Ports North

APPENDIX D.1

Draft : Environmental Impact Statement

Appendix D.1

Geotechnical Investigations Supporting Reports

September 2013

PRELIMINARY GEOTECHNICAL INVESTIGATION - FACTUAL REPORT

CAIRNS SHIPPING DEVELOPMENT PROJECT (EIS) - TRINITY INLET, CAIRNS

Submitted to:
Jeff Bunt (Consultant Project Manager)
Ports North

~Transmission via email - Jeff.Bunt@portsnorth.com.au~

REPORT

Report Number. 137632122-001-R-Rev0

Distribution:

1 Copy Electronic (PDF) - Ports North

Golder Associates

Table of Contents

1.0 INTRODUCTION

Ports North commissioned Golder Associates (Golder) to provide geotechnical services related to the Cairns Shipping Development Project (CSDP) at Trinity Inlet, Cairns.

The project involves the proposed widening and deepening of the Cairns shipping channel. An Environmental Impact Study (EIS) for the project is being undertaken by Arup.

A preliminary geotechnical assessment on the materials encountered within the proposed dredge zone is understood to be required to support the EIS. The objectives of the preliminary geotechnical investigation conducted by Golder are to:

- Assess subsurface conditions at locations/depths nominated by Ports North/Arup to confirm consistency with existing information.
- Assess strength and composition of material to be dredged for later modelling for impacts of sedimentation on habitats.

2.0 PREVIOUS GEOTECHNICAL SERVICES

Golder has previously carried out the following works related to the CDSP:

- Geotechnical review of proposed development strategy based on subsurface information available at the time of the study (Golder reference 117672052-001-R-Rev0, dated November 2011). This report was subsequently updated together with reconsideration of geotechnical recommendations based on additional subsurface information and provided under separate cover (Golder reference 117672052-003-L-Rev0, dated 23 March 2012).
- Overview of dredge material assessment and provision of factual report, together with results of limited laboratory testing (Golder reference 107672522-008-Rev1, dated 22 June 2012).

3.0 FIELD INVESTIGATION

The field investigation was carried out by Golder in general accordance with the geotechnical brief prepared by Arup and under the direction of Ports North. Fieldwork consisted of the following:

- Drilling and sampling of seven geotechnical boreholes – designated BH1 to BH7 - at locations nominated by Ports North / Arup. The locations are presented in plan on Figure 1.
- Boreholes were drilled using a hydrapower scout drilling rig, mounted onto a Ports North operated floating barge. Establishment of the drilling rig at each investigation location was carried out by Ports North.
- Boreholes were drilled to target depth of between 4.55 m to 12.10 m below the existing seabed level. Target depths were nominated by Ports North/Arup.
- Standard penetrometer testing (SPT) and push tube “undisturbed” (U75) and/ or piston tube sampling carried out at nominal intervals in suitable materials.
- Pocket penetrometer readings and hand-vane shear testing was carried out in the base of the recovered undisturbed samples. *Down-hole In-situ* shear vane testing was carried out at the discretion of the geotechnical engineer where safe to do so, to facilitate assessment of insitu consistency of cohesive soils.

Geotechnical engineers from Golder supervised drilling operations, recorded subsurface conditions encountered within the boreholes, recovered samples for laboratory testing and carried out and/ or observed the field tests.

Investigation location coordinates were obtained by Ports North using a differential GPS device and provided to Golder. Seabed surface levels at borehole locations were estimated by measuring the depth to seabed, and comparing the depth relative to the approximate tide height at the time of obtaining the measurement. A summary of the investigation locations is presented in Table 1.

Table 1: Summary of Investigation Locations

Borehole ID	Approximate Location	Coordinates*		Design Dredge Level (m LAT)	Approx. Seabed Level (mLAT)**	Borehole Depth (m) [mLAT]
		Latitude (S)	Longitude (N)			
BH1	Inner Harbour	16° 56.4406’	145° 46.9976’	-8.3	-5.10	5.15 [-10.25]
BH2	Inner Harbour	16° 55.5741’	145° 47.0603’	-8.3	-6.20	4.55 [-10.75]
BH3	Inner Harbour	16° 55.0414’	145° 47.1200’	-9.7	-7.60	5.25 [-12.85]
BH4	CH 15180 (approx.)	16° 54.3445’	145° 47.2424’	-11.1	-8.40	5.85 [-14.25]
BH5	CH 17260 (approx.)	16° 53.2749’	145° 47.8804’	-10.1	-1.70	12.10 [-13.80]
BH6	CH 19985 (approx.)	16° 51.9879’	145° 48.6458’	-11.1	-4.00	9.95 [-13.95]
BH7	CH 22715 (approx.)	16° 50.5967’	145° 49.3973’	-9.9	-6.90	5.90 [-12.80]

* Coordinates provided by Ports North.

**Seabed level measured relative to tide.

4.0 SUBSURFACE CONDITIONS

Borehole reports are presented in Appendix A and should be referred to for a detailed description of ground conditions encountered at the investigation locations. The borehole reports presented in Appendix A should be read in conjunction with *Explanation of Notes, Abbreviations and Terms Used on Borehole and Test Pit Reports*.

Ground conditions encountered at the investigation locations are briefly summarised as follows:

- Silty CLAY (Unit 1), predominantly high plasticity, grey and/ or grey brown, very soft/ soft, varying fine grained sand content and trace shells. This unit is typically 3.1 m to 5 m thick in BH1, BH2, BH4, BH6 and BH7, and extends to the full depth of BH5 (12.1 m below sea bed). This unit was not observed within BH3.
- Silty CLAY (Unit 2), predominantly high plasticity, grey and/ or pale grey with yellow brown and orange brown pockets, stiff and/ or very stiff to hard. This unit was observed to comprise discontinuous fine grained sand seams/ zones of less than about 200 mm thickness and a trace of cemented nodules (<5 mm nominal diameter). This unit typically persisted to the maximum depth of investigation within all boreholes with the exception of BH5.

5.0 LABORATORY TESTING

Selected samples obtained during the investigation were submitted to a NATA accredited laboratory for testing. Laboratory testing consisted of the following:

- 22 no. moisture content;
- 22 no. Atterberg Limit and Linear Shrinkage testing
- 27 no. Particle size distribution by combined sieve and hydrometer analyses method; and
- 16 no. Shear strength triaxial testing (unconsolidated, undrained).

All testing was carried out in accordance with relevant AS1289 test methods. Laboratory reports are attached in Appendix B, and a summary of the reported results are presented in the following tables.

Table 2: Classification Testing

Borehole [Sample ID]	Sample Depth (m)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Linear Shrinkage (%)	Percentage Sand (%)	Percentage Fines (% <75µm)	Percentage Clay (% <2µm)	Soil Classification AS1726
BH1 [001]	0.10 – 0.50	86.2	75	44	17.5	7.4	92.6	38.6	Silty CLAY, CH
BH1 [003]	2.10 - 2.50	77.8	65	42	16.0	3.8	96.2	49	Silty CLAY, CH
BH1 [004]	3.10 - 3.50	88.1	65	38	14.5	3.4	96.6	43.6	Silty CLAY, CH
BH1 [005]	4.10 - 4.50	40.6	55	37	16.5	5.6	94.4	50.8	Silty CLAY, CH
BH2 [001]	1.10 - 1.50	ND	ND	ND	ND	3.1	96.9	45.2	Silty CLAY, CH
BH2 [002]	2.10 - 2.50	40.8	64	34	16.5	5.4	94.1	53.1	Silty CLAY, CH
BH2 [003]	3.10 - 3.55	23.2	56	38	17.0	6.5	93.5	46.2	Silty CLAY, CH
BH3 [001]	0.40 - 0.80	36.1	62	43	17.5	2.4	97.6	53.0	Silty CLAY, CH
BH3 [002]	1.40 - 1.80	33.3	69	49	19.5	2.1	97.9	49.4	Silty CLAY, CH
BH3 [003]	2.40 - 2.63	30.4	70	44	18.0	1.7	98.3	51.4	Silty CLAY, CH
BH3 [006]	4.80 - 5.25	29.8	61	43	18.5	1.8	98.2	51.4	Silty CLAY, CH
BH4 [001]	2.40 - 2.80	68.2	76	51	17.5	1.3	98.7	53.5	Silty CLAY, CH
BH4 [002]	3.40 - 3.80	71.5	70	47	18.0	5.0	95.0	46.9	Silty CLAY, CH
BH4 [003]	4.40 - 4.80	44.0	66	45	18.0	8.5	90.3	51.4	Silty CLAY, CH
BH4 [004]	5.40 – 5.85	ND	ND	ND	ND	14.5	84.6	39.9	Silty CLAY, CH
BH5 [001]	2.40 - 2.80	54.6	49	28	12.0	3.5	96.5	31.5	Silty CLAY, CI
BH5 [003]	4.40 - 4.80	ND	ND	ND	ND	6.7	93.3	29.7	Silty CLAY, CI
BH5 [006]	7.40 - 7.90	69.4	79	51	18.5	1.7	98.3	60.7	Silty CLAY, CH
BH5 [009]	10.40 - 10.80	58.0	71	48	16.5	12.5	87.5	48.9	Silty CLAY, CH
BH6 [001]	0.00 - 0.40	ND	ND	ND	ND	7.9	92.1	27.2	Silty CLAY, CI
BH6 [003]	2.00 - 2.40	49.6	46	24	9.5	7.5	92.5	28.6	Silty CLAY, CI
BH6 [006]	5.00 - 5.40	81.9	61	39	15.5	12.6	87.4	36.0	Silty CLAY, CH
BH6 [007]	6.00 - 6.40	45.0	59	38	16.0	9.4	89.7	40.2	Silty CLAY, CH
BH6 [009]	8.00 - 8.45	ND	ND	ND	ND	34.6	60.0	26.4	Silty CLAY, CH
BH7 [002]	3.20 - 3.60	55.2	48	29	12.5	14.8	85.2	34.0	Silty CLAY, CI
BH7 [003]	4.20 – 4.60	43.3	56	37	15.5	8.9	91.1	43.0	Silty CLAY, CH
BH7 [004]	5.45 – 5.90	22.8	40	26	12.0	24.1	74.4	30.3	Silty CLAY, CI

Note: NO – not obtainable; NP – not possible; ND – not determined.

Table 3: Summary of Unconsolidated Undrained (UU) Triaxial Testing (3-Stage)

Borehole [Sample ID]	Sample Depth (m)	Stage	Initial Cell Pressure (kPa)	Maximum Principal Stress (kPa) σ_1	Minimum Principal Stress (kPa) σ_3	Maximum Deviator Stress (kPa)	Failure Strain (%)
BH1 [003]	2.10 – 2.50	1	50	68	50	18	1.3
		2	100	122	100	22	2.6
		3	150	177	150	27	4.8
BH1 [004]	3.10 – 3.50	1	50	96	50	46	2.4
		2	100	151	100	51	3.2
		3	150	212	150	62	5.3
BH1 [005]	4.10 – 4.50	1	50	101	50	51	1.1
		2	100	159	100	59	1.6
		3	150	219	150	69	3.7
BH2 [002]	2.10 – 2.50	1	50	106	50	56	1.3
		2	100	159	100	59	1.8
		3	150	217	150	67	3.7

Borehole [Sample ID]	Sample Depth (m)	Stage	Initial Cell Pressure (kPa)	Maximum Principal Stress (kPa) σ_1	Minimum Principal Stress (kPa) σ_3	Maximum Deviator Stress (kPa)	Failure Strain (%)
BH3 [001]	0.40 – 0.80	1	50	156	50	106	1.3
		2	100	221	100	121	1.8
		3	150	290	150	140	4.7
BH3 [002]	1.40 – 1.80	1	50	237	50	187	1.8
		2	100	340	100	240	2.6
		3	150	457	150	307	5.8
BH3 [003]	2.40 – 2.63	1	50	242	50	192	1.3
		2	100	335	100	235	2.4
		3	150	436	150	286	4.2
BH4 [001]	2.40 – 2.80	1	50	65	50	15	1.3
		2	100	115	100	15	2.7
		3	150	166	150	16	4.3
BH4 [002]	3.40 – 3.80	Test not achievable: specimen slumping under own weight.					
BH4 [003]	4.40 – 4.80	1	50	105	50	55	1.3
		2	100	157	100	57	1.8
		3	150	210	150	60	4.7
BH5 [006]	7.40 – 7.90	1	50	72	50	22	1.3
		2	100	123	100	23	1.8
		3	150	175	150	25	3.2
BH6 [003]	2.00 – 2.40	1	50	59	50	9	1.1
		2	100	109	100	9	2.4
		3	150	161	150	11	3.7
BH6 [006]	5.00 – 5.40	1	50	89	50	39	1.9
		2	100	144	100	44	2.6
		3	150	201	150	51	4.8
BH6 [007]	6.00 – 6.40	1	50	113	50	63	1.8
		2	100	166	100	66	2.6
		3	150	223	150	73	4.7
BH7 [002]	3.20 – 3.60	1	50	57	50	7	1.6
		2	100	108	100	8	3.1
		3	150	160	150	10	4.7
BH7 [003]	4.20 – 4.60	1	50	131	50	81	1.6
		2	100	188	100	88	2.1
		3	150	251	150	101	4.2

6.0 LIMITATIONS

Your attention is drawn to the document - “Limitations”, which is included as an Appendix to this report. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be. The document is not intended to reduce the level of responsibility accepted by Golder Associates, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing. We trust this information meets your requirements. Should you have any queries, please do not hesitate to contact the undersigned.

GOLDER ASSOCIATES PTY LTD

Joseph Parisi
Engineer

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Senior Engineer, RPEQ

JJP/RJ/cs

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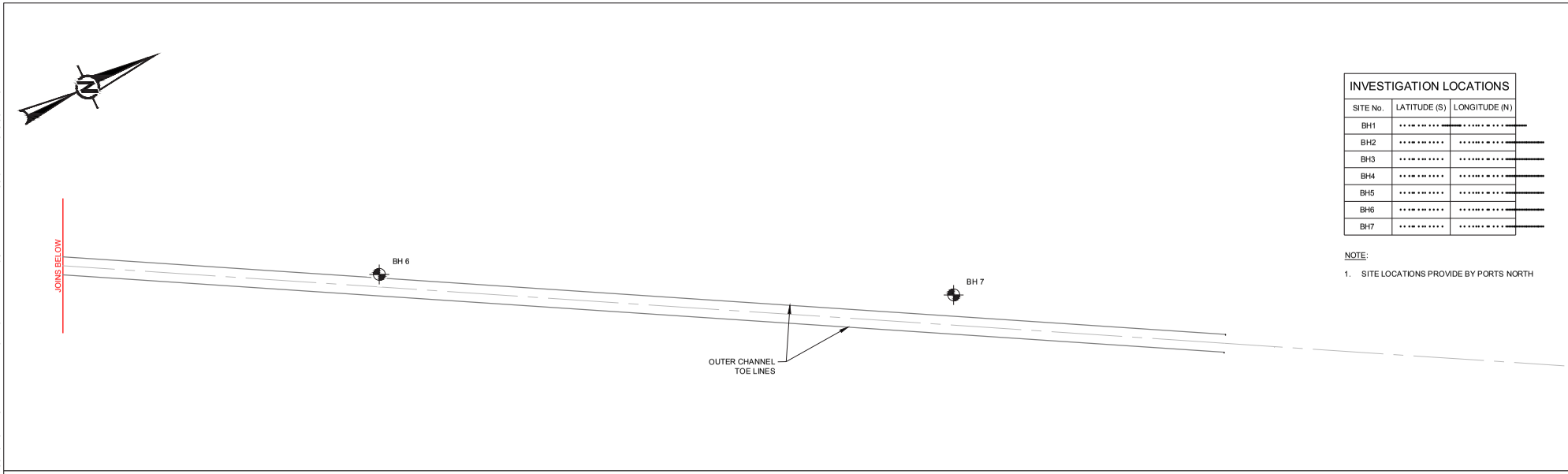
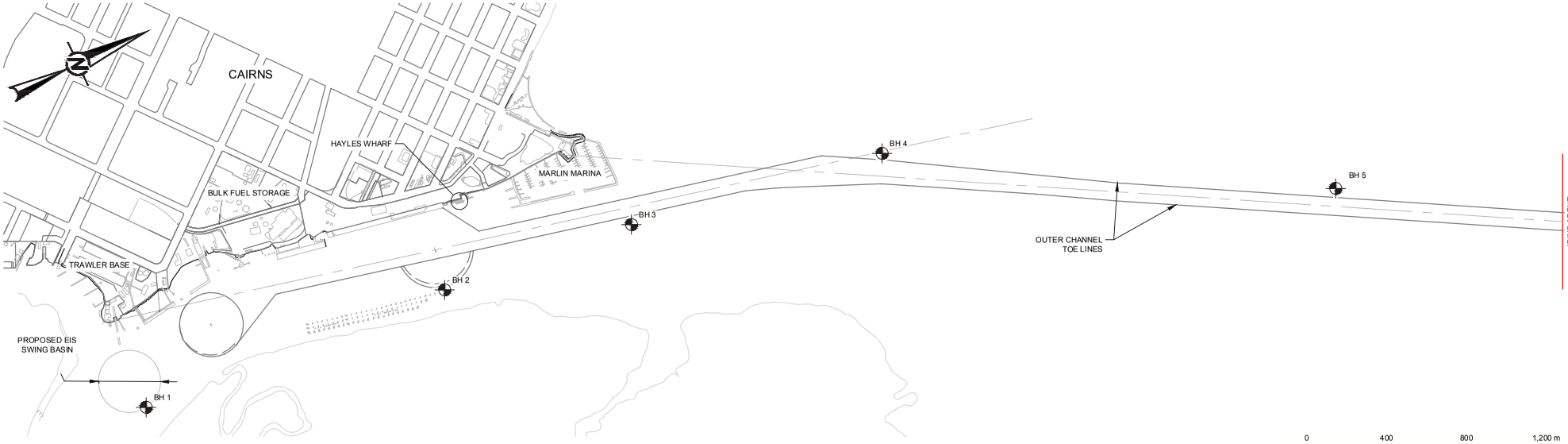
j:\geo\2013\137632122-ports north-cairns shipping channel development (eis)-preliminary geotech services\corr out\137632122-001-r-rev0-preliminary geotechnical investigation (eis)-factual report.docx



INVESTIGATION LOCATIONS		
SITE No.	LATITUDE (S)	LONGITUDE (N)
BH1		
BH2		
BH3		
BH4		
BH5		
BH6		
BH7		

NOTE:

1. SITE LOCATIONS PROVIDE BY PORTS NORTH



LEGEND

SITE 7 — GEOTECHNICAL INVESTIGATION LOCATIONS

BASE DRAWING TAKEN FROM PORTS NORTH DRG. 2013 Channel Development Project - Current Linework GDA'94.dwg DATED 19/08/2013

