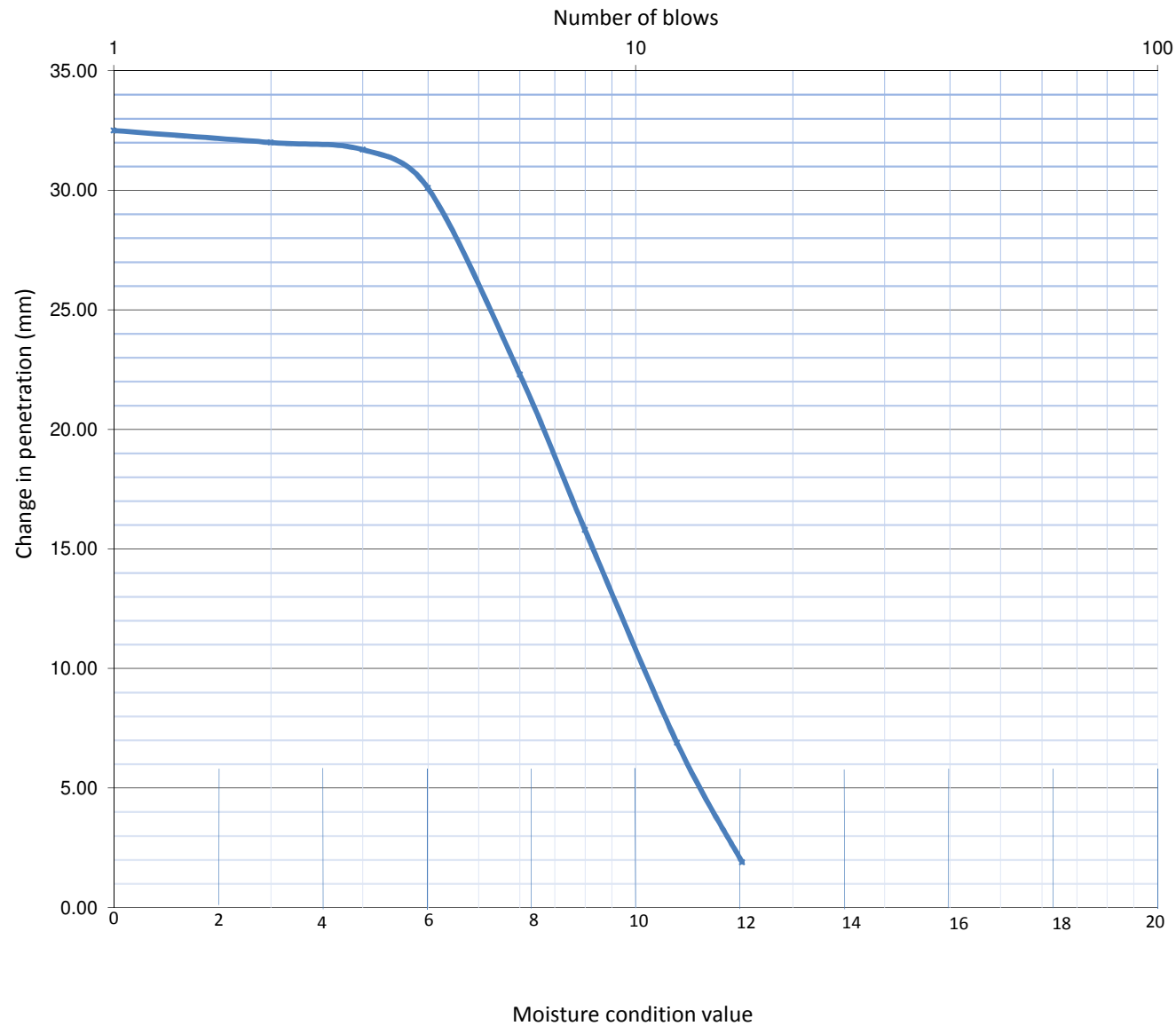


Determination of moisture condition value in accordance with BS1377 Part 4 Clause 5



Moisture content: 28.6

MCV: 11.2

Initial wet mass sieved: 40463g

% retained on 20mm: 7.7

% retained on 37.5mm: 5.8

Sample type: disturbed

Method:

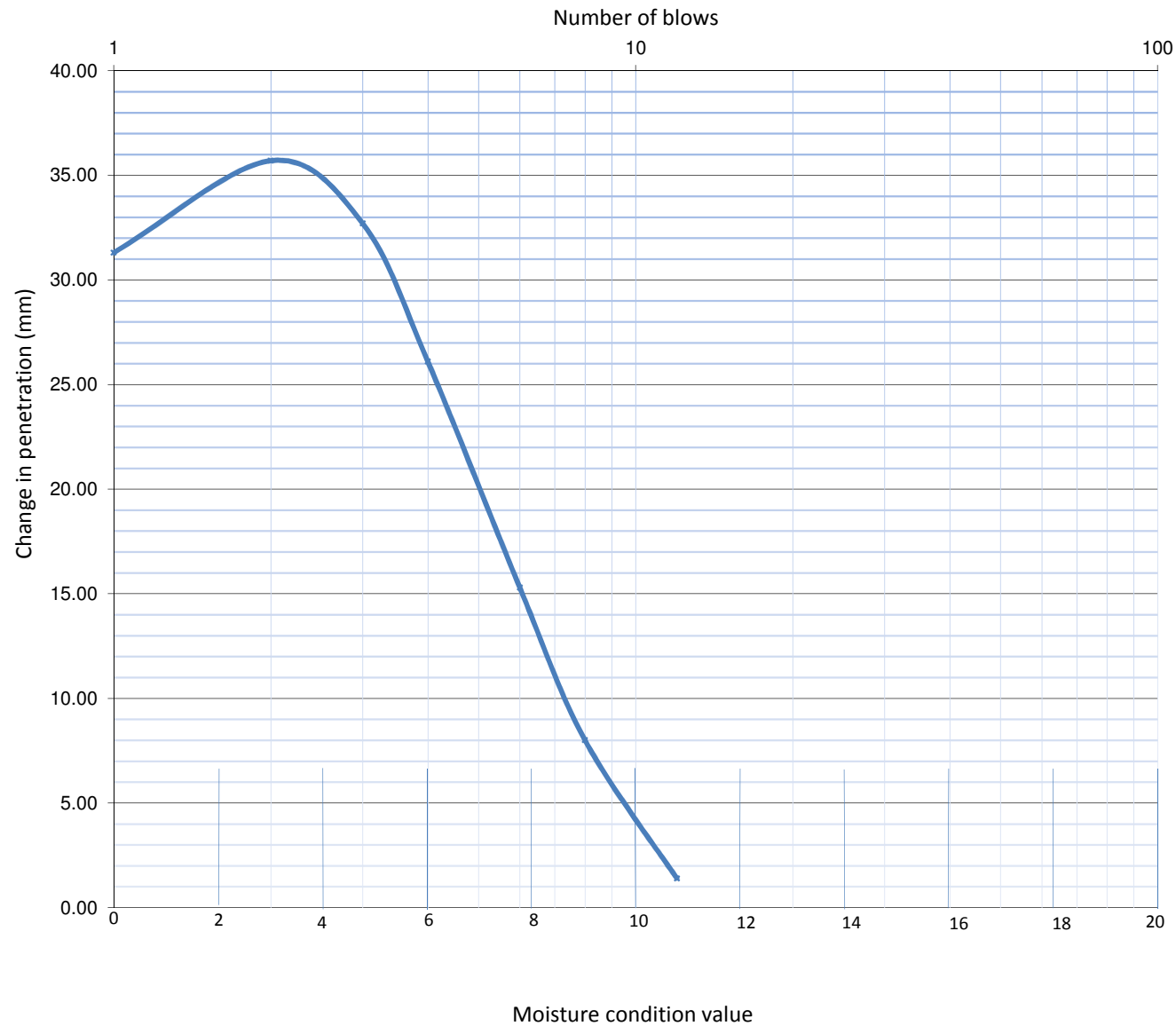
Sample prepared by passing 20mm sieve

Batch prepared

Graph interpretation: steepest line through 5mm change in penetration

Sample description: Made ground: brown sandy clay with occasional gravel and very occasional concrete and brick

Determination of moisture condition value in accordance with BS1377 Part 4 Clause 5



Moisture content: 32.8

MCV: 9.8

Initial wet mass sieved: 40463g

% retained on 20mm: 7.7

% retained on 37.5mm: 5.8

Sample type: disturbed

Method:

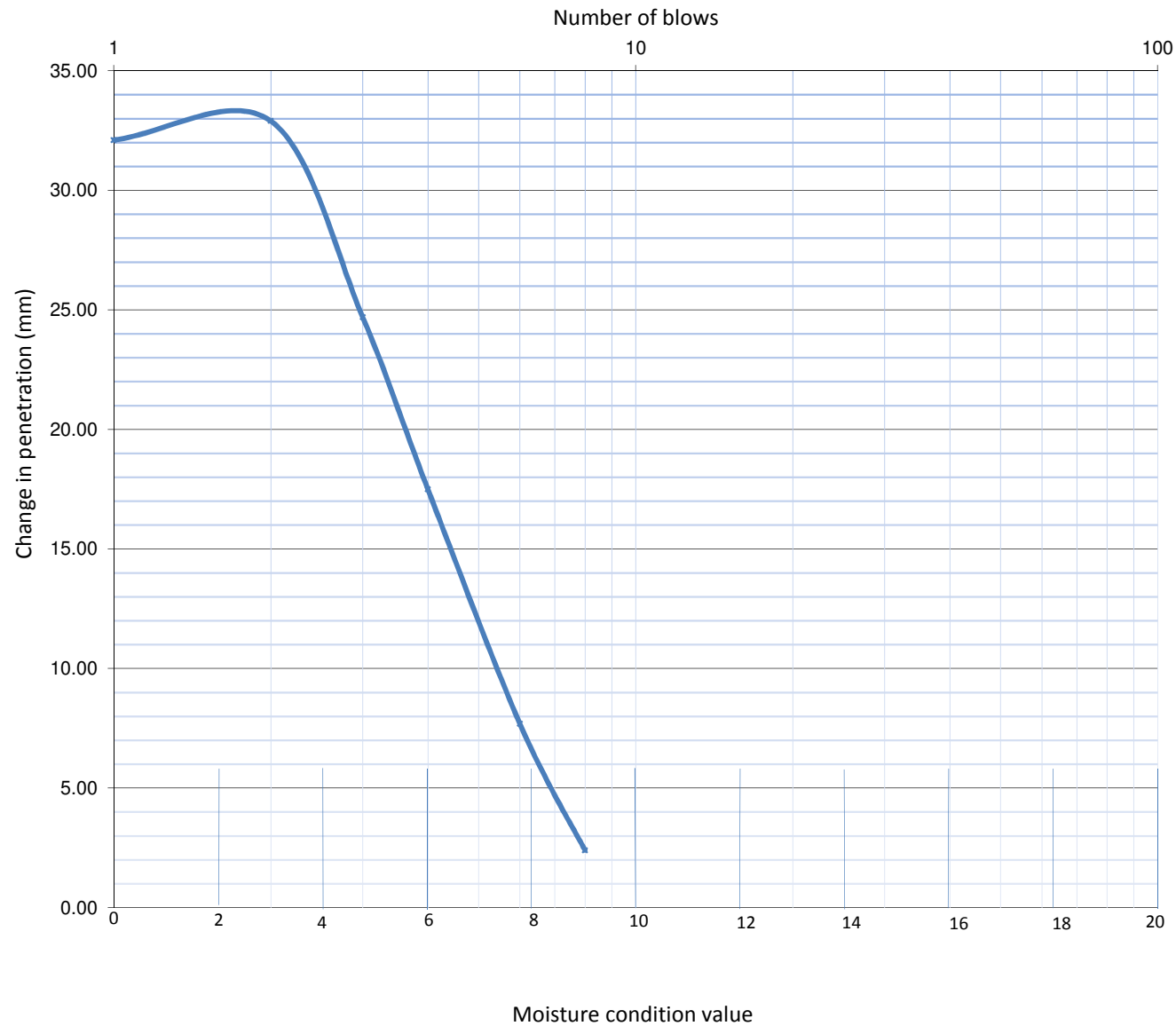
Sample prepared by passing 20mm sieve

Batch prepared

Graph interpretation: steepest line through 5mm change in penetration

Sample description: Made ground: brown sandy clay with occasional gravel and very occasional concrete and brick

Determination of moisture condition value in accordance with BS1377 Part 4 Clause 5



Moisture content: 35.6

MCV: 8.4

Initial wet mass sieved: 40463g

% retained on 20mm: 7.7

% retained on 37.5mm: 5.8

Sample type: disturbed

Method:

