STRUCTURAL SOILS

FINAL

GENERAL LOG

Contract:		Client:		Exploratory position:
Bramley Moore Dock Wall		**Everton FC**		**CR03**
Contract Ref:	Date:	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
764954	**30.07.19**	**7.96**	**E:333675.8 N:392555.5**	**3** of **3**

Core 03 close up 2

Core 03 close up 3

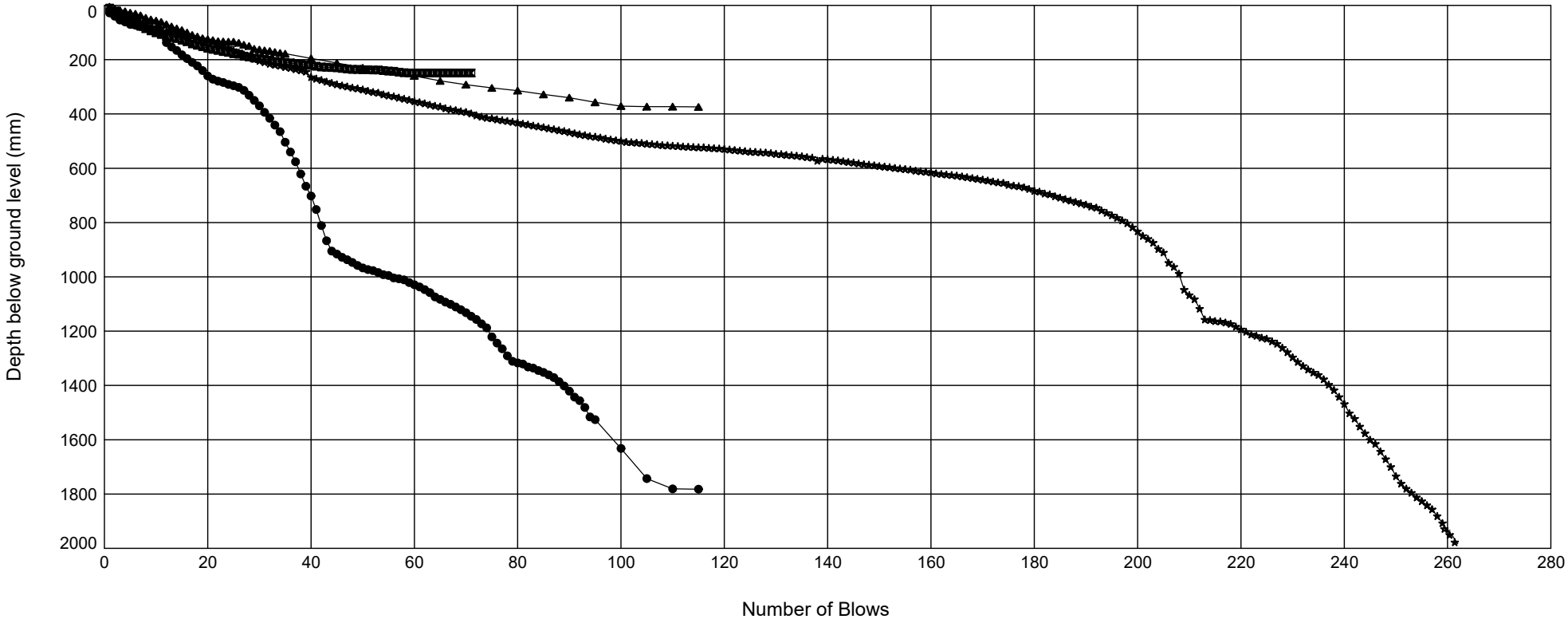
Method Used:	Plant Used:	Logged By:	Checked By:
Concrete core	**Hilti Concrete Corer**	**IHayes**	**NG**

APPENDIX C -
IN-SITU TESTING

(i) TRL DCP blows vs. depth plot

(ii) TRL DCP CBR values vs. depth plot

DCP TEST RESULTS - DEPTH vs NUMBER OF BLOWS



LEGEND

● - TRL DCP 01 ⊠ - TRL DCP 02 ▲ - TRL DCP 02 ★ - TRL DCP 03

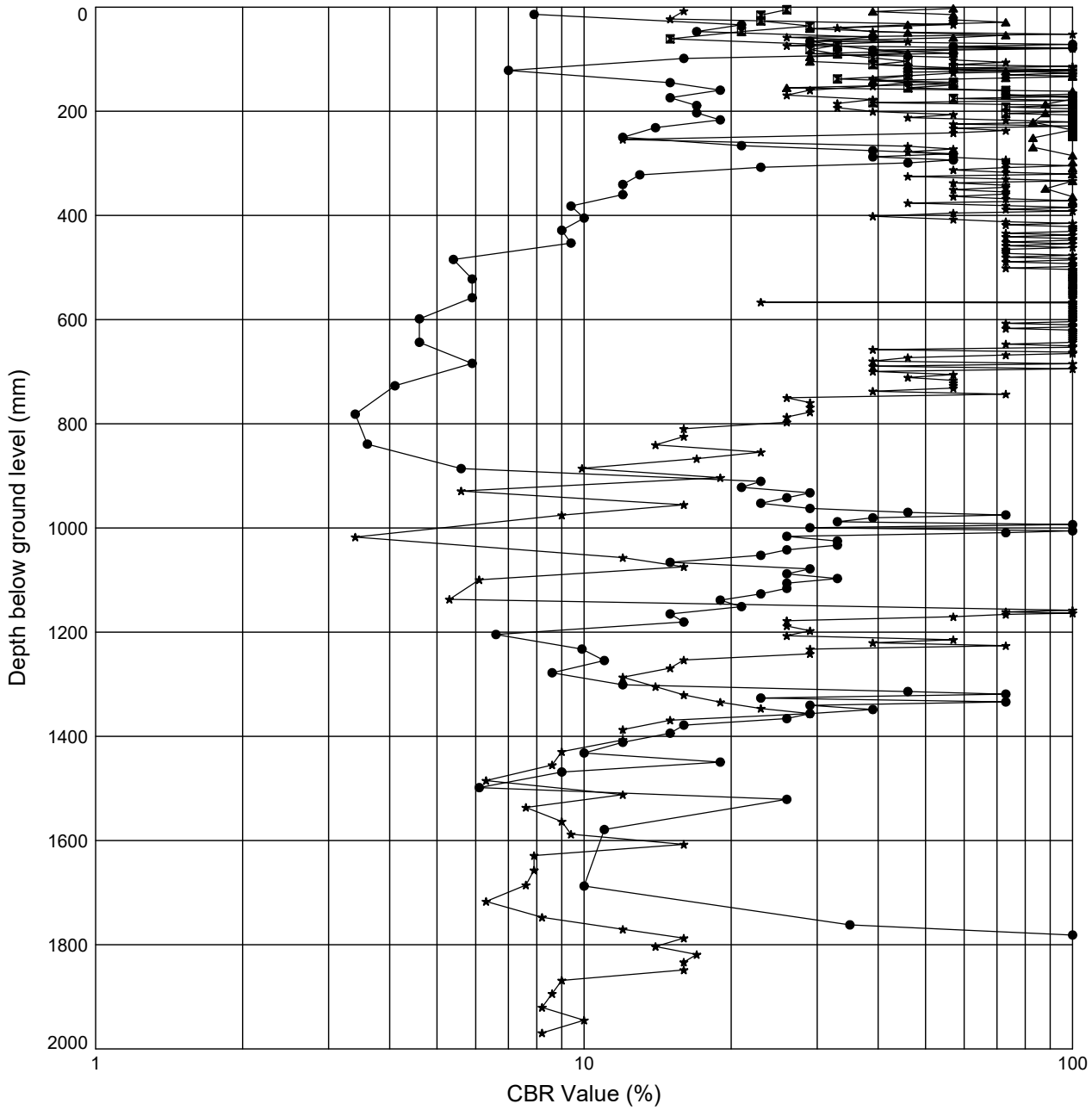
STRUCTURAL SOILS
The Potteries
Pottery Street
Castleford
W. Yorkshire WF10 1NJ