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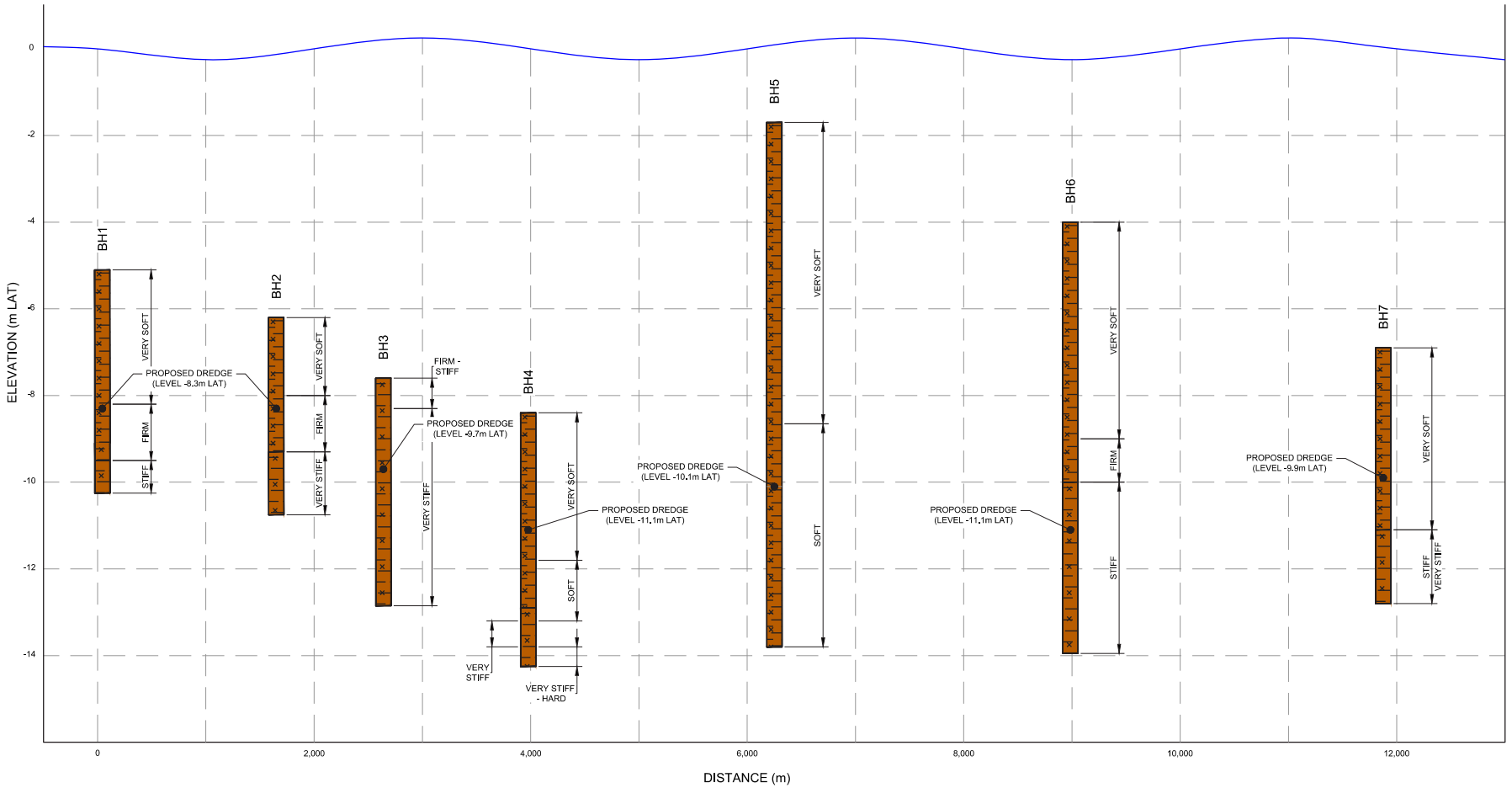
CLIENT: PORTS NORTH		PROJECT: CAIRNS SHIPPING CHANNEL DEVELOPMENT	
DRAWN BY: ACF	DATE: 30.08.2013	DRAWING TITLE: •• GEOTECHNICAL INVESTIGATION PLAN ••	
CHECKED BY: JJP	DATE: 20.09.2013		
SCALE: 1:20,000	SHEET SIZE: A3	PROJECT No: 137632122	DOC No: 001 / DOC TYPE: R / FIGURE No: F001 / REVISION: 0 — FIGURE 1

Plot Date: 20 September 2013 Time:3:53:15 PM By: Farlow, Alan Path: K:\GEO\2013\137632122-Ports North-Cairns Shipping Channel Development (EIS)-Preliminary Geotech Services\FIGURES - File Name:137632122-001-R-F001-Rev0.dwg
Xref: GAP_LOGO-A3.dwg; 137632122-XREF-EXISTING LINEWORK.dwg;



LEGEND

Silty CLAY

HORZ. SCALE 1:40,000
VERT. SCALE 1:100

A F002 LONG SECTION

0 800 1,600 2,400 m
1:40,000

0 2 4 6 m
1:100

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CLIENT: PORTS NORTH		PROJECT: CAIRNS SHIPPING CHANNEL DEVELOPMENT						
DRAWN BY: ACF	DATE: 20.09.2013	DRAWING TITLE: LONG SECTION						
CHECKED BY: JJP	DATE: 20.09.2013							
SCALE: AS SHOWN	SHEET SIZE: A3	PROJECT No: 137632122	DOC No: 001	DOC TYPE: R	FIGURE No: F002	REVISION: 0	FIGURE 2	

Plot Date: 23 September 2013 Time:2:01:44 PM By: Farlow, Alan Path: K:\GEO\2013\137632122-Ports North-Cairns Shipping Channel Development (EIS)-Preliminary Geotech Services\FIGURES - File Name:137632122-001-R-F001-Rev0.dwg
Xref: GAP_LOGO-A3.dwg; 137632122-XREF-EXISTING LINEWORK.dwg;

APPENDIX A

Results of Field Investigation

REPORT OF BOREHOLE: BH1

SHEET: 1 OF 1

CLIENT: Ports North
COORDS: S 16° 56.4406' E 145° 46.9976'
DRILL RIG: HYDRA SCT

PROJECT: Cairns Shipping Development Project (EIS)
SURFACE RL: -5.10 m DATUM: LAT
CONTRACTOR: Geo Investigate

LOCATION: Trinity Inlet, Cairns
INCLINATION: -90° DIRECTION: 000°
LOGGED: JKW DATE: 5/8/13

JOB NO: 137632122
HOLE DEPTH: 5.15 m
CHECKED: JJP DATE: 8/8/13

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
RD	L		0	-5.10	BH1-001 U75 0.10-0.50 m Rec = 400/400 mm PP = <0.1 kg/cm^2 Sv = <0.1 kg/cm^2			CH	Silty CLAY high plasticity, grey, with some shells		VS	Inner Harbour
			1		BH1-002 U75 1.10-1.50 m Rec = 400/400 mm PP = 0.2 kg/cm^2 Sv = < 0.1 kg/cm^2							
			2	*2.10* -7.20	BH1-003 U75 2.10-2.50 m Rec = 400/400 mm				trace organics			
			3		Insitu Shear Vane at 2.5m Sv = 10 kPa BH1-004 U75 3.10-3.50 m Rec = 400/400 mm PP = 0.6-0.8 kg/cm^2 Sv = 0.2 kg/cm^2 Insitu Shear Vane at 3.5m Sv = 15 kPa						F	
			4	*4.00* -9.10	BH1-005 U75 4.10-4.50 m Rec = 400/400 mm PP = 2.0-2.3 kg/cm^2 Sv = 0.65 kg/cm^2				grey and brown, with some shells, trace organics			
			5		BH1-006 Rec = 450/450 mm SPT 4.70-5.15 m 3, 3, 6 N=9						St	
				-10.25					END OF BOREHOLE @ 5.15 m TARGET DEPTH DRILLED OVER WATER			
			6									
			7									

REPORT OF BOREHOLE: BH2

SHEET: 1 OF 1

CLIENT: Ports North
COORDS: S 16° 55.5741' E 145° 47.0603'
DRILL RIG: HYDRA SCT

PROJECT: Cairns Shipping Development Project (EIS)
SURFACE RL: -6.20 m DATUM: LAT
CONTRACTOR: Geo Investigate

LOCATION: Trinity Inlet, Cairns
INCLINATION: -90° DIRECTION: 000°
LOGGED: JKW DATE: 30/7/13

JOB NO: 137632122
HOLE DEPTH: 4.55 m
CHECKED: JJP DATE: 8/8/13

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
RD	L		0	-6.20				CH	Silty CLAY high plasticity, grey, with some shells		VS	Inner Harbour
			1		BH2-001 U75 1.10-1.50 m Rec = 400/400 mm PP = 0.2-0.5 kg/cm^2 Sv = <0.1 kg/cm^2							
			2		BH2-002 U75 2.10-2.50 m Rec = 400/400 mm PP= 0.5-0.75 kg/cm^2 Sv = 0.4 kg/cm^2						F	
			3	*3.10* -9.30	BH2-003 Rec = 450/450 mm SPT 3.10-3.55 m 5, 7, 10 N=17				grey and yellow brown pockets, with some shells			
	M		4		BH2-004 Rec = 450/450 mm SPT 4.10-4.55 m 6, 10, 13 N=23						VSt	
				-10.75	Insitu Shear Vane at 4.55m Sv= 13kPa				END OF BOREHOLE @ 4.55 m TARGET DEPTH DRILLED OVER WATER			
			5									
			6									
			7									

REPORT OF BOREHOLE: BH3

SHEET: 1 OF 1

CLIENT: Ports North
COORDS: S 16° 55.0414' E 145° 47.1200'
DRILL RIG: HYDRA SCT

PROJECT: Cairns Shipping Development Project (EIS)
SURFACE RL: -7.60 m DATUM: LAT
CONTRACTOR: Geo Investigate

LOCATION: Trinity Inlet, Cairns
INCLINATION: -90° DIRECTION: 000°
LOGGED: JJP DATE: 29/7/13

JOB NO: 137632122
HOLE DEPTH: 5.25 m
CHECKED: RJ DATE: 8/8/13

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			0	-7.60				CH	Silty CLAY high plasticity, pale orange brown, trace organics in surfical layer			Inner Channel
	L			*0.40*							F - St	
				-8.00	BH3-001 U75 0.40-0.80 m Rec = 400/400 mm PP= 3.3-3.7 kg/cm^2 Sv = 1.8-2.0 kg/cm^2				pale grey with pale orange brown pockets			
			1									
				1.40								
				-9.00	BH3-002 U75 1.40-1.80 m Rec = 400/400 mm PP = 3.6- 4.7 kg/cm^2 Sv = 1.6-2.4 kg/cm^2				trace lower strength seams (<100mm thickness), trace cemented nodules (<5mm)			
			2									
				2.50	BH3-003							
RD				-10.10	U75 2.40-2.63 m Rec = 230/230 mm PP = 4.2-4.5 kg/cm^2 Sv = 1.75-1.90 kg/cm^2				pale green grey with pale orange brown pockets, with some interbedded seams (<50 mm thickness) comprising increased silt content			
	M				BH3-004 Rec = 230/450 mm SPT 2.80-3.25 m 6, 9, 10 N=19						VSt	
			3									
					BH3-005 Rec = 380/450 mm SPT 3.80-4.25 m 4, 7, 9 N=16							
			4	*4.25*								
				-11.85					pale brown with pale grey pockets, increasing silt content with depth, trace weakly to moderately cemented nodules (<10 mm), black			
					BH3-006 Rec = 450/450 mm SPT 4.80-5.25 m 4, 7, 10 N=17							
			5									
				-12.85					END OF BOREHOLE @ 5.25 m TARGET DEPTH DRILLED OVER WATER			
			6									
			7									

REPORT OF BOREHOLE: BH4

SHEET: 1 OF 1

CLIENT: Ports North
PROJECT: Cairns Shipping Development Project (EIS)
LOCATION: Trinity Inlet, Cairns
JOB NO: 137632122

COORDS: S 16° 54.3445' E 145° 47.2424'
SURFACE RL: -8.40 m DATUM: LAT
INCLINATION: -90° DIRECTION: 000°
HOLE DEPTH: 5.85 m

DRILL RIG: HYDRA SCT
CONTRACTOR: Geo Investigate
LOGGED: JKW DATE: 31/7/13
CHECKED: JJP DATE: 8/8/13

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
RD	L		0	-8.40				CH	Silty CLAY high plasticity, grey and brown, trace fine grained sand		VS	Approx. CH 15180
			1									
			2		BH4-001 U75 2.40-2.80 m Rec = 400/400 mm PP = 0.15-0.2 kg/cm^2 Sv = <0.1 kg/cm^2							
			3									
				3.50 -11.90	BH4-002 U75 3.40-3.80 m Rec = 400/400 mm PP = 0.4-0.5 kg/cm^2 Sv = <0.1 kg/cm^2				trace shell fragments		S	
			4									
	M			*4.50* -12.90	BH4-003 U75 4.40-4.80 m Rec = 400/400 mm PP = 2.1-2.9 kg/cm^2 Sv = 0.7 kg/cm^2				grey and yellow brown pockets, trace shells		VSt	
			5		BH4-004 Rec = 450/450 mm SPT 5.40-5.85 m 7, 9, 12 N=21						VSt - H	
			6	-14.25					END OF BOREHOLE @ 5.85 m TARGET DEPTH DRILLED OVER WATER			
			7									

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GAP gINT FN. F01a
RL3

REPORT OF BOREHOLE: BH5

SHEET: 1 OF 2

CLIENT: Ports North
COORDS: S 16° 53.2749' E 145° 47.8804'
DRILL RIG: HYDRA SCT

PROJECT: Cairns Shipping Development Project (EIS)
SURFACE RL: -1.70 m DATUM: LAT
CONTRACTOR: Geo Investigate

LOCATION: Trinity Inlet, Cairns
INCLINATION: -90° DIRECTION: 000°
LOGGED: JKW DATE: 1/8/13

JOB NO: 137632122
HOLE DEPTH: 12.10 m
CHECKED: JJP DATE: 8/8/13

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
RD	L		0	-1.70				CI-CH	Silty CLAY medium to high plasticity, grey, with some shells		VS	Approx. CH 17260
			1									
			2		BH5-001 U75 2.40-2.80 m Rec = 360/400 mm PP = 0.1-0.2 kg/cm^2 Sv = < 0.1 kg/cm^2							
			3		BH5-002 U75 3.40-3.80 m Rec = 400/400 mm PP = < 0.1 kg/cm^2 Sv = < 0.1 kg/cm^2 Insitu Shear Vane at 3.8m Sv = 10 kPa							
			4		BH5-003 U75 4.40-4.80 m Rec = 400/400 mm PP = < 0.1 kg/cm^2 Sv = < 0.1 kg/cm^2							
			5		BH5-004 U75 5.40-5.80 m Rec = 400/400 mm PP = < 0.1 kg/cm^2 Sv = < 0.1 kg/cm^2 Insitu Shear Vane at 5.8m Sv = 10 kPa							
			6		BH5-005 Rec = 450/450 mm SPT 6.40-6.85 m 0, 0, 0 N=HW							
			7	7.00								

This report of borehole must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

REPORT OF BOREHOLE: BH5

SHEET: 2 OF 2

CLIENT: Ports North
COORDS: S 16° 53.2749' E 145° 47.8804'
DRILL RIG: HYDRA SCT

PROJECT: Cairns Shipping Development Project (EIS)
SURFACE RL: -1.70 m DATUM: LAT
CONTRACTOR: Geo Investigate

LOCATION: Trinity Inlet, Cairns
INCLINATION: -90° DIRECTION: 000°
LOGGED: JKW DATE: 1/8/13

JOB NO: 137632122
HOLE DEPTH: 12.10 m
CHECKED: JJP DATE: 8/8/13

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			7	-8.70				CI-CH CH	Silty CLAY medium to high plasticity, grey, with some shells high plasticity		S	Approx. CH 17260
					BH5-006 U75 7.40-7.90 m Rec = 400/500 mm PP = 0.4-0.5 kg/cm^2 Sv = < 0.1 kg/cm^2							
			8		Insitu Shear Vane at 7.9m Sv = 14 kPa							
					BH5-007 U75 8.40-8.80 m Rec = 400/400 mm PP = 0.2-0.3 kg/cm^2 Sv = < 0.1 kg/cm^2							
			9									
				9.20								
				-10.90					layer of sand (~200mm thickness)			
RD	L				BH5-008 U75 9.40-9.80 m Rec = 400/400 mm PP = < 0.1 kg/cm^2 Sv = < 0.1 kg/cm^2						S	
			10									
					BH5-009 U75 10.40-10.80 m Rec = 400/400 mm PP = 0.2-0.3 kg/cm^2 Sv = < 0.1 kg/cm^2							
			11									
					BH5-010 U63 11.40-11.80 m Rec = 400/400 mm PP = 0.1-0.2 kg/cm^2 Sv = < 0.1 kg/cm^2							
			12									
				-13.80					END OF BOREHOLE @ 12.10 m TARGET DEPTH DRILLED OVER WATER			
			13									
			14									

REPORT OF BOREHOLE: BH6

SHEET: 1 OF 2

CLIENT: Ports North
COORDS: S 16° 51.9879' E 145° 48.6458'
DRILL RIG: HYDRA SCT

PROJECT: Cairns Shipping Development Project (EIS)
SURFACE RL: -4.00 m DATUM: LAT
CONTRACTOR: Geo Investigate

LOCATION: Trinity Inlet, Cairns
INCLINATION: -90° DIRECTION: 000°
LOGGED: JKW DATE: 2/8/13

JOB NO: 137632122
HOLE DEPTH: 9.95 m
CHECKED: JJP DATE: 8/8/13

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
RD	L		0	-4.00	BH6-001 U75 0.00-0.40 m Rec = 400/400 mm PP = < 0.1 kg/cm^2 Sv = <0.1 kg/cm^2			CI-CH	Silty CLAY medium to high plasticity, grey, with some shells		VS	Approx. CH 19985
			1		BH6-002 U75 1.00-1.40 m Rec = 400/400 mm PP = < 0.1 kg/cm^2 Sv = <0.1 kg/cm^2 Insitu Shear Vane at 1.4m Sv = 5 kPa							
			2		BH6-003 U75 2.00-2.40 m Rec = 400/400 mm PP1 = <0.1 kg/cm^2 Sv= <0.1 kg/cm^2							
			3		BH6-004 U75 3.00-3.40 m Rec = 400/400 mm PP = < 0.2 kg/cm^2 Sv = <0.1 kg/cm^2 Insitu Shear Vane at 3.4m Sv = 4 kPa							
			4		BH6-005 U75 4.00-4.40 m Rec = 400/400 mm PP = < 0.1 kg/cm^2 Sv = <0.1 kg/cm^2							
			5	*5.00* -9.00	BH6-006 U75 5.00-5.40 m Rec = 400/400 mm PP = 0.5-0.6 kg/cm^2 Sv = <0.1 kg/cm^2 Insitu Shear Vane at 5.4m Sv = 17 kPa			CH	high plasticity		F	
	M		6	*6.00* -10.00	BH6-007 U75 6.00-6.40 m Rec = 400/400 mm PP = 0.8 - 1.3kg/cm^2 Sv = 0.3 kg/cm^2				grey and brown and yellow brown, trace fine to medium grained sand		St	
			7									

REPORT OF BOREHOLE: BH6

SHEET: 2 OF 2

CLIENT: Ports North
COORDS: S 16° 51.9879' E 145° 48.6458'
DRILL RIG: HYDRA SCT

PROJECT: Cairns Shipping Development Project (EIS)
SURFACE RL: -4.00 m DATUM: LAT
CONTRACTOR: Geo Investigate

LOCATION: Trinity Inlet, Cairns
INCLINATION: -90° DIRECTION: 000°
LOGGED: JKW DATE: 2/8/13

