.212	20		
0.15	19		
0.063	15		

Dry Mass of sample, g: 2545

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	65.4
Sand	19.6
Silt	12.9
Clay	2.1

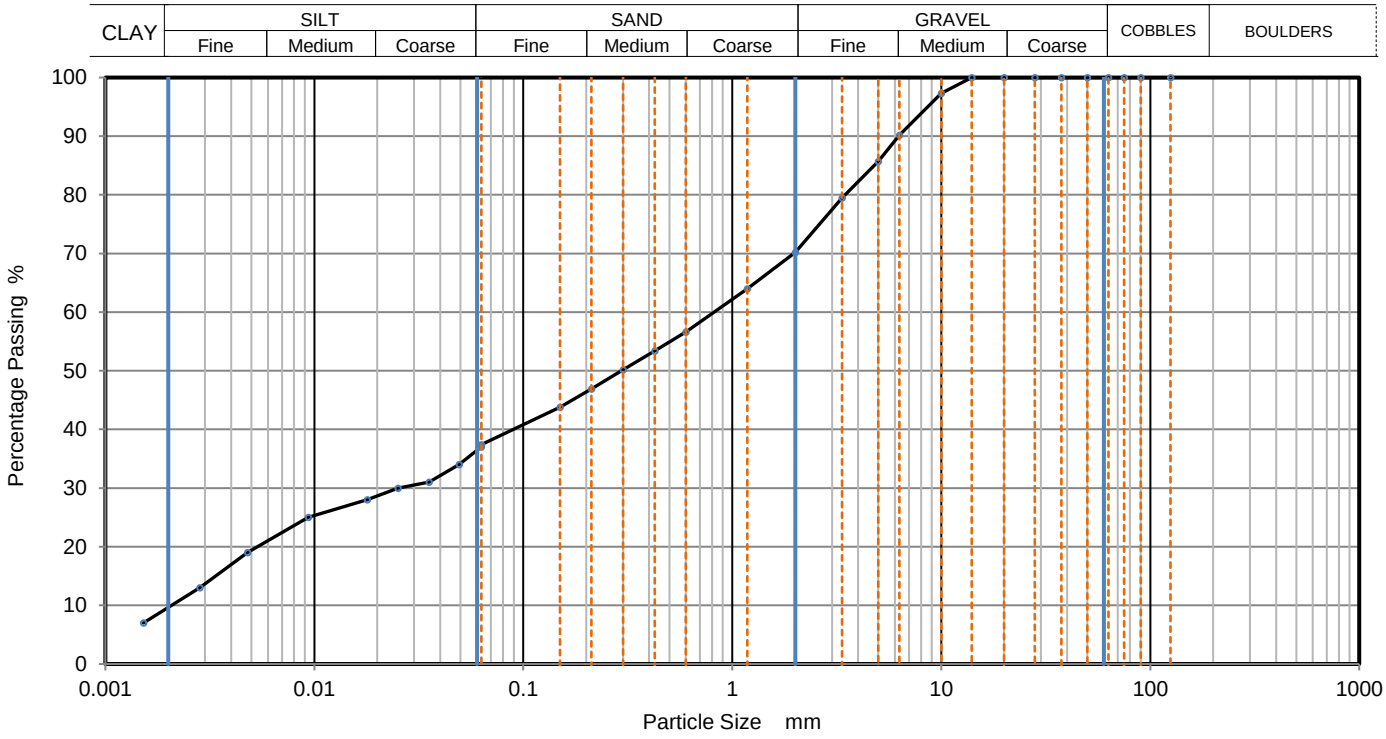
Grading Analysis		
D100	mm	
D60	mm	7.82
D30	mm	1.16
D10	mm	0.0169
Uniformity Coefficient		460
Curvature Coefficient		10

Remarks

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

Approved
Stephen.Watson

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION				Job Ref	20-0399B
					Borehole/Pit No.	R6-CP10
Site Name	Bus Connects Route 6 - Lucan to City Centre				Sample No.	4
Soil Description	Greyish brown sandy gravelly silty CLAY.				Depth, m	1.00
Specimen Reference	9	Specimen Depth	1	m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5				KeyLAB ID	Caus2020103037



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	37
90	100	0.04939	34
75	100	0.03537	31
63	100	0.02517	30
50	100	0.01791	28
37.5	100	0.00936	25
28	100	0.00479	19
20	100	0.00283	13
14	100	0.00152	7
10	97		
6.3	90		
5	86		
3.35	80		
2	70		
1.18	64		
0.6	57	Particle density	(assumed)
0.425	53	2.65	Mg/m3
0.3	50		
0.212	47		
0.15	44		
0.063	37		

Dry Mass of sample, g: 508

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	29.8
Sand	32.7
Silt	27.4
Clay	10.1

Grading Analysis		
D100	mm	
D60	mm	0.817
D30	mm	0.0256
D10	mm	0.00197
Uniformity Coefficient		410
Curvature Coefficient		0.41