Compiled By	Date	Checked By	Date	Contract Ref:
MG	21/08/19	MG	21/08/19	764954

Contract

Bramley Moore Dock Wall

DCP TEST RESULTS - DEPTH vs CBR VALUE



LEGEND

● - TRL DCP 01 ⧓ - TRL DCP 02 ▲ - TRL DCP 02 ★ - TRL DCP 03

STRUCTURAL SOILS The Potteries Pottery Street Castleford W. Yorkshire WF10 1NJ	Contract **Bramley Moore Dock Wall**	Date **21.08.19**	Compiled By HG
	Client **Everton FC**	Contract Ref: **764954**	

APPENDIX D - GEOTECHNICAL LABORATORY TESTING

(i) Laboratory Test Verification Sheet

(ii) Laboratory Test Results

TESTING VERIFICATION CERTIFICATE

1774

The test results included in this report are certified as:-

ISSUE STATUS: **FINAL**

In accordance with the Structural Soils Ltd Laboratory Quality Management System, results sheets and summaries of results issued by the laboratory are checked by an approved signatory. The integrity of the test data and results are ensured by control of the computer system employed by the laboratory as part of the Software Verification Program as detailed in the Laboratory Quality Manual.

This testing verification certificate covers all testing compiled on or before the following datetime: **06/09/2019 15:19:13**.

Testing reported after this date is not covered by this Verification Certificate.

Approved Signatory
Luke Fisher (Materials Laboratory Manager)

(Head Office)
Bristol Laboratory
Unit 1A, Princess Street
Bedminster
Bristol
BS3 4AG

Castleford Laboratory
The Potteries, Pottery Street
Castleford
West Yorkshire
WF10 1NJ

Hemel Laboratory
18 Frogmore Road
Hemel Hempstead
Hertfordshire
HP3 9RT

Tonbridge Laboratory
Anerley Court, Half Moon Lane
Hildenborough
Tonbridge
TN11 9HU

STRUCTURAL SOILS LTD	Contract: **Bramley Moore Dock Wall**	Job No: **764954**

SUMMARY OF SOIL CLASSIFICATION TESTS

In accordance with clauses 3.2,4.3,4.4,5.3,5.4,7.2,8.2,8.3 of BS1377:Part 2:1990

Exploratory Position ID	Sample Ref	Sample Type	Depth (m)	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	% <425um	Description of Sample
TP01	6	B	1.00	26	29	21	8	80	Brown slightly gravelly sandy CLAY
TP02	6	B	2.00	25	NP	NP	NP		Light brown slightly gravelly sandy CLAY
TP03	8	B	1.60	30	43	21	22	94	Brown slightly gravelly sandy CLAY

STRUCTURAL SOILS LTD

Contract:

Bramley Moore Dock Wall

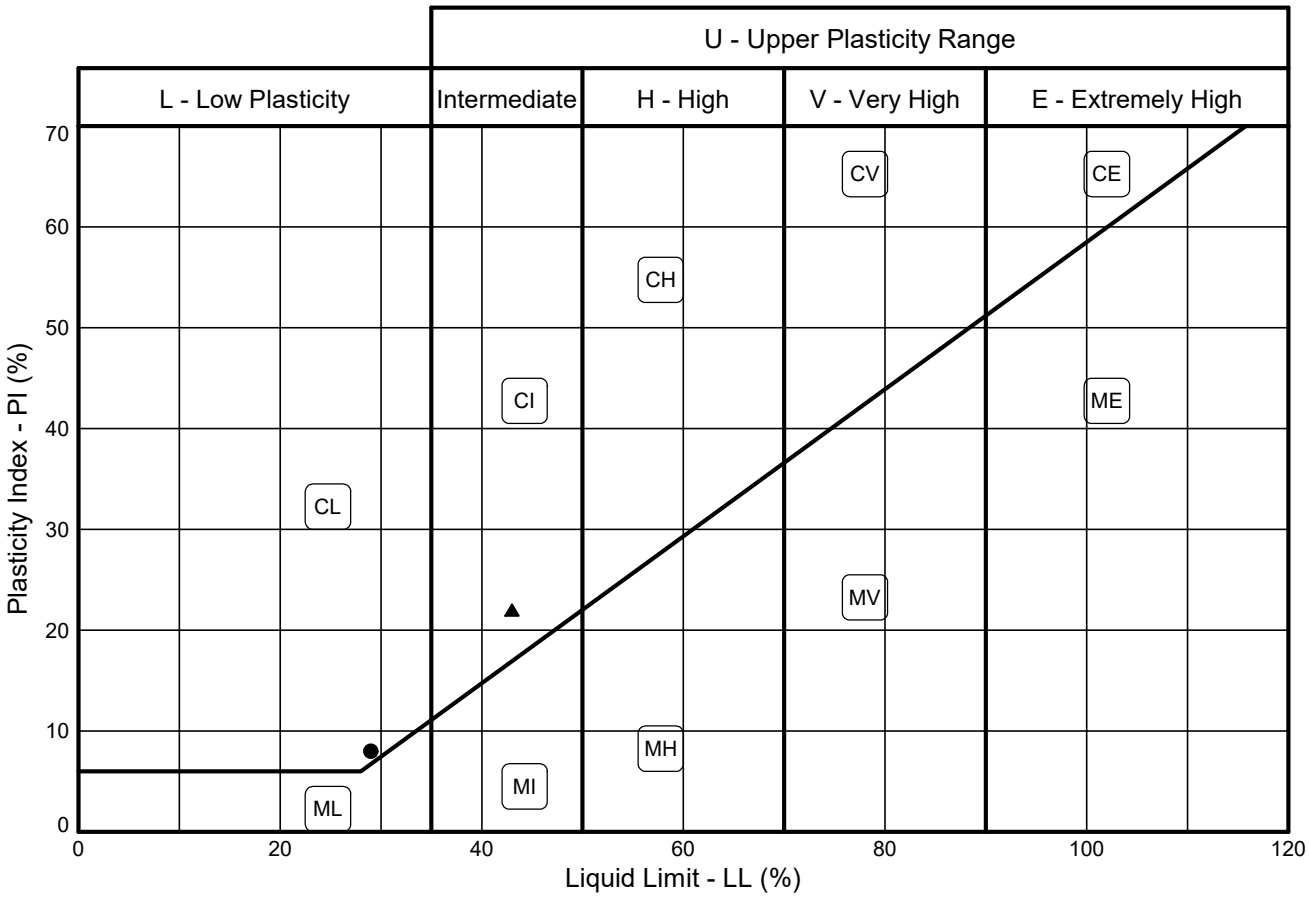
Contract Ref:

764954

AGS

PLASTICITY CHART - PI Vs LL

In accordance with BS5930:2015
Testing in accordance with BS1377-2:1990



Sample Identification				BS Test Method #	Preparation Method +	MC %	LL %	PL %	PI %	<425um %	Lab location	
	Exploratory Position ID	Sample	Depth (m)									
●	TP01	6B	1.00	3.2/4.3/5.3/5.4	4.2.4	26	29	21	8	80	C	
	TP02	6B	2.00	3.2/4.3/5.3/5.4	4.2.3	25	NP	NP	NP		C	
▲	TP03	8B	1.60	3.2/4.3/5.3/5.4	4.2.4	30	43	21	22	94	C	

Tested in accordance with the following clauses of BS1377-2:1990.

3.2 - Moisture Content
4.3 - Cone Penetrometer Method
4.4 - One Point Cone Penetrometer Method
4.6 - One Point Casagrande Method
5.3 - Plastic Limit Method
5.4 - Plasticity Index

+ Tested in accordance with the following clauses of BS1377-2:1990.

4.2.3 - Natural State
4.2.4 - Wet Sieved

Key: * = Non-standard test, NP = Non plastic.