JOB NO: 137632122
HOLE DEPTH: 9.95 m
CHECKED: JJP DATE: 8/8/13

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
RD	M		7		BH6-008 Rec = 450/450 mm SPT 7.00-7.45 m 3, 4, 6 N=10			CI-CH	Silty CLAY medium to high plasticity, grey, with some shells		St	Approx. CH 19985
			8		BH6-009 Rec = 450/450 mm SPT 8.00-8.45 m 3, 5, 6 N=11							
					BH6-010 Rec = 450/450 mm SPT 8.50-8.95 m 4, 5, 6 N=11							
			9									
				9.50 -13.50	BH6-011 Rec = 450/450 mm SPT 9.50-9.95 m 4, 5, 10 N=15				with some medium to coarse grained sand			
			10	-13.95					END OF BOREHOLE @ 9.95 m TARGET DEPTH DRILLED OVER WATER			
			11									
			12									
			13									
			14									

REPORT OF BOREHOLE: BH7

SHEET: 1 OF 1

CLIENT: Ports North
COORDS: S 16° 50.5967' E 145° 49.3973'
DRILL RIG: HYDRA SCT

PROJECT: Cairns Shipping Development Project (EIS)
SURFACE RL: -6.90 m DATUM: LAT
CONTRACTOR: Geo Investigate

LOCATION: Trinity Inlet, Cairns
INCLINATION: -90° DIRECTION: 000°
LOGGED: JKW DATE: 1/8/13

JOB NO: 137632122
HOLE DEPTH: 5.90 m
CHECKED: JJP DATE: 8/8/13

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
RD	L		0	-6.90				CI-CH	Silty CLAY medium to high plasticity, grey, with some shells		VS	Approx. CH 22715
			1									
			2		BH7-001 PT 1.70-2.10 m Rec = 0/400 mm							
			3		BH7-002 U75 3.20-3.60 m Rec = 400/400 mm PP = 0.1-0.4 kg/cm^2 Sv = < 0.1 kg/cm^2							
			4	4.20								
	M			-11.10	BH7-003 U75 4.20-4.60 m Rec = 400/400 mm PP = 1.0-1.2 kg/cm^2 Sv = 0.2 kg/cm^2 Insitu Shear Vane at 4.6m Sv = >28 kPa				grey and brown and yellow brown pockets		St - VSt	
			5		BH7-004 Rec = 450/450 mm SPT 5.45-5.90 m 4, 7, 9 N=16							
			6	-12.80					END OF BOREHOLE @ 5.90 m TARGET DEPTH DRILLED OVER WATER			
			7									

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GAP gINT FN. F01a
RL3

EXPLANATION OF NOTES, ABBREVIATIONS & TERMS USED ON BOREHOLE AND TEST PIT REPORTS

DRILLING/EXCAVATION METHOD

AS*	Auger Screwing	RD	Rotary blade or drag bit	NQ	Diamond Core - 47 mm
AD*	Auger Drilling	RT	Rotary Tricone bit	NMLC	Diamond Core - 52 mm
*V	V-Bit	RAB	Rotary Air Blast	HQ	Diamond Core - 63 mm
*T	TC-Bit, e.g. ADT	RC	Reverse Circulation	HMLC	Diamond Core – 63mm
HA	Hand Auger	PT	Push Tube	BH	Tractor Mounted Backhoe
ADH	Hollow Auger	CT	Cable Tool Rig	EX	Tracked Hydraulic Excavator
DTC	Diatube Coring	JET	Jetting	EE	Existing Excavation
WB	Washbore or Bailer	NDD	Non-destructive digging	HAND	Excavated by Hand Methods

PENETRATION/EXCAVATION RESISTANCE

L **Low resistance.** Rapid penetration possible with little effort from the equipment used.

M **Medium resistance.** Excavation/possible at an acceptable rate with moderate effort from the equipment used.

H **High resistance** to penetration/excavation. Further penetration is possible at a slow rate and requires significant effort from the equipment.

R **Refusal or Practical Refusal.** No further progress possible without the risk of damage or unacceptable wear to the digging implement or machine.

These assessments are subjective and are dependent on many factors including the equipment power, weight, condition of excavation or drilling tools, and the experience of the operator.

WATER

▽	Water level at date shown	◁	Partial water loss
▷	Water inflow	◀	Complete water loss

GROUNDWATER NOT OBSERVED	The observation of groundwater, whether present or not, was not possible due to drilling water, surface seepage or cave in of the borehole/test pit.
GROUNDWATER NOT ENCOUNTERED	The borehole/test pit was dry soon after excavation. However, groundwater could be present in less permeable strata. Inflow may have been observed had the borehole/test pit been left open for a longer period.

SAMPLING AND TESTING

SPT	Standard Penetration Test to AS1289.6.3.1-2004
4,7,11 N=18	4,7,11 = Blows per 150mm. N = Blows per 300mm penetration following 150mm seating
30/80mm	Where practical refusal occurs, the blows and penetration for that interval are reported
RW	Penetration occurred under the rod weight only
HW	Penetration occurred under the hammer and rod weight only
HB	Hammer double bouncing on anvil
DS	Disturbed sample
BDS	Bulk disturbed sample
G	Gas Sample
W	Water Sample
FP	Field permeability test over section noted
FV	Field vane shear test expressed as uncorrected shear strength (s_v = peak value, s_r = residual value)
PID	Photoionisation Detector reading in ppm
PM	Pressuremeter test over section noted
PP	Pocket penetrometer test expressed as instrument reading in kPa
U63	Thin walled tube sample - number indicates nominal sample diameter in millimetres
WPT	Water pressure tests
DCP	Dynamic cone penetration test
CPT	Static cone penetration test
CPTu	Static cone penetration test with pore pressure (u) measurement

Ranking of Visually Observable Contamination and Odour (for specific soil contamination assessment projects)

R = 0	No visible evidence of contamination	R = A	No non-natural odours identified
R = 1	Slight evidence of visible contamination	R = B	Slight non-natural odours identified
R = 2	Visible contamination	R = C	Moderate non-natural odours identified
R = 3	Significant visible contamination	R = D	Strong non-natural odours identified

ROCK CORE RECOVERY

TCR = Total Core Recovery (%)

$$= \frac{\text{Length of core recovered}}{\text{Length of core run}} \times 100$$

SCR = Solid Core Recovery (%)

$$= \frac{\sum \text{Length of cylindrical core recovered}}{\text{Length of core run}} \times 100$$

RQD = Rock Quality Designation (%)

$$= \frac{\sum \text{Axial lengths of core} > 100 \text{ mm}}{\text{Length of core run}} \times 100$$

METHOD OF SOIL DESCRIPTION USED ON BOREHOLE AND TEST PIT REPORTS


FILL


GRAVEL (GP or GW)


SAND (SP or SW)


SILT (ML or MH)


CLAY (CL, CI or CH)


ORGANIC SOILS (OL or OH or Pt)


COBBLES or BOULDERS

Combinations of these basic symbols may be used to indicate mixed materials such as sandy clay.

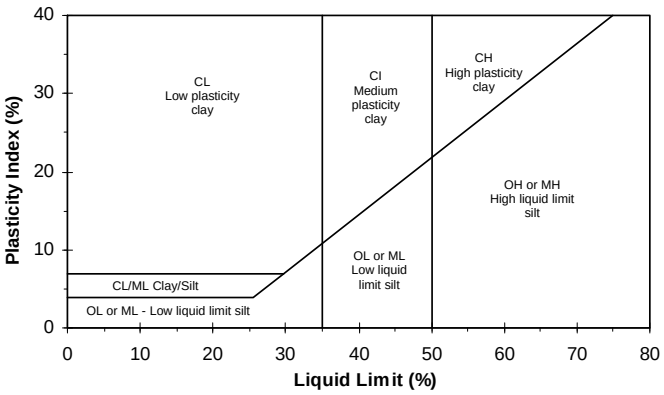
CLASSIFICATION AND INFERRED STRATIGRAPHY

Soil and Rock is classified and described in Reports of Boreholes and Test Pits using the preferred method given in AS1726 – 1993, (Amdt1 – 1994 and Amdt2 – 1994), Appendix A. The material properties are assessed in the field by visual/tactile methods.

Particle Size

Major Division	Sub Division	Particle Size
BOULDERS		> 200 mm
COBBLES		63 to 200 mm
GRAVEL	Coarse	20 to 63 mm
	Medium	6.0 to 20 mm
	Fine	2.0 to 6.0 mm
SAND	Coarse	0.6 to 2.0 mm
	Medium	0.2 to 0.6 mm
	Fine	0.075 to 0.2 mm
SILT		0.002 to 0.075 mm
CLAY		< 0.002 mm

Plasticity Properties



MOISTURE CONDITION

AS1726 - 1993

Symbol	Term	Description
D	Dry	Sands and gravels are free flowing. Clays & Silts may be brittle or friable and powdery.
M	Moist	Soils are darker than in the dry condition & may feel cool. Sands and gravels tend to cohere.
W	Wet	Soils exude free water. Sands and gravels tend to cohere.

CONSISTENCY AND DENSITY

AS1726 - 1993

Symbol	Term	Undrained Shear Strength
VS	Very Soft	0 to 12 kPa
S	Soft	12 to 25 kPa
F	Firm	25 to 50 kPa
St	Stiff	50 to 100 kPa
VSt	Very Stiff	100 to 200 kPa
H	Hard	Above 200 kPa

Symbol	Term	Density Index %	SPT "N" #
VL	Very Loose	Less than 15	0 to 4
L	Loose	15 to 35	4 to 10
MD	Medium Dense	35 to 65	10 to 30
D	Dense	65 to 85	30 to 50
VD	Very Dense	Above 85	Above 50

In the absence of test results, consistency and density may be assessed from correlations with the observed behaviour of the material.

SPT correlations are not stated in AS1726 – 1993, and may be subject to corrections for overburden pressure and equipment type.

APPENDIX B

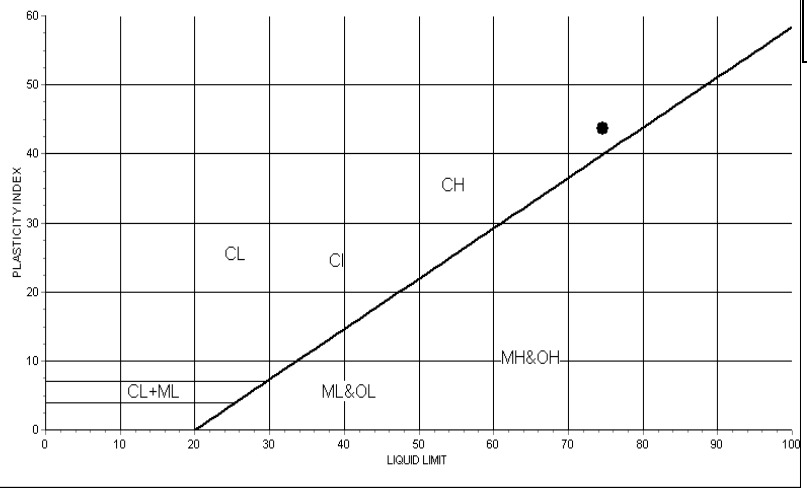
Results of Laboratory Testing

Golder Associates Pty Ltd
A.B.N. 64 006 107 857
Brisbane Laboratory
28 Bank Street
West End QLD 4101
(PO Box 3247 South Brisbane BC QLD 4101)
T: (61-7) 3840 9500
F: (61-7) 3840 9501
E: BNELab@golder.com.au

Atterberg Limits Report

Client:	**Ports North**	Report Number:	**137632122 - 2**
Client Address:	**Cnr Grafton & Hartley Streets Cairns QLD**		
Job Number:	**137632122**	Report Date:	**23/09/2013**
Project:	**Cairns Shipping Development**	Order Number:	**-**
Location	**Trinity Inlet , Cairns**		Page 1 of 22
Lab No:	**13303492**	Sample Location	
Date Sampled / Received:	**12/08/2013**	BH1 (0.1-0.5 m)	
Date Tested:	**30/08/2013**	001 U75	
Sampled By:	**Golder**	Sampled 29/7/13 to 5/8/13	
Sample Method:	**-**		
Material Source:	**Insitu**	Spec Description:	-
For Use As:	**Investigation**	Lot Number:	-
Remarks:	**This replaces the report dated 3/09/2013**	Spec Number:	-

Plasticity Tests		Test Method	Specification Minimum	Result	Specification Maximum
Sample History:	Oven Dried low temp.				
Moisture Content (%):°C	105 to 110	**AS1289.2.1.1**	-	**86.2**	-
Liquid Limit (%)		**AS1289.3.1.2**		**75**	
Plastic Limit (%)		**AS1289.3.2.1**		**31**	
Plasticity Index (%)		**AS1289.3.3.1**		**44**	
Linear Shrinkage (%)		**AS1289.3.4.1**		**17.5**	
			Linear Shrinkage State after drying	No crumbling or curling	



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APPROVED SIGNATORY

Mike Sandilands - Laboratory Manager

NATA Accred No:1961

FORM NUMBER: R37-RL-25

Golder Associates Pty Ltd
A.B.N. 64 006 107 857
Brisbane Laboratory
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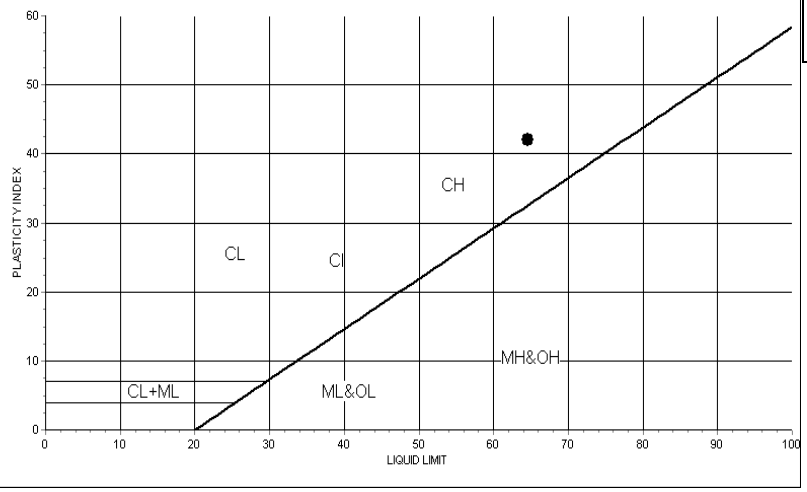
Atterberg Limits Report

Client:	**Ports North**	Report Number:	**137632122 - 2**
Client Address:	**Cnr Grafton & Hartley Streets Cairns QLD**		
Job Number:	**137632122**	Report Date:	**23/09/2013**
Project:	**Cairns Shipping Development**	Order Number:	**-**
Location	**Trinity Inlet , Cairns**		
Lab No:	**13303493**	Sample Location	
Date Sampled / Received:	**12/08/2013**	BH1 (2.1-2.5 m)	
Date Tested:	**30/08/2013**	003 U75	
Sampled By:	**Golder**	Sampled 29/7/13 to 5/8/13	
Sample Method:	**-**		
Material Source:	**Insitu**	Spec Description:	-
For Use As:	**Investigation**	Lot Number:	-
Remarks:	**This replaces the report dated 3/09/2013**	Spec Number:	-

Plasticity Tests		Test Method	Specification Minimum	Result	Specification Maximum
Sample History:	Oven Dried low temp.				
Moisture Content (%):°C	105 to 110	**AS1289.2.1.1**	-	**77.8**	-
Liquid Limit (%)		**AS1289.3.1.2**		**65**	
Plastic Limit (%)		**AS1289.3.2.1**		**23**	
Plasticity Index (%)		**AS1289.3.3.1**		**42**	
Linear Shrinkage (%)		**AS1289.3.4.1**		**16.0**	
			Linear Shrinkage State after drying	No crumbling or curling	



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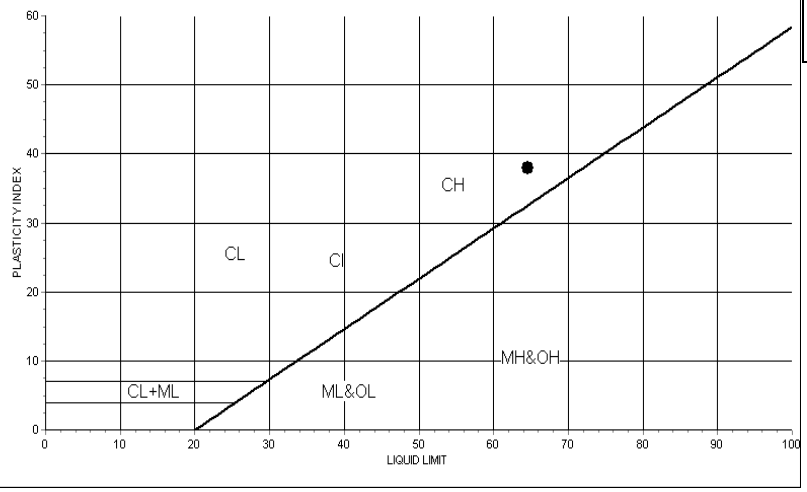
Atterberg Limits Report

Client:	**Ports North**	Report Number:	**137632122 - 2**
Client Address:	**Cnr Grafton & Hartley Streets Cairns QLD**		
Job Number:	**137632122**	Report Date:	**23/09/2013**
Project:	**Cairns Shipping Development**	Order Number:	**-**
Location	**Trinity Inlet , Cairns**		
Lab No:	**13303494**	Sample Location	
Date Sampled / Received:	**12/08/2013**	BH1 (3.1-3.5 m)	
Date Tested:	**29/08/2013**	004 U75	
Sampled By:	**Golder**	Sampled 29/7/13 to 5/8/13	
Sample Method:	**-**		
Material Source:	**Insitu**	Spec Description:	-
For Use As:	**Investigation**	Lot Number:	-
Remarks:	**This replaces the report dated 3/09/2013**	Spec Number:	-

Plasticity Tests		Test Method	Specification Minimum	Result	Specification Maximum
Sample History:	Oven Dried low temp.				
Moisture Content (%):°C	105 to 110	**AS1289.2.1.1**	-	**88.1**	-
Liquid Limit (%)		**AS1289.3.1.2**		**65**	
Plastic Limit (%)		**AS1289.3.2.1**		**27**	
Plasticity Index (%)		**AS1289.3.3.1**		**38**	
Linear Shrinkage (%)		**AS1289.3.4.1**		**14.5**	
			Linear Shrinkage State after drying	No crumbling or curling	



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APPROVED SIGNATORY

Mike Sandilands - Laboratory Manager

NATA Accred No:1961

FORM NUMBER: R37-RL-25

Golder Associates Pty Ltd
A.B.N. 64 006 107 857
Brisbane Laboratory
28 Bank Street
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(PO Box 3247 South Brisbane BC QLD 4101)
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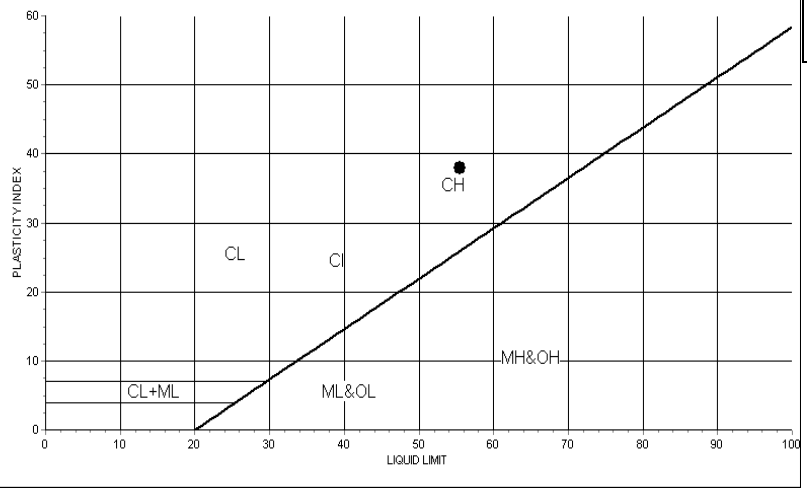
Atterberg Limits Report