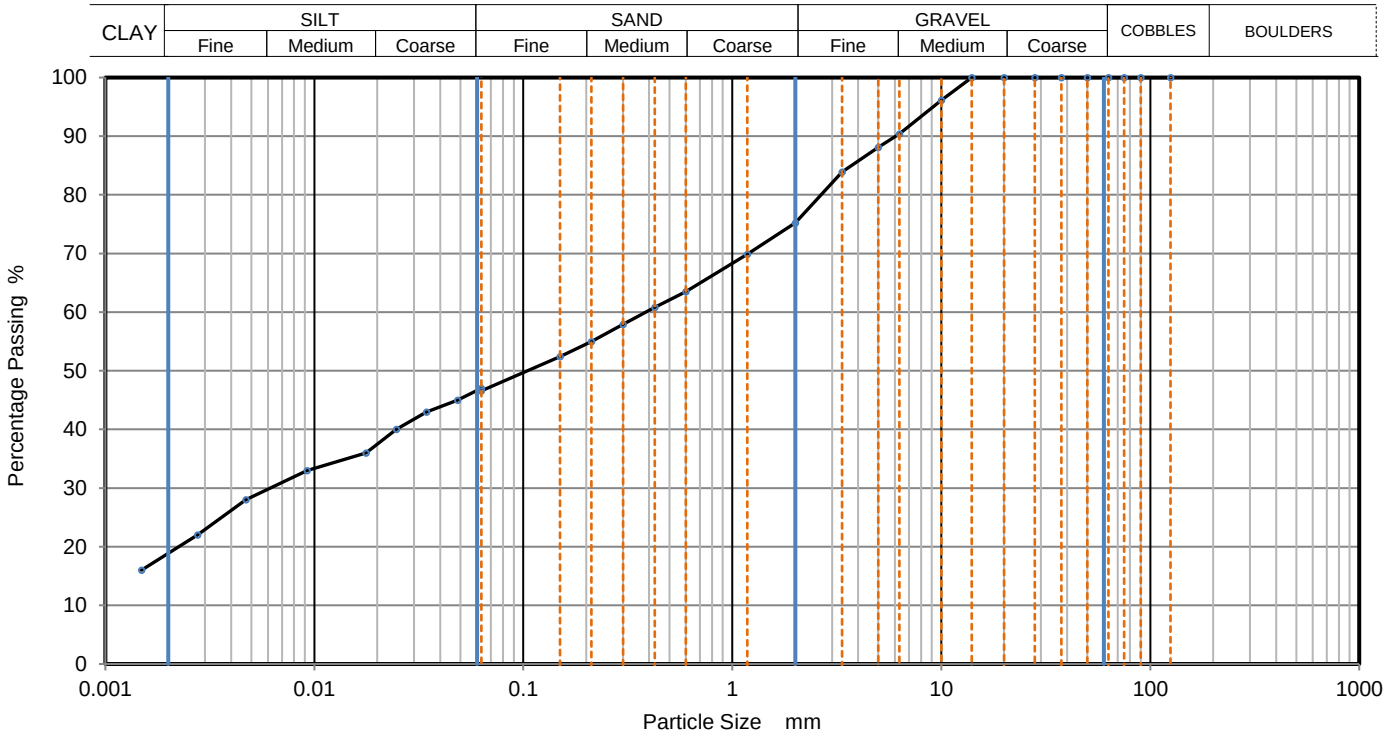
Remarks

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	**20-0399B**
				Borehole/Pit No.	R6-CP11
Site Name	Bus Connects Route 6 - Lucan to City Centre			Sample No.	8
Soil Description	Greyish brown sandy slightly gravelly silty CLAY.			Depth, m	2.00
Specimen Reference	9	Specimen Depth	2 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2020103041



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	47
90	100	0.04843	45
75	100	0.03447	43
63	100	0.02470	40
50	100	0.01769	36
37.5	100	0.00925	33
28	100	0.00471	28
20	100	0.00277	22
14	100	0.00149	16
10	96		
6.3	90		
5	88		
3.35	84		
2	75		
1.18	70		
0.6	64	Particle density	(assumed)
0.425	61	2.65	Mg/m3
0.3	58		
0.212	55		
0.15	52		
0.063	47		

Dry Mass of sample, g	516

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	24.8
Sand	28.7
Silt	27.7
Clay	18.8

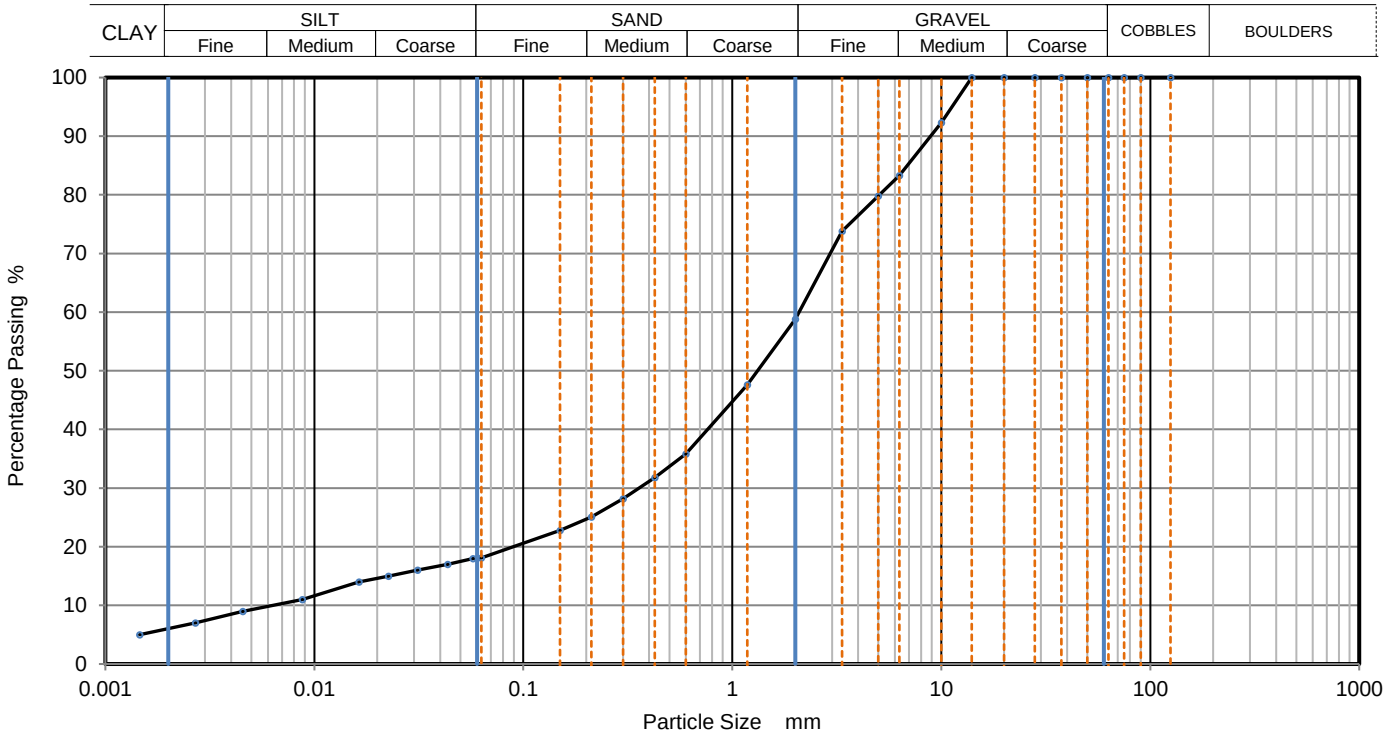
Grading Analysis		
D100	mm	
D60	mm	0.385
D30	mm	0.00643
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