Lab location: B = Bristol (BS3 4AG), C = Castleford (WF10 1NJ), H = Hemel Hempstead (HP3 9RT), T = Tonbridge (TN11 9HU)

STRUCTURAL SOILS
The Potteries
Pottery Street
Castleford
W. Yorkshire WF10 1NJ

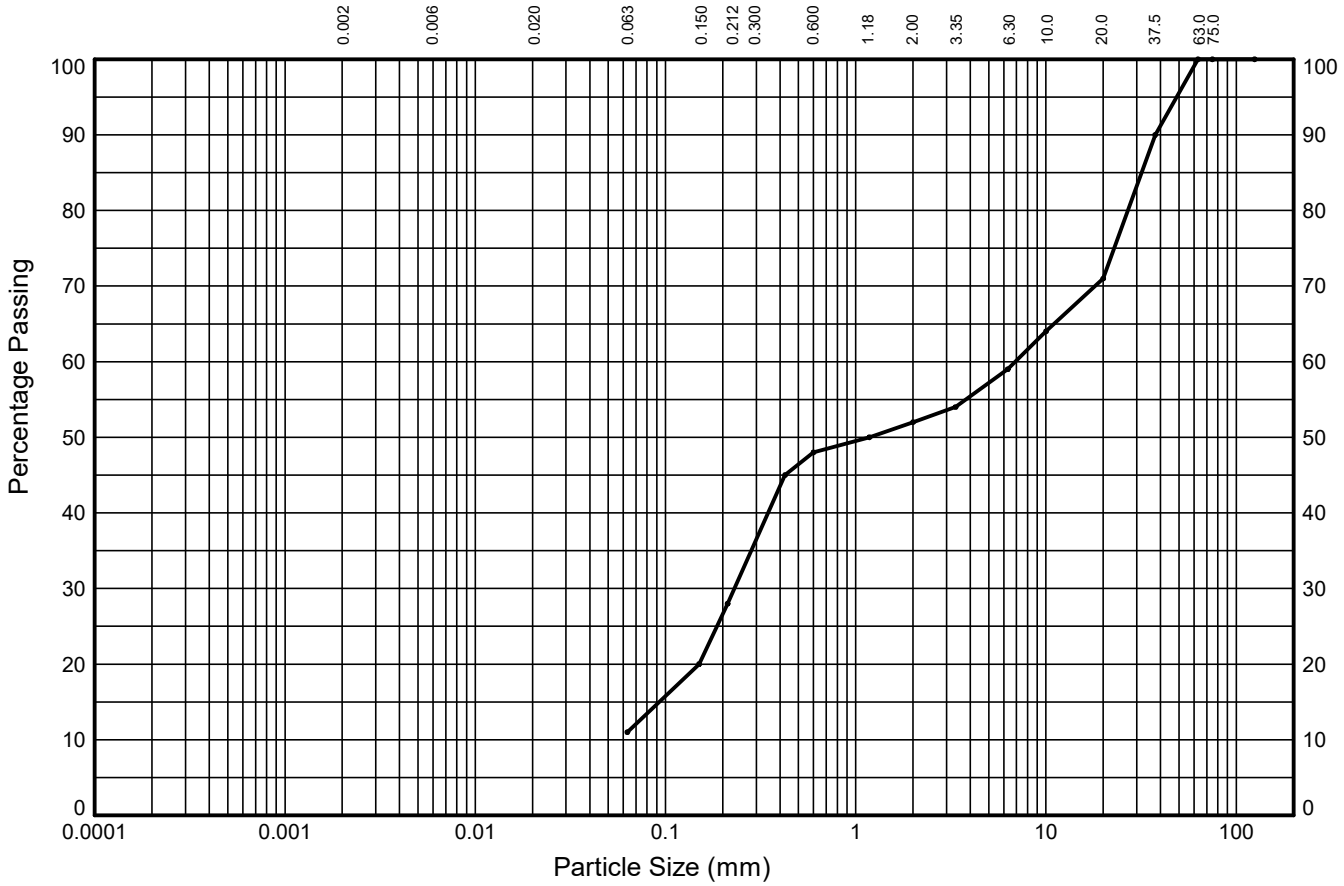
Compiled By		Date
	LORNA WHITWORTH	06/09/19

Contract	Contract Ref:
Bramley Moore Dock Wall	**764954**

PARTICLE SIZE DISTRIBUTION TEST

In accordance with clauses 9.2 of BS1377:Part 2:1990

Trial Pit: **TP01** Sample Ref: **2** Sample Type: **B** Depth (m): **0.10**



CLAY	fine	medium	coarse	fine	medium	coarse	fine	medium	coarse	COBBLES
	-	-	-	15%	22%	4%	7%	12%	29%	
	SILT			SAND			GRAVEL			
11%				41%			48%			0%

Test Sieve (mm)	Percent Passing (%)
125.0	**100**
75.0	**100**
63.0	**100**
37.5	**90**
20.0	**71**
10.0	**64**
6.30	**59**
3.35	**54**
2.00	**52**
1.18	**50**
0.600	**48**
0.425	**45**
0.212	**28**
0.150	**20**
0.063	**11**

Particle Diameter (mm)	Percent Passing (%)

Sedimentation sample was not pre-treated

Coefficients	
D_{10} (mm)	**NA**
D_{15} (mm)	**0.093**
D_{30} (mm)	**0.230**
D_{50} (mm)	**1.180**
D_{60} (mm)	**6.910**
D_{85} (mm)	**31.783**
D_{90} (mm)	**37.500**
C_U	**NA**
C_C	**NA**

Soil Description:

Dark brown clayey SAND and GRAVEL

Key: C_U = Uniformity coefficient. C_C = Coefficient of curvature as defined in BS EN ISO 14688-2

STRUCTURAL SOILS
The Potteries
Pottery Street
Castleford
W. Yorkshire WF10 1NJ

Compiled By		Date
M. Fisher	**MAUREEN FISHER**	**06/09/19**

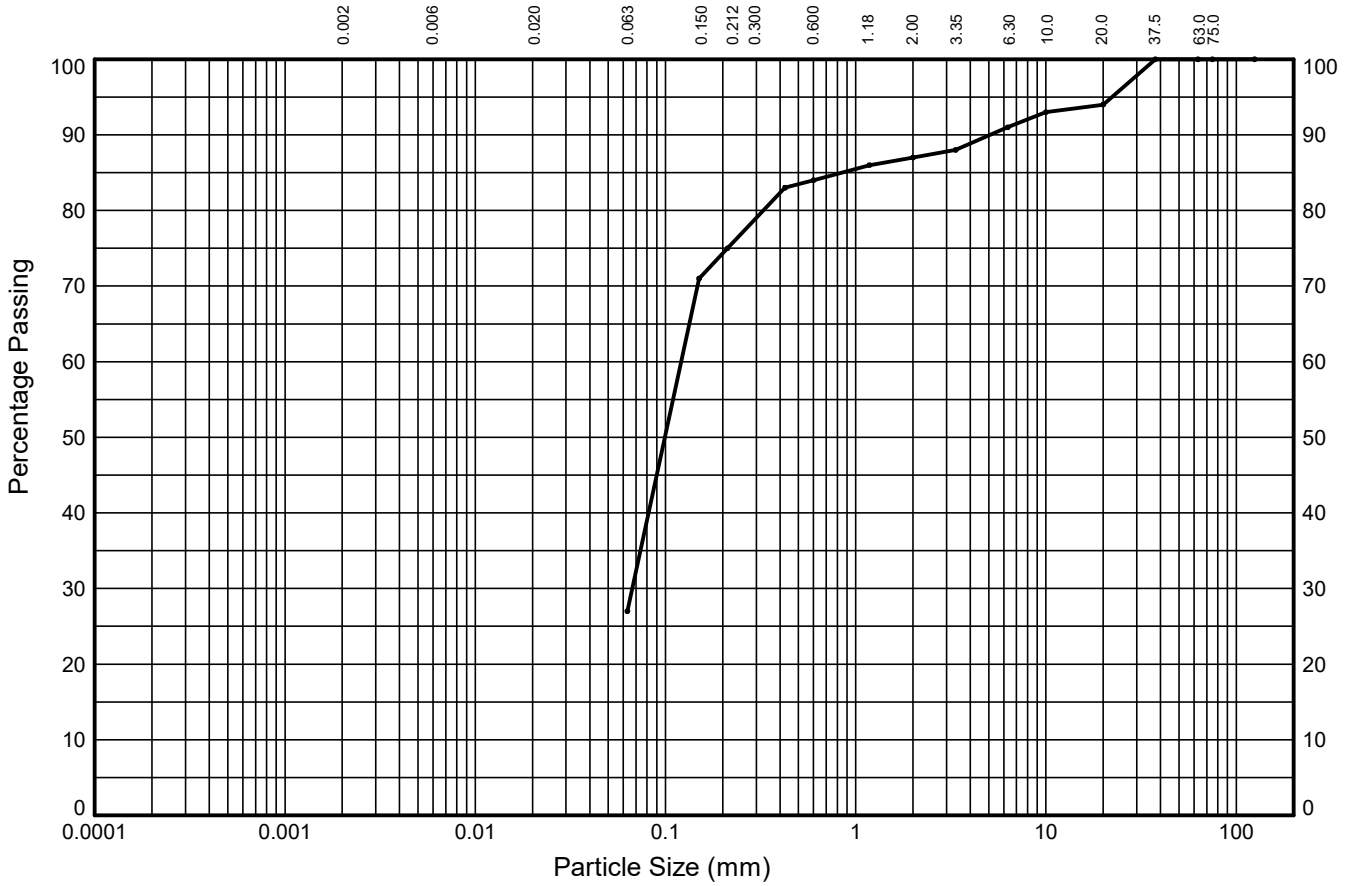
Contract	Contract Ref:
Bramley Moore Dock Wall	**764954**