Client:	**Ports North**	Report Number:	**137632122 - 2**
Client Address:	**Cnr Grafton & Hartley Streets Cairns QLD**		
Job Number:	**137632122**	Report Date:	**23/09/2013**
Project:	**Cairns Shipping Development**	Order Number:	**-**
Location	**Trinity Inlet , Cairns**		
Lab No:	**13303495**	Sample Location	
Date Sampled / Received:	**12/08/2013**	BH1 (4.1-4.5 m)	
Date Tested:	**30/08/2013**	005 U75	
Sampled By:	**Golder**	Sampled 29/7/13 to 5/8/13	
Sample Method:	**-**		
Material Source:	**Insitu**	Spec Description:	-
For Use As:	**Investigation**	Lot Number:	-
Remarks:	**This replaces the report dated 3/09/2013**	Spec Number:	-

Plasticity Tests		Test Method	Specification Minimum	Result	Specification Maximum
Sample History:	Oven Dried low temp.				
Moisture Content (%):°C	105 to 110	**AS1289.2.1.1**	-	**40.6**	-
Liquid Limit (%)		**AS1289.3.1.2**		**55**	
Plastic Limit (%)		**AS1289.3.2.1**		**18**	
Plasticity Index (%)		**AS1289.3.3.1**		**37**	
Linear Shrinkage (%)		**AS1289.3.4.1**		**16.5**	
			Linear Shrinkage State after drying	No crumbling or curling	



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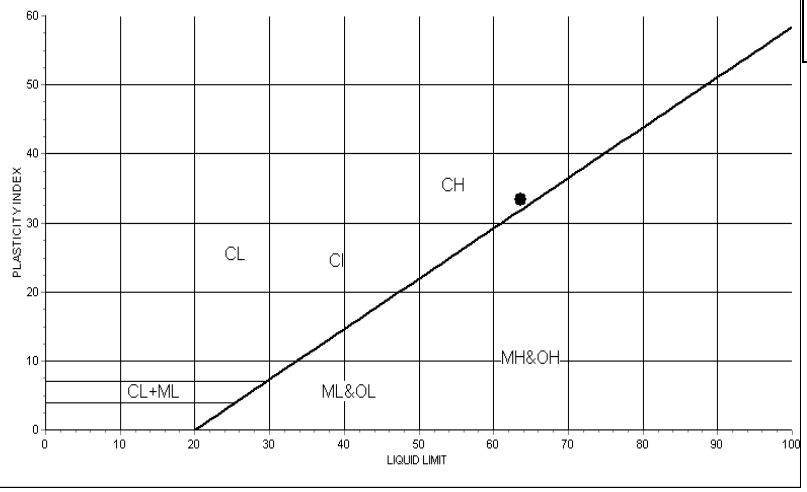
Atterberg Limits Report

Client:	**Ports North**	Report Number:	**137632122 - 2**
Client Address:	**Cnr Grafton & Hartley Streets Cairns QLD**		
Job Number:	**137632122**	Report Date:	**23/09/2013**
Project:	**Cairns Shipping Development**	Order Number:	**-**
Location	**Trinity Inlet , Cairns**		
Lab No:	**13303497**	Sample Location	
Date Sampled / Received:	**12/08/2013**	BH2 (2.1-2.5 m)	
Date Tested:	**29/08/2013**	002 U75	
Sampled By:	**Golder**	Sampled 29/7/13 to 5/8/13	
Sample Method:	**-**		
Material Source:	**Insitu**	Spec Description:	-
For Use As:	**Investigation**	Lot Number:	-
Remarks:	**This replaces the report dated 3/09/2013**	Spec Number:	-

Plasticity Tests		Test Method	Specification Minimum	Result	Specification Maximum
Sample History:	Oven Dried low temp.				
Moisture Content (%):°C	105 to 110	**AS1289.2.1.1**	-	**40.8**	-
Liquid Limit (%)		**AS1289.3.1.2**		**64**	
Plastic Limit (%)		**AS1289.3.2.1**		**30**	
Plasticity Index (%)		**AS1289.3.3.1**		**34**	
Linear Shrinkage (%)		**AS1289.3.4.1**		**16.5**	
			Linear Shrinkage State after drying	No crumbling or curling	



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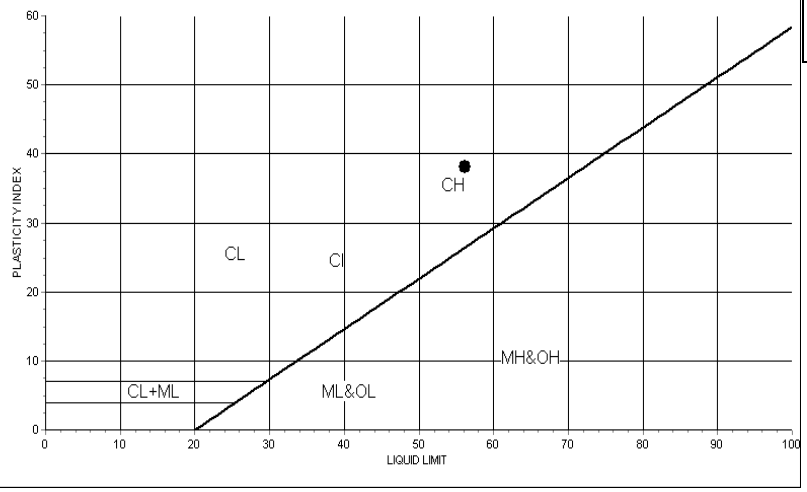
Atterberg Limits Report

Client:	**Ports North**	Report Number:	**137632122 - 2**
Client Address:	**Cnr Grafton & Hartley Streets Cairns QLD**		
Job Number:	**137632122**	Report Date:	**23/09/2013**
Project:	**Cairns Shipping Development**	Order Number:	**-**
Location	**Trinity Inlet , Cairns**		Page 6 of 22
Lab No:	**13303498**	Sample Location	
Date Sampled / Received:	**12/08/2013**	BH2 (3.1-3.55 m)	
Date Tested:	**30/08/2013**	003 SPT	
Sampled By:	**Golder**	Sampled 29/7/13 to 5/8/13	
Sample Method:	**-**		
Material Source:	**Insitu**	Spec Description:	-
For Use As:	**Investigation**	Lot Number:	-
Remarks:	**This replaces the report dated 3/09/2013**	Spec Number:	-

Plasticity Tests		Test Method	Specification Minimum	Result	Specification Maximum
Sample History:	Oven Dried low temp.				
Moisture Content (%):°C	105 to 110	**AS1289.2.1.1**	-	**23.2**	-
Liquid Limit (%)		**AS1289.3.1.2**		**56**	
Plastic Limit (%)		**AS1289.3.2.1**		**18**	
Plasticity Index (%)		**AS1289.3.3.1**		**38**	
Linear Shrinkage (%)		**AS1289.3.4.1**		**17.0**	
			Linear Shrinkage State after drying	No crumbling or curling	



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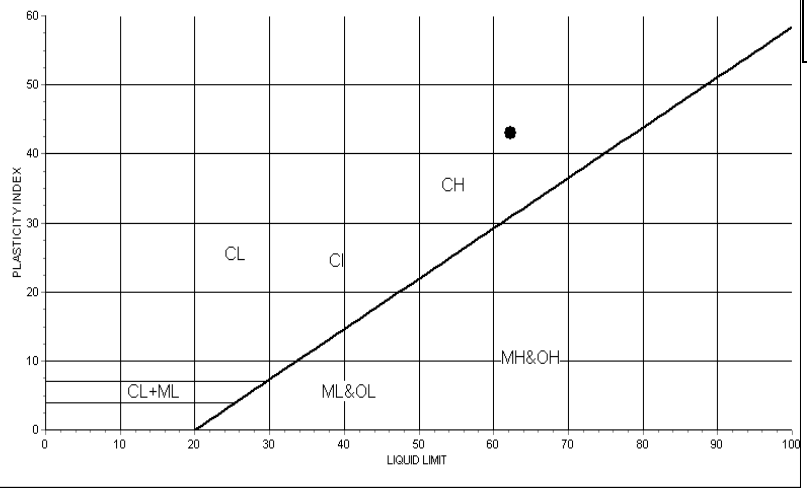
Atterberg Limits Report

Client:	**Ports North**	Report Number:	**137632122 - 2**
Client Address:	**Cnr Grafton & Hartley Streets Cairns QLD**		
Job Number:	**137632122**	Report Date:	**23/09/2013**
Project:	**Cairns Shipping Development**	Order Number:	**-**
Location	**Trinity Inlet , Cairns**		
Lab No:	**13303499**	Sample Location	
Date Sampled / Received:	**12/08/2013**	BH3 (0.4-0.8 m)	
Date Tested:	**29/08/2013**	001 U75	
Sampled By:	**Golder**	Sampled 29/7/13 to 5/8/13	
Sample Method:	**-**		
Material Source:	**Insitu**	Spec Description:	-
For Use As:	**Investigation**	Lot Number:	-
Remarks:	**This replaces the report dated 3/09/2013**	Spec Number:	-

Plasticity Tests		Test Method	Specification Minimum	Result	Specification Maximum
Sample History:	Oven Dried low temp.				
Moisture Content (%):°C	105 to 110	**AS1289.2.1.1**	-	**36.1**	-
Liquid Limit (%)		**AS1289.3.1.2**		**62**	
Plastic Limit (%)		**AS1289.3.2.1**		**19**	
Plasticity Index (%)		**AS1289.3.3.1**		**43**	
Linear Shrinkage (%)		**AS1289.3.4.1**		**17.5**	
			Linear Shrinkage State after drying	No crumbling or curling	



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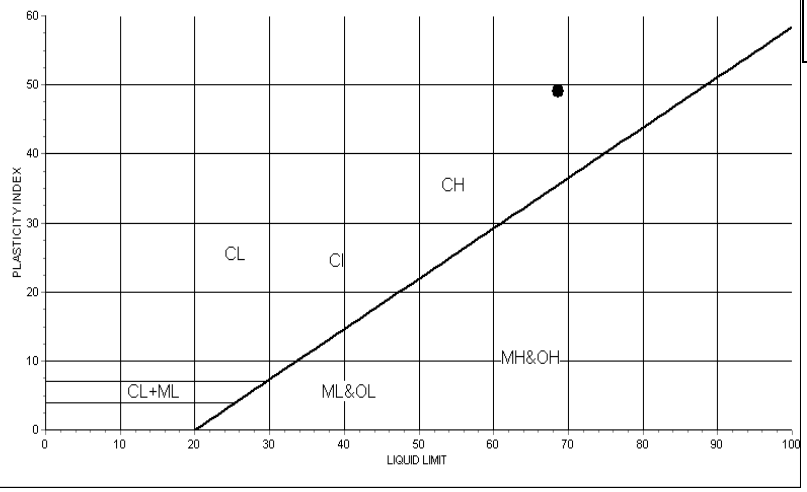
Atterberg Limits Report

Client:	**Ports North**	Report Number:	**137632122 - 2**
Client Address:	**Cnr Grafton & Hartley Streets Cairns QLD**		
Job Number:	**137632122**	Report Date:	**23/09/2013**
Project:	**Cairns Shipping Development**	Order Number:	**-**
Location	**Trinity Inlet , Cairns**		
Lab No:	**13303500**	Sample Location	
Date Sampled / Received:	**12/08/2013**	BH3 (1.4-1.8 m)	
Date Tested:	**29/08/2013**	002 U75	
Sampled By:	**Golder**	Sampled 29/7/13 to 5/8/13	
Sample Method:	**-**		
Material Source:	**Insitu**	Spec Description:	-
For Use As:	**Investigation**	Lot Number:	-
Remarks:	**This replaces the report dated 3/09/2013**	Spec Number:	-

Plasticity Tests		Test Method	Specification Minimum	Result	Specification Maximum
Sample History:	Oven Dried low temp.				
Moisture Content (%):°C	105 to 110	**AS1289.2.1.1**	-	**33.3**	-
Liquid Limit (%)		**AS1289.3.1.2**		**69**	
Plastic Limit (%)		**AS1289.3.2.1**		**20**	
Plasticity Index (%)		**AS1289.3.3.1**		**49**	
Linear Shrinkage (%)		**AS1289.3.4.1**		**19.5**	
			Linear Shrinkage State after drying	No crumbling or curling	



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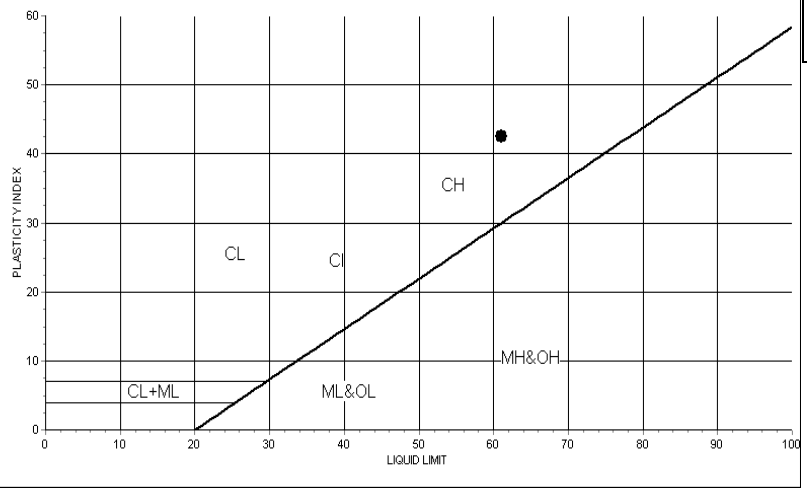
Atterberg Limits Report

Client:	**Ports North**	Report Number:	**137632122 - 2**
Client Address:	**Cnr Grafton & Hartley Streets Cairns QLD**		
Job Number:	**137632122**	Report Date:	**23/09/2013**
Project:	**Cairns Shipping Development**	Order Number:	**-**
Location	**Trinity Inlet , Cairns**		
Lab No:	**13303501**	Sample Location	
Date Sampled / Received:	**12/08/2013**	BH3 (4.8-5.25 m)	
Date Tested:	**29/08/2013**	006 SPT	
Sampled By:	**Golder**	Sampled 29/7/13 to 5/8/13	
Sample Method:	**-**		
Material Source:	**Insitu**	Spec Description:	-
For Use As:	**Investigation**	Lot Number:	-
Remarks:	**This replaces the report dated 3/09/2013**	Spec Number:	-

Plasticity Tests		Test Method	Specification Minimum	Result	Specification Maximum
Sample History:	Oven Dried low temp.				
Moisture Content (%):°C	105 to 110	**AS1289.2.1.1**	-	**29.8**	-
Liquid Limit (%)		**AS1289.3.1.2**		**61**	
Plastic Limit (%)		**AS1289.3.2.1**		**18**	
Plasticity Index (%)		**AS1289.3.3.1**		**43**	
Linear Shrinkage (%)		**AS1289.3.4.1**		**18.5**	



Linear Shrinkage State after drying	No crumbling or curling

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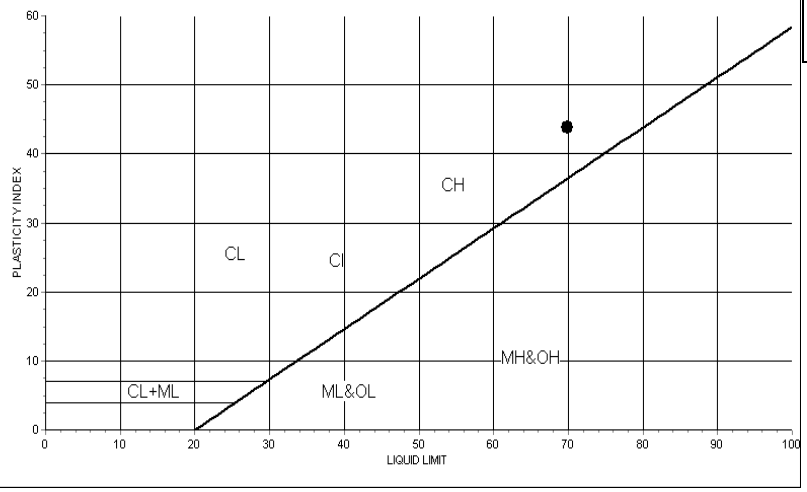
Atterberg Limits Report

Client:	**Ports North**	Report Number:	**137632122 - 2**
Client Address:	**Cnr Grafton & Hartley Streets Cairns QLD**		
Job Number:	**137632122**	Report Date:	**23/09/2013**
Project:	**Cairns Shipping Development**	Order Number:	**-**
Location	**Trinity Inlet , Cairns**		
Lab No:	**13303502**	Sample Location	
Date Sampled / Received:	**12/08/2013**	BH3 (2.4-2.63 m)	
Date Tested:	**29/08/2013**	003 U75	
Sampled By:	**Golder**	Sampled 29/7/13 to 5/8/13	
Sample Method:	**-**		
Material Source:	**Insitu**	Spec Description:	-
For Use As:	**Investigation**	Lot Number:	-
Remarks:	**This replaces the report dated 3/09/2013**	Spec Number:	-

Plasticity Tests		Test Method	Specification Minimum	Result	Specification Maximum
Sample History:	Oven Dried low temp.				
Moisture Content (%):°C	105 to 110	**AS1289.2.1.1**	-	**30.4**	-
Liquid Limit (%)		**AS1289.3.1.2**		**70**	
Plastic Limit (%)		**AS1289.3.2.1**		**26**	
Plasticity Index (%)		**AS1289.3.3.1**		**44**	
Linear Shrinkage (%)		**AS1289.3.4.1**		**18.0**	
			Linear Shrinkage State after drying	No crumbling or curling	



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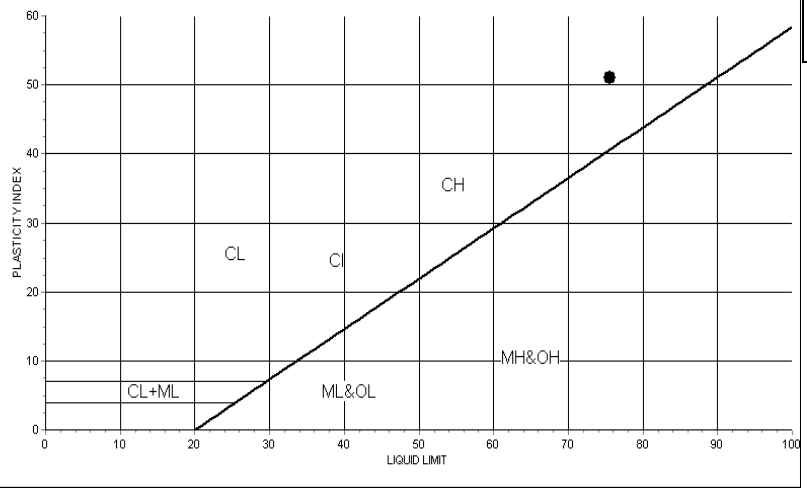
Atterberg Limits Report