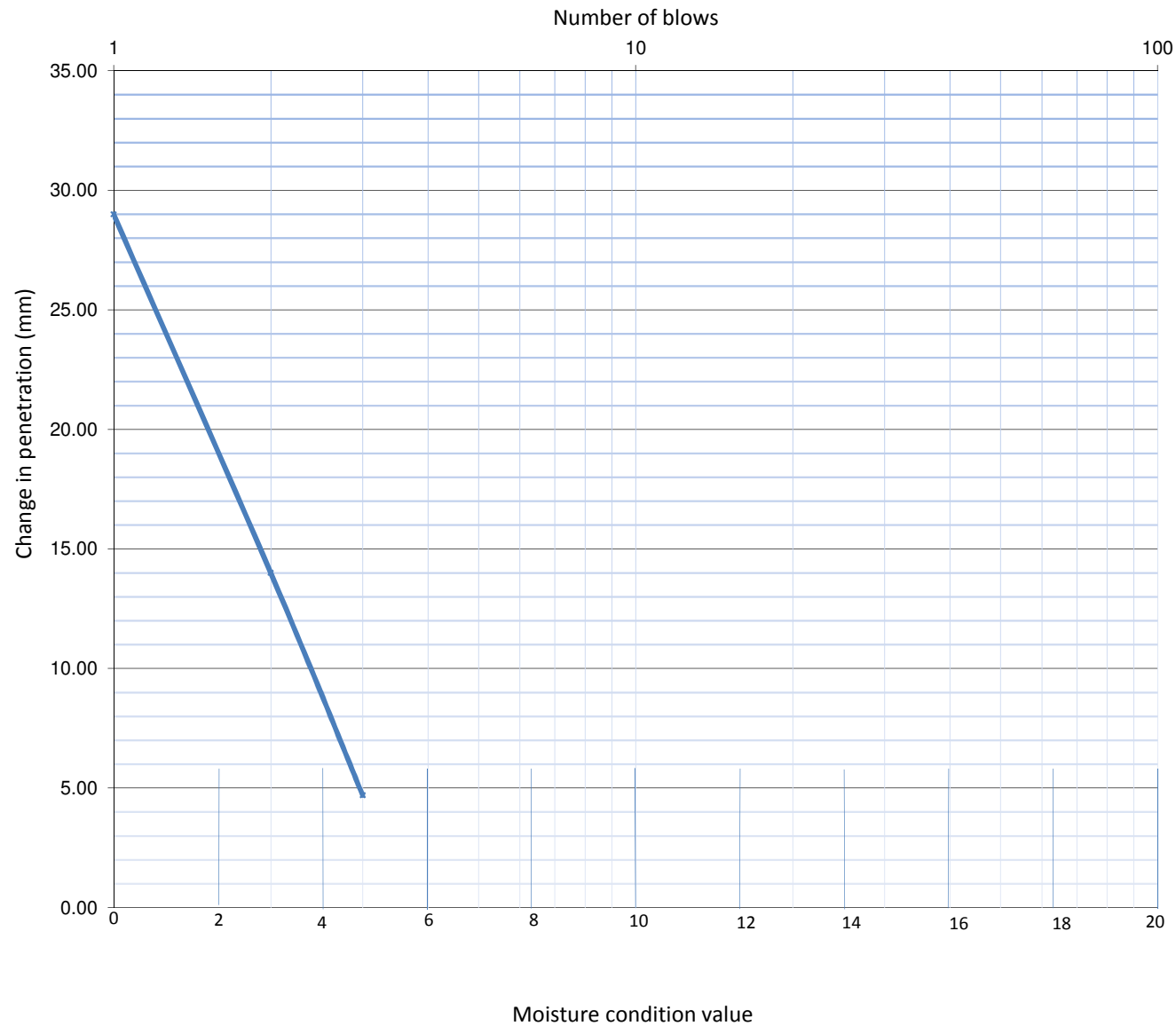
Sample prepared by passing 20mm sieve

Batch prepared

Graph interpretation: steepest line through 5mm change in penetration

Sample description: Made ground: brown sandy clay with occasional gravel and very occasional concrete and brick

Determination of moisture condition value in accordance with BS1377 Part 4 Clause 5



Moisture content: 41.2
MCV: 4.8

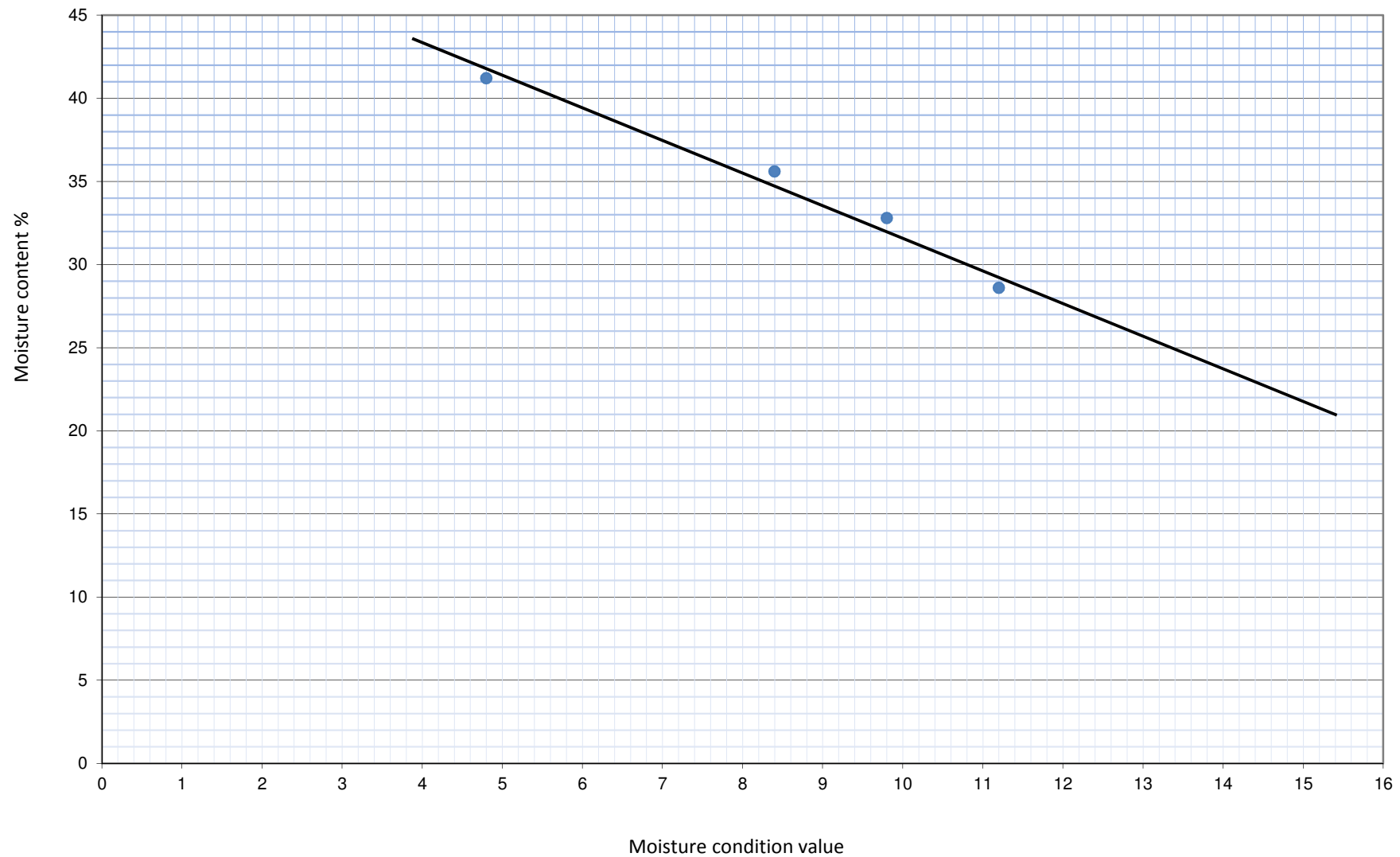
Initial wet mass sieved: 40463g
% retained on 20mm: 7.7
% retained on 37.5mm: 5.8

Sample type: disturbed

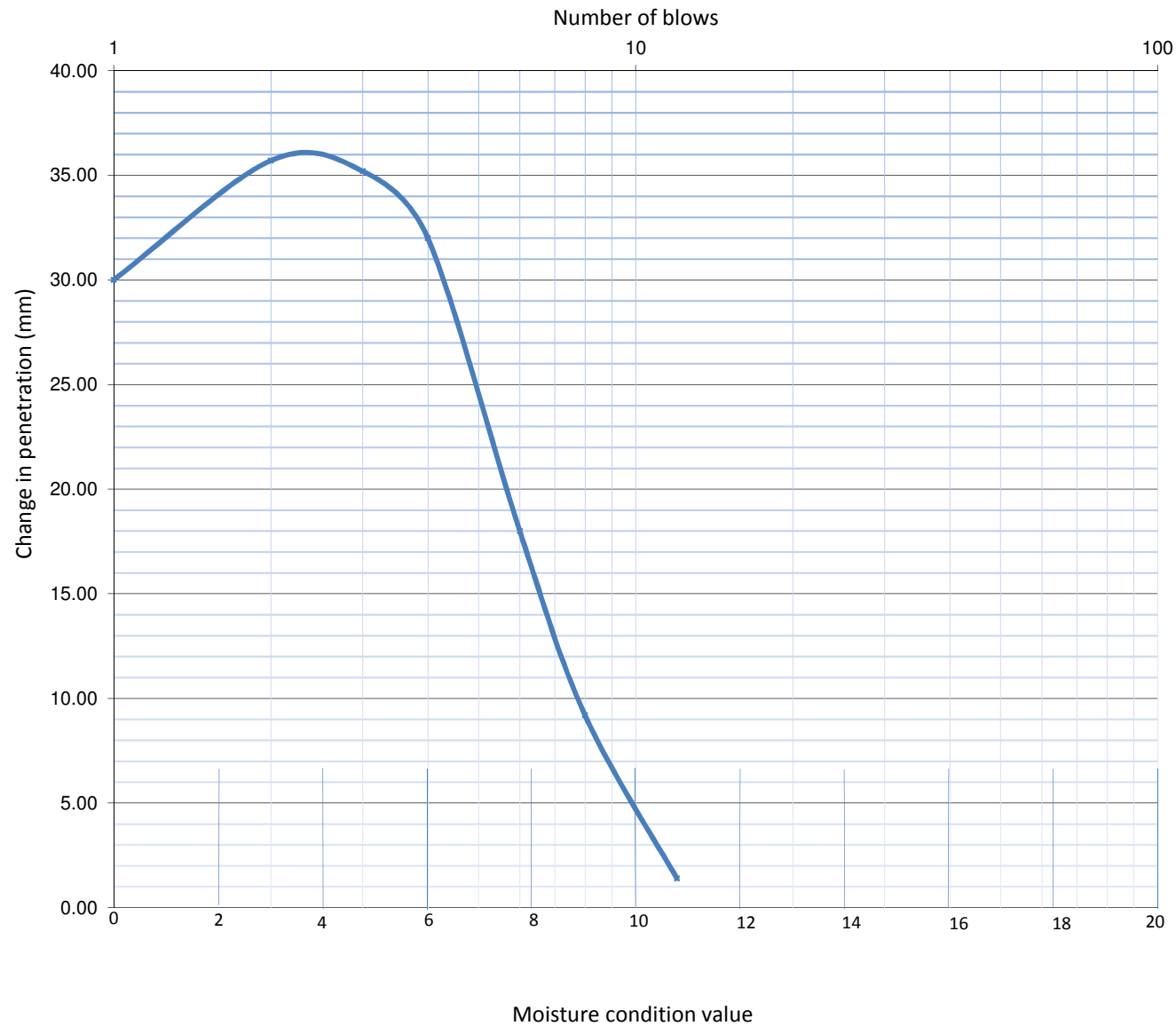
Method:
Sample prepared by passing 20mm sieve
Batch prepared
Graph interpretation: steepest line through 5mm change in penetration

Sample description: Made ground:
brown sandy clay with occasional gravel and very occasional concrete and brick

Determination of moisture condition value in accordance with BS1377 Part 4 Clause 5



Determination of moisture condition value in accordance with BS1377 Part 4 Clause 5



Moisture content: 26.8

MCV: 9.9

Initial wet mass sieved: 46530g

% retained on 20mm: 3.8

% retained on 37.5mm: 0

Sample type: disturbed

Method:

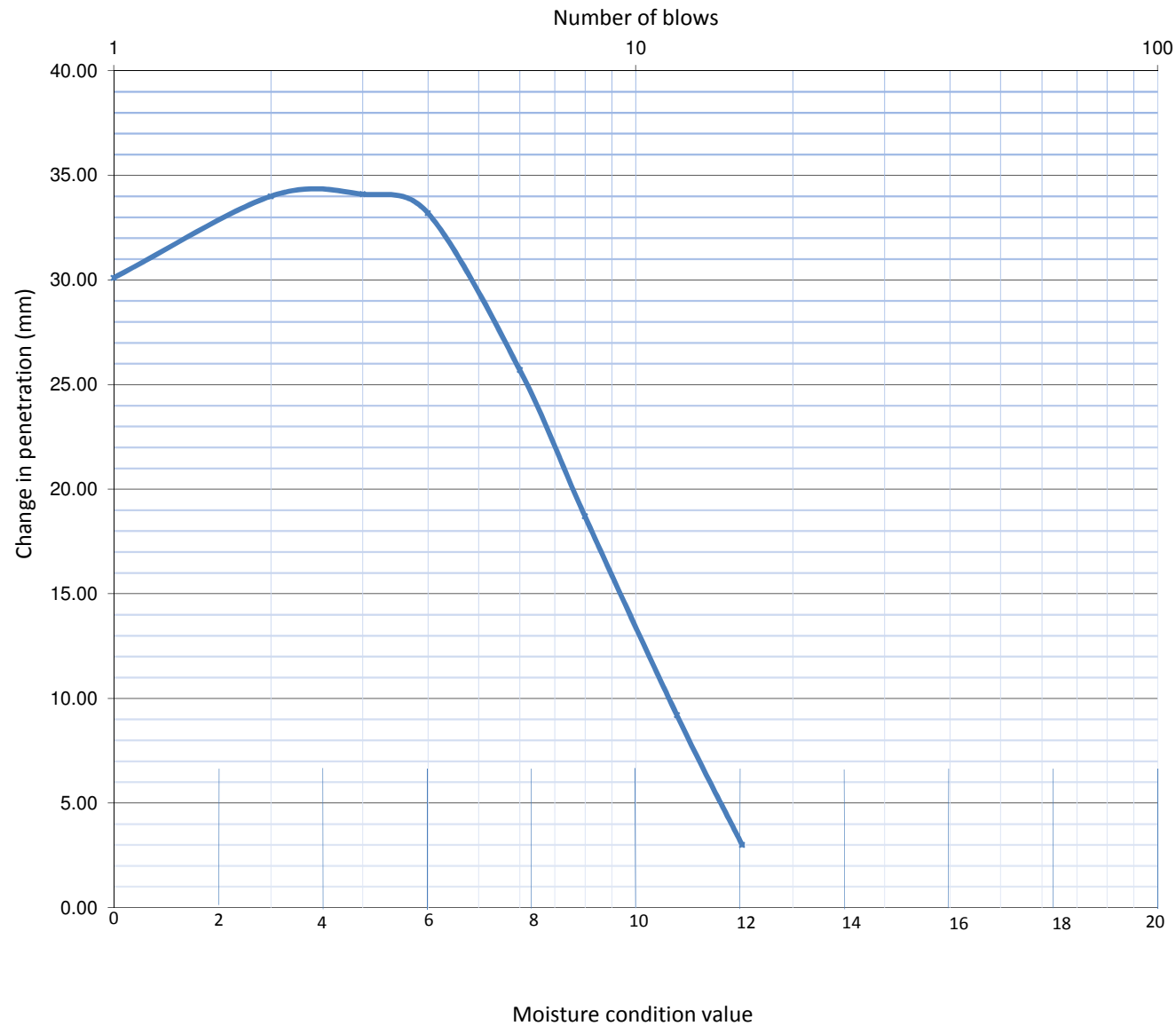
Sample prepared by passing 20mm sieve

Batch prepared

Graph interpretation: steepest line through 5mm change in penetration

Sample description: Made ground: brown sandy clay with occasional gravel and very occasional concrete and brick

Determination of moisture condition value in accordance with BS1377 Part 4 Clause 5



Moisture content: 28.6
MCV: 11.6

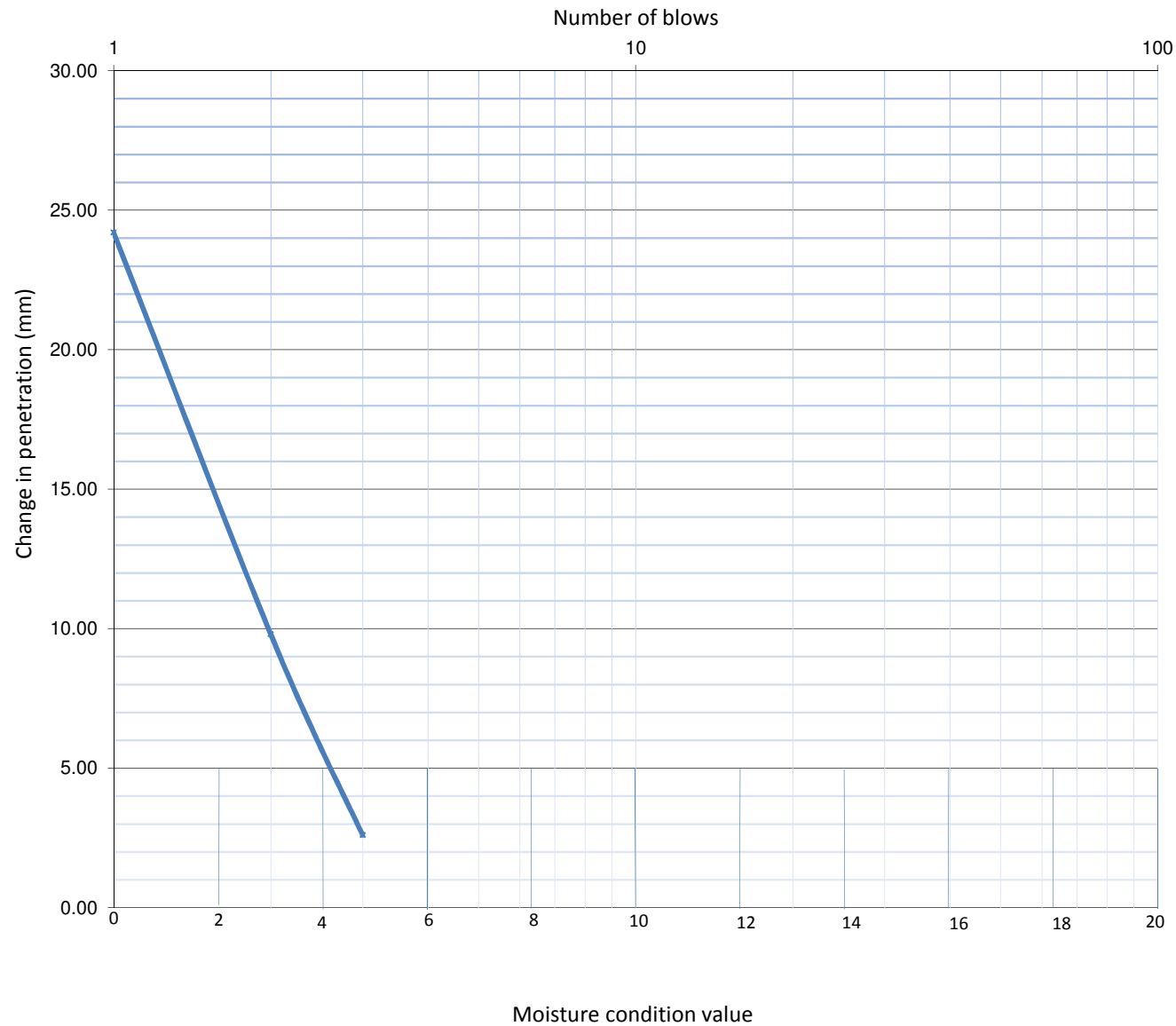
Initial wet mass sieved: 46530g
% retained on 20mm: 3.8
% retained on 37.5mm: 0

Sample type: disturbed

Method:
Sample prepared by passing 20mm
sieve
Batch prepared
Graph interpretation: steepest line
through 5mm change in penetration

Sample description: Made ground:
brown sandy clay with occasional
gravel and very occasional concrete
and brick

Determination of moisture condition value in accordance with BS1377 Part 4 Clause 5



Moisture content: 37.7
MCV: 4.2

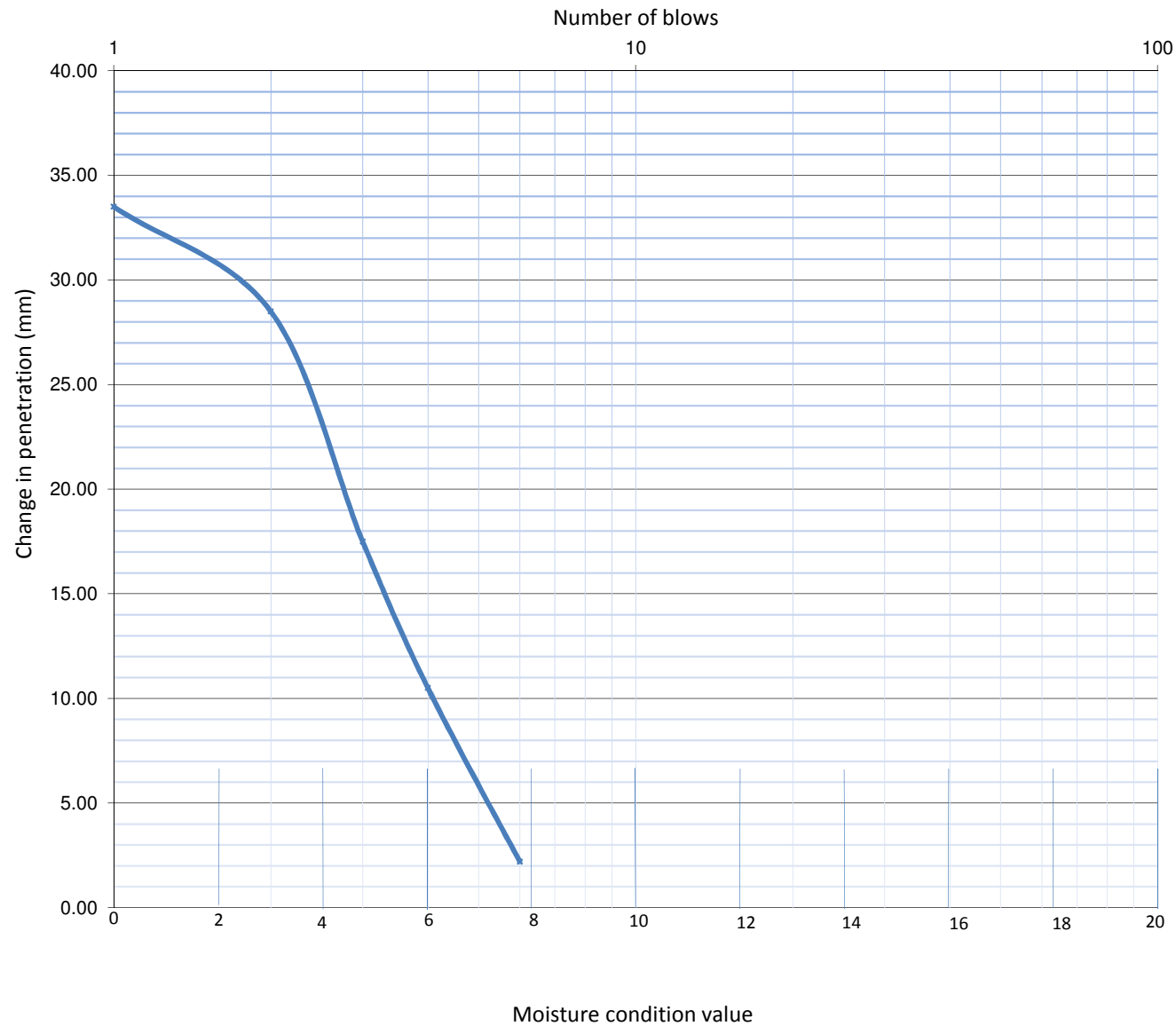
Initial wet mass sieved: 46530g
% retained on 20mm: 3.8
% retained on 37.5mm: 0

Sample type: disturbed

Method:
Sample prepared by passing 20mm
sieve
Batch prepared
Graph interpretation: steepest line
through 5mm change in penetration

Sample description: Made ground:
brown sandy clay with occasional
gravel and very occasional concrete
and brick

Determination of moisture condition value in accordance with BS1377 Part 4 Clause 5