PARTICLE SIZE DISTRIBUTION TEST

In accordance with clauses 9.2 of BS1377:Part 2:1990

NON-STANDARD TEST

Trial Pit: **TP01** Sample Ref: **6** Sample Type: **B** Depth (m): **1.00**



CLAY	fine	medium	coarse	fine	medium	coarse	fine	medium	coarse	COBBLES
	-	-	-	47%	10%	3%	4%	3%	6%	
	SILT			SAND			GRAVEL			
27%				60%			13%			0%

Test Sieve (mm)	Percent Passing (%)
125.0	**100**
75.0	**100**
63.0	**100**
37.5	**100**
20.0	**94**
10.0	**93**
6.30	**91**
3.35	**88**
2.00	**87**
1.18	**86**
0.600	**84**
0.425	**83**
0.212	**75**
0.150	**71**
0.063	**27**

Particle Diameter (mm)	Percent Passing (%)

Sedimentation sample was not pre-treated

Coefficients	
D_{10} (mm)	**NA**
D_{15} (mm)	**NA**
D_{30} (mm)	**0.067**
D_{50} (mm)	**0.099**
D_{60} (mm)	**0.121**
D_{85} (mm)	**0.841**
D_{90} (mm)	**5.104**
C_U	**NA**
C_C	**NA**

Soil Description:

Brown gravelly very clayey SAND

Key: C_U = Uniformity coefficient. C_C = Coefficient of curvature as defined in BS EN ISO 14688-2

STRUCTURAL SOILS
The Potteries
Pottery Street
Castleford
W. Yorkshire WF10 1NJ

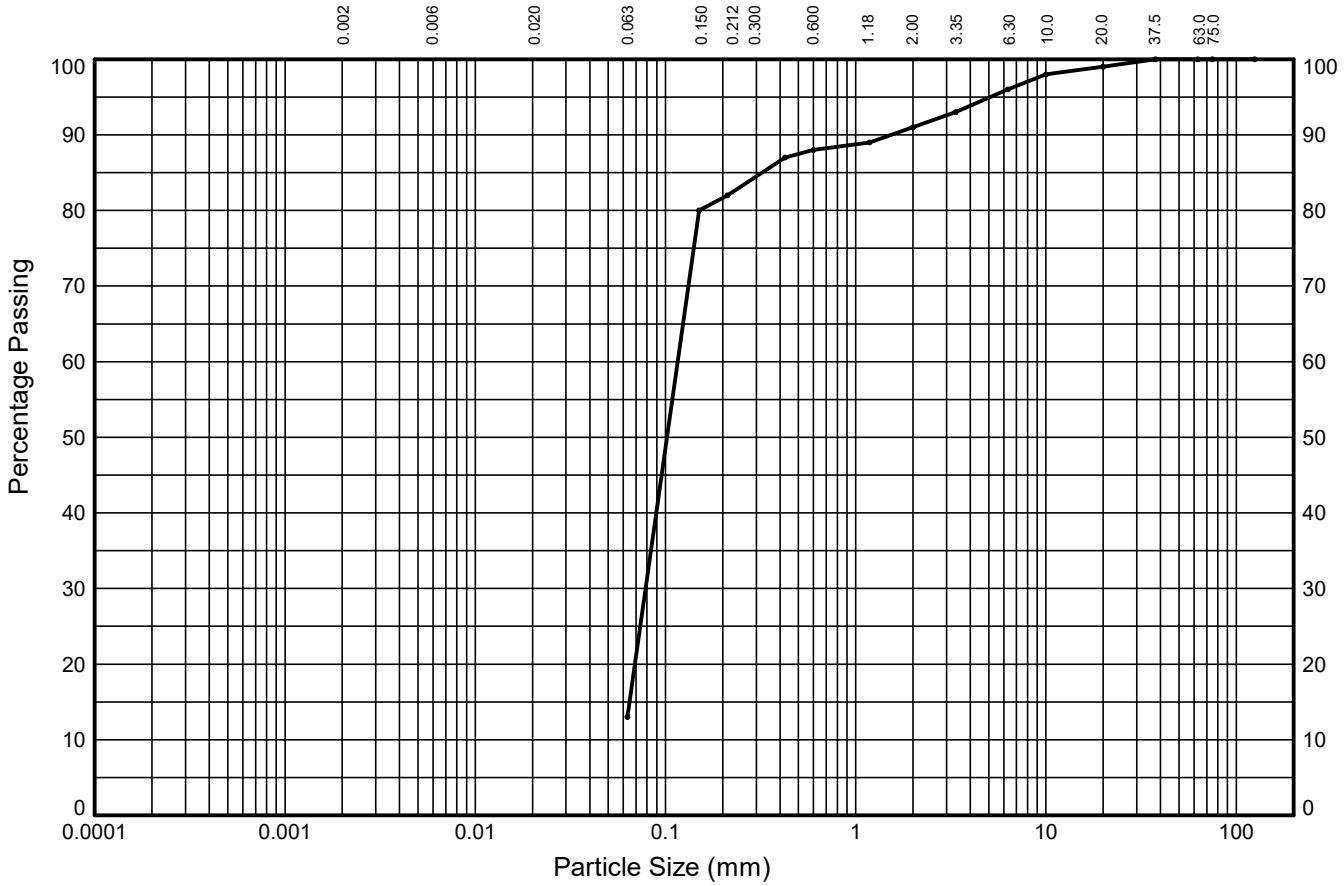
Compiled By	Date
LORNA WHITWORTH	06/09/19

Contract	Contract Ref:
Bramley Moore Dock Wall	**764954**

PARTICLE SIZE DISTRIBUTION TEST

In accordance with clauses 9.2 of BS1377:Part 2:1990

Trial Pit: **TP02** Sample Ref: **6** Sample Type: **B** Depth (m): **2.00**



CLAY	fine	medium	coarse	fine	medium	coarse	fine	medium	coarse	COBBLES
	-	-	-	69%	6%	3%	5%	3%	1%	
	SILT			SAND			GRAVEL			
13%				78%			9%			0%

Test Sieve (mm)	Percent Passing (%)
125.0	**100**
75.0	**100**
63.0	**100**
37.5	**100**
20.0	**99**
10.0	**98**
6.30	**96**
3.35	**93**
2.00	**91**
1.18	**89**
0.600	**88**
0.425	**87**
0.212	**82**
0.150	**80**
0.063	**13**

Particle Diameter (mm)	Percent Passing (%)