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

Approved
Stephen.Watson

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION				Job Ref	20-0399B
					Borehole/Pit No.	R6-WS01
Site Name	Bus Connects Route 6 - Lucan to City Centre				Sample No.	2
Soil Description	Greyish brown sandy gravelly silty CLAY.				Depth, m	0.40
Specimen Reference	3	Specimen Depth	0.4	m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5				KeyLAB ID	Caus2020103043



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.05742	18
90	100	0.04343	17
75	100	0.03122	16
63	100	0.02260	15
50	100	0.01635	14
37.5	100	0.00875	11
28	100	0.00455	9
20	100	0.00269	7
14	100	0.00146	5
10	92		
6.3	83		
5	80		
3.35	74		
2	59		
1.18	48		
0.6	36	Particle density	(assumed)
0.425	32	2.65	Mg/m3
0.3	28		
0.212	25		
0.15	23		
0.063	18		

Dry Mass of sample, g: 511

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	41.2
Sand	40.7
Silt	12.1
Clay	6.0

Grading Analysis		
D100	mm	
D60	mm	2.08
D30	mm	0.358
D10	mm	0.00607
Uniformity Coefficient		340
Curvature Coefficient		10

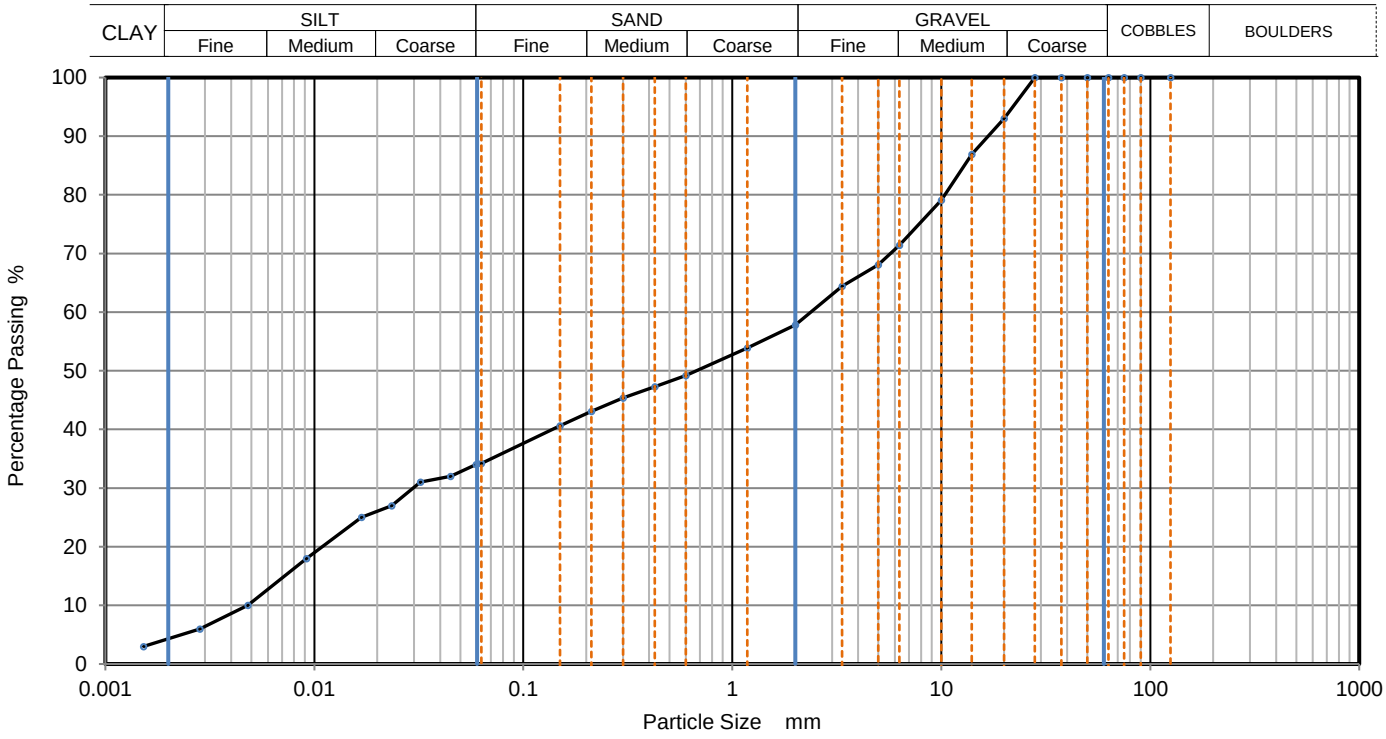
Remarks

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	**20-0399B**
				Borehole/Pit No.	R6-WS02
Site Name	Bus Connects Route 6 - Lucan to City Centre			Sample No.	1
Soil Description	Greyish brown sandy gravelly silty CLAY.			Depth, m	0.30
Specimen Reference	3	Specimen Depth	0.3 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2020103044