Moisture content: 35.6
MCV: 7.2

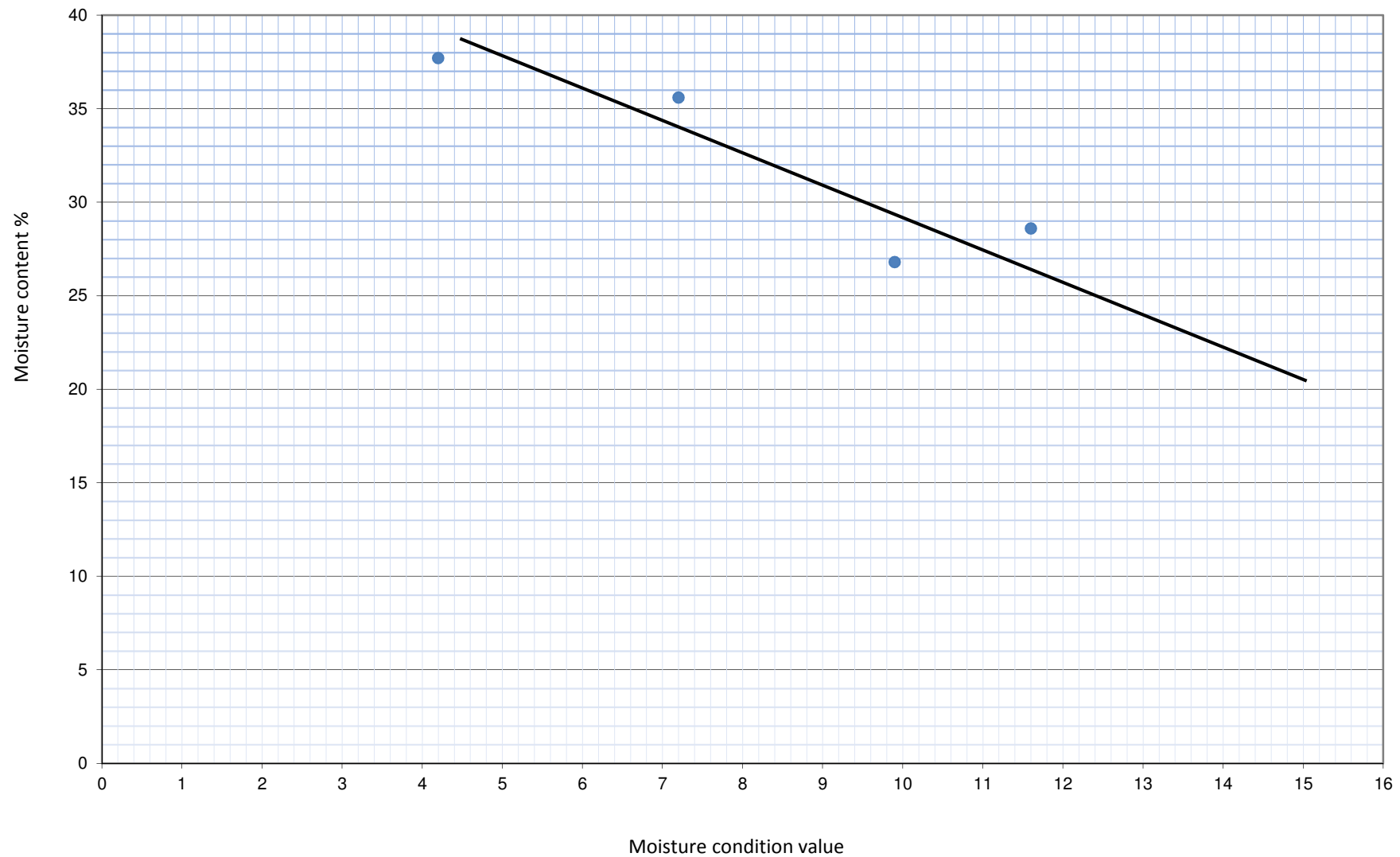
Initial wet mass sieved: 46530g
% retained on 20mm: 3.8
% retained on 37.5mm: 0

Sample type: disturbed

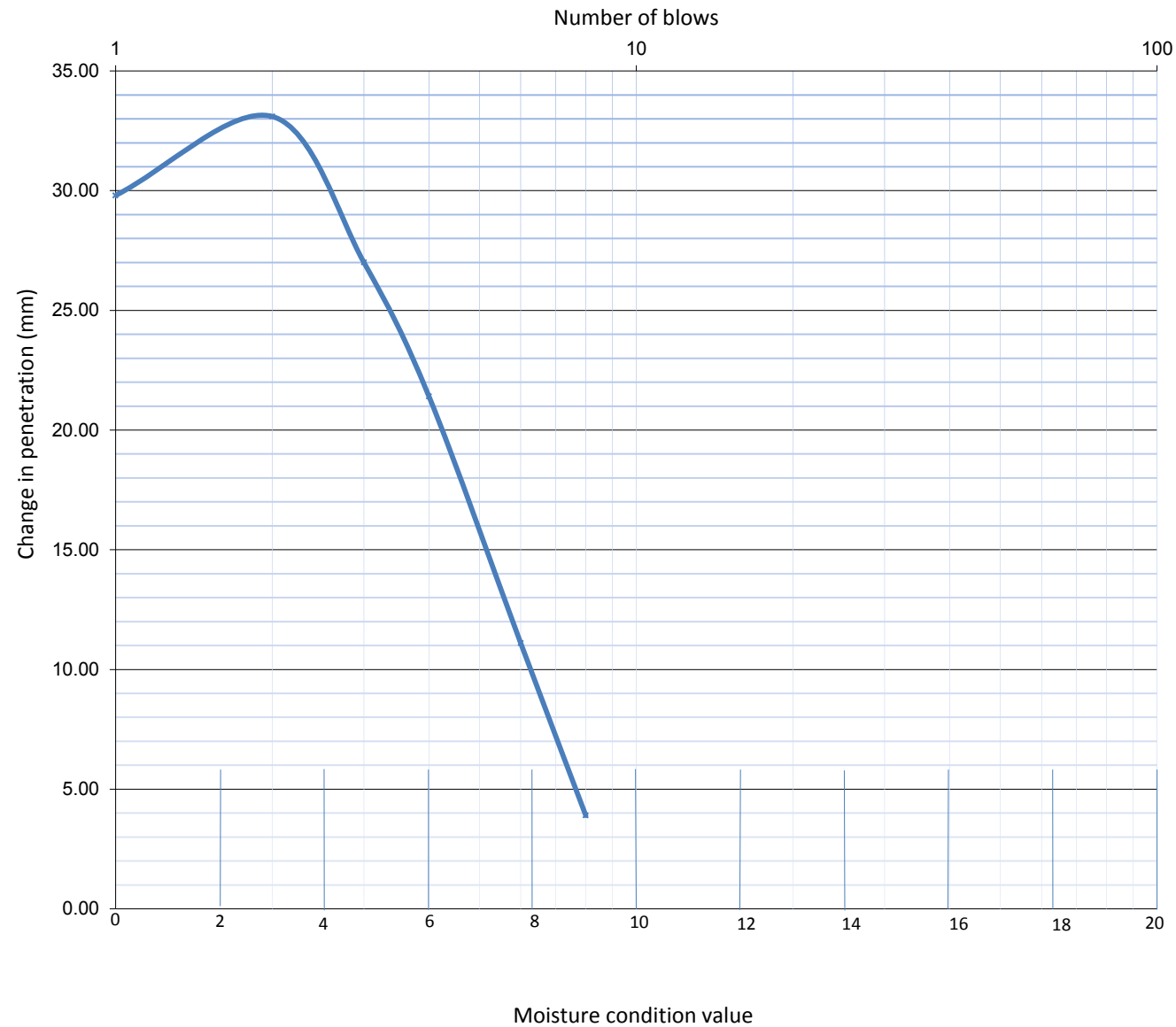
Method:
Sample prepared by passing 20mm
sieve
Batch prepared
Graph interpretation: steepest line
through 5mm change in penetration

Sample description: Made ground:
brown sandy clay with occasional
gravel and very occasional concrete
and brick

Determination of moisture condition value in accordance with BS1377 Part 4 Clause 5



Determination of moisture condition value in accordance with BS1377 Part 4 Clause 5



Moisture content: 30.3

MCV: 8.7

Initial wet mass sieved: 37881g

% retained on 20mm: 13.0

% retained on 37.5mm: 6.7

Sample type: disturbed

Method:

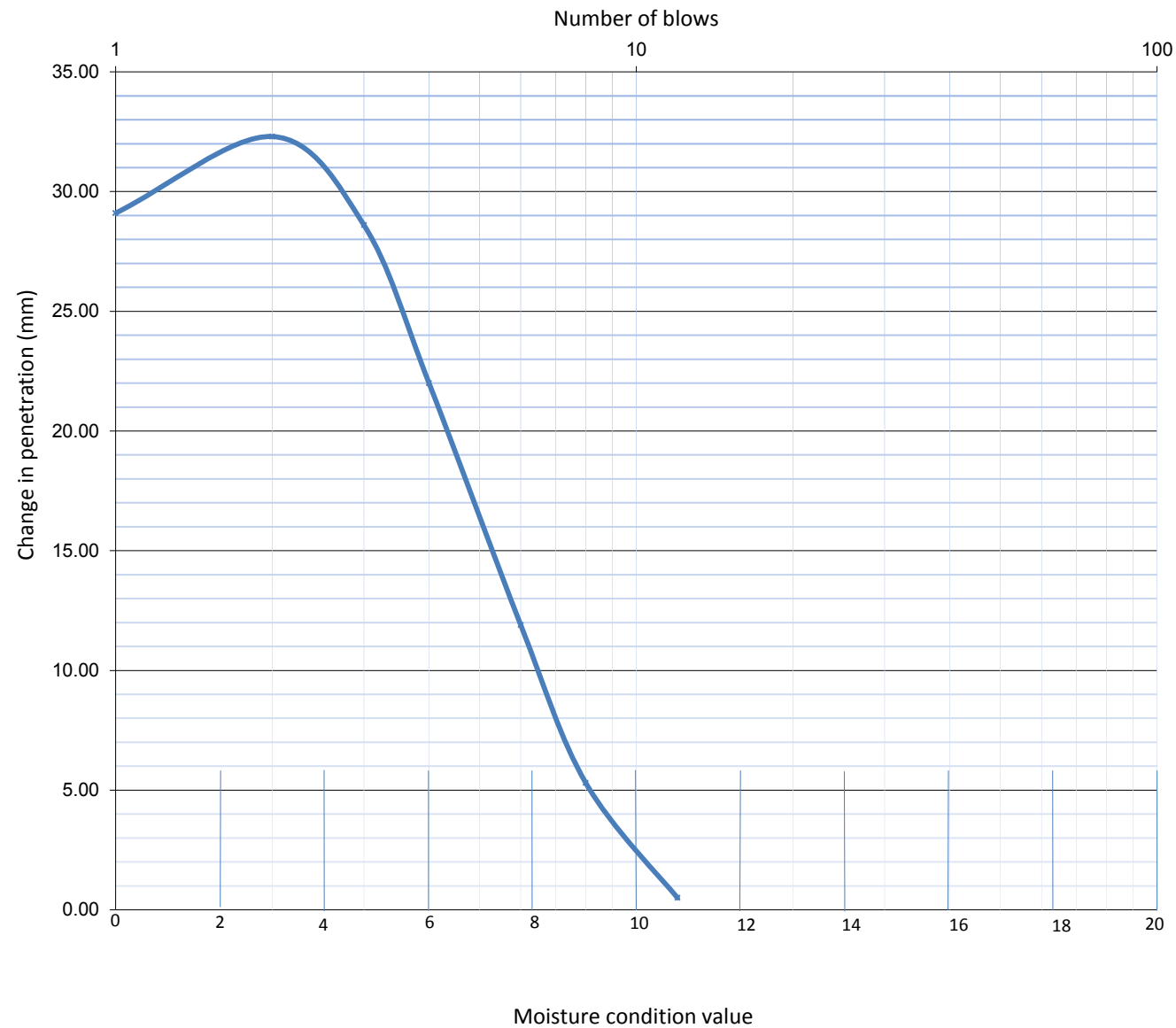
Sample prepared by passing 20mm sieve

Batch prepared

Graph interpretation: steepest line through 5mm change in penetration

Sample description: Made ground: brown sandy clay with occasional gravel and very occasional brick

Determination of moisture condition value in accordance with BS1377 Part 4 Clause 5



Moisture content: 25.8

MCV: 9.2

Initial wet mass sieved: 9301g

% retained on 20mm: 17.1

% retained on 37.5mm: 0

Sample type: disturbed

Method:

Sample prepared by passing 20mm sieve

Batch prepared

Graph interpretation: steepest line through 5mm change in penetration

Sample description: Made ground: brown sandy clay with occasional gravel and very occasional concrete

APPENDIX C

Chemical Test Results

**Oliver Rhodes**

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i2 Analytical Ltd.
7 Woodshots Meadow,
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Analytical Report Number : 17-40686

Replaces Analytical Report Number : 17-40686, issue no. 1

Project / Site name:	Southall Access Advanced Works	Samples received on:	20/02/2017
Your job number:	CGN-03732-C	Samples instructed on:	22/02/2017
Your order number:	4052	Analysis completed by:	06/03/2017
Report Issue Number:	2	Report issued on:	06/03/2017
Samples Analysed:	6 soil samples		

Signed:

Rexona Rahman
Reporting Manager
For & on behalf of i2 Analytical Ltd.