Sedimentation sample was not pre-treated

Coefficients	
D_{10} (mm)	**NA**
D_{15} (mm)	**0.065**
D_{30} (mm)	**0.079**
D_{50} (mm)	**0.102**
D_{60} (mm)	**0.116**
D_{85} (mm)	**0.322**
D_{90} (mm)	**1.536**
C_U	**NA**
C_C	**NA**

Soil Description:

Light brown clayey gravelly SAND

Key: C_U = Uniformity coefficient. C_C = Coefficient of curvature as defined in BS EN ISO 14688-2

STRUCTURAL SOILS
The Potteries
Pottery Street
Castleford
W. Yorkshire WF10 1NJ

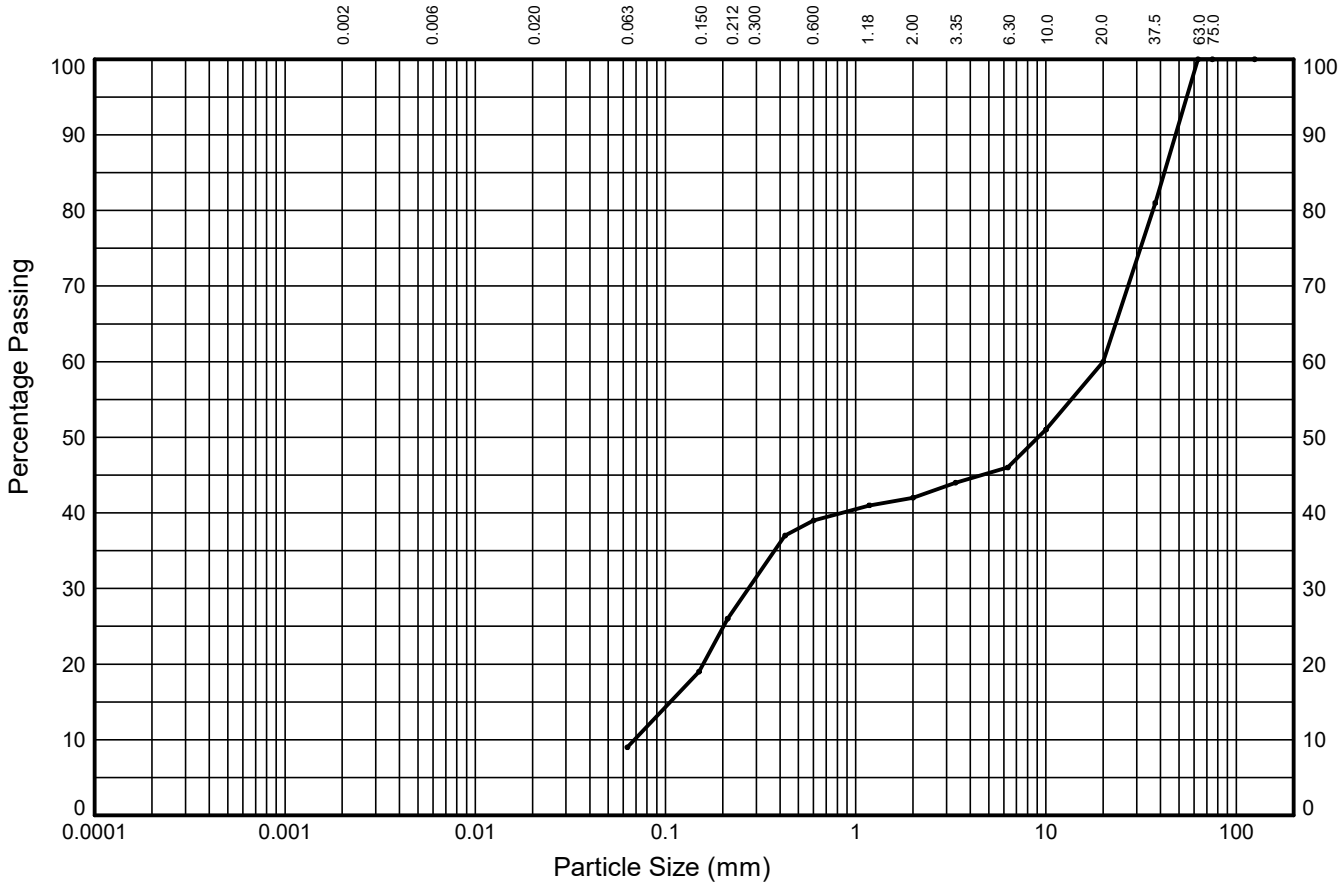
Compiled By		Date
M. Fisher.	**MAUREEN FISHER**	**06/09/19**

Contract	Contract Ref:
Bramley Moore Dock Wall	**764954**

PARTICLE SIZE DISTRIBUTION TEST

In accordance with clauses 9.2 of BS1377:Part 2:1990

Trial Pit: **TP03** Sample Ref: **6** Sample Type: **B** Depth (m): **1.10**



CLAY	fine	medium	coarse	fine	medium	coarse	fine	medium	coarse	COBBLES
	-	-	-	16%	14%	3%	4%	14%	40%	
	SILT			SAND			GRAVEL			
9%				33%			58%			0%

Test Sieve (mm)	Percent Passing (%)
125.0	**100**
75.0	**100**
63.0	**100**
37.5	**81**
20.0	**60**
10.0	**51**
6.30	**46**
3.35	**44**
2.00	**42**
1.18	**41**
0.600	**39**
0.425	**37**
0.212	**26**
0.150	**19**
0.063	**9**

Particle Diameter (mm)	Percent Passing (%)

Sedimentation sample was not pre-treated

Coefficients	
D_{10} (mm)	**0.069**
D_{15} (mm)	**0.106**
D_{30} (mm)	**0.273**
D_{50} (mm)	**9.117**
D_{60} (mm)	**20.000**
D_{85} (mm)	**41.828**
D_{90} (mm)	**47.946**
C_U	**291**
C_C	**0.05**

Soil Description:

Dark brown yellow clayey very sandy GRAVEL

Key: C_U = Uniformity coefficient. C_C = Coefficient of curvature as defined in BS EN ISO 14688-2