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.05937	34
90	100	0.04486	32
75	100	0.03221	31
63	100	0.02346	27
50	100	0.01682	25
37.5	100	0.00916	18
28	100	0.00480	10
20	93	0.00283	6
14	87	0.00152	3
10	79		
6.3	71		
5	68		
3.35	64		
2	58		
1.18	54		
0.6	49	Particle density	(assumed)
0.425	47	2.65	Mg/m3
0.3	45		
0.212	43		
0.15	41		
0.063	34		

Dry Mass of sample, g	2045

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	42.2
Sand	23.6
Silt	29.8
Clay	4.4

Grading Analysis		
D100	mm	
D60	mm	2.38
D30	mm	0.0309
D10	mm	0.00469
Uniformity Coefficient		510
Curvature Coefficient		0.085

Remarks

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

Approved
Stephen.Watson

LAB 05R Version 4

UKAS TESTING
10122

Moisture Condition Value at Natural Moisture Content
Summary of Results

Project No.	Project Name
20-0399B	Bus Connects Route 6 - Lucan 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						
R6-CP07	7	1.00		B	Brown sandy slightly gravelly silty CLAY.	30	19	9.3	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

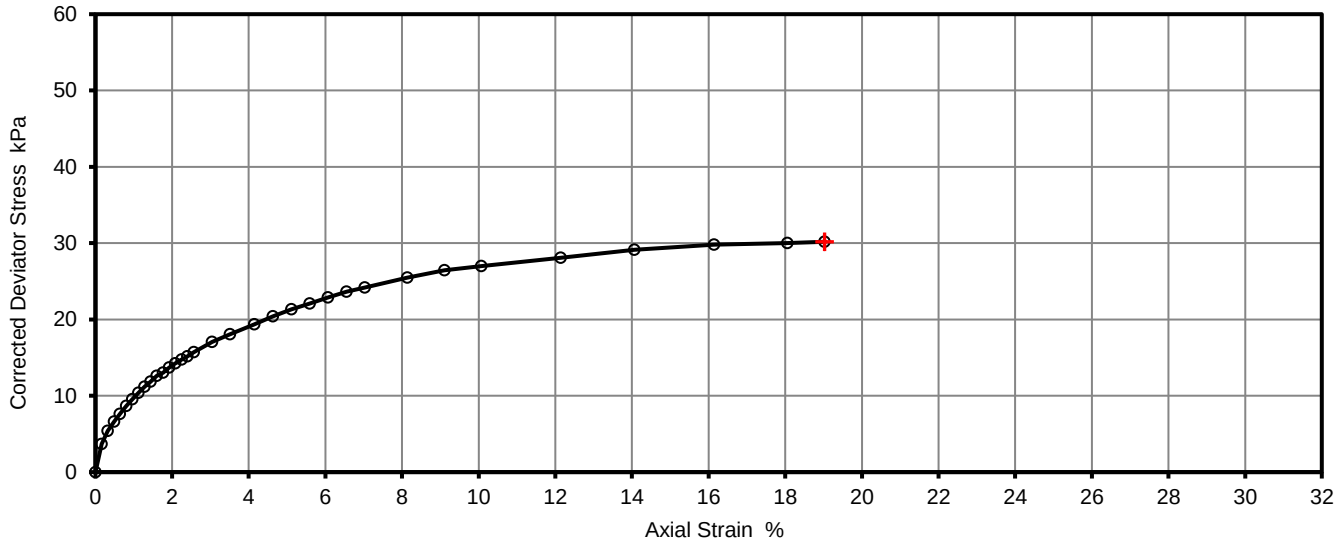
UKAS TESTING

10122

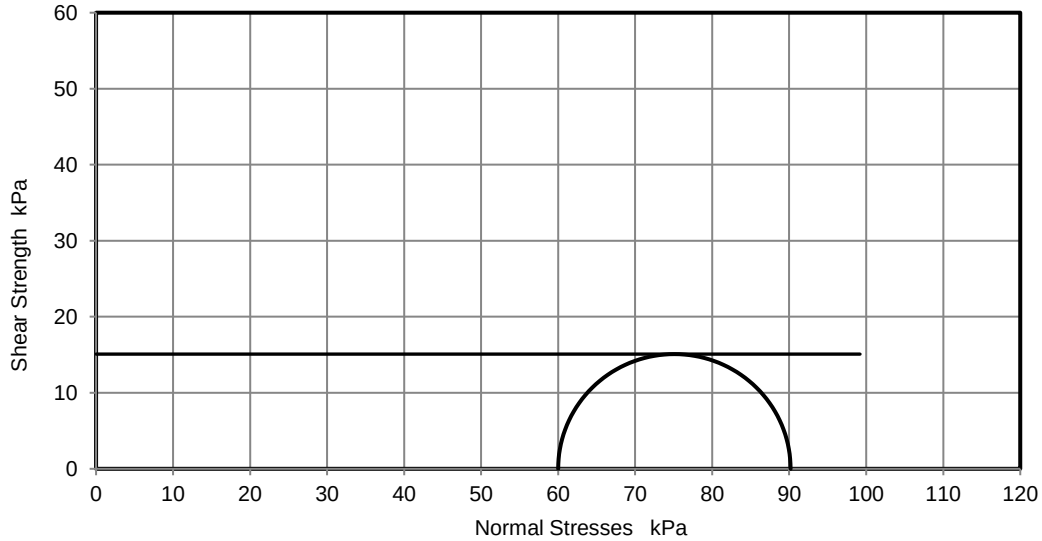
CAUSEWAY GEOTECH	**Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen**			Job Ref	20-0399B
				Borehole/Pit No.	R6-CP09
Site Name	Bus Connects Route 6 - Lucan to City Centre			Sample No.	15
Soil Description	Greyish brown sandy silty CLAY.			Depth	3.00
Specimen Reference	6	Specimen Depth	3.05 m	Sample Type	U
Specimen Description	Very soft greyish brown sandy silty CLAY.			KeyLAB ID	Caus2020103036
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen			Date of test	09/11/2020