Signed:

Dr Irma Doyle
Senior Account Manager
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

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Analytical Report Number: 17-40686

Project / Site name: Southall Access Advanced Works

Your Order No: 4052

Lab Sample Number				706649	706650	706651	706652	706653
Sample Reference				TP101	TP103	TP104	TP105	TP107
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				1.00	0.80	0.60	1.20	1.50
Date Sampled				17/02/2017	17/02/2017	17/02/2017	17/02/2017	17/02/2017
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	N/A	NONE	14	22	16	17	11
Total mass of sample received	kg	0.001	NONE	1.7	1.6	1.7	1.6	1.9

Asbestos in Soil Screen / Identification Name	Type	N/A	ISO 17025	Chrysotile	-	Chrysotile	-	Chrysotile
Asbestos in Soil	Type	N/A	ISO 17025	Detected	Not-detected	Detected	Not-detected	Detected
Asbestos Quantification (Stage 2)	%	0.001	ISO 17025	< 0.001	-	< 0.001	-	< 0.001
Asbestos Quantification Total	%	0.001	ISO 17025	< 0.001	-	< 0.001	-	< 0.001

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	8.1	8.0	8.1	8.3	8.7
Total Cyanide	mg/kg	1	MCERTS	< 1	< 1	< 1	< 1	< 1
Total Sulphate as SO ₄	mg/kg	50	MCERTS	3000	2200	1500	1600	4000
Organic Matter	%	0.1	MCERTS	2.6	0.8	0.8	0.6	2.3

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
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Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	0.18	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.1	MCERTS	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthene	mg/kg	0.1	MCERTS	0.29	< 0.10	< 0.10	< 0.10	< 0.10
Fluorene	mg/kg	0.1	MCERTS	0.37	< 0.10	< 0.10	< 0.10	< 0.10
Phenanthrene	mg/kg	0.1	MCERTS	4.3	< 0.10	< 0.10	< 0.10	0.78
Anthracene	mg/kg	0.1	MCERTS	1.1	< 0.10	< 0.10	< 0.10	0.22
Fluoranthene	mg/kg	0.1	MCERTS	6.2	< 0.10	0.54	0.62	1.9
Pyrene	mg/kg	0.1	MCERTS	4.9	< 0.10	0.52	0.66	1.7
Benzo(a)anthracene	mg/kg	0.1	MCERTS	3.5	< 0.10	0.38	0.43	1.1
Chrysene	mg/kg	0.05	MCERTS	2.7	< 0.05	0.31	0.37	1.0
Benzo(b)fluoranthene	mg/kg	0.1	MCERTS	3.2	< 0.10	0.38	0.51	1.2
Benzo(k)fluoranthene	mg/kg	0.1	MCERTS	2.2	< 0.10	0.32	0.46	0.95
Benzo(a)pyrene	mg/kg	0.1	MCERTS	3.3	< 0.10	0.43	0.55	1.3
Indeno(1,2,3-cd)pyrene	mg/kg	0.1	MCERTS	1.9	< 0.10	0.25	0.33	0.71
Dibenz(a,h)anthracene	mg/kg	0.1	MCERTS	0.52	< 0.10	< 0.10	< 0.10	< 0.10
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	2.2	< 0.05	0.30	0.37	0.88
Coronene	mg/kg	0.05	NONE	0.99	< 0.05	< 0.05	< 0.05	< 0.05

Total PAH

Total WAC-17 PAHs	mg/kg	1.6	NONE	38	< 1.6	3.4	4.3	12
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Heavy Metals / Metalloids

Antimony (aqua regia extractable)	mg/kg	1	ISO 17025	2.2	< 1.0	< 1.0	< 1.0	2.3
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	12	11	14	12	17
Barium (aqua regia extractable)	mg/kg	1	MCERTS	120	54	68	75	140
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	0.69	0.81	1.1	1.3	0.78
Boron (water soluble)	mg/kg	0.2	MCERTS	1.8	3.2	1.8	2.8	1.6
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	0.2	< 0.2	< 0.2	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	1.2	MCERTS	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2
Chromium (III)	mg/kg	1	NONE	30	39	31	32	31
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	31	40	31	32	31
Copper (aqua regia extractable)	mg/kg	1	MCERTS	46	36	29	26	57
Lead (aqua regia extractable)	mg/kg	1	MCERTS	78	58	23	33	330
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	25	33	36	33	24
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	51	59	48	46	42
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	100	77	68	62	150



Analytical Report Number: 17-40686

Project / Site name: Southall Access Advanced Works

Your Order No: 4052

Lab Sample Number				706649	706650	706651	706652	706653
Sample Reference				TP101	TP103	TP104	TP105	TP107
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				1.00	0.80	0.60	1.20	1.50
Date Sampled				17/02/2017	17/02/2017	17/02/2017	17/02/2017	17/02/2017
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					

Monoaromatics

Benzene	ug/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	ug/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	ug/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
p & m-xylene	ug/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-xylene	ug/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	ug/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

Petroleum Hydrocarbons

TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0	< 1.0	3.5	3.1	< 1.0
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	5.9	< 2.0	4.1	4.5	2.8
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	33	< 8.0	< 8.0	< 8.0	10
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	100	36	22	35	76
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	140	41	35	50	90

TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	2.8	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	6.9	< 2.0	< 2.0	2.8	< 2.0
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	44	< 10	< 10	< 10	12
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	170	< 10	17	14	67
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	220	< 10	27	27	80



Analytical Report Number: 17-40686

Project / Site name: Southall Access Advanced Works

Your Order No: 4052

Lab Sample Number				706654				
Sample Reference				TP108				
Sample Number				None Supplied				
Depth (m)				1.20				
Date Sampled				17/02/2017				
Time Taken				None Supplied				
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	< 0.1				
Moisture Content	%	N/A	NONE	22				
Total mass of sample received	kg	0.001	NONE	1.9				

Asbestos in Soil Screen / Identification Name	Type	N/A	ISO 17025	-				
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected				
Asbestos Quantification (Stage 2)	%	0.001	ISO 17025	-				
Asbestos Quantification Total	%	0.001	ISO 17025	-				

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	8.2				
Total Cyanide	mg/kg	1	MCERTS	< 1				
Total Sulphate as SO ₄	mg/kg	50	MCERTS	700				
Organic Matter	%	0.1	MCERTS	0.6				

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0				
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Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	< 0.05				
Acenaphthylene	mg/kg	0.1	MCERTS	< 0.10				
Acenaphthene	mg/kg	0.1	MCERTS	< 0.10				
Fluorene	mg/kg	0.1	MCERTS	< 0.10				
Phenanthrene	mg/kg	0.1	MCERTS	0.37				
Anthracene	mg/kg	0.1	MCERTS	< 0.10				
Fluoranthene	mg/kg	0.1	MCERTS	0.58				
Pyrene	mg/kg	0.1	MCERTS	0.51				
Benzo(a)anthracene	mg/kg	0.1	MCERTS	0.30				
Chrysene	mg/kg	0.05	MCERTS	0.29				
Benzo(b)fluoranthene	mg/kg	0.1	MCERTS	0.28				
Benzo(k)fluoranthene	mg/kg	0.1	MCERTS	0.27				
Benzo(a)pyrene	mg/kg	0.1	MCERTS	0.33				
Indeno(1,2,3-cd)pyrene	mg/kg	0.1	MCERTS	0.22				
Dibenz(a,h)anthracene	mg/kg	0.1	MCERTS	< 0.10				
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	0.26				
Coronene	mg/kg	0.05	NONE	< 0.05				

Total PAH

Total WAC-17 PAHs	mg/kg	1.6	NONE	3.4				
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Heavy Metals / Metalloids

Antimony (aqua regia extractable)	mg/kg	1	ISO 17025	2.2				
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	9.6				
Barium (aqua regia extractable)	mg/kg	1	MCERTS	73				
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	1.1				
Boron (water soluble)	mg/kg	0.2	MCERTS	2.2				
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2				
Chromium (hexavalent)	mg/kg	1.2	MCERTS	< 1.2				
Chromium (III)	mg/kg	1	NONE	36				
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	36				
Copper (aqua regia extractable)	mg/kg	1	MCERTS	32				
Lead (aqua regia extractable)	mg/kg	1	MCERTS	29				
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3				
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	39				
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0				
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	56				
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	79				



Analytical Report Number: 17-40686

Project / Site name: Southall Access Advanced Works

Your Order No: 4052

Lab Sample Number				706654				
Sample Reference				TP108				
Sample Number				None Supplied				
Depth (m)				1.20				
Date Sampled				17/02/2017				
Time Taken				None Supplied				
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					

Monoaromatics

Benzene	ug/kg	1	MCERTS	< 1.0				
Toluene	ug/kg	1	MCERTS	< 1.0				
Ethylbenzene	ug/kg	1	MCERTS	< 1.0				
p & m-xylene	ug/kg	1	MCERTS	< 1.0				
o-xylene	ug/kg	1	MCERTS	< 1.0				
MTBE (Methyl Tertiary Butyl Ether)	ug/kg	1	MCERTS	< 1.0				

Petroleum Hydrocarbons

TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.1	MCERTS	< 0.1				
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.1	MCERTS	< 0.1				
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.1	MCERTS	< 0.1				
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0				
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0				
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	< 8.0				
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	14				
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	18				

TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.1	MCERTS	< 0.1				
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.1	MCERTS	< 0.1				
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.1	MCERTS	< 0.1				
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0				
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0				
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	< 10				
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	24				
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	35				



Analytical Report Number: 17-40686
Project / Site name: Southall Access Advanced Works
Your Order No: 4052

Certificate of Analysis - Asbestos Quantification

Methods:

Qualitative Analysis

The samples were analysed qualitatively for asbestos by polarising light and dispersion staining as described by the Health and Safety Executive in HSG 248.

Quantitative Analysis

The analysis was carried out using our documented in-house method A006 based on HSE Contract Research Report No: 83/1996: Development and Validation of an analytical method to determine the amount of asbestos in soils and loose aggregates (Davies et al, 1996) and HSG 248. Our method includes initial examination of the entire representative sample, then fractionation and detailed analysis of each fraction, with quantification by hand picking and weighing.

The limit of detection (reporting limit) of this method is 0.001 %.

The method has been validated using samples of at least 100 g, results for samples smaller than this should be interpreted with caution.

Both Qualitative and Quantitative Analyses are UKAS accredited.

Sample Number	Sample ID	Sample Depth (m)	Sample Weight (g)	Asbestos Containing Material Types Detected (ACM)	PLM Results	Asbestos by hand picking/weighing (%)	Total % Asbestos in Sample
706649	TP101	1.00	124	Loose Fibres	Chrysotile	< 0.001	< 0.001
706651	TP104	0.60	118	Bitumen	Chrysotile	< 0.001	< 0.001
706653	TP107	1.50	122	Loose Fibres	Chrysotile	< 0.001	< 0.001

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.



Analytical Report Number : 17-40686

Project / Site name: Southall Access Advanced Works

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
706649	TP101	None Supplied	1.00	Brown clay and loam with gravel and vegetation.
706650	TP103	None Supplied	0.80	Brown clay and loam with gravel.
706651	TP104	None Supplied	0.60	Brown clay and loam with gravel and vegetation.
706652	TP105	None Supplied	1.20	Brown clay and loam with gravel and vegetation.
706653	TP107	None Supplied	1.50	Brown loam and sand with glass and gravel
706654	TP108	None Supplied	1.20	Brown clay and loam with gravel and brick.

Analytical Report Number : 17-40686

Project / Site name: Southall Access Advanced Works

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with disperion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Asbestos Quantification - Gravimetric	Asbestos quantification by gravimetric method - in ouse method based on references.	HSE Report No: 83/1996, HSG 248, HSG 264 & SCA Blue Book (draft).	A006-PL	D	ISO 17025
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES.	In-house method based on Second Site Properties version 3	L038-PL	D	MCERTS
BTEX and MTBE in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	MCERTS
Cr (III) in soil	In-house method by calculation from total Cr and Cr VI.	In-house method by calculation	L080-PL	W	NONE
Hexavalent chromium in soil (Lower Level)	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazine followed by colorimetry.	In-house method	L080-PL	W	MCERTS
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically.	In-house method based on BS1377 Part 2, 1990, Chemical and Electrochemical Tests	L019-UK/PL	W	NONE
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	MCERTS
Organic matter in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L023-PL	D	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L099-PL	D	MCERTS
Speciated WAC-17 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	NONE
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Total cyanide in soil	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	MCERTS
Total sulphate (as SO4 in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L038-PL	D	MCERTS
TPHCWG (Soil)	Determination of hexane extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method	L076-PL	W	MCERTS

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

Iss No 17-40686-2 Southall Access Advanced Works CGN-03732-C

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The results included within the report are representative of the samples submitted for analysis.