STRUCTURAL SOILS
The Potteries
Pottery Street
Castleford
W. Yorkshire WF10 1NJ

Compiled By		Date
M. Fisher.	**MAUREEN FISHER**	**06/09/19**

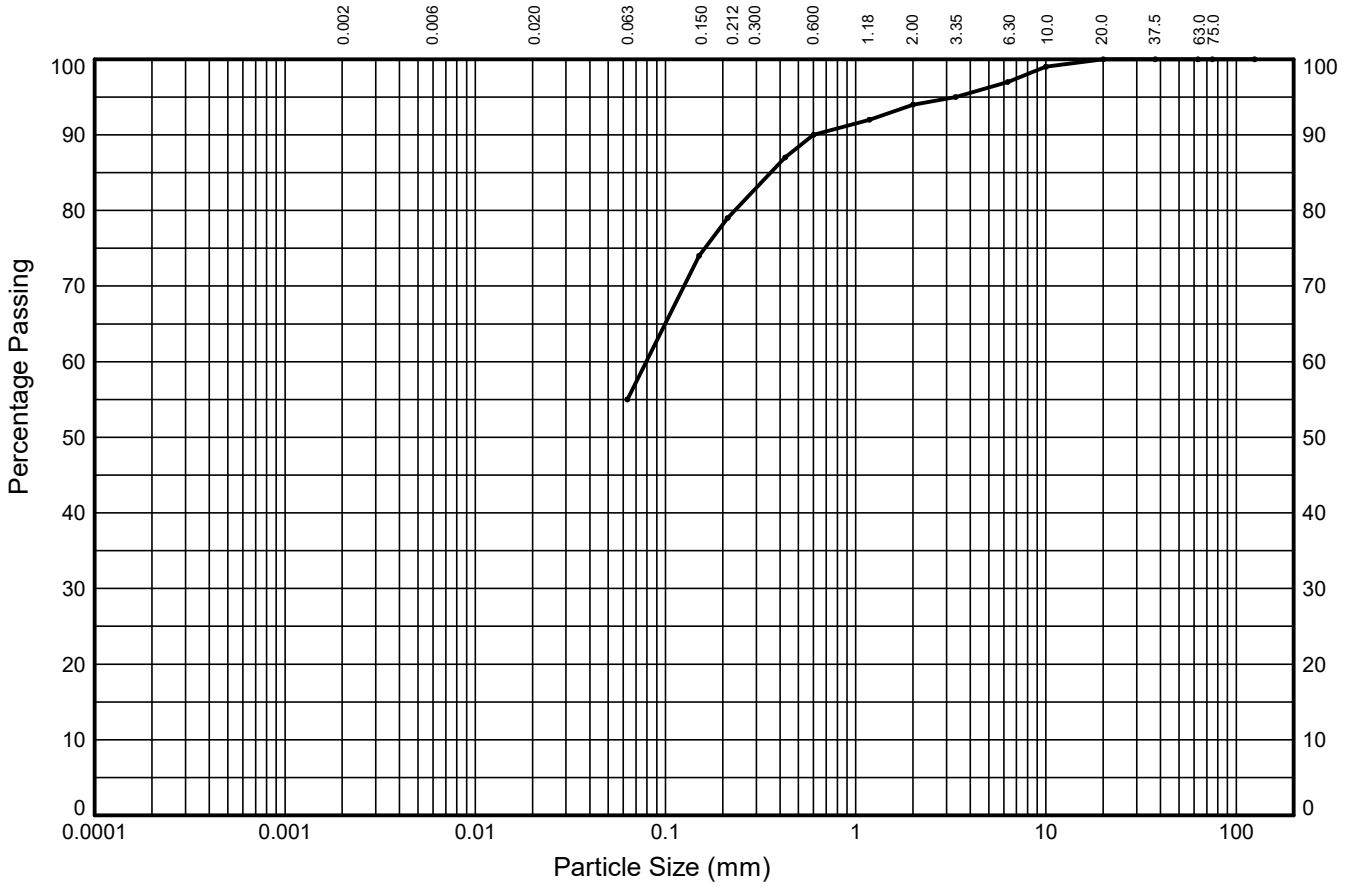
Contract	Contract Ref:
Bramley Moore Dock Wall	**764954**

AGS

PARTICLE SIZE DISTRIBUTION TEST

In accordance with clauses 9.2 of BS1377:Part 2:1990

Trial Pit: **TP03** Sample Ref: **8** Sample Type: **B** Depth (m): **1.60**



CLAY	fine	medium	coarse	fine	medium	coarse	fine	medium	coarse	COBBLES
	-	-	-	23%	12%	4%	3%	3%	0%	
	SILT			SAND			GRAVEL			
55%				39%			6%			0%

Test Sieve (mm)	Percent Passing (%)
125.0	**100**
75.0	**100**
63.0	**100**
37.5	**100**
20.0	**100**
10.0	**99**
6.30	**97**
3.35	**95**
2.00	**94**
1.18	**92**
0.600	**90**
0.425	**87**
0.212	**79**
0.150	**74**
0.063	**55**

Particle Diameter (mm)	Percent Passing (%)

Sedimentation sample was not pre-treated

Coefficients	
D_{10} (mm)	**NA**
D_{15} (mm)	**NA**
D_{30} (mm)	**NA**
D_{50} (mm)	**NA**
D_{60} (mm)	**0.079**
D_{85} (mm)	**0.357**
D_{90} (mm)	**0.600**
C_U	**NA**
C_C	**NA**

Soil Description:

Brown slightly gravelly sandy CLAY

Key: C_U = Uniformity coefficient. C_C = Coefficient of curvature as defined in BS EN ISO 14688-2

STRUCTURAL SOILS
The Potteries
Pottery Street
Castleford
W. Yorkshire WF10 1NJ

Compiled By		Date
M. Fisher	**MAUREEN FISHER**	**06/09/19**

Contract	Contract Ref:
Bramley Moore Dock Wall	**764954**

APPENDIX E -
MASONRY LABORATORY TESTING

(i) Laboratory Test Results

RSK Environment Ltd
Tel: +44 (0) 1442 437500
Fax: +44 (0) 1442 437550
Email: info2@rsk.co.uk
Web: www.rsk.co.uk

Materials & Structures
18 Frogmore Road
Hemel Hempstead
Hertfordshire
HP3 9RT

UKAS TESTING
0278

Mix Proportions of Mortar
BS 4551: 2005 + A2: 2013

1281674 Bramley Moore Dock Wall (764954)

Client details	
Structural Soils Ltd The Potteries Pottery Street Castleford WF10 1NJ	
Contact name	Izaak Hayes
Order date	23/09/19

Sample details			
Sample type	Mortar		
Sampled by	RSK	Sampling date	Not advised
RSK batch no.	18623	No. of samples	3
Receipt date	29/08/19	Test period	17-18/10/19

Methods	
Test	The samples were dried at 105°C and on cooling were prepared and chemically analysed by the methods specified in BS 4551:2005. The interpretation of our analytical data has been made on the basis of calculations described in BS 4551:2005 using the following assumptions as applicable: • Soluble silica content of the cement = 20.5 % • Calcium oxide content of the cement = 64.5 % • Calcium oxide content of hydrated lime = 72.7 % • Bulk density of sand = 1675 kg/m^3 • Bulk density of cement = 1450 kg/m^3 • Bulk density of hydrated lime = 575 kg/m^3
Deviations	None.
Precision	Repeatability limits from duplicate testing for cement content as % mass of sample 1.3 % and 0.8 % from soluble silica and calcium oxides, respectively. BS 4551 estimates repeatabilities of 2.2 % and 0.8 %, respectively.

Results
The results are reported on page 2 of this certificate.

Certification			
Certificate prepared by Sam Lewis Trainee Chemistry Technician		Certificate reviewed & authorised by Benjamin Stainton Principal Chemistry Technician	
Testing by	SGL	Certificate issue date	21/10/19

The results given in this certificate relate only to those samples submitted and specimens tested and to any materials properly represented by those samples and specimens. Any opinions and interpretations expressed herein are outside the scope of our UKAS accreditation

RSK Environment Ltd
Tel: +44 (0) 1442 437500
Fax: +44 (0) 1442 437550
Email: info2@rsk.co.uk
Web: www.rsk.co.uk

Materials & Structures
18 Frogmore Road
Hemel Hempstead
Hertfordshire
HP3 9RT

0278

Details of samples			
RSK sample reference	**Mass [g]**	**Client sample reference**	**Description**
18623/C1	166	Exploratory Position CR01 - C2 - 0.22-0.43 m	Dark grey mortar
18623/C2	132	Exploratory Position CR02 - C1 - 0-0.16 m	Dark grey mortar
18623/C3	102	Exploratory Position CR03 - C3 - 0.37-0.54 m	Dark grey / brown mortar

RSK sample reference	18623/C1	18623/C2	18623/C3
Determined values	**% by mass**		
Insoluble residue	51.6	50.6	52.0
Soluble silica	10.93	10.98	10.87
Calcium oxide	22.16	21.57	20.82
Assuming cement:sand mix	**% by mass on dry mass**		
Portland cement	34.5	33.5	32.5
Mortar designation	None	None	None
Portland cement:sand	1:1.3	1:1.3	1:1.4

Remarks

The determined results did not conform with any of the mortar designations for either cement:sand or cement:lime:sand mortars in tables 4 and 7 of BS 4551: 2005, therefore the approximate mix proportions by volume were calculated.

End of Certificate

RSK Environment Ltd
Tel: +44 (0) 1442 437500
Fax: +44 (0) 1442 437550
Email: info2@rsk.co.uk
Web: www.rsk.co.uk

Materials & Structures
18 Frogmore Road
Hemel Hempstead
Hertfordshire
HP3 9RT

UKAS TESTING
0278

Determination of Compressive Strength

BS EN 1926: 2006

1281696 Bramley Moore Dock Wall

Client Details:	Structural Soils Limited The Potteries Pottery Street Castleford WF10 1NJ		
Contact Name	Izaak Hayes		
Order Reference	Email dated 12/09/19	Order Date	12/09/19

Sample Details			
Sample Type	Stone cores from masonry	No Samples Received	8
Sampled By	Client	Sampling Date	Not advised
RSK Batch No	18642	No Samples Tested	2
Receipt Date	21/09/19	Test Date	23/09/19

Methods	
Preparation	BS EN 1926. Two nominal 70 mm diameter cores were cut to nominal 70mm length, ends ground to flatness.
Test	BS EN 1926: 2006. Load rate 2.5kN/s
Note	Eight samples were provided for testing, two of which were suitable for testing.