Test Number		1	
Length		208.2	mm
Diameter		105.2	mm
Bulk Density		2.10	Mg/m3
Moisture Content		22.5	%
Dry Density		1.71	Mg/m3
Rate of Strain		2.0	%/min
Cell Pressure		60	kPa
At failure	Axial Strain	19.0	%
	Deviator Stress, (σ1 - σ3)f	30	kPa
	Undrained Shear Strength, cu	15	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: 19/11/2020 08:54

UKAS TESTING
10122

CAUSEWAY GEOTECH

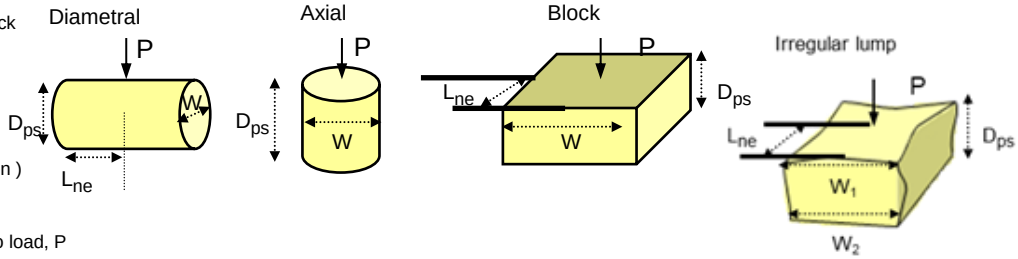
Point Load Strength Index Tests
Summary of Results

Project No.: 20-0399B

Project Name: Bus Connects Route 6 - Lucan 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	
R6-CP07	6.85		C	1	6.85	LIMESTONE	A	U	NO		101.5	56.0	55.0	23.2	84.3	3.3	4.1	
R6-CP07	7.60		C	2	7.60	LIMESTONE	D	U	NO	68.3	101.6	101.6	99.0	30.1	100.3	3.0	4.1	
R6-CP07	7.80		C	3	7.80	LIMESTONE	D	U	YES	58.5	101.6	101.6	98.0	11.6	99.8	1.2	1.6	
R6-CP07	8.50		C	4	8.50	LIMESTONE	D	U	YES	71.0	101.7	101.7	98.0	10.1	99.8	1.0	1.4	
R6-CP07	9.40		C	5	9.40	LIMESTONE	I	U	NO	102.1	80.7	58.0	56.0	5.6	75.9	1.0	1.2	
R6-CP07	10.60		C	6	10.60	LIMESTONE	A	U	NO	101.6	101.6	62.0	60.0	5.2	88.1	0.7	0.9	

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: 17/11/2020

Approved By: Stephen.Watson

UKAS TESTING 10122

UNIAXIAL COMPRESSION TEST ON ROCK - SUMMARY OF RESULTS

Project No.	Project Name
20-0399B	Bus Connects Route 6 - Lucan 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	
R6-CP07		8.85	9.05	C	LIMESTONE	101.6	254.0	2.5	2.67	0.6	as received	F	35.6	

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	17/11/2020	Stephen.Watson	1 sheet 1

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CB8 0AL
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Email: info@chemtest.com

UKAS TESTING
2183

Final Report

Report No.:	20-30010-1
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	20-0399B Bus Connects Route 6

Quotation No.:		**Date Received:**	05-Nov-2020
Order No.:		**Date Instructed:**	05-Nov-2020
No. of Samples:	16		
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: 20-0399B Bus Connects Route 6

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		20-30010	20-30010	20-30010	20-30010	20-30010	20-30010	20-30010	20-30010	20-30010
Quotation No.:			**Chemtest Sample ID.:**		1092206	1092207	1092208	1092209	1092210	1092211	1092212	1092213	1092214
Order No.:			Client Sample Ref.:		10	1	5	6	6	7	12		7
			Client Sample ID.:		R6-CP03	R6-CP04	R6-CP04	R6-CP05	R6-CP06	R6-CP07	R6-CP07	R6-CP07	R6-CP08
			Sample Type:		SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Top Depth (m):		2.00	0.10	1.70	2.50	1.90	1.00	3.20	5.20	2.00
			Date Sampled:		04-Nov-2020	04-Nov-2020	04-Nov-2020	04-Nov-2020	04-Nov-2020	04-Nov-2020	04-Nov-2020	04-Nov-2020	04-Nov-2020
Determinand	**Accred.**	**SOP**	**Units**	**LOD**									
Moisture	N	2030	%	0.020	14	9.2	11	7.7	8.6	14	20	12	13
pH	U	2010		4.0	8.8	8.7	8.5	8.7	8.9	8.6	8.2	8.8	8.9
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	0.069	0.024	< 0.010