Client:	**Ports North**	Report Number:	**137632122 - 2**
Client Address:	**Cnr Grafton & Hartley Streets Cairns QLD**		
Job Number:	**137632122**	Report Date:	**23/09/2013**
Project:	**Cairns Shipping Development**	Order Number:	**-**
Location	**Trinity Inlet , Cairns**		Page 11 of 22
Lab No:	**13303503**		Sample Location
Date Sampled / Received:	**12/08/2013**		BH4 (2.4-2.8 m)
Date Tested:	**30/08/2013**		001 U75
Sampled By:	**Golder**		Sampled 29/7/13 to 5/8/13
Sample Method:	**-**		
Material Source:	**Insitu**	Spec Description:	-
For Use As:	**Investigation**	Lot Number:	-
Remarks:	**This replaces the report dated 3/09/2013**	Spec Number:	-

Plasticity Tests		Test Method	Specification Minimum	Result	Specification Maximum
Sample History:	Oven Dried low temp.				
Moisture Content (%):°C	105 to 110	**AS1289.2.1.1**	-	**68.2**	-
Liquid Limit (%)		**AS1289.3.1.2**		**76**	
Plastic Limit (%)		**AS1289.3.2.1**		**25**	
Plasticity Index (%)		**AS1289.3.3.1**		**51**	
Linear Shrinkage (%)		**AS1289.3.4.1**		**17.5**	
			Linear Shrinkage State after drying	No crumbling or curling	



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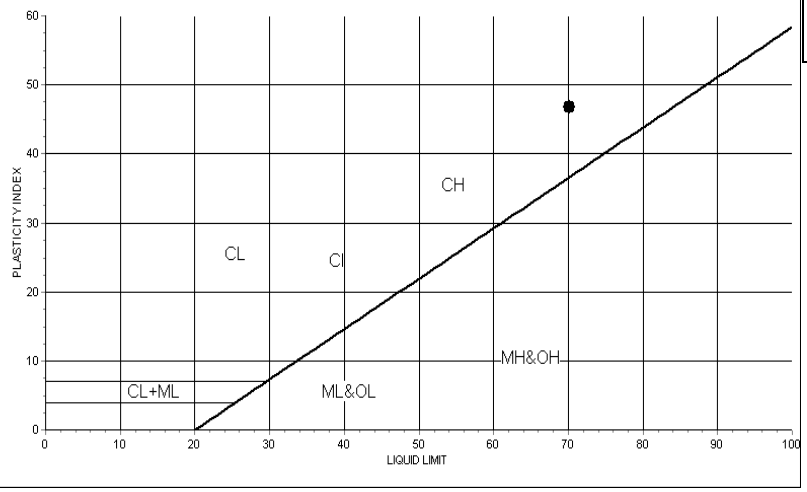
Atterberg Limits Report

Client:	**Ports North**	Report Number:	**137632122 - 2**
Client Address:	**Cnr Grafton & Hartley Streets Cairns QLD**		
Job Number:	**137632122**	Report Date:	**23/09/2013**
Project:	**Cairns Shipping Development**	Order Number:	**-**
Location	**Trinity Inlet , Cairns**		
Lab No:	**13303504**	Sample Location	
Date Sampled / Received:	**12/08/2013**	BH4 (3.4-3.8 m)	
Date Tested:	**29/08/2013**	002 U75	
Sampled By:	**Golder**	Sampled 29/7/13 to 5/8/13	
Sample Method:	**-**		
Material Source:	**Insitu**	Spec Description:	-
For Use As:	**Investigation**	Lot Number:	-
Remarks:	**This replaces the report dated 3/09/2013**	Spec Number:	-

Plasticity Tests		Test Method	Specification Minimum	Result	Specification Maximum
Sample History:	Oven Dried low temp.				
Moisture Content (%):°C	105 to 110	**AS1289.2.1.1**	-	**71.5**	-
Liquid Limit (%)		**AS1289.3.1.2**		**70**	
Plastic Limit (%)		**AS1289.3.2.1**		**23**	
Plasticity Index (%)		**AS1289.3.3.1**		**47**	
Linear Shrinkage (%)		**AS1289.3.4.1**		**18.0**	
			Linear Shrinkage State after drying	No crumbling or curling	



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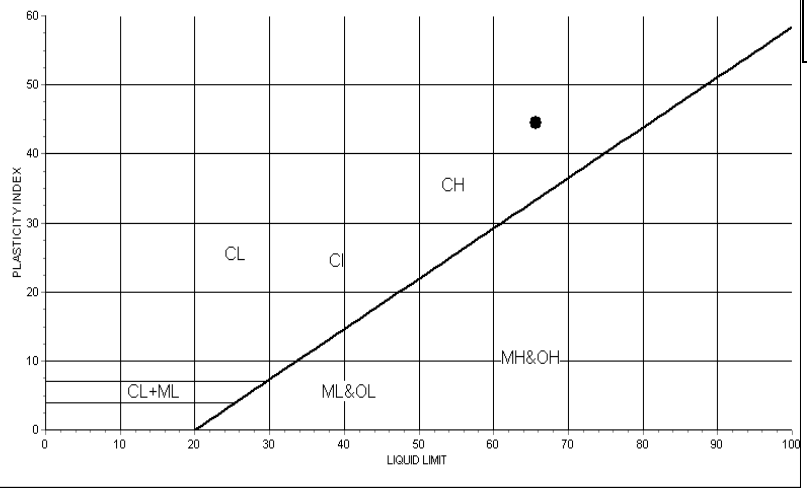
Atterberg Limits Report

Client:	**Ports North**	Report Number:	**137632122 - 2**
Client Address:	**Cnr Grafton & Hartley Streets Cairns QLD**		
Job Number:	**137632122**	Report Date:	**23/09/2013**
Project:	**Cairns Shipping Development**	Order Number:	**-**
Location	**Trinity Inlet , Cairns**		
Lab No:	**13303505**	Sample Location	
Date Sampled / Received:	**12/08/2013**	BH4 (4.4-4.8 m)	
Date Tested:	**30/08/2013**	003 U75	
Sampled By:	**Golder**	Sampled 29/7/13 to 5/8/13	
Sample Method:	**-**		
Material Source:	**Insitu**	Spec Description:	-
For Use As:	**Investigation**	Lot Number:	-
Remarks:	**This replaces the report dated 3/09/2013**	Spec Number:	-

Plasticity Tests		Test Method	Specification Minimum	Result	Specification Maximum
Sample History:	Oven Dried low temp.				
Moisture Content (%):°C	105 to 110	**AS1289.2.1.1**	-	**44.0**	-
Liquid Limit (%)		**AS1289.3.1.2**		**66**	
Plastic Limit (%)		**AS1289.3.2.1**		**21**	
Plasticity Index (%)		**AS1289.3.3.1**		**45**	
Linear Shrinkage (%)		**AS1289.3.4.1**		**18.0**	
			Linear Shrinkage State after drying	No crumbling or curling	



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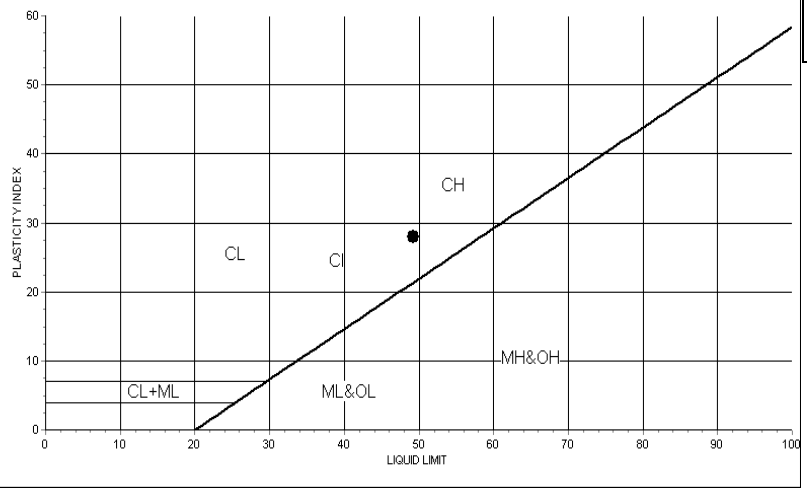
Atterberg Limits Report

Client:	**Ports North**	Report Number:	**137632122 - 2**
Client Address:	**Cnr Grafton & Hartley Streets Cairns QLD**		
Job Number:	**137632122**	Report Date:	**23/09/2013**
Project:	**Cairns Shipping Development**	Order Number:	**-**
Location	**Trinity Inlet , Cairns**		
Lab No:	**13303507**	Sample Location	
Date Sampled / Received:	**12/08/2013**	BH5 (2.4-2.8 m)	
Date Tested:	**29/08/2013**	001 U75	
Sampled By:	**Golder**	Sampled 29/7/13 to 5/8/13	
Sample Method:	**-**		
Material Source:	**Insitu**	Spec Description:	-
For Use As:	**Investigation**	Lot Number:	-
Remarks:	**This replaces the report dated 3/09/2013**	Spec Number:	-

Plasticity Tests		Test Method	Specification Minimum	Result	Specification Maximum
Sample History:	Oven Dried low temp.				
Moisture Content (%):°C	105 to 110	**AS1289.2.1.1**	-	**54.6**	-
Liquid Limit (%)		**AS1289.3.1.2**		**49**	
Plastic Limit (%)		**AS1289.3.2.1**		**21**	
Plasticity Index (%)		**AS1289.3.3.1**		**28**	
Linear Shrinkage (%)		**AS1289.3.4.1**		**12.0**	
			Linear Shrinkage State after drying	No crumbling or curling	



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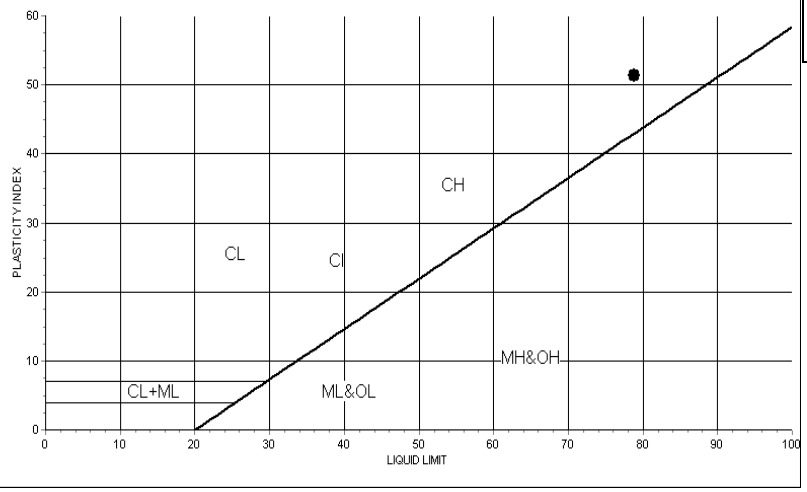
Atterberg Limits Report

Client:	**Ports North**	Report Number:	**137632122 - 2**
Client Address:	**Cnr Grafton & Hartley Streets Cairns QLD**		
Job Number:	**137632122**	Report Date:	**23/09/2013**
Project:	**Cairns Shipping Development**	Order Number:	**-**
Location	**Trinity Inlet , Cairns**		Page 15 of 22
Lab No:	**13303509**	Sample Location	
Date Sampled / Received:	**12/08/2013**	BH5 (7.4-7.9 m)	
Date Tested:	**30/08/2013**	006 U75	
Sampled By:	**Golder**	Sampled 29/7/13 to 5/8/13	
Sample Method:	**-**		
Material Source:	**Insitu**	Spec Description:	-
For Use As:	**Investigation**	Lot Number:	-
Remarks:	**This replaces the report dated 3/09/2013**	Spec Number:	-

Plasticity Tests		Test Method	Specification Minimum	Result	Specification Maximum
Sample History:	Oven Dried low temp.				
Moisture Content (%):°C	105 to 110	**AS1289.2.1.1**	-	**69.4**	-
Liquid Limit (%)		**AS1289.3.1.2**		**79**	
Plastic Limit (%)		**AS1289.3.2.1**		**28**	
Plasticity Index (%)		**AS1289.3.3.1**		**51**	
Linear Shrinkage (%)		**AS1289.3.4.1**		**18.5**	
			Linear Shrinkage State after drying	No crumbling or curling	



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FORM NUMBER: R37-RL-25

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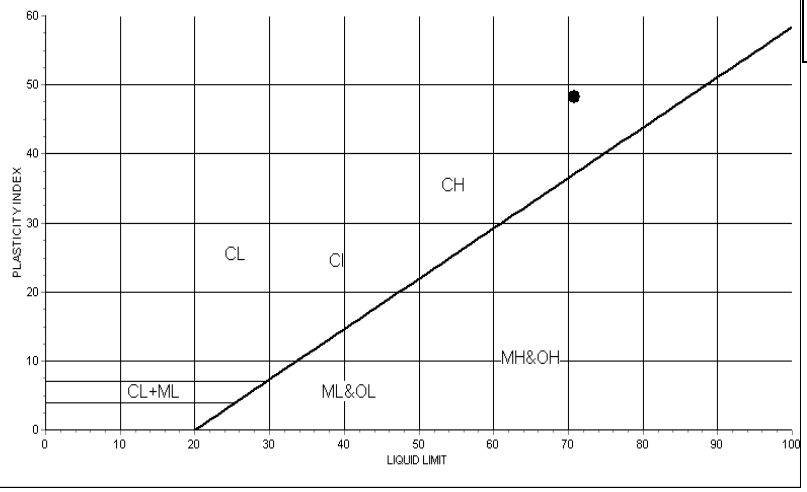
Atterberg Limits Report

Client:	**Ports North**	Report Number:	**137632122 - 2**
Client Address:	**Cnr Grafton & Hartley Streets Cairns QLD**		
Job Number:	**137632122**	Report Date:	**23/09/2013**
Project:	**Cairns Shipping Development**	Order Number:	**-**
Location	**Trinity Inlet , Cairns**		Page 16 of 22
Lab No:	**13303510**		Sample Location
Date Sampled / Received:	**12/08/2013**		BH5 (10.4-10.8 m)
Date Tested:	**29/08/2013**		009 U75
Sampled By:	**Golder**		Sampled 29/7/13 to 5/8/13
Sample Method:	**-**		
Material Source:	**Insitu**	Spec Description:	-
For Use As:	**Investigation**	Lot Number:	-
Remarks:	**This replaces the report dated 3/09/2013**	Spec Number:	-

Plasticity Tests		Test Method	Specification Minimum	Result	Specification Maximum
Sample History:	Oven Dried low temp.				
Moisture Content (%):°C	105 to 110	**AS1289.2.1.1**	-	**58.0**	-
Liquid Limit (%)		**AS1289.3.1.2**		**71**	
Plastic Limit (%)		**AS1289.3.2.1**		**23**	
Plasticity Index (%)		**AS1289.3.3.1**		**48**	
Linear Shrinkage (%)		**AS1289.3.4.1**		**16.5**	
			Linear Shrinkage State after drying	No crumbling or curling	



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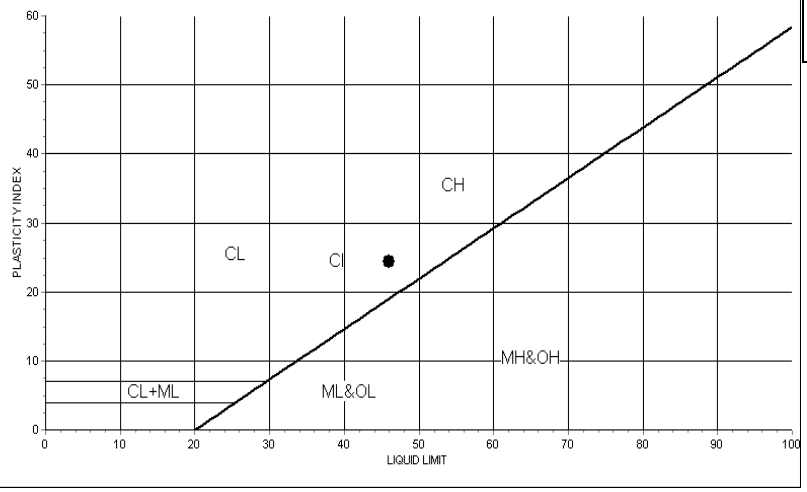
Atterberg Limits Report

Client:	**Ports North**	Report Number:	**137632122 - 2**
Client Address:	**Cnr Grafton & Hartley Streets Cairns QLD**		
Job Number:	**137632122**	Report Date:	**23/09/2013**
Project:	**Cairns Shipping Development**	Order Number:	**-**
Location	**Trinity Inlet , Cairns**		
Lab No:	**13303512**	Sample Location	
Date Sampled / Received:	**12/08/2013**	BH6 (2.0-2.4 m)	
Date Tested:	**30/08/2013**	003 U75	
Sampled By:	**Golder**	Sampled 29/7/13 to 5/8/13	
Sample Method:	**-**		
Material Source:	**Insitu**	Spec Description:	-
For Use As:	**Investigation**	Lot Number:	-
Remarks:	**This replaces the report dated 3/09/2013**	Spec Number:	-

Plasticity Tests		Test Method	Specification Minimum	Result	Specification Maximum
Sample History:	Oven Dried low temp.				
Moisture Content (%):°C	105 to 110	**AS1289.2.1.1**	-	**49.6**	-
Liquid Limit (%)		**AS1289.3.1.2**		**46**	
Plastic Limit (%)		**AS1289.3.2.1**		**22**	
Plasticity Index (%)		**AS1289.3.3.1**		**24**	
Linear Shrinkage (%)		**AS1289.3.4.1**		**9.5**	
			Linear Shrinkage State after drying	No crumbling or curling	



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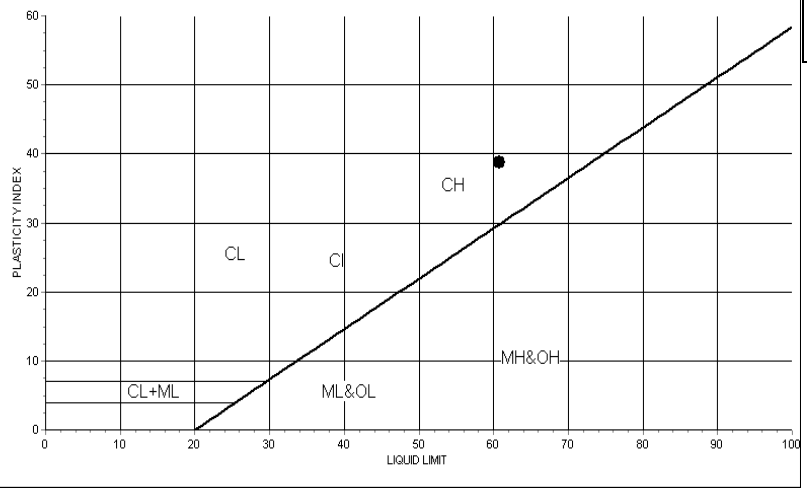
Atterberg Limits Report

Client:	**Ports North**	Report Number:	**137632122 - 2**
Client Address:	**Cnr Grafton & Hartley Streets Cairns QLD**		
Job Number:	**137632122**	Report Date:	**23/09/2013**
Project:	**Cairns Shipping Development**	Order Number:	**-**
Location	**Trinity Inlet , Cairns**		
Lab No:	**13303513**	Sample Location	
Date Sampled / Received:	**12/08/2013**	BH6 (5.0-5.4 m)	
Date Tested:	**30/08/2013**	006 U75	
Sampled By:	**Golder**	Sampled 29/7/13 to 5/8/13	
Sample Method:	**-**		
Material Source:	**Insitu**	Spec Description:	-
For Use As:	**Investigation**	Lot Number:	-
Remarks:	**This replaces the report dated 3/09/2013**	Spec Number:	-