Results

Sample No.	**Load Direction**	**Average Dimensions** (mm)		**Failure Load** kN	**Compressive Strength** Mpa
		Diameter	Length		
4	Parallel	68.0	73.1	490.4	135.0
5		68.0	74.0	577.7	159.1
				Mean:	**147.1**

Certification

Certificate prepared by		Certificate reviewed and authorised by	
Clive Rayner Principal Technician		**Dr Ian G Blanchard** Associate Director	
Tested by	CR	Certificate issue date	04/10/19

The results given in this certificate relate only to those samples submitted and specimens tested and to any materials properly represented by those samples and specimens. Any opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.

End of Certificate

APPENDIX F - GEOPHYSICAL SURVEYS

(i) RSK Geophysical Survey Report

Spring Lodge
172 Chester Road
Helsby
Cheshire
WA6 0AR
UK

Telephone: +44 (0)1928 726006
Fax: +44 (0)1928 725633
www.rsk.co.uk

12 August 2019
Our reference: 55320-LR01(00)

Buro Happold Limited
2 Brewery Place
Brewery Wharf
Leeds
LS10 1NE

THE PEOPLE's PROJECT – GROUND PENERTRATING RADAR (GPR) RESULTS

On the instructions of Structural Soils Limited on behalf of Buro Happold Limited, RSK Environment Limited carried out a geophysical site investigation to determine if there are any changes in construction at three locations on the boundary wall between Bramley-Moore Dock and Regent Road, Liverpool.

Objective and Geophysical Approach

As part of the proposed development for Everton Football Club's new stadium at Bramley-Moore Dock a detailed understanding is required of the structural build-up of the boundary wall. The wall is 4m high and is Grade II listed and believed to have been constructed in 1848.

A non-intrusive GPR survey and intrusive coring has been commissioned by the client in order to ascertain the structural build up of the wall. 3(no.) locations were identified by the client for the GPR survey and intrusive coring as marked on **Figure 1**. The survey was approached this way as the GPR results can be verified from the intrusive core information to allow extrapolation of the GPR interpretation across each survey area. The intrusive coring was undertaken by Structural Soils Limited.

GPR Survey, Data Processing and Presentation

The GPR technique operates by directing a pulse of electromagnetic radiation into the subsurface, which is reflected back to the instrument at boundaries between materials with contrasting electrical properties. Theoretically, the contrast between varying construction materials, their thickness and possible voids within the wall should provide anomalous reflections that would be easily identified in the data. The survey is undertaken by passing the radar antenna across the surface in a straight line to build up a cross-section of data which is representative of the subsurface conditions immediately beneath the survey line.

GPR data were collected using a SIR (Subsurface Interface Radar) System-4000 manufactured by Geophysical Survey Systems Inc. (see equipment specifications appended to this letter report). A high frequency 1.5GHz antenna was employed that sampled up to approximately 500mm depth into the wall structure. At each of the 3(no.) survey locations GPR data were collected on a series of closely spaced vertical survey lines spaced at 0.25m apart across a width of 8m. Data were collected on both sides of the wall in order to provide full thickness coverage. The GPR survey grids were positioned by measuring distances off known features on site. The lateral location of the features is recorded using a calibrated odometer wheel mounted on the antenna unit. On the dock side of the wall, at survey locations 2 & 3, GPR

data could not be collected at the base of the wall due to the presence of either spoil or other brickwork from former structures that were attached to the wall.

The GPR data collected were processed back in the office and the following processing steps were employed.

Table 1: Summary of GPR processing methods

Method	*Justification*
Distance calibration	Horizontal measurement is undertaken using a wheel odometer mounted to the antenna and is calibrated daily and saved on the GPR console. An on-site check over 2m was conducted and found to be accurate.
Depth calibration	A dielectric constant of 5.5 (typical of stone) has been assumed in order to give the most accurate indication of depth. The calculated depths are expected to be typically ±20%.
Zero-offset	To correct the signal to the actual ground surface level.
Gain control	To compensate for the signal attenuation with depth and enhance the signals from deeper reflectors to aid interpretation. Each profile was enhanced with the same gain parameters.
Filtering	High and low pass filters were set at frequencies of 750 MHz and 3 GHz for the 1.5GHz antenna to remove noise from the data, and to isolate "legitimate" signals from reflections of the pulse from the instrument.

Intrusive & GPR Results and Interpretation

The table below summarises the intrusive core results at each of the 3(no.) survey locations. All thickness/depths are taken from the dock side of the wall. In general, the wall is constructed of granite facing blocks with a sandstone rubble & cement fill in its core. The thickness of the wall ranges between 540 to 640mm. Within the sandstone & rubble fill a number of voids of varying sizes have been identified ranging between 2 to 40mm in size.

Table 2: Summary of intrusive core results

Survey Location	*Thickness (mm)*	*Description*	*Voids (% Approx)*	*Voids Size (mm)*
1	0 - 97	Granite blocks	0	n/a
	97 - 495	Sandstone Rubble and Cement Fill	15	2 – 40
	495 - 640	Granite blocks	0	n/a
2	0 – 158	Granite blocks	0	n/a
	158 – 390	Sandstone & Granite Rubble and Cement Fill	10	5 – 30
	390 - 610	Granite blocks	0	n/a
3	0 -150	Granite blocks	0	n/a
	150 - 370	Sandstone & Granite Rubble and Cement Fill	10	2 -20
	370 – 540	Granite blocks	0	n/a

Example GPR data from each of the 3(no.) survey locations are shown in **Figures 2A to C**.

The GPR data displays a number of discreet high amplitude GPR reflections that are indicative of potential voids within the wall as highlighted in **Figures 2A to C**. These anomalous GPR reflections mainly occur at cover depths that coincide with the core fill within the wall and are likely caused by the voids similar to those observed in the 3(no.) cores taken on site. Some of the GPR anomalies occur at the depths that coincide with the interpreted back of the granite facing blocks taken from the core results, for example at location 2 in **Figure 2B**. It is possible that these GPR anomalies are not necessarily within the granite facing blocks but sit behind them in the core fill, as different sized granite blocks may have been used in the construction of the wall.

Although the GPR technique cannot determine the actual size of the voids, based on the results from the intrusive cores it is plausible that the voids are in the region of 2 to 40mm in size. In **Figures 2A to C**, example GPR traces are displayed from opposite sides of the wall and in some instances the same reflection anomaly can be seen in the two separate co-located traces on either side of the wall. These anomalies may indicate slightly larger or deeper voids within the wall structure. In other instances, a GPR anomaly can only be seen in a trace from one side of the wall. This may indicate slightly smaller or shallower voids within the core of the wall.

Conclusions

The GPR anomalies that are interpreted to be caused by potential voids within the core of the wall are located sporadically and are located at varying cover depths. This agrees with what would be expected from a rubble and cement fill as observed in the intrusive core data. The GPR data displays a similar pattern of reflections throughout each of the 8m wide survey areas, with no areas showing significantly more or less reflection anomalies than that shown in the example data. Based on this it can be assumed that the construction build-up of the wall is similar across the 3(no.) scanned areas.

Limitations

Non-intrusive geophysical techniques seek to locate boundaries across which there is a marked contrast in physical properties. Such a contrast may be detected remotely because it gives rise to a geophysical anomaly, which is indicative of variation in a physical property relative to some background value. Insufficient contrast (including high levels of cultural noise) can result in masking of the sought anomaly. Therefore, there may be other conditions prevailing at the site which have not been revealed by this investigation and which have therefore not been taken into account in this report.