Page 8 of 8

**Owen Flowers**

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Analytical Report Number : 17-41587

Project / Site name:	Southall Access Advanced Works	Samples received on:	20/02/2017
Your job number:	CGN-03732-C	Samples instructed on:	02/03/2017
Your order number:	4052	Analysis completed by:	06/03/2017
Report Issue Number:	1	Report issued on:	06/03/2017
Samples Analysed:	2 soil samples		

Signed:

Dr Irma Doyle
Senior Account Manager
For & on behalf of i2 Analytical Ltd.

Signed:

Emma Winter
Assistant Reporting Manager
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :	soils	- 4 weeks from reporting
	leachates	- 2 weeks from reporting
	waters	- 2 weeks from reporting
	asbestos	- 6 months from reporting

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Analytical Report Number: 17-41587

Project / Site name: Southall Access Advanced Works

Your Order No: 4052

Lab Sample Number				711643	711644			
Sample Reference				TP102	TP106			
Sample Number				None Supplied	None Supplied			
Depth (m)				0.80	1.00			
Date Sampled				17/02/2017	17/02/2017			
Time Taken				None Supplied	None Supplied			
Analytical Parameter (Soil Analysis)				Units	Limit of detection	Accreditation Status		
Asbestos in Soil				Type	N/A	ISO 17025	Not-detected	Not-detected



Analytical Report Number : 17-41587

Project / Site name: Southall Access Advanced Works

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with disperion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
D.O. for Gravimetric Quant if Screen/ID positive	Dependent option for Gravimetric Quant if Screen/ID positive scheduled.	In house asbestos methods A001 & A006.	A006-PL	D	NONE

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

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Analytical Report Number : 17-43258

Replaces Analytical Report Number : 17-43258, issue no. 1

Project / Site name:	Southall	Samples received on:	17/03/2017
Your job number:	CGN-3732C	Samples instructed on:	21/03/2017
Your order number:		Analysis completed by:	27/03/2017
Report Issue Number:	2	Report issued on:	27/03/2017
Samples Analysed:	6 soil samples		

Signed:

Dr Irma Doyle
Senior Account Manager
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :	soils	- 4 weeks from reporting
	leachates	- 2 weeks from reporting
	waters	- 2 weeks from reporting
	asbestos	- 6 months from reporting

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Analytical Report Number: 17-43258

Project / Site name: Southall

Lab Sample Number				721270	721271	721272	721273	721274
Sample Reference				TP101	TP102	TP103	TP105	TP107
Sample Number				D	D	D	D	D
Depth (m)				1.00	0.80	0.80	1.20	1.50
Date Sampled				17/02/2017	17/02/2017	17/02/2017	17/02/2017	17/02/2017
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	N/A	NONE	14	9.2	12	7.6	10
Total mass of sample received	kg	0.001	NONE	0.11	0.13	0.10	0.10	0.08

General Inorganics

pH - Manual	pH Units	N/A	MCERTS	7.8	7.9	7.9	8.0	8.0
Total Sulphate as SO ₄	mg/kg	50	MCERTS	4300	1100	2700	1700	3300
Total Sulphate as SO ₄	%	0.005	MCERTS	0.430	0.108	0.273	0.170	0.330
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	1.5	0.34	1.2	0.47	1.5
Total Sulphur	mg/kg	50	MCERTS	1700	460	1400	1500	1200
Total Sulphur	%	0.005	MCERTS	0.167	0.046	0.138	0.152	0.122



Analytical Report Number: 17-43258

Project / Site name: Southall

Lab Sample Number				721275				
Sample Reference				TP108				
Sample Number				D				
Depth (m)				1.20				
Date Sampled				17/02/2017				
Time Taken				None Supplied				
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	< 0.1				
Moisture Content	%	N/A	NONE	13				
Total mass of sample received	kg	0.001	NONE	0.10				

General Inorganics

pH - Manual	pH Units	N/A	MCERTS	8.1				
Total Sulphate as SO ₄	mg/kg	50	MCERTS	640				
Total Sulphate as SO ₄	%	0.005	MCERTS	0.064				
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.091				
Total Sulphur	mg/kg	50	MCERTS	460				
Total Sulphur	%	0.005	MCERTS	0.046				



Analytical Report Number : 17-43258

Project / Site name: Southall

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
721270	TP101	D	1.00	Brown clay and sand with gravel.
721271	TP102	D	0.80	Brown clay and sand with gravel and vegetation.
721272	TP103	D	0.80	Brown clay and sand with gravel.
721273	TP105	D	1.20	Brown clay and sand with gravel.
721274	TP107	D	1.50	Brown clay and sand with gravel and vegetation.
721275	TP108	D	1.20	Brown clay and sand with gravel.

Analytical Report Number : 17-43258

Project / Site name: Southall

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Moisture Content	Moisture content, determined gravimetrically.	In-house method based on BS1377 Part 2, 1990, Chemical and Electrochemical Tests	L019-UK/PL	W	NONE
pH in soil	Determination of pH in soil by addition of water followed by electrometric measurement.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L005-PL	W	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests, 2:1 water:soil extraction, analysis by ICP-OES.	L038-PL	D	MCERTS
Total sulphate (as SO ₄ in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L038-PL	D	MCERTS
Total Sulphate in soil as %	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests"	L038	D	MCERTS
Total Sulphur in soil	Determination of total sulphur in soil by extraction with aqua-regia, potassium bromide/bromate followed by ICP-OES.	In-house method based on BS1377 Part 3, 1990, and MEWAM 2006 Methods for the Determination of Metals in Soil	L038-PL	D	MCERTS

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

Sample Deviation Report



Sample ID	Other_ID	Sample Type	Job	Sample Number	Sample Deviation Code	test_name	test_ref	Test Deviation code
TP101	D	S	17-43258	721270	c	pH in soil	L005-PL	c
TP102	D	S	17-43258	721271	c	pH in soil	L005-PL	c
TP103	D	S	17-43258	721272	c	pH in soil	L005-PL	c
TP105	D	S	17-43258	721273	c	pH in soil	L005-PL	c
TP107	D	S	17-43258	721274	c	pH in soil	L005-PL	c
TP108	D	S	17-43258	721275	c	pH in soil	L005-PL	c



Clark Smith Partnership

Western Access, Southall
*Earthworks Material Acceptability
and Waste Characterisation
(Lagoon Bund and Bridge Bund)*

May, 2017



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Reference	CGN/03732D	Revision 1
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FIGURES

Figure 1 – Site location plan

Figure 2 – Trial pit location plan

APPENDICES

Appendix A – Trial pit logs

Appendix B – Geotechnical test results

Appendix C – Chemical test results

Appendix D – WAC test results

1. INTRODUCTION

Card Geotechnics Limited (CGL) have been instructed by Clark Smith Partnership (CSP) to undertake initial trial pit and laboratory testing in order to provide a preliminary assessment of material suitability for direct transfer off-site or reuse on-site under a Materials Management Plan (MMP). Additionally, the testing has been scheduled to identify the suitability of these site won materials for lime or cement stabilisation.

The trial pitting undertaken within the Western Access site Southall was completed on the Friday 24th February 2017. This Letter Report specifically details the findings from the investigation undertaken at two locations; the Minet Tip lagoon bund and at the location of the proposed temporary access bridge referred to as 'Bridge 1'. The Preliminary Geotechnical Design Report (PGDR) detailing the ground conditions across the site was re-issued in December 2016¹.

An additional day of trial pitting was undertaken by CGL on Wednesday 8th March 2017, to understand the depth of groundwater likely to be encountered at site in relation to proposed formation levels. A total of 5no trial pits were undertaken at locations on either side of the proposed embankment to provide advanced information on likely formation depths and the likely groundwater levels at the site.

¹ CGL (December 2016). *CGN03732 Southall, Pump Lane Western Access*. Preliminary Geotechnical Design Report. Rev1

2. SITE DESCRIPTION

The development area as a whole covers approximately 7.66Ha. The area encompassing all three permanent earthworks is centred approximately on National Grid Reference (NGR) 511254, 179810. An overall site location plan is presented as Figure 1 and a trial pit location plan showing the site areas relevant to this report is presented as Figure 2.

The eastern most site considered during this investigation comprises a stockpile created by the deposition of canal dredging's upon the original ground level to form a 'lagoon' for the further deposition of material. The stockpile and lagoon (herein referred to as *Lagoon Bund*) represents a raised area of ground between the Yeading Brook and the Grand Union Canal. The western most site comprises a stockpile of material (herein referred to as *Bridge Bund*) located approximately 50m south-east of the A312/Pump Lane highway flyover and north-west of the River Crane. The Bridge Bund is proposed to be reduced in height to approximately 28mOD to facilitate the construction of a temporary access bridge and associated haul road. It is proposed that the excavated material be stockpiled approximately 50m further south along the west bank of the River Crane for future use within the earthworks construction, subject to suitability. Foundations for the proposed 'Bridge 1' abutments are to be located on the east and west banks of the River Crane flood channel.

There are currently no proposals for excavation of the Lagoon Bund in advance of the main earthworks, however the requirement is for the material to be tested to determine its acceptability for future use within the permanent embankments.

3. INTRUSIVE INVESTIGATION

3.1 Summary of works

Eight trial pits were excavated in the Bridge Bund and Lagoon Bund areas within Made Ground and natural strata sampled during the investigation undertaken on the 24th February 2017. Representative samples were taken from each trial pit location for the purposes of geotechnical and chemical testing and these are shown on the trial pits logs presented in Appendix A. In-situ hand shear vane testing was undertaken within trial pits TP-1B, TP-2B and TP-5B to assist in the design of the temporary bridge foundations. The results of these in-situ tests are reported under a separate cover².

A further five trial pits were excavated in the area between the River Crane and Grand Union Canal, located away from the Lagoon Tip, to determine the nature of sub surface ground conditions and the likely depth of groundwater across the site. These pits were targeted to understand how groundwater level will affect the likely formation level constraints imposed during the Arup Outline GDR.

3.2 Ground conditions

3.2.1 Lagoon Bund

The Lagoon Bund is comprised of Made Ground recorded as brown slightly sandy slightly gravelly silty clay with fragments of brick, glass, plastic, wood, metal and polystyrene. Whilst the material was heterogeneous in nature, no distinct differences in the material were recorded between the trial pit locations TP01 to TP03.

Trial pit TP04, undertaken away from the main *Lagoon Bund* and near to the Yeading Brook, was recorded to comprise dark brown topsoil overlying orangish brown slightly gravelly silty clay. The colour was noted to become grey and the gravel content increased at a depth of 1.0m below ground level, which represented the top surface of the River Terrace Deposits.

3.2.2 Bridge Bund

The Bridge Bund stockpile was recorded to comprise greyish brown very sandy gravelly clay and slightly clayey sandy gravel. A large quantity of anthropogenic material was noted within the bund itself and comprised; metal wires and bars, compressed metal containers, concrete slabs, brick, glass, wood, textile and plastic.

² CGL (February 2017). CGN03732C - Bridge 1 Detailed Design. Calculation Report. Rev1.

Trial pits TP-1B and TP-5B, undertaken away from the main Bridge Bund stockpile at the locations of west and east bridge abutments respectively, were recorded to comprise brown sandy gravelly clay with wood, plastic and glass (Made Ground) overlying yellowish brown slightly sandy slightly gravelly clay (Alluvium). The River Terrace Deposits were noted within trial pit TP-2B_A.

3.2.3 Visual and olfactory indicators of contamination

No visual and olfactory indicators of contamination were recorded within the material at either location.

3.3 Environmental laboratory testing

A total of five samples retrieved from the Lagoon Bund area and three samples from the Bridge Bund area were scheduled for testing for a range of contaminants including; heavy metals, polycyclic aromatic hydrocarbons (PAH), total petroleum hydrocarbons (TPH), BTEX and an asbestos. In addition to this testing, Waste Acceptance Criteria (WAC) tests were undertaken to assess the suitability of the material if disposal offsite to landfill is required.

3.4 Geotechnical laboratory testing

Seven samples from the Lagoon Bund area and seven samples from the Bridge Bund area were scheduled for geotechnical testing including; Atterberg Limits, particle size distribution, moisture content, MCV, MCV/mc relationship, mc/MDD relationship, unconsolidated undrained triaxial and sulphates.

4. MATERIAL CHARACTERISATION

CGL have compared the results of the geotechnical and chemical tests to the limiting criteria detailed in the Earthworks Specification contained within the PDGR and have assessed each of the locations under each of the three headings below:

- Material acceptability – compared against criteria within Appendix 6/1.