Plasticity Tests		Test Method	Specification Minimum	Result	Specification Maximum
Sample History:	Oven Dried low temp.				
Moisture Content (%):°C	105 to 110	**AS1289.2.1.1**	-	**81.9**	-
Liquid Limit (%)		**AS1289.3.1.2**		**61**	
Plastic Limit (%)		**AS1289.3.2.1**		**22**	
Plasticity Index (%)		**AS1289.3.3.1**		**39**	
Linear Shrinkage (%)		**AS1289.3.4.1**		**15.5**	
			Linear Shrinkage State after drying	No crumbling or curling	



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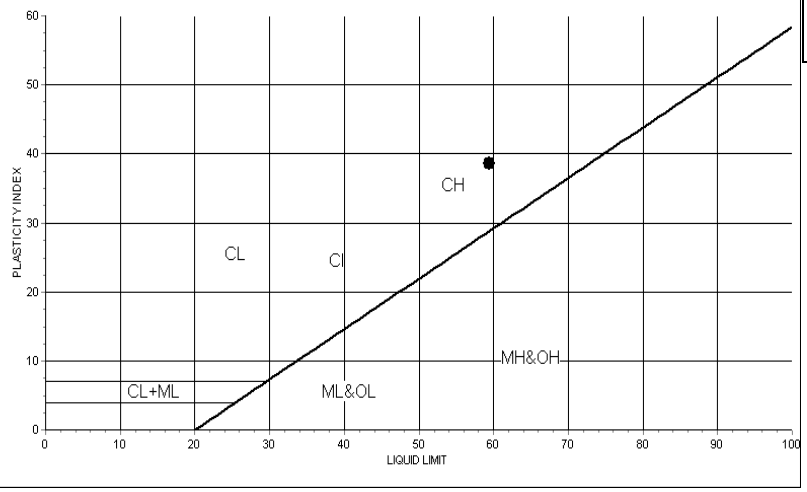
Atterberg Limits Report

Client:	**Ports North**	Report Number:	**137632122 - 2**
Client Address:	**Cnr Grafton & Hartley Streets Cairns QLD**		
Job Number:	**137632122**	Report Date:	**23/09/2013**
Project:	**Cairns Shipping Development**	Order Number:	**-**
Location	**Trinity Inlet , Cairns**		Page 19 of 22
Lab No:	**13303514**		Sample Location
Date Sampled / Received:	**12/08/2013**		BH6 (6.0-6.4 m)
Date Tested:	**30/08/2013**		007 U75
Sampled By:	**Golder**		Sampled 29/7/13 to 5/8/13
Sample Method:	**-**		
Material Source:	**Insitu**	Spec Description:	-
For Use As:	**Investigation**	Lot Number:	-
Remarks:	**This replaces the report dated 3/09/2013**	Spec Number:	-

Plasticity Tests		Test Method	Specification Minimum	Result	Specification Maximum
Sample History:	Oven Dried low temp.				
Moisture Content (%):°C	105 to 110	**AS1289.2.1.1**	-	**45.0**	-
Liquid Limit (%)		**AS1289.3.1.2**		**59**	
Plastic Limit (%)		**AS1289.3.2.1**		**21**	
Plasticity Index (%)		**AS1289.3.3.1**		**38**	
Linear Shrinkage (%)		**AS1289.3.4.1**		**16.0**	
			Linear Shrinkage State after drying	No crumbling or curling	



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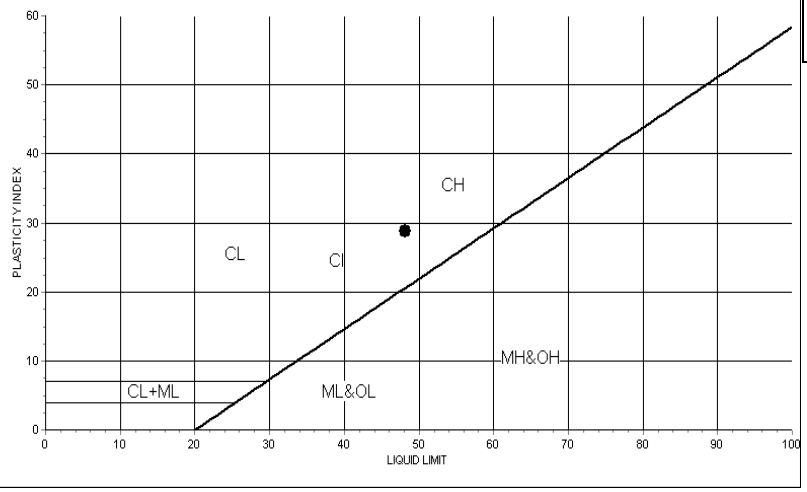
Atterberg Limits Report

Client:	**Ports North**	Report Number:	**137632122 - 2**
Client Address:	**Cnr Grafton & Hartley Streets Cairns QLD**		
Job Number:	**137632122**	Report Date:	**23/09/2013**
Project:	**Cairns Shipping Development**	Order Number:	**-**
Location	**Trinity Inlet , Cairns**		
Lab No:	**13303516**	Sample Location	
Date Sampled / Received:	**12/08/2013**	BH7 (3.2-3.6 m)	
Date Tested:	**29/08/2013**	002 U75	
Sampled By:	**Golder**	Sampled 29/7/13 to 5/8/13	
Sample Method:	**-**		
Material Source:	**Insitu**	Spec Description:	-
For Use As:	**Investigation**	Lot Number:	-
Remarks:	**This replaces the report dated 3/09/2013**	Spec Number:	-

Plasticity Tests		Test Method	Specification Minimum	Result	Specification Maximum
Sample History:	Oven Dried low temp.				
Moisture Content (%):°C	105 to 110	**AS1289.2.1.1**	-	**55.2**	-
Liquid Limit (%)		**AS1289.3.1.2**		**48**	
Plastic Limit (%)		**AS1289.3.2.1**		**19**	
Plasticity Index (%)		**AS1289.3.3.1**		**29**	
Linear Shrinkage (%)		**AS1289.3.4.1**		**12.5**	
			Linear Shrinkage State after drying	No crumbling or curling	



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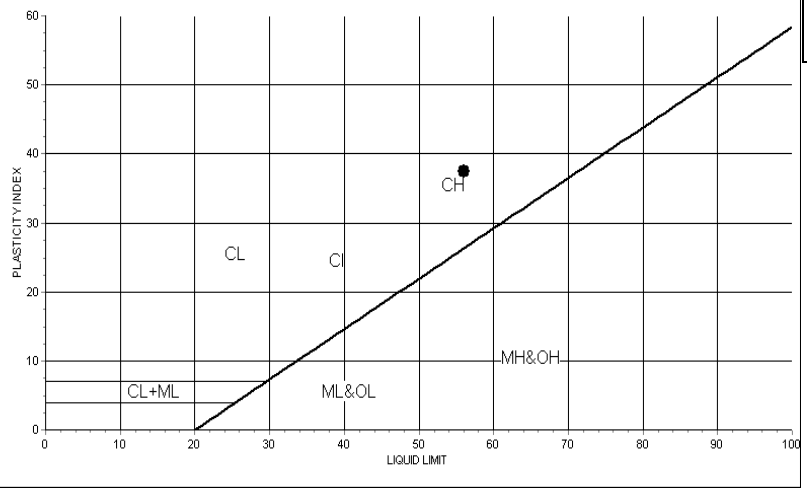
Atterberg Limits Report

Client:	**Ports North**	Report Number:	**137632122 - 2**
Client Address:	**Cnr Grafton & Hartley Streets Cairns QLD**		
Job Number:	**137632122**	Report Date:	**23/09/2013**
Project:	**Cairns Shipping Development**	Order Number:	**-**
Location	**Trinity Inlet , Cairns**		
Lab No:	**13303517**	Sample Location	
Date Sampled / Received:	**12/08/2013**	BH7 (4.2-4.6 m)	
Date Tested:	**29/08/2013**	003 U75	
Sampled By:	**Golder**	Sampled 29/7/13 to 5/8/13	
Sample Method:	**-**		
Material Source:	**Insitu**	Spec Description:	-
For Use As:	**Investigation**	Lot Number:	-
Remarks:	**This replaces the report dated 3/09/2013**	Spec Number:	-

Plasticity Tests		Test Method	Specification Minimum	Result	Specification Maximum
Sample History:	Oven Dried low temp.				
Moisture Content (%):°C	105 to 110	**AS1289.2.1.1**	-	**43.3**	-
Liquid Limit (%)		**AS1289.3.1.2**		**56**	
Plastic Limit (%)		**AS1289.3.2.1**		**19**	
Plasticity Index (%)		**AS1289.3.3.1**		**37**	
Linear Shrinkage (%)		**AS1289.3.4.1**		**15.5**	
			Linear Shrinkage State after drying	No crumbling or curling	



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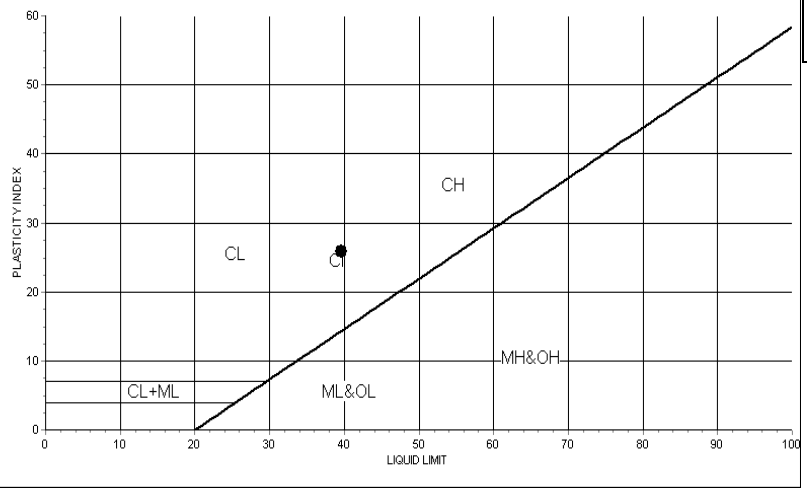
Atterberg Limits Report

Client:	**Ports North**	Report Number:	**137632122 - 2**
Client Address:	**Cnr Grafton & Hartley Streets Cairns QLD**		
Job Number:	**137632122**	Report Date:	**23/09/2013**
Project:	**Cairns Shipping Development**	Order Number:	**-**
Location	**Trinity Inlet , Cairns**		Page 22 of 22
Lab No:	**13303518**		Sample Location
Date Sampled / Received:	**12/08/2013**		BH7 (5.45-5.9 m)
Date Tested:	**29/08/2013**		004 SPT
Sampled By:	**Golder**		Sampled 29/7/13 to 5/8/13
Sample Method:	**-**		
Material Source:	**Insitu**	Spec Description:	-
For Use As:	**Investigation**	Lot Number:	-
Remarks:	**This replaces the report dated 3/09/2013**	Spec Number:	-

Plasticity Tests		Test Method	Specification Minimum	Result	Specification Maximum
Sample History:	Oven Dried low temp.				
Moisture Content (%):°C	105 to 110	**AS1289.2.1.1**	-	**22.8**	-
Liquid Limit (%)		**AS1289.3.1.2**		**40**	
Plastic Limit (%)		**AS1289.3.2.1**		**14**	
Plasticity Index (%)		**AS1289.3.3.1**		**26**	
Linear Shrinkage (%)		**AS1289.3.4.1**		**12.0**	
			Linear Shrinkage State after drying	No crumbling or curling	



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Moisture Content Report

Client :	**Ports North**	Report Number:	**137632122 - 1**
Client Address:	**Cnr Grafton & Hartley Streets Cairns QLD**		
Job Number :	**137632122**	Report Date:	**23/09/2013**
Project :	**Cairns Shipping Development**	Order Number:	
Location :	**Trinity Inlet , Cairns**	Test Method:	**AS1289.2.1.1**

Lab No :	13303492	13303493	13303494	13303495
ID No :	-	-	-	-
Lot No :	-	-	-	-
Item No :	-	-	-	-
Date Sampled / Received :	12/8/2013	12/8/2013	12/8/2013	12/8/2013
Date Tested :	19/8/2013	19/8/2013	19/8/2013	19/8/2013
Material Source :	Insitu	Insitu	Insitu	Insitu
For Use As :	Investigation	Investigation	Investigation	Investigation
Sample Location :	BH1 (0.1-0.5 m) 001 U75 Sampled 29/7/13 to 5/8/13	BH1 (2.1-2.5 m) 003 U75 Sampled 29/7/13 to 5/8/13	BH1 (3.1-3.5 m) 004 U75 Sampled 29/7/13 to 5/8/13	BH1 (4.1-4.5 m) 005 U75 Sampled 29/7/13 to 5/8/13
Drying Temperature(°C):	**105 to 110**	**105 to 110**	**105 to 110**	**105 to 110**
Moisture Content(%):	**86.0**	**78.0**	**88.0**	**40.6**
Remarks :	**This replaces the report dated 3/09/2013**			

Lab Number:	Soil Description
13303492	
13303493	
13303494	
13303495	

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Moisture Content Report

Client :	**Ports North**	Report Number:	**137632122 - 1**
Client Address:	**Cnr Grafton & Hartley Streets Cairns QLD**		
Job Number :	**137632122**	Report Date:	**23/09/2013**
Project :	**Cairns Shipping Development**	Order Number:	
Location :	**Trinity Inlet , Cairns**	Test Method:	**AS1289.2.1.1**

Lab No :	13303497	13303498	13303499	13303500
ID No :	-	-	-	-
Lot No :	-	-	-	-
Item No :	-	-	-	-
Date Sampled / Received :	12/8/2013	12/8/2013	12/8/2013	12/8/2013
Date Tested :	20/8/2013	20/8/2013	20/8/2013	20/8/2013
Material Source :	Insitu	Insitu	Insitu	Insitu
For Use As :	Investigation	Investigation	Investigation	Investigation
Sample Location :	BH2 (2.1-2.5 m) 002 U75 Sampled 29/7/13 to 5/8/13	BH2 (3.1-3.55 m) 003 SPT Sampled 29/7/13 to 5/8/13	BH3 (0.4-0.8 m) 001 U75 Sampled 29/7/13 to 5/8/13	BH3 (1.4-1.8 m) 002 U75 Sampled 29/7/13 to 5/8/13
Drying Temperature(°C):	**105 to 110**	**105 to 110**	**105 to 110**	**105 to 110**
Moisture Content(%):	**40.8**	**23.2**	**36.1**	**33.3**
Remarks :	**This replaces the report dated 3/09/2013**			

Lab Number:	Soil Description
13303497	
13303498	
13303499	
13303500	

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Moisture Content Report

Client :	**Ports North**	Report Number:	**137632122 - 1**
Client Address:	**Cnr Grafton & Hartley Streets Cairns QLD**		
Job Number :	**137632122**	Report Date:	**23/09/2013**
Project :	**Cairns Shipping Development**	Order Number:	
Location :	**Trinity Inlet , Cairns**	Test Method:	**AS1289.2.1.1**

Lab No :	13303501	13303502	13303503	13303504
ID No :	-	-	-	-
Lot No :	-	-	-	-
Item No :	-	-	-	-
Date Sampled / Received :	12/8/2013	12/8/2013	12/8/2013	12/8/2013
Date Tested :	20/8/2013	20/8/2013	20/8/2013	27/8/2013
Material Source :	Insitu	Insitu	Insitu	Insitu
For Use As :	Investigation	Investigation	Investigation	Investigation
Sample Location :	BH3 (4.8-5.25 m) 006 SPT Sampled 29/7/13 to 5/8/13	BH3 (2.4-2.63 m) 003 U75 Sampled 29/7/13 to 5/8/13	BH4 (2.4-2.8 m) 001 U75 Sampled 29/7/13 to 5/8/13	BH4 (3.4-3.8 m) 002 U75 Sampled 29/7/13 to 5/8/13
Drying Temperature(°C):	**105 to 110**	**105 to 110**	**105 to 110**	**105 to 110**
Moisture Content(%):	**29.8**	**30.4**	**68.0**	**71.5**
Remarks :	**This replaces the report dated 3/09/2013**			

Lab Number:	Soil Description
13303501	
13303502	
13303503	
13303504	

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FORM NUMBER: R69-RL-17

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Moisture Content Report

Client :	**Ports North**	Report Number:	**137632122 - 1**
Client Address:	**Cnr Grafton & Hartley Streets Cairns QLD**		
Job Number :	**137632122**	Report Date:	**23/09/2013**
Project :	**Cairns Shipping Development**	Order Number:	
Location :	**Trinity Inlet , Cairns**	Test Method:	**AS1289.2.1.1**

Lab No :	13303505	13303507	13303509	13303510
ID No :	-	-	-	-
Lot No :	-	-	-	-
Item No :	-	-	-	-
Date Sampled / Received :	12/8/2013	12/8/2013	12/8/2013	12/8/2013
Date Tested :	20/8/2013	20/8/2013	20/8/2013	20/8/2013
Material Source :	Insitu	Insitu	Insitu	Insitu
For Use As :	Investigation	Investigation	Investigation	Investigation
Sample Location :	BH4 (4.4-4.8 m) 003 U75 Sampled 29/7/13 to 5/8/13	BH5 (2.4-2.8 m) 001 U75 Sampled 29/7/13 to 5/8/13	BH5 (7.4-7.9 m) 006 U75 Sampled 29/7/13 to 5/8/13	BH5 (10.4-10.8 m) 009 U75 Sampled 29/7/13 to 5/8/13
Drying Temperature(°C):	**105 to 110**	**105 to 110**	**105 to 110**	**105 to 110**
Moisture Content(%):	**44.0**	**54.5**	**69.5**	**58.0**
Remarks :	**This replaces the report dated 3/09/2013**			

Lab Number:	Soil Description
13303505	
13303507	
13303509	
13303510	

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APPROVED SIGNATORY

Mike Sandilands - Laboratory Manager

NATA Accred No:1961

FORM NUMBER: R69-RL-17

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Moisture Content Report

Client :	**Ports North**	Report Number:	**137632122 - 1**
Client Address:	**Cnr Grafton & Hartley Streets Cairns QLD**		
Job Number :	**137632122**	Report Date:	**23/09/2013**
Project :	**Cairns Shipping Development**	Order Number:	
Location :	**Trinity Inlet , Cairns**	Test Method:	**AS1289.2.1.1**

Lab No :	13303512	13303513	13303514	13303516
ID No :	-	-	-	-
Lot No :	-	-	-	-
Item No :	-	-	-	-
Date Sampled / Received :	12/8/2013	12/8/2013	12/8/2013	12/8/2013
Date Tested :	20/8/2013	20/8/2013	20/8/2013	20/8/2013
Material Source :	Insitu	Insitu	Insitu	Insitu
For Use As :	Investigation	Investigation	Investigation	Investigation
Sample Location :	BH6 (2.0-2.4 m) 003 U75 Sampled 29/7/13 to 5/8/13	BH6 (5.0-5.4 m) 006 U75 Sampled 29/7/13 to 5/8/13	BH6 (6.0-6.4 m) 007 U75 Sampled 29/7/13 to 5/8/13	BH7 (3.2-3.6 m) 002 U75 Sampled 29/7/13 to 5/8/13
Drying Temperature(°C):	**105 to 110**	**105 to 110**	**105 to 110**	**105 to 110**
Moisture Content(%):	**49.6**	**82.0**	**45.0**	**55.0**
Remarks :	**This replaces the report dated 3/09/2013**			