The response of the structure to different physical forces can be highly variable. Interpretation of the responses contained in this report is based on experience in similar environments and site conditions.

The materials encountered and samples obtained during on-site intrusive investigations represent only a small proportion of the materials present on-site. It should be accepted, therefore, that the interpretation from remotely sensed geophysical data may be inconsistent with that arising from direct methods of investigation.

Yours faithfully

For RSK Company Limited

Author

Stephen Owen *CGeol CSci*

Associate Director

Technical & Quality Reviewer

Matt Stringfellow *CGeol*

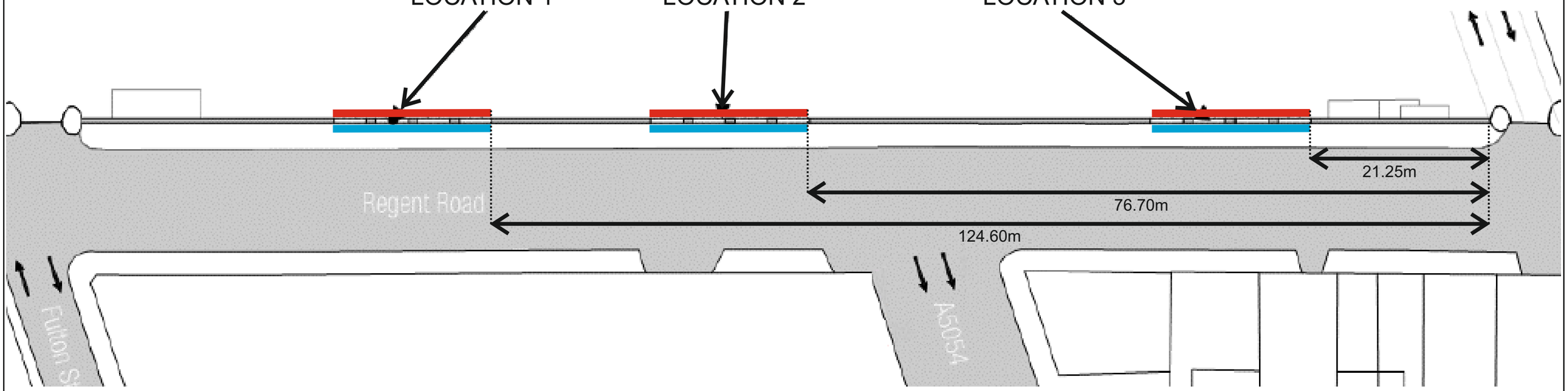
Associate Director

Enc: **Figure 1** Site Location

Figure 2A-C Example Ground Penetrating Radar Data at Survey Locations 1 to 3

Appendices – GPR Equipment Specifications

BRAMLEY MOORE DOCK



Key

- Dock-side GPR Survey Area
- Road-side GPR Survey Area

RSK

Client: BURO HAPPOLD

Site/Project: BRAMLEY MOORE DOCK

SURVEY LAYOUT

Figure: 1

Job: 55320

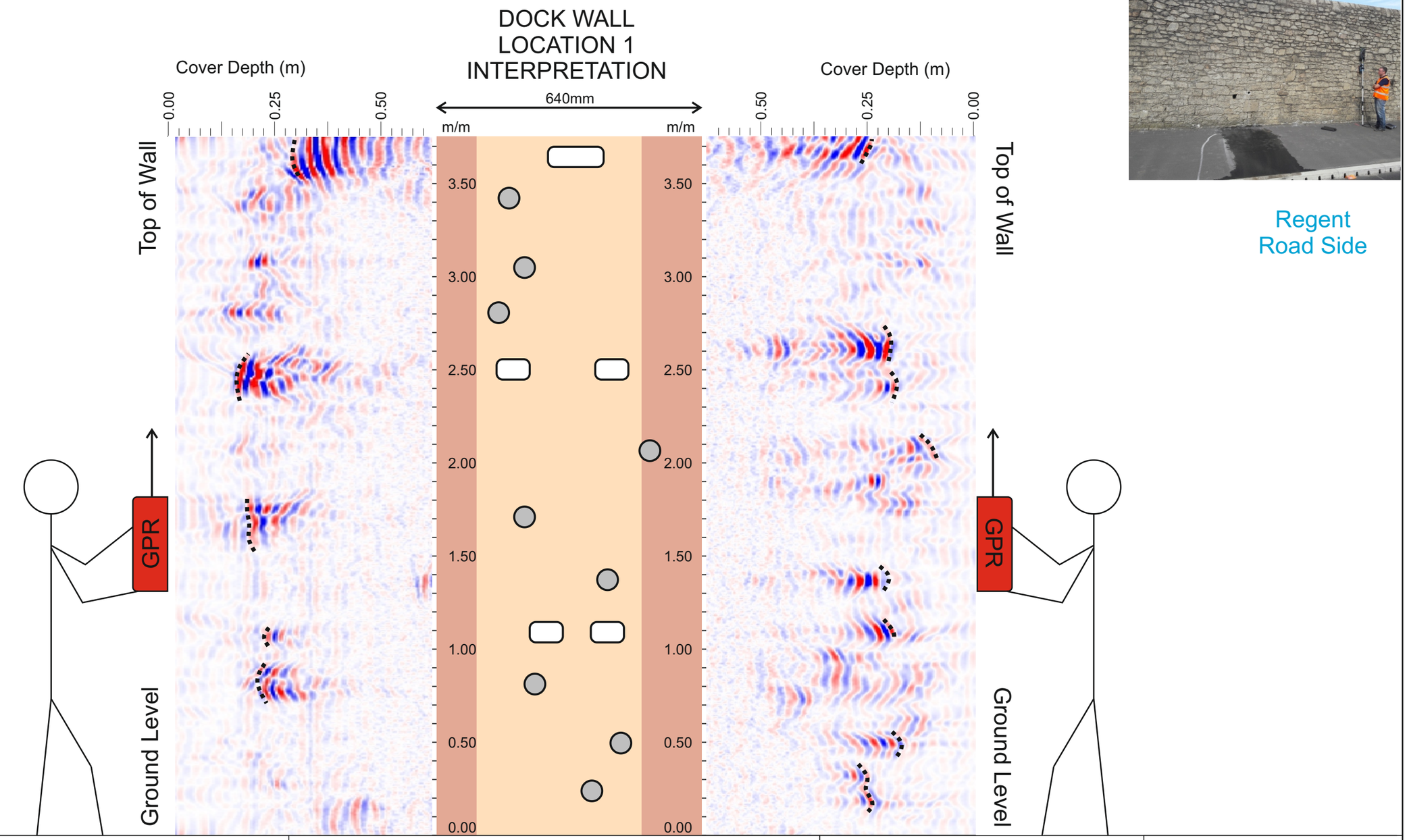
Report: 55320-R01

Date: August 2019

Scale: Not to Scale

Dock Side

DOCK WALL LOCATION 1 INTERPRETATION



Regent Road Side

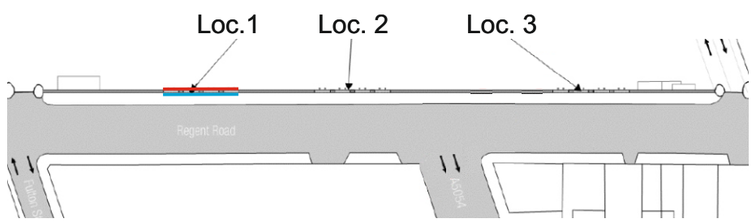
Key

- Interpreted void or rubble observed from either side of the wall
- Interpreted void or rubble observed on one side of the wall
- Outline of high amplitude GPR reflection indicative of a void
- Granite Stone Blocks (depth from core logs)
- Sandstone Rubble & Cement Fill (depth from core logs)

-1 0 +1

normalised amplitude

Site Layout



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Client: BURO HAPPOLD

Site/Project: BRAMLEY MOORE DOCK

EXAMPLE GPR DATA - SURVEY LOCATION 1

Figure: 2A

Job: 55320

Report: 55320-R01

Date: August 2019

Scale: As Shown