Results - Soil

Project: 20-0399B Bus Connects Route 6

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		20-30010	20-30010	20-30010	20-30010	20-30010	20-30010	20-30010
Quotation No.:			**Chemtest Sample ID.:**		1092215	1092216	1092217	1092218	1092219	1092220	1092221
Order No.:			Client Sample Ref.:		11	8	3	3	11	2	1
			Client Sample ID.:		R6-CP09	R6-CP09	R6-CP10	R6-CP11	R6-CP11	R6-WS01	R6-WS02
			Sample Type:		SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Top Depth (m):		1.20	3.00	1.20	1.20	3.00	0.40	0.30
			Date Sampled:		04-Nov-2020	04-Nov-2020	04-Nov-2020	04-Nov-2020	04-Nov-2020	04-Nov-2020	04-Nov-2020
Determinand	**Accred.**	**SOP**	**Units**	**LOD**							
Moisture	N	2030	%	0.020	17	15	7.3	8.1	11	7.2	8.1
pH	U	2010		4.0	8.6	8.6	8.5	8.2	9.4	8.7	8.8
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	0.025	< 0.010	0.082	1.2	0.21	< 0.010	< 0.010

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

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.:	20-31075-1
Initial Date of Issue:	19-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	20-0399B Route 6 Lucan to City Centre

Quotation No.:		**Date Received:**	16-Nov-2020
Order No.:		**Date Instructed:**	16-Nov-2020
No. of Samples:	1		
Turnaround (Wkdays):	5	**Results Due:**	20-Nov-2020
Date Approved:	19-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: 20-0399B Route 6 Lucan to City Centre

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		20-31075
Quotation No.:			**Chemtest Sample ID.:**		1097049
			Sample Location:		R6-CP07
			Sample Type:		SOIL
			Top Depth (m):		6.85
			Date Sampled:		13-Nov-2020
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
Moisture	N	2030	%	0.020	1.9
pH	U	2010		4.0	8.6
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	0.088

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

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	20-0399B	To	Sean Ross
Project Name	Bus Connects Route 9 - Lucan to City Centre	Position	Project Manager
TR reference	20-0399B / 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			
R6 CP01	14	3.00	U	UU Triaxial	Unable to obtain specimen for test - coarse gravel content too high	CANCEL
R6 CP03	12	1.20	U	UU Triaxial	Unable to obtain specimen for test - sample broken by layer of sand	CANCEL
R6 CP04	6	2.00	U	UU Triaxial	Unable to obtain specimen for test - sample broken on extrusion	CANCEL
R6 CP05	5	2.00	U	UU Triaxial	Unable to obtain specimen for test - coarse gravel content too high	CANCEL
R6 CP06	9	2.00	U	UU Triaxial	Unable to obtain specimen for test - cobbles present in sample	CANCEL
R6 CP07	7	1.00	B	UU Triaxial	Unable to obtain specimen for test - cobbles present in sample	CANCEL
R6 CP07		6.20	C	UU Triaxial	Unable to obtain specimen for test - cobbles present in sample	CANCEL
R6 CP08	13	2.00	U	UU Triaxial	Unable to obtain specimen for test - coarse gravel content too high	CANCEL

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

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

CAUSEWAY GEOTECH

APPENDIX G

ENVIRONMENTAL LABORATORY TEST RESULTS

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Eurofins Chemtest Ltd
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Email: info@chemtest.com

Final Report

Report No.:	20-26018-1
Initial Date of Issue:	02-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	20-0399B Bus Connects Route 6

Quotation No.:	Q20-21063	**Date Received:**	28-Sep-2020
Order No.:		**Date Instructed:**	28-Sep-2020
No. of Samples:	1		
Turnaround (Wkdays):	5	**Results Due:**	02-Oct-2020
Date Approved:	02-Oct-2020		

Approved By:

Details: Glynn Harvey, Technical Manager

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

Results - Leachate

Project: 20-0399B Bus Connects Route 6

Client: Causeway Geotech Ltd				**Chemtest Job No.:**		20-26018
Quotation No.: Q20-21063				**Chemtest Sample ID.:**		1071187
				Sample Location:		R6-CP07
				Sample Type:		SOIL
				Top Depth (m):		0.50
				Date Sampled:		25-Sep-2020
Determinand	**Accred.**	**SOP**	**Type**	**Units**	**LOD**	
Ammonium	U	1220	10:1	mg/l	0.050	0.45
Ammonium	N	1220	10:1	mg/kg	0.10	9.3

Results - Soil

Project: 20-0399B Bus Connects Route 6

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		20-26018
Quotation No.: Q20-21063			**Chemtest Sample ID.:**		1071187
			Sample Location:		R6-CP07
			Sample Type:		SOIL
			Top Depth (m):		0.50
			Date Sampled:		25-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	14
pH	M	2010		4.0	8.7
Boron (Hot Water Soluble)	M	2120	mg/kg	0.40	0.56
Sulphur (Elemental)	M	2180	mg/kg	1.0	3.2
Cyanide (Total)	M	2300	mg/kg	0.50	< 0.50
Sulphide (Easily Liberatable)	N	2325	mg/kg	0.50	9.1
Sulphate (Total)	M	2430	%	0.010	0.023
Arsenic	M	2450	mg/kg	1.0	4.8
Barium	M	2450	mg/kg	10	42
Cadmium	M	2450	mg/kg	0.10	< 0.10
Chromium	M	2450	mg/kg	1.0	29
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	15
Mercury	M	2450	mg/kg	0.10	< 0.10
Nickel	M	2450	mg/kg	0.50	25
Lead	M	2450	mg/kg	0.50	14
Selenium	M	2450	mg/kg	0.20	< 0.20
Zinc	M	2450	mg/kg	0.50	50
Chromium (Trivalent)	N	2490	mg/kg	1.0	29
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50
Total Organic Carbon	M	2625	%	0.20	1.4
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: 20-0399B Bus Connects Route 6