Lab Number:	Soil Description
13303512	
13303513	
13303514	
13303516	

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FORM NUMBER: R69-RL-17

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Moisture Content Report

Client :	**Ports North**	Report Number:	**137632122 - 1**
Client Address:	**Cnr Grafton & Hartley Streets Cairns QLD**		
Job Number :	**137632122**	Report Date:	**23/09/2013**
Project :	**Cairns Shipping Development**	Order Number:	
Location :	**Trinity Inlet , Cairns**	Test Method:	**AS1289.2.1.1**

Lab No :	13303517	13303518		
ID No :	-	-		
Lot No :	-	-		
Item No :	-	-		
Date Sampled / Received :	12/8/2013	12/8/2013		
Date Tested :	20/8/2013	20/8/2013		
Material Source :	Insitu	Insitu		
For Use As :	Investigation	Investigation		
Sample Location :	BH7 (4.2-4.6 m) 003 U75 Sampled 29/7/13 to 5/8/13	BH7 (5.45-5.9 m) 004 SPT Sampled 29/7/13 to 5/8/13		
Drying Temperature(°C):	**105 to 110**	**105 to 110**		
Moisture Content(%):	**43.3**	**22.8**		
Remarks :	**This replaces the report dated 3/09/2013**			

Lab Number:	Soil Description
13303517	
13303518	

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NATA Accred No:1961

FORM NUMBER: R69-RL-17

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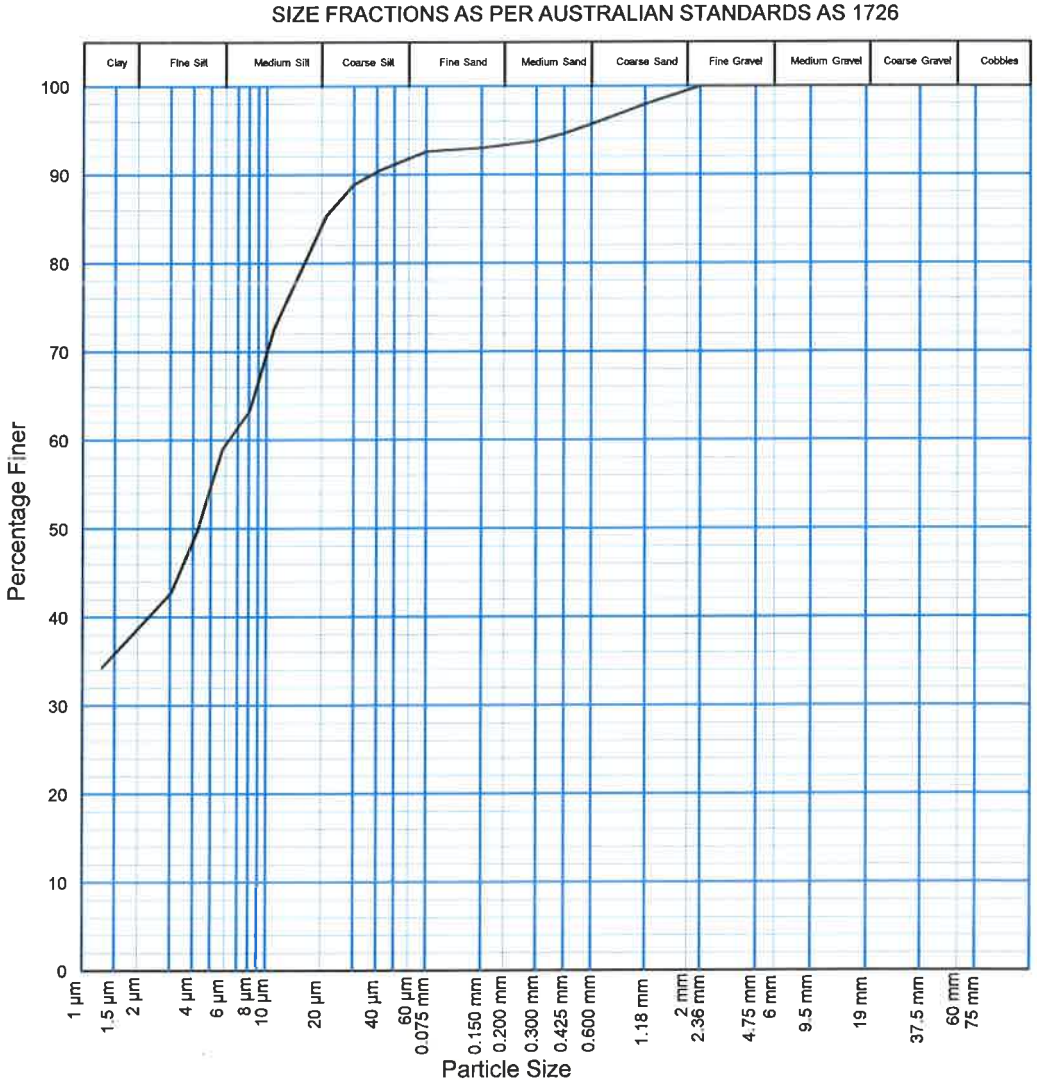
PARTICLE SIZE DISTRIBUTION BY HYDROMETER

Client :	Ports North	Report No. :	R16139
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122-4000
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303492
Location/Sample ID :	BH1 001 (0.10 - 0.50m)	Senders No. :	
		Date Received :	12/08/2013
		Sampled By :	Golder

Particle Size (mm)	Percent Passing
150	
75	
37.5	
19.0	
9.5	
4.75	
2.36	100.0
1.18	98.0
0.600	95.7
0.425	94.7
0.300	93.8
0.150	93.0
0.075	92.6
Particle Size (Microns)	**Percent Passing**
41.7	90.5
29.7	88.8
21.2	85.4
11.0	72.6
8.1	63.3
5.8	59.0
4.2	49.6
3.0	42.8
1.3	34.3



Pretreatment	Tested as received	Soil Particle Density (assumed)	2.70 t/m³
Loss in Pretreatment (%)	-	Type of Hydrometer	ASTM E100
Method of Dispersion	Mixer		
Test Procedure : AS 1289.3.6.3	- Variations to test method a)assumed particle density used b) testing up to 24 hours		
Prepared by : NF		Checked by : GH	

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Nick Farrer
Approved Signatory

Senior Technical Officer
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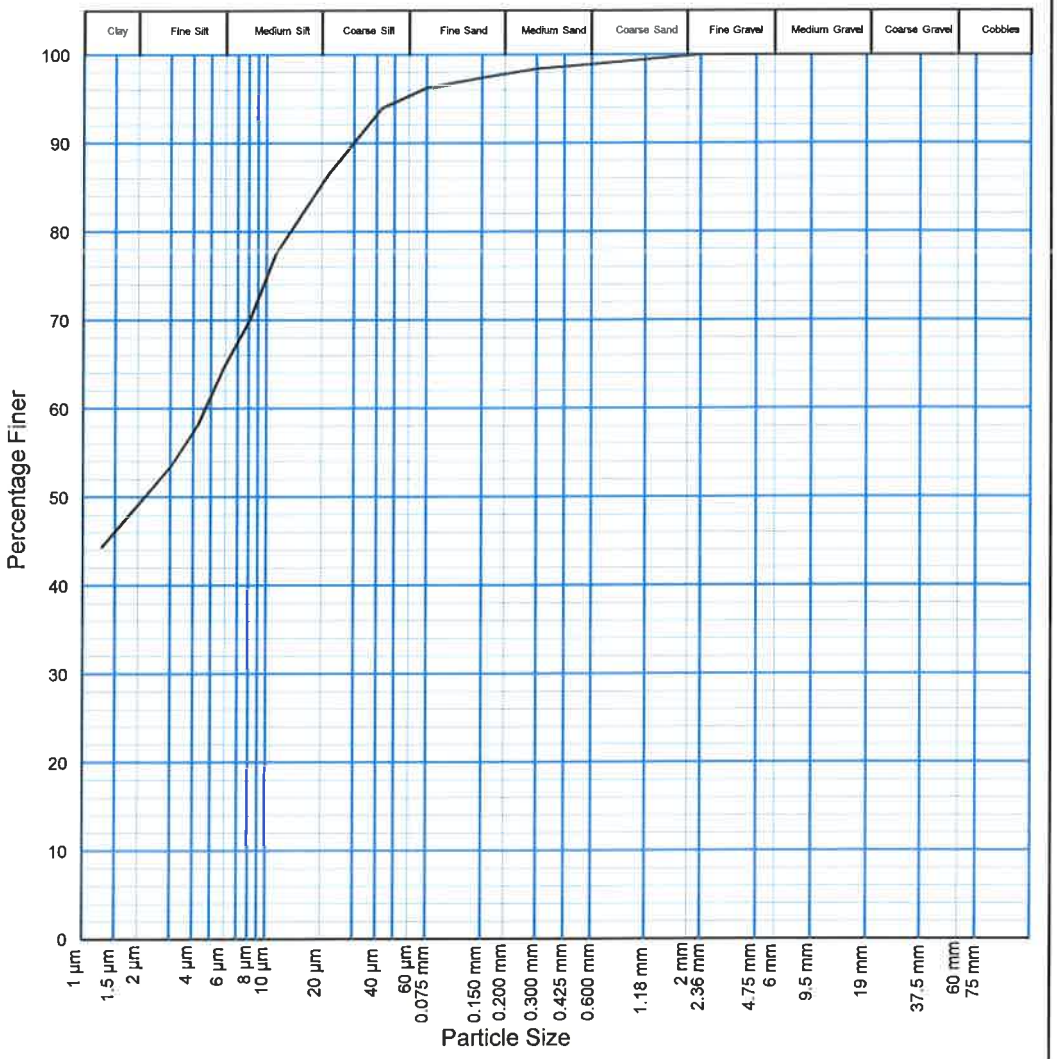
PARTICLE SIZE DISTRIBUTION BY HYDROMETER

Client :	Ports North	Report No. :	R16140
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122-4000
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303493
Location/Sample ID :	BH1 003 (2.10 - 2.50m)	Senders No. :	
		Date Received :	12/08/2013
		Sampled By :	Golder

SIZE FRACTIONS AS PER AUSTRALIAN STANDARDS AS 1726

Particle Size (mm)	Percent Passing
150	
75	
37.5	
19.0	
9.5	
4.75	
2.36	100.0
1.18	99.4
0.600	98.9
0.425	98.6
0.300	98.4
0.150	97.4
0.075	96.2
Particle Size (Microns)	**Percent Passing**
42.8	94.0
30.6	90.3
21.9	86.6
11.2	77.4
8.1	70.1
5.8	64.6
4.2	58.1
3.0	53.5
1.3	44.4



Pretreatment	Tested as received	Soil Particle Density (assumed)	2.70 t/m³
Loss in Pretreatment (%)	-	Type of Hydrometer	ASTM E100
Method of Dispersion	Mixer		
Test Procedure : AS 1289.3.6.3	- Variations to test method a)assumed particle density used b) testing up to 24 hours		
Prepared by : NF		Checked by : NF	

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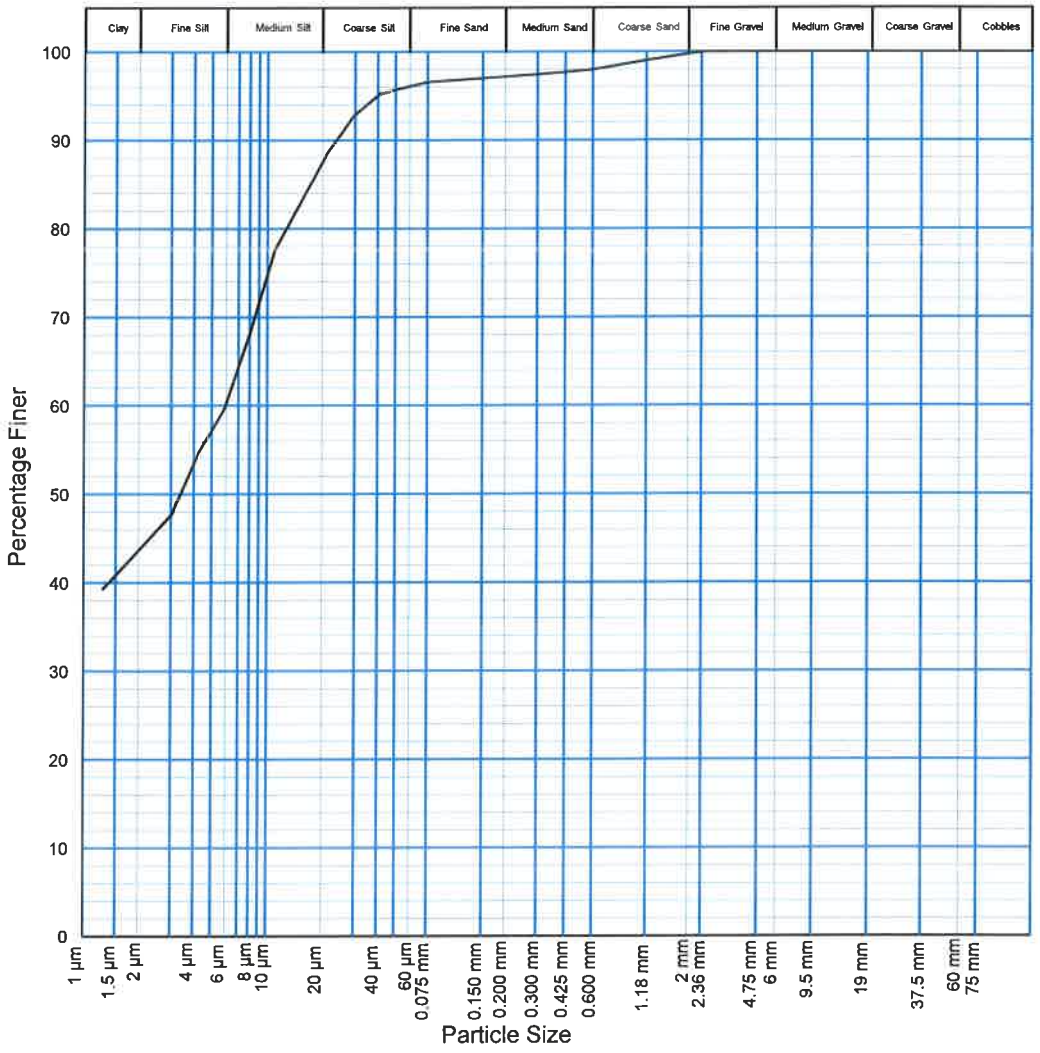
PARTICLE SIZE DISTRIBUTION BY HYDROMETER

Client :	Ports North	Report No. :	R16141
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122-4000
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303494
Location/Sample ID :	BH1 004 (3.10 - 3.50m)	Senders No. :	
		Date Received :	12/08/2013
		Sampled By :	Golder

SIZE FRACTIONS AS PER AUSTRALIAN STANDARDS AS 1726

Particle Size (mm)	Percent Passing
150	
75	
37.5	
19.0	
9.5	
4.75	
2.36	100.0
1.18	99.0
0.600	98.0
0.425	97.7
0.300	97.4
0.150	97.0
0.075	96.6
Particle Size (Microns)	Percent Passing
41.4	95.3
29.6	92.8
21.2	88.5
11.0	77.5
8.0	68.1
5.8	59.7
4.2	54.6
3.0	47.8
1.3	39.3



Pretreatment	Tested as received	Soil Particle Density (assumed)	2.70 t/m³
Loss in Pretreatment (%)	-	Type of Hydrometer	ASTM E100
Method of Dispersion	Mixer		
Test Procedure : AS 1289.3.6.3	- Variations to test method a)assumed particle density used b) testing up to 24 hours		
Prepared by : NF		Checked by : GH	

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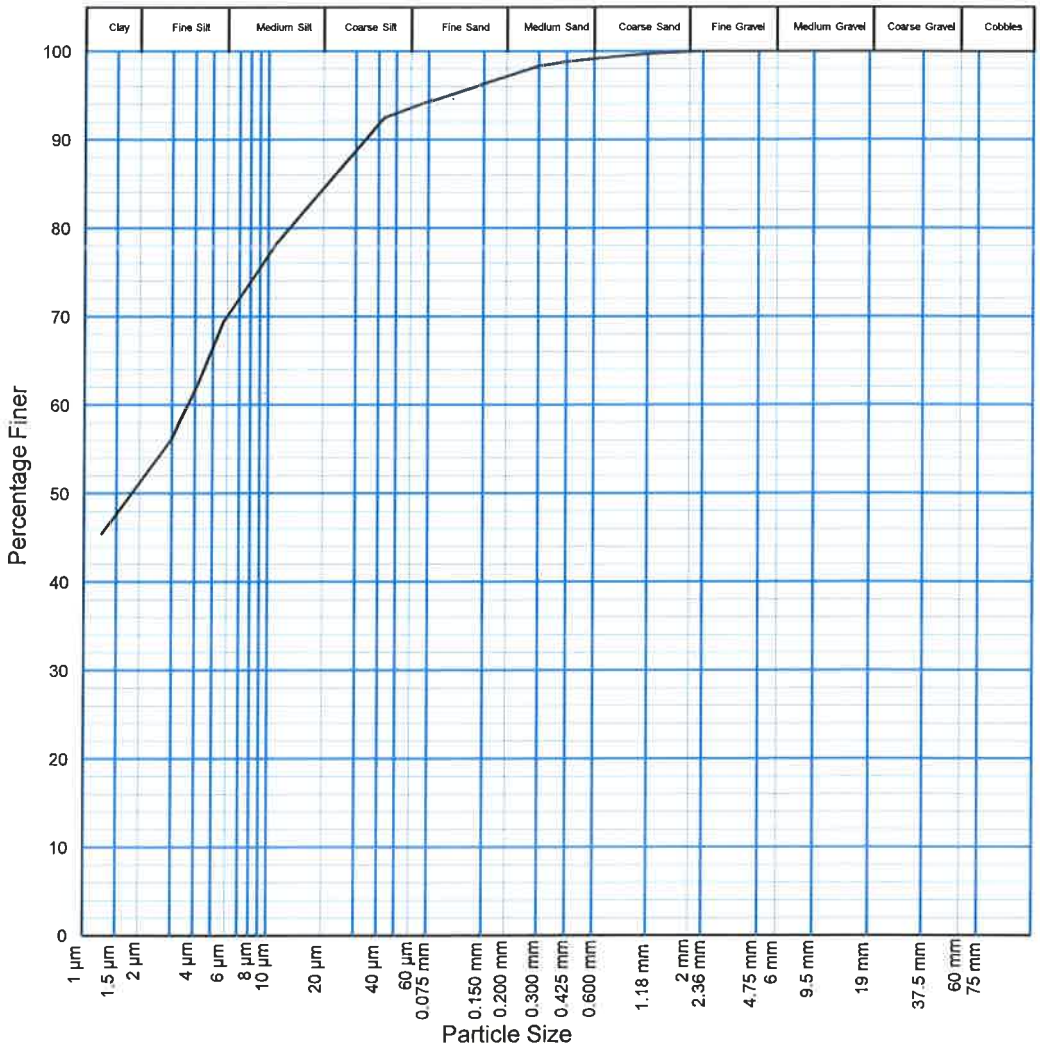
PARTICLE SIZE DISTRIBUTION BY HYDROMETER

Client :	Ports North	Report No. :	R16142
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122-4000
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303495
Location/Sample ID :	BH1 005 (4.10 - 4.50m)	Senders No. :	
		Date Received :	12/08/2013
		Sampled By :	Golder