This indicates whether the material is acceptable for use in the earthworks based upon geotechnical properties. If the in-situ material is considered to be unacceptable, then the suitability for lime or cement stabilisation has been assessed;

- Contamination concentrations – compared against limiting values within Appendix 6/14

This indicates whether the material is acceptable for use in the earthworks based upon concentrations of contamination recorded within the in-situ materials. Where exceedances are noted, the material may be classified as Class U1B or U2 unacceptable material;

- Waste characterisation – compared against criteria outlined within WM3³

This indicates, for material that may be designated for direct transfer off-site, whether disposal at an inert, non-hazardous or hazardous waste facility would be required.

In order to assess the likely requirements for re-use and/or disposal off-site, CGL has reviewed the Morgan Tucker drawings (A720-E05-IW-MTU-EW-DR-0610 and A720-E05-IW-MTU-EW-DR-0600), which detail the proposed earthworks cut and fill volumes. Based upon a net cut of approximately 76,000m³ and a net fill of 80,400m³ across the development area, a deficit of approximately 4,300m³ of fill exists. The drawings indicate smaller zones of material balance across the site, however as these zones still generally cover larger areas than that sampled within this investigation, the volumes stated cannot be applied to these results.

4.1 Earthworks classification and acceptability testing

4.1.1 Sulfates

Testing was undertaken to TRL 477⁴ methods 1, 2 & 4 to determine the Total Potential Sulfate (TPS) within five samples taken from the Lagoon Bund area. The mean value of the

³ WM3 (2015). Waste Classification: *Guidance on the classification and assessment of waste* (1st Edition 2015).

two highest results has been reported in accordance with MCHW 1. The results are presented below in Table 1.

Table 1 - Summary of sulfate test results

	Total Potential Sulfate (%SO ₄) ¹	Acid Soluble Sulfate (%SO ₄) ²
Lagoon Bund	1.16	1.12
Bridge Bund	0.37	0.22
¹ Average of two highest recorded values		
² Maximum value across all samples		

The results indicate that Total Potential Sulfates (TPS) exceed the recommended limiting value of 0.25%⁵ for suitability for lime improvement and stabilisation. At the *Lagoon Bund* area TPS exceeds the upper bound limit of 1.00%, which could result in a high risk of expansion of lime treated material. The risk of expansion will be related to the percentage addition of lime required to achieved the necessary properties and can be further assessed by undertaking trials on lime treated material or the addition of additive.

4.1.2 Atterberg Limit & Moisture Content

Seven samples from the *Bridge Bund* area and six samples from the *Lagoon Bund* area were tested to determine the Plastic and Liquid Limits of the cohesive soils in accordance with BS 1377 (1990), Part 2, Clause 5.3. Full laboratory testing data is provided in Appendix B, and a summary of the Plastic and Liquid Limits for the site won materials is set out below in Table 2.

Table 2 - Summary of Atterberg Limit test results

Atterberg Limits							
Sample Location	No. of tests	Moisture content (%)	Liquid Limit (%)	Plastic Limit (%)	% material <425µm	I _p ²	Volume change potential
<i>Bridge Bund</i>	4	10-15	43-50	24-26	36-48	7-12	Low
<i>Bridge 1 location</i>	3	11-30	48-54	NP-19	50-86	18-28	Medium
<i>Lagoon Bund</i>	3	21-60	64-85	35-43	78-89	23-37	Medium
<i>Area below Lagoon Bund</i>	1	22	72	28	69	30	Medium

The results indicate that the material meets the general requirements for acceptability based upon Liquid Limit or Plasticity Index and would not likely be classified as Class U1A on this basis.

⁴ TRL Limited (2001). *Sulfate specification for structural backfills*. TRL Report TRL447.

⁵ Britpave (2005). *Stabilisation of sulfate-bearing soils- Technical Guidelines*. Britpave: Camberley.

The majority of the samples taken from the Lagoon Bund area have a natural moisture content of between 44-60%. This is likely to be above the upper acceptability limit for the material, based upon a limit of Optimum Moisture Content + 2%. However, drying or lime modification may be employed to reduce the natural moisture content to within acceptable limits, further to an assessment of suitability for lime improvement.

The materials in the *Lagoon Bund* generally classify as a silt of high to very high plasticity. The material within the *Bridge Bund* generally classify as clay of intermediate to high plasticity.

4.1.3 Particle Size Distribution testing

Four samples from the both the *Bridge Bund* area and the *Lagoon Bund* area were tested for Particle Size Distribution (PSD) in accordance BS 1377:1990 Part 2:9.2. Full geotechnical laboratory testing data is provided in Appendix B.

- *Bridge Bund area*

The results indicate that all four samples conform to the Class 2C specification.

- *Lagoon Bund area*

The results indicate that the majority of samples conform to the Class 2A/B specification (75% of samples tested). One sample (TP4) relating to the natural River Terrace Deposits did not conform to the Class 2A specifications due to the lack of materials passing through the 2mm sieve during testing, and instead conform to Class 2C. This is consistent with the classification of the River Terrace Deposits at the *Bridge Bund* area.

All samples from the *Lagoon Bund* area predominantly comprise silt, which is highly sensitive to variations in moisture content. Strict control of this material during excavation, transportation and deposition will be essential to avoid the material deteriorating through trafficking into an unacceptable material. This indicates that lime improvement of the material in this area would be highly beneficial.

4.1.4 Maximum dry density/moisture content relationship

Four samples from the *Lagoon Bund* area and one sample from the *Bridge Bund* area were tested to determine the optimum moisture contents and maximum dry density of the soils in accordance with BS 1377 (1990), Part 4, Clause 3.3 using a 2.5kg proctor mould. Full

laboratory testing data is provided in Appendix B, and a summary of the maximum dry densities for the site won materials is set out below in Table 3.

Table 3 - Summary of compaction test results (2.5kg hammer method)

Material	Number of tests	Maximum dry density for method compaction (Mg/m ³)	Optimum moisture content range (%)
Lagoon Bund	4	1.07 – 1.60	21-54
Bridge Bund	1	1.80	15

The results indicate that all samples tested from the *Lagoon Bund* area were received as ‘wet of optimum moisture content’. One sample (TP3) is recorded as having a lower maximum dry density and higher natural moisture content than other samples from the same location. This suggests that materials in this region may require division into a sub-class, which would require strict controls on-site to separate out materials. The results here further indicate that the material in this area would benefit from lime improvement. The results indicate that the single sample tested from the *Bridge Bund* area was received as slightly ‘dry of optimum’, but is considered workable as a fill material within minimum site working.

A further two samples from the *Bridge Bund* were tested in accordance with BS 1377 (1990), Part 4, Clause 3.7 using a vibrating hammer method, owing to the granular nature of the material. The results are displayed in Table 4 below.

Table 4 - Summary of compaction test results (Vibrating hammer method)

Material	Number of tests	Maximum dry density for method compaction (Mg/m ³)	Optimum moisture content range (%)
Bridge Bund	2	1.80-1.81	15-17

The results show these two samples were received as ‘dry of optimum’, indicating that some wetting may be required to achieve sufficient compaction, however this will depend on weather conditions and site controls during the transportation of material on site.

4.1.5 Moisture Condition Value (MCV) and MCV/mc relationship

Four samples from the *Lagoon Bund* area and three samples from the *Bridge Bund* area were tested to determine a single point Moisture Condition Value in accordance with BS 1377 (1990), Part 4. Full laboratory testing data is provided in Appendix B, and a summary of the undrained shear strength for the tested materials is set out below in Table 6.

Table 5 - Summary of MCV test results

Material	Number of tests	Single point Moisture Condition Value (MCV)
Lagoon Bund	4	6.7-11.6
Bridge Bund	3	8.5-13.6

The Moisture Condition Value can provide a simple controlling value for a given soil to obtain near-full compaction. The results indicate that nearly all samples from the *Lagoon Bund* area fall outside of typical limiting values for a Class 2A soil (lower limit 12 and upper limit 16).

Four samples from the *Lagoon Bund* area and one sample from the *Bridge Bund* area were also tested to determine the relationship between Moisture Condition Value and Moisture Content in accordance with BS 1377 (1990), Part 4, Clause 5.5. This provides a calibration line for the materials tested and allow a more specific assessment of limiting values of MCV. The results indicate that the samples from the *Lagoon Bund* area (Class 2A material) may warrant a MCV lower limit of 14-16 and an MCV upper limit of around 18, for use within the Earthworks Specification. These limits are higher than the general guidance values and therefore, this indicates that the material would benefit from stabilisation to improve compaction characteristics.

The results from the single sample at the *Bridge Bund* area indicate that a lower MCV range of between 7-11 may be appropriate for this material.

4.1.6 Undrained Shear Strength

Four samples from the *Lagoon Bund* area and one sample from the *Bridge Bund* area were tested to determine the undrained shear strength in accordance with BS 1377 (1990), Part 7. Full laboratory testing data is provided in Appendix B, and a summary of the undrained shear strength for the tested materials is set out below in Table 6.

Table 6 - Summary of unconsolidated undrained triaxial test results

Material	Number of tests	Undrained Shear Strength (kN/m ²)
Lagoon Bund	4	23-90
Bridge Bund	1	56

The results indicate that the majority of samples (80% of tested samples) exceed the value of undrained shear strength that has been assumed within the PGDR of 40kN/m². One sample (TP3) relating to the Lagoon Bund material recorded an undrained shear strength of 23kN/m², which is below the design value.

4.1.7 Summary of geotechnical results

The results of the geotechnical testing indicate the material from the *Lagoon Bund* area would be generally acceptable as a Class 2A material based upon grading. However the high natural moisture content and sensitivity to moisture content changes noted with this material would pose a risk to material handling on-site and would require significant drying in order to achieve compaction requirements. Additionally, the material is highly variable within the area sampled as shown by the compaction and strength testing, with some samples below the undrained shear strength required, and would make site processes for placement difficult without treatment. This material would benefit from lime improvement and probably stabilisation in order to render the material acceptable for use within the earthworks. However, the sulfate concentrations will necessitate that lime treatment trials are undertaken to determine the risk of expansion of the treated material. It may be necessary to stabilise the material using Ground Granulated Blastfurnace Slag (GGBS) in combination with lime.

The material from the *Bridge Bund* area is generally classified as a Class 2C material based upon grading. Natural moisture contents are recorded to be slightly dry of optimum moisture content (OMC), as determined by compaction testing. To achieve the compaction requirements, wetting of the material may be required however, it is anticipated that a small increase in moisture content would occur through the process of material handling on site during wet periods. The results indicate some variability in the material and it may be prudent to consider treatment using a low percentage of lime to produce a material that requires a lower level of site controls to manage. The material may require treatment trials to determine the expansion potential and it is likely that the addition of water would be needed to retain a moisture content at or near OMC.

4.2 Contamination assessment - Risks to human health

The chemical results have been compared against the limiting values within Appendix 6/14 of the PDGR, derived from the Generic Assessment Criteria (GACs) derived in house by CGL for the “commercial” land-use category, considered to be conservative in this scenario. None of the concentrations recorded within the Made Ground or natural soils exceeded the assessment criteria. In addition, no asbestos was identified in any samples.

4.3 Waste characterisation

The waste characterisation of the sampled material was undertaken in accordance with the waste classification guidance document, WM3⁶ to determine its characterisation and hazardous properties.

It should be noted that in May/June 2012, HMR&C issued Briefs 15/12 and 18/12 clarifying how construction spoil and excess soils will be assessed for landfill tax purposes. Detailed accurate descriptions of waste are required for all wastes to support the landfill tax assessment. Uncontaminated naturally occurring soils will remain inert by default and eligible for the lower rate of landfill tax. Similarly 'reworked soils' and demolition 'stone' comprising ONLY materials listed in the Schedule of the Landfill Tax (Qualifying Material) Order 2011 (SI 2011/1017) will also be eligible for the lower rate of landfill tax. However, Made Ground containing soil and foreign objects such as timber, plastic, rubber, metal, paper, plasterboard, asbestos etc., regardless of the results of chemical analysis for waste classification purposes, will be eligible for the standard (higher) rate of landfill tax. Therefore, to maximise eligibility for lower rate landfill tax on waste construction spoil/reworked ground, careful waste segregation and controls are necessary, and Made Ground recorded onsite will need sorting to remove foreign objects.

4.3.1 Lagoon Bund

The results of the preliminary assessment indicate that the material associated with the samples from the *Lagoon Bund* are deemed 'hazardous' on the basis of elevated concentrations of TPH. Two WAC tests were undertaken on this material. All concentrations recorded passed the Hazardous Waste Landfill criteria with the exception of Loss on ignition from one test. It is recommended that further WAC testing is undertaken to confirm whether the organic content (i.e. loss on ignition %) is characteristic of the stockpile as a whole or a more localised anomaly. On the basis of results received to date, it is likely the material from the *Lagoon Bund* will need to be sent to a soil treatment facility for recovery prior to disposal. Notwithstanding this, early discussions with potential landfill operators may allow the acceptance of this material to hazardous landfill without treatment.

4.3.2 Bridge Bund

The results of the preliminary assessment indicate that the material associated with the samples from the *Bridge Bund* are deemed 'not hazardous.' A singular WAC test was

undertaken on this material. All concentrations recorded passed the Inert Waste Landfill criteria. To qualify for the lower landfill tax rate foreign objects (recorded throughout the bund) will need to be removed and disposed of via the appropriate waste stream.

4.4 Groundwater and formation considerations

Five trial pits were excavated across the central part of the site between the Grand Union Canal and the River Crane to identify likely groundwater levels in relation to proposed formation strata. These trial pits did not encounter any significant groundwater strikes to excavated base within permeable material. However, TP04 and TP05 did encounter moderate seepage at the interface between the Topsoil and underlying gravels which is associated with surface water infiltration from the surrounding area. The site was noted to be waterlogged at surface level during the trial pitting works, which is anticipated to be as a result of the higher clay fraction within the upper River Terrace Deposits acting as a shallow low permeability surface.

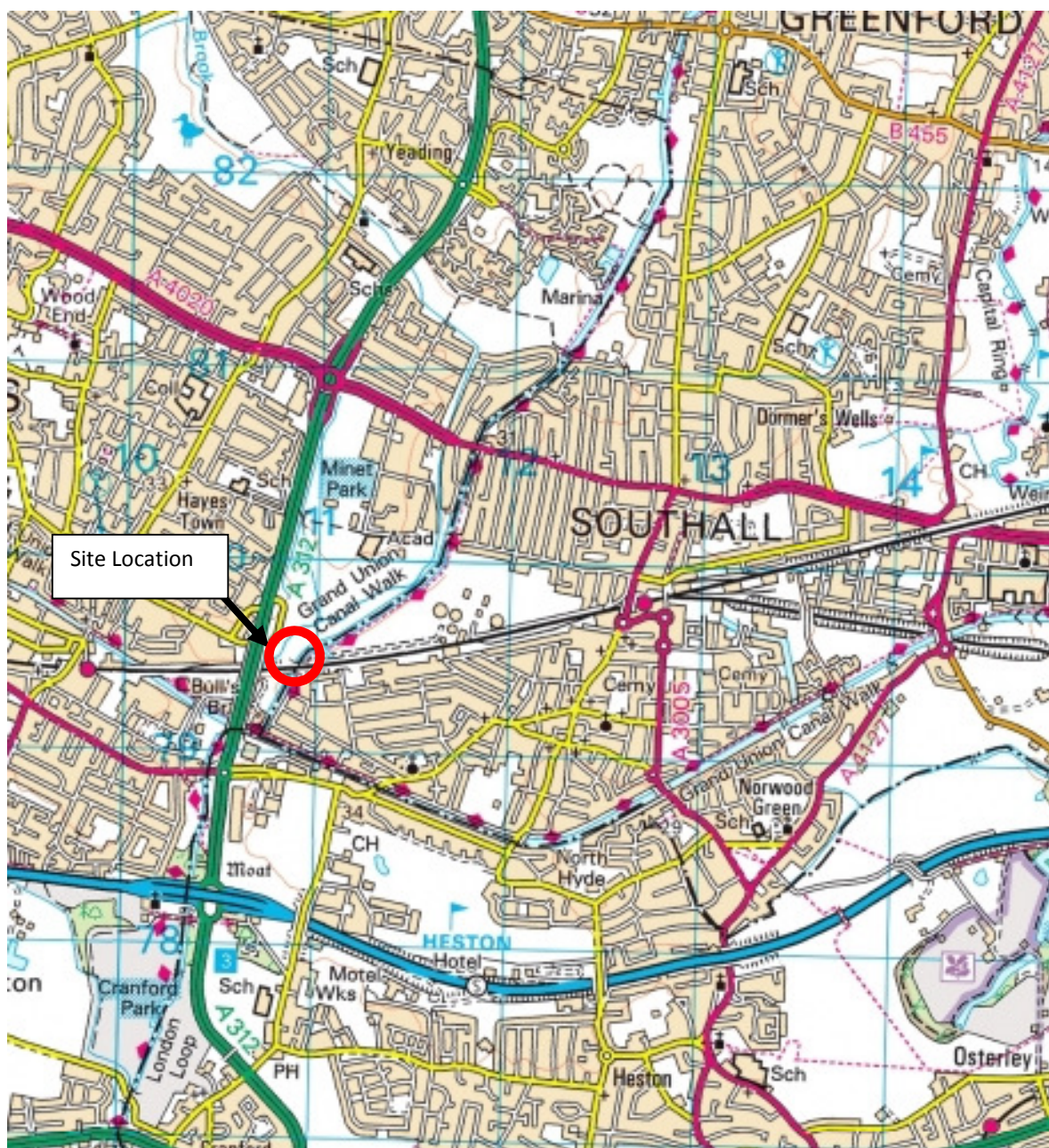
Trial pits all indicated that suitable formation strata for the proposed embankment is likely between depths of 0.8m and dependent on embankment loadings and ground conditions present (Alluvium or River Terrace Deposits). Where suitable forming strata was encountered, further excavation confirmed that likely formation levels would be in excess of 500mm above groundwater levels. However, further assessment of this should be picked up during the proposed additional advanced works to further classify the materials across the site.

Based on observations made during the site works on 8th March, the cohesive nature of upper formation strata likely encountered and the collection of surface water across parts of the central site, it is considered that care will have to be given during strip and construction works to protect the formation level from softening and weakening during site works and trafficking.

5. SUMMARY

This report provides the results of trial pitting and subsequent laboratory testing undertaken as part of the advanced works phase of the Western Access scheme. The results show that the material from the Lagoon Bund area has large variability in its geotechnical properties and as a result may benefit from treatment with lime to stabilise the material. The material from the Bridge Bund area demonstrates less variability and will likely be suitable for re-use providing good site controls are employed to manage the source materials on site.

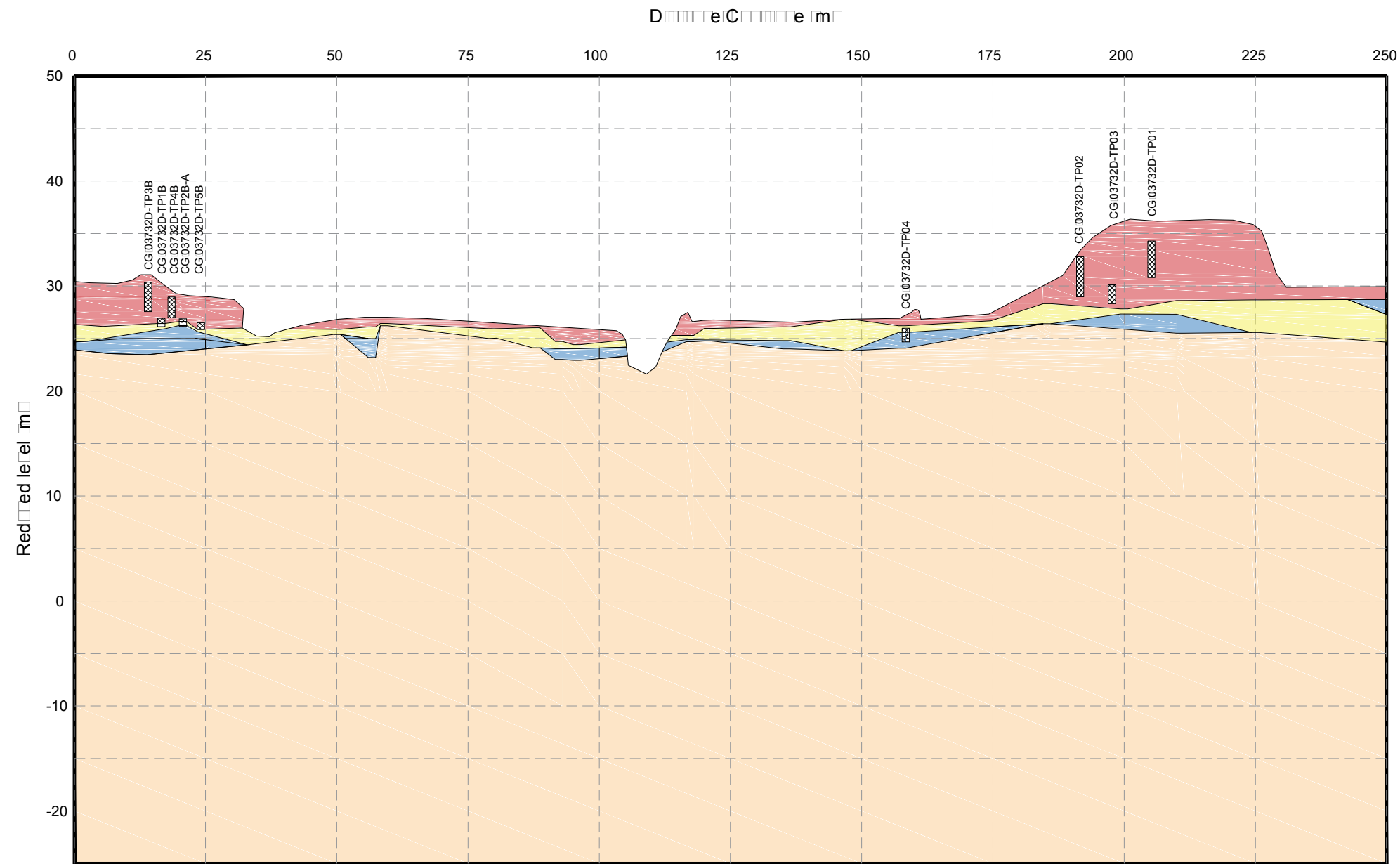
FIGURES



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Client	Project	Job No
CSP Limited	Southall Advanced Works	CGN/3732D
	Title	
	Site location plan	Figure 1

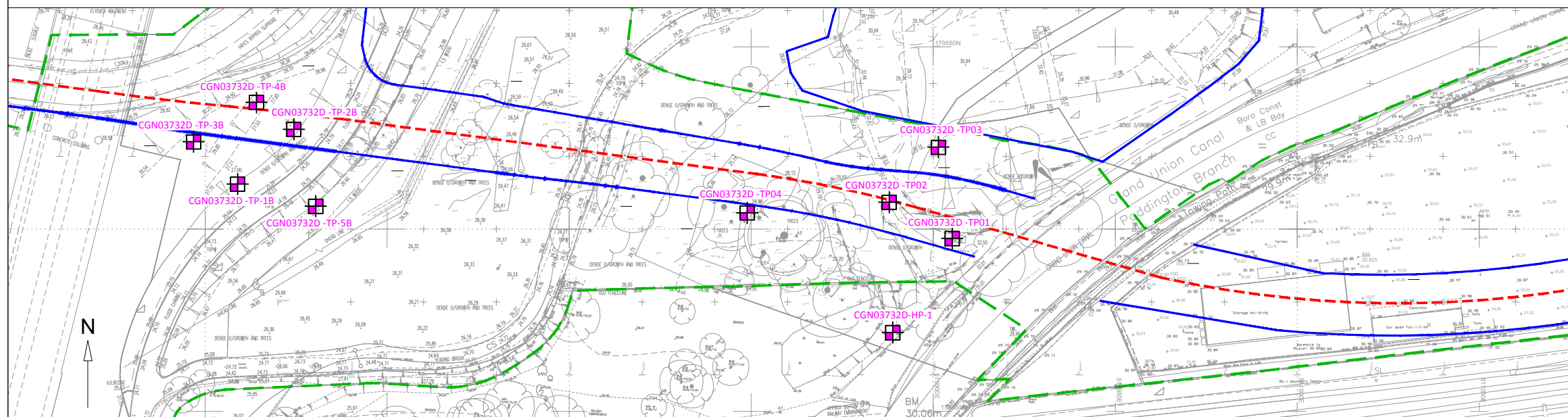


KEY

- Made Ground
- Alluvium
- Gravels
- London Clay Formation
- Trial pit
- Site boundary
- Road Alignment

Drawing produced from: A724-E05-PA-VEC-HW-DR-0001

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Rev	Date	Comments
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Project Pump Lane Access, Southall		
Client FM Conway Limited		
Drawing title Figure 2 - Trial pit location plan and longitudinal geological cross section		
Scale(s) NTS		Job No. CGN/03732D
Drawn TSS	09/03/17	Dwg No. A720-E05-IW-CGL-GEO-DR-0001
Checked		Rev. 0
Approved		
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APPENDIX A

Trial Pit Logs