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		20-26018
Quotation No.: Q20-21063			**Chemtest Sample ID.:**		1071187
			Sample Location:		R6-CP07
			Sample Type:		SOIL
			Top Depth (m):		0.50
			Date Sampled:		25-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: 20-0399B Bus Connects Route 6

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		20-26018
Quotation No.: Q20-21063			**Chemtest Sample ID.:**		1071187
			Sample Location:		R6-CP07
			Sample Type:		SOIL
			Top Depth (m):		0.50
			Date Sampled:		25-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: 20-0399B Bus Connects Route 6

					Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	20-26018						
Chemtest Sample ID:	1071187						
Sample Ref:							
Sample ID:							
Sample Location:	R6-CP07						
Top Depth(m):	0.50						
Bottom Depth(m):							
Sampling Date:	25-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	%	1.4	3	5	6
Loss On Ignition	2610	M	%	8.7	--	--	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		8.7	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg	0.057	--	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	0.0077	< 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	0.0070	0.070	2	50	100
Mercury	1450	U	< 0.00050	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.0031	< 0.050	0.5	10	30
Nickel	1450	U	0.0030	< 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	0.0091	< 0.50	4	50	200
Chloride	1220	U	12	120	800	15000	25000
Fluoride	1220	U	0.35	3.5	10	150	500
Sulphate	1220	U	12	120	1000	20000	50000
Total Dissolved Solids	1020	N	140	1400	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	4.8	< 50	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	14

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

UKAS TESTING
2183

Final Report

Report No.:	20-29269-1
Initial Date of Issue:	03-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	20-0399B Bus Connects Route 6

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:	03-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: 20-0399B Bus Connects Route 6

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		20-29269
Quotation No.: Q20-21063			**Chemtest Sample ID.:**		1088344
			Sample Location:		R6-CP09
			Sample Type:		SOIL
			Top Depth (m):		1.00
			Date Sampled:		23-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	9.6
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	20
Cadmium	U	2450	mg/kg	0.10	1.4
Chromium	U	2450	mg/kg	1.0	13
Copper	U	2450	mg/kg	0.50	23
Mercury	U	2450	mg/kg	0.10	< 0.10
Nickel	U	2450	mg/kg	0.50	32
Lead	U	2450	mg/kg	0.50	27
Zinc	U	2450	mg/kg	0.50	56
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	0.66
Anthracene	U	2700	mg/kg	0.10	0.19
Fluoranthene	U	2700	mg/kg	0.10	1.3
Pyrene	U	2700	mg/kg	0.10	1.4
Benzo[a]anthracene	U	2700	mg/kg	0.10	0.72
Chrysene	U	2700	mg/kg	0.10	0.72
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	5.0
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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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

UKAS TESTING
2183

Final Report

Report No.:	20-29273-1
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	20-0399B Bus Connects Route 6

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 - Soil

Project: 20-0399B Bus Connects Route 6

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		20-29273
Quotation No.: Q20-21063			**Chemtest Sample ID.:**		1088370
			Sample Location:		R6-CP10
			Sample Type:		SOIL
			Top Depth (m):		1.00
			Date Sampled:		24-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	8.3
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	0.50
Cyanide (Total)	U	2300	mg/kg	0.50	< 0.50
Arsenic	U	2450	mg/kg	1.0	18
Cadmium	U	2450	mg/kg	0.10	1.6
Chromium	U	2450	mg/kg	1.0	16
Copper	U	2450	mg/kg	0.50	24
Mercury	U	2450	mg/kg	0.10	< 0.10
Nickel	U	2450	mg/kg	0.50	41
Lead	U	2450	mg/kg	0.50	27
Zinc	U	2450	mg/kg	0.50	79
Organic Matter	U	2625	%	0.40	1.9
Total TPH >C6-C40	U	2670	mg/kg	10	230
Naphthalene	U	2700	mg/kg	0.10	9.2
Acenaphthylene	U	2700	mg/kg	0.10	0.57
Acenaphthene	U	2700	mg/kg	0.10	5.7
Fluorene	U	2700	mg/kg	0.10	4.8
Phenanthrene	U	2700	mg/kg	0.10	18
Anthracene	U	2700	mg/kg	0.10	3.1
Fluoranthene	U	2700	mg/kg	0.10	11
Pyrene	U	2700	mg/kg	0.10	10
Benzo[a]anthracene	U	2700	mg/kg	0.10	4.5
Chrysene	U	2700	mg/kg	0.10	4.7
Benzo[b]fluoranthene	U	2700	mg/kg	0.10	4.8
Benzo[k]fluoranthene	U	2700	mg/kg	0.10	2.0
Benzo[a]pyrene	U	2700	mg/kg	0.10	4.0
Indeno(1,2,3-c,d)Pyrene	U	2700	mg/kg	0.10	2.1
Dibenz(a,h)Anthracene	U	2700	mg/kg	0.10	0.98
Benzo[g,h,i]perylene	U	2700	mg/kg	0.10	2.2
Coronene	N	2700	mg/kg	0.10	< 0.10
Total Of 17 PAH's	N	2700	mg/kg	2.0	88
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