SIZE FRACTIONS AS PER AUSTRALIAN STANDARDS AS 1726

Particle Size (mm)	Percent Passing
150	
75	
37.5	
19.0	
9.5	
4.75	
2.36	100.0
1.18	99.7
0.600	99.1
0.425	98.8
0.300	98.4
0.150	96.4
0.075	94.4
Particle Size (Microns)	**Percent Passing**
42.5	92.5
30.4	88.9
21.8	85.4
11.1	78.3
7.9	73.9
5.7	69.4
4.1	62.3
3.0	56.1
1.3	45.5



Pretreatment	Tested as received	Soil Particle Density (assumed)	2.70 t/m³
Loss in Pretreatment (%)	-	Type of Hydrometer	ASTM E100
Method of Dispersion	Mixer		
Test Procedure : AS 1289.3.6.3	- Variations to test method a)assumed particle density used b) testing up to 24 hours		
Prepared by : NF		Checked by : GH	

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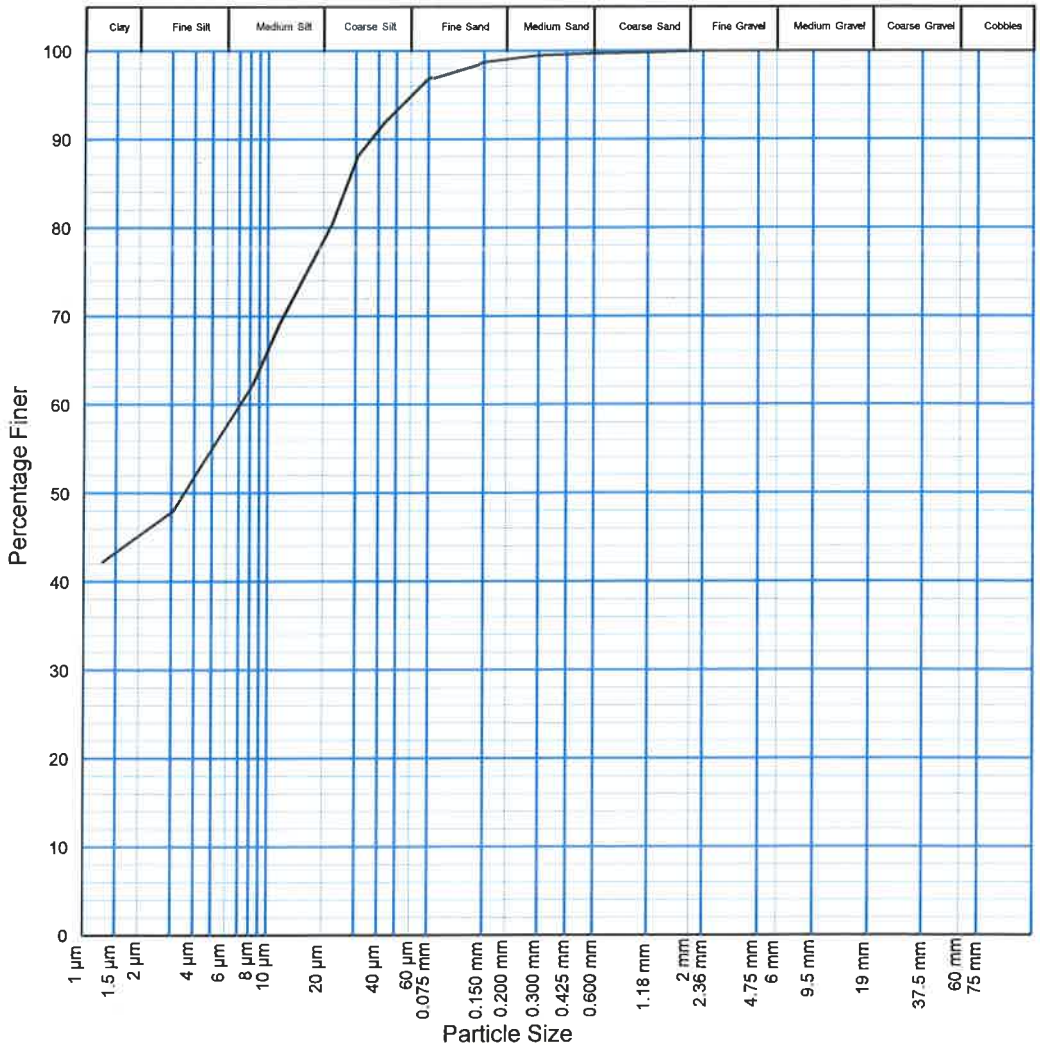
PARTICLE SIZE DISTRIBUTION BY HYDROMETER

Client :	Ports North	Report No. :	R16143
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122-4000
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303496
Location/Sample ID :	BH2 001 (1.10 - 1.50m)	Senders No. :	
		Date Received :	12/08/2013
		Sampled By :	Golder

SIZE FRACTIONS AS PER AUSTRALIAN STANDARDS AS 1726

Particle Size (mm)	Percent Passing
150	
75	
37.5	
19.0	
9.5	
4.75	
2.36	100.0
1.18	99.8
0.600	99.7
0.425	99.6
0.300	99.5
0.150	98.7
0.075	96.9
Particle Size (Microns)	**Percent Passing**
43.0	91.9
30.8	88.1
22.3	80.5
11.5	69.0
8.3	62.3
5.9	57.5
4.3	52.8
3.0	48.0
1.3	42.3



Pretreatment	Tested as received	Soil Particle Density (assumed)	2.70 t/m³
Loss in Pretreatment (%)	-	Type of Hydrometer	ASTM E100
Method of Dispersion	Mixer		
Test Procedure : AS 1289.3.6.3	- Variations to test method a)assumed particle density used b) testing up to 24 hours		
Prepared by : NF		Checked by : GH	

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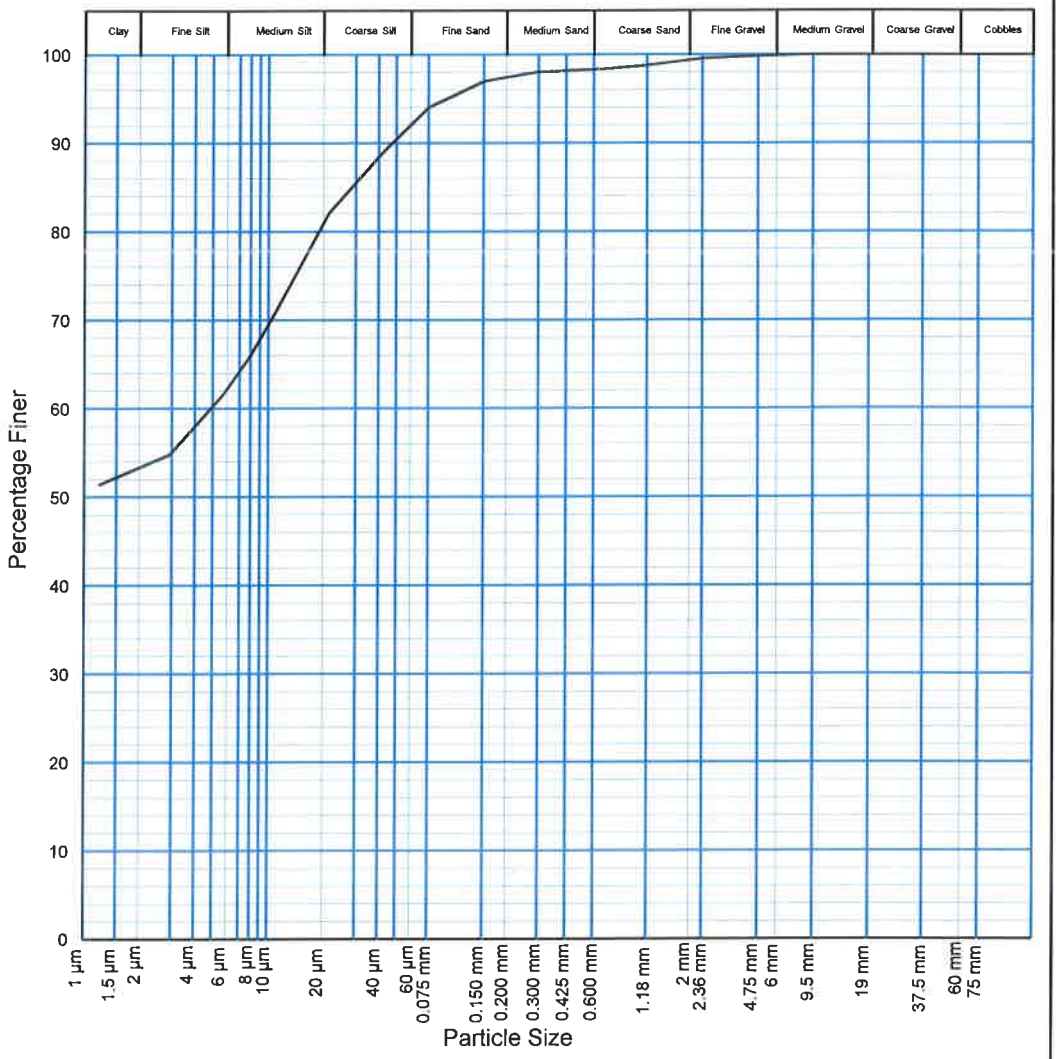
PARTICLE SIZE DISTRIBUTION BY HYDROMETER

Client :	Ports North	Report No. :	R16144
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122-4000
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303497
Location/Sample ID :	BH2 002 (2.10 - 2.50m)	Senders No. :	
		Date Received :	12/08/2013
		Sampled By :	Golder

Particle Size (mm)	Percent Passing
150	
75	
37.5	
19.0	
9.5	100.0
4.75	99.8
2.36	99.5
1.18	98.8
0.600	98.3
0.425	98.2
0.300	98.1
0.150	97.0
0.075	94.1
Particle Size (Microns)	Percent Passing
41.9	89.0
30.0	85.6
21.5	82.2
11.1	71.1
8.0	65.9
5.7	61.7
4.1	58.3
2.9	54.8
1.2	51.4

SIZE FRACTIONS AS PER AUSTRALIAN STANDARDS AS 1726



Pretreatment	Tested as received	Soil Particle Density (assumed)	2.70 t/m³
Loss in Pretreatment (%)	-	Type of Hydrometer	ASTM E100
Method of Dispersion	Mixer		
Test Procedure : AS 1289.3.6.3	- Variations to test method a)assumed particle density used b) testing up to 24 hours		
Prepared by : NF		Checked by : GH	

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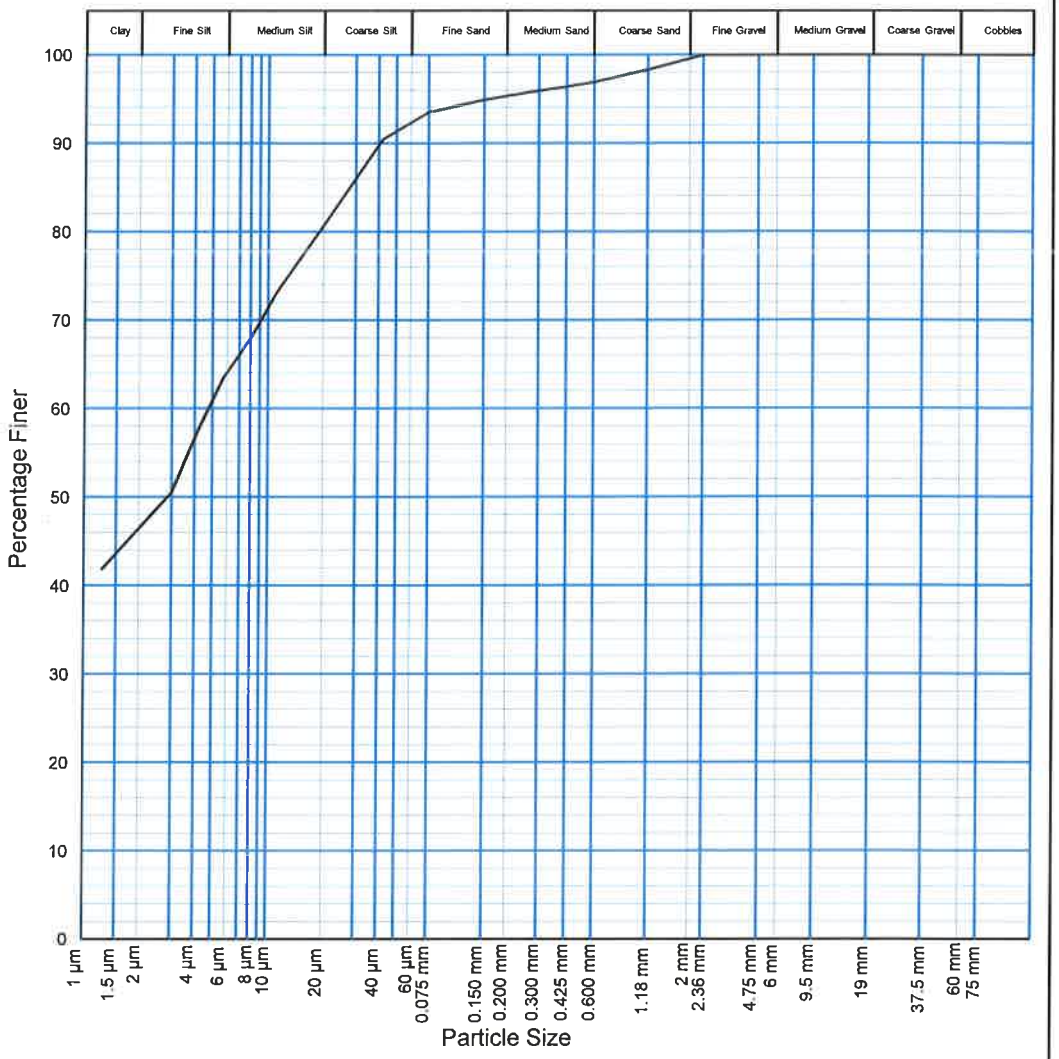
PARTICLE SIZE DISTRIBUTION BY HYDROMETER

Client :	Ports North	Report No. :	R16145
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122-4000
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303498
Location/Sample ID :	BH2 003 (3.10 - 3.55m)	Senders No. :	
		Date Received :	12/08/2013
		Sampled By :	Golder

SIZE FRACTIONS AS PER AUSTRALIAN STANDARDS AS 1726

Particle Size (mm)	Percent Passing
150	
75	
37.5	
19.0	
9.5	
4.75	
2.36	100.0
1.18	98.3
0.600	96.9
0.425	96.4
0.300	95.9
0.150	94.9
0.075	93.5
Particle Size (Microns)	Percent Passing
41.9	90.4
30.1	86.1
21.7	81.8
11.1	73.1
8.0	67.9
5.7	63.6
4.1	57.5
3.0	50.5
1.3	41.9



Pretreatment	Tested as received	Soil Particle Density (assumed)	2.70 t/m³
Loss in Pretreatment (%)	-	Type of Hydrometer	ASTM E100
Method of Dispersion	Mixer		
Test Procedure : AS 1289.3.6.3	- Variations to test method a)assumed particle density used b) testing up to 24 hours		
Prepared by : NF		Checked by : CH	

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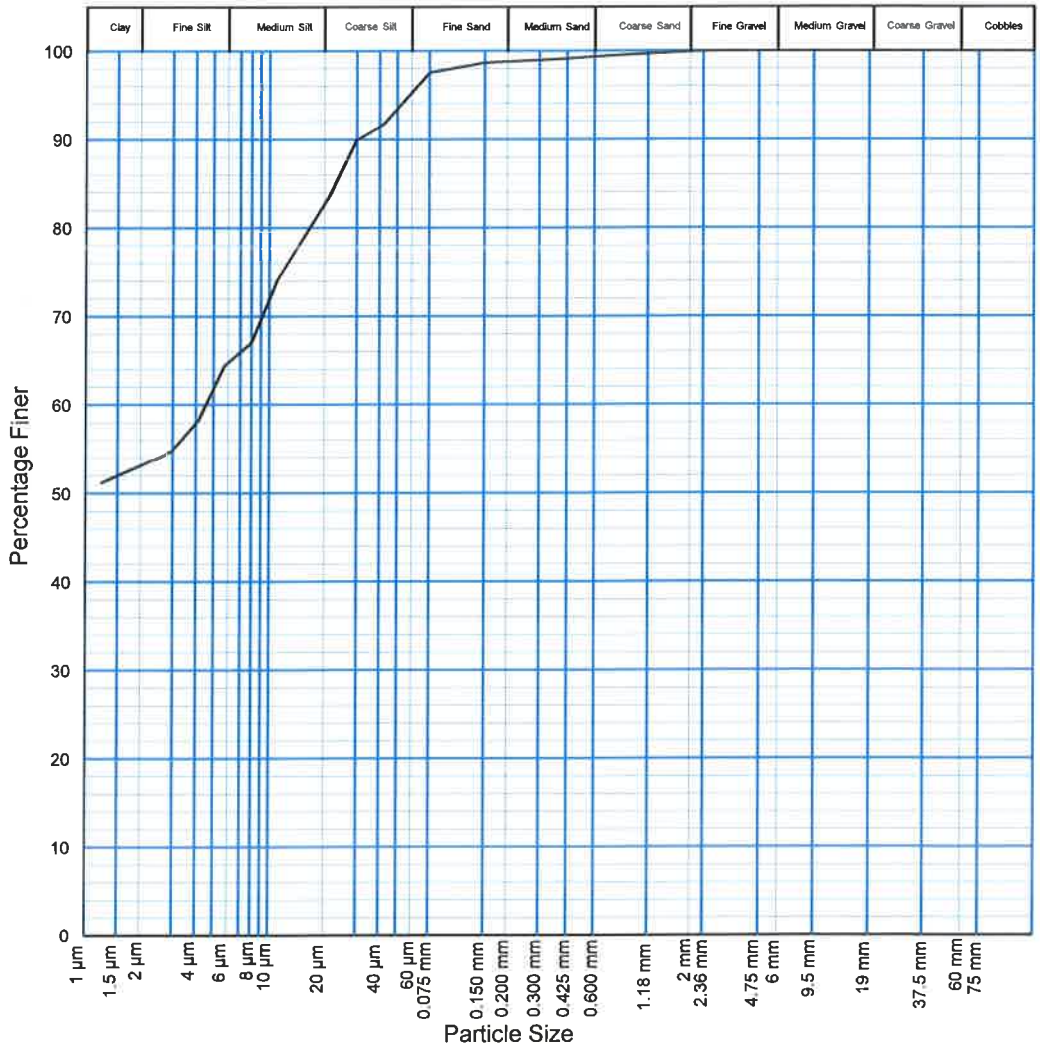
PARTICLE SIZE DISTRIBUTION BY HYDROMETER

Client :	Ports North	Report No. :	R16146
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122-4000
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303499
Location/Sample ID :	BH3 001 (0.40 - 0.80m)	Senders No. :	
		Date Received :	12/08/2013
		Sampled By :	Golder

SIZE FRACTIONS AS PER AUSTRALIAN STANDARDS AS 1726

Particle Size (mm)	Percent Passing
150	
75	
37.5	
19.0	
9.5	
4.75	
2.36	100.0
1.18	99.7
0.600	99.4
0.425	99.1
0.300	99.0
0.150	98.7
0.075	97.6
Particle Size (Microns)	**Percent Passing**
41.9	91.7
29.9	89.9
21.6	83.8
11.1	74.1
8.0	67.1
5.7	64.4
4.1	58.3
3.0	54.8
1.2	51.2



Pretreatment	Tested as received	Soil