CAUSEWAY GEOTECH

APPENDIX H

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

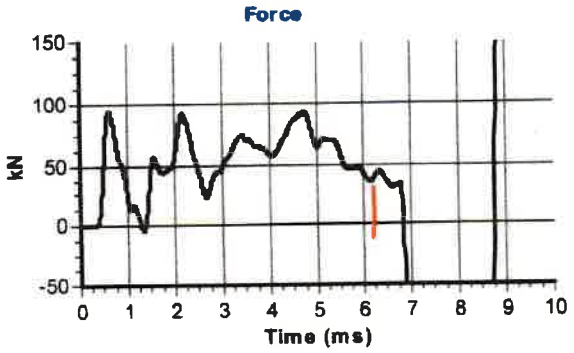
Instrumented Rod Data

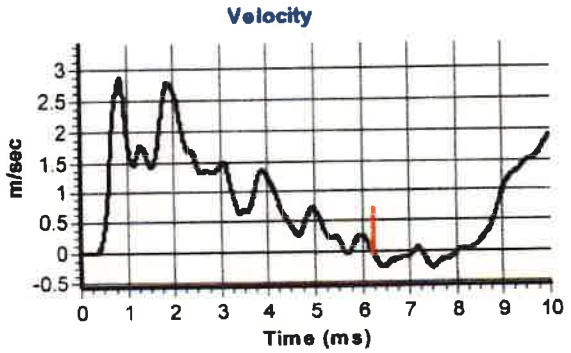
Diameter d_r (mm):	54
Wall Thickness t_r (mm):	6.0
Assumed Modulus E_a (GPa):	200
Accelerometer No.1:	6458
Accelerometer No.2:	9607

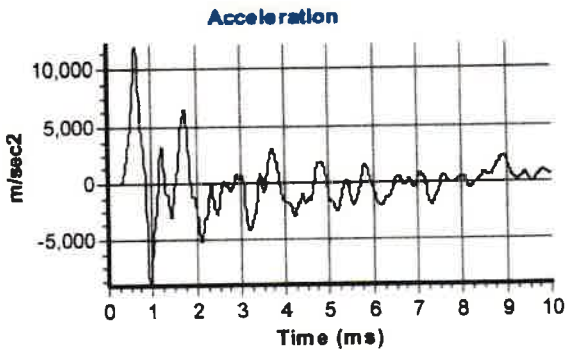
SPT Hammer Information

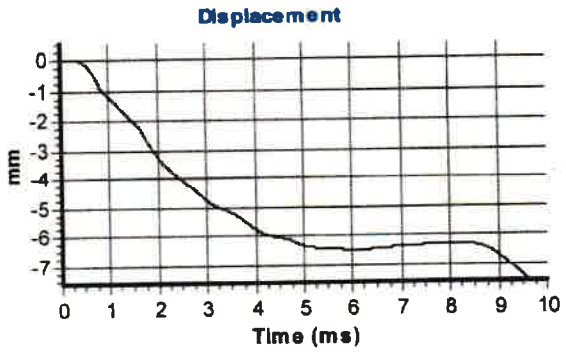
Hammer Mass m (kg):	63.5
Falling Height h (mm):	760
SPT String Length L (m):	10.0

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

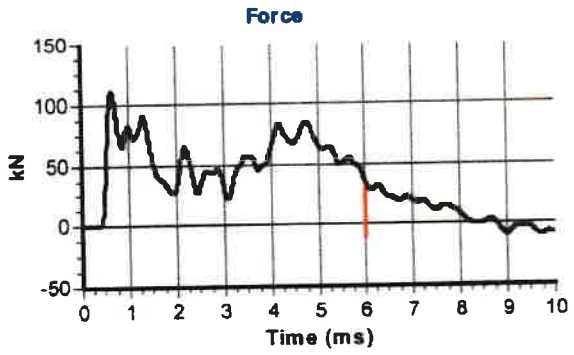
Diameter d_r (mm): 54
Wall Thickness t_r (mm): 6.0
Assumed Modulus E_a (GPa): 200
Accelerometer No.1: 6458
Accelerometer No.2: 9607

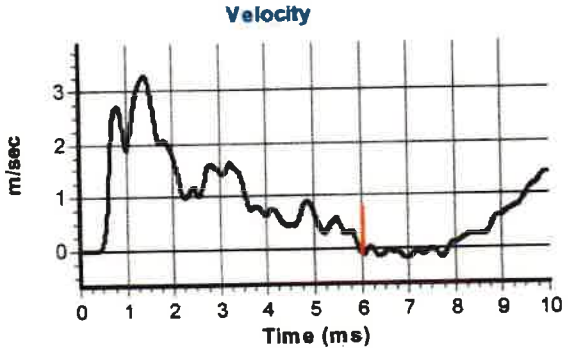
SPT Hammer Information

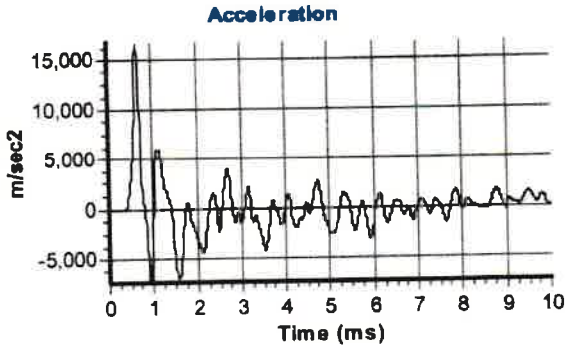
Hammer Mass m (kg): 63.5
Falling Height h (mm): 760
SPT String Length L (m): 10.0

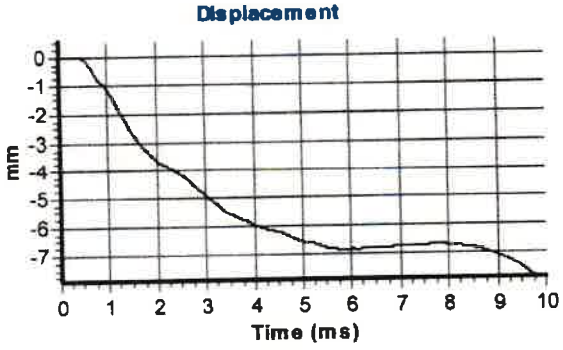
Comments / Location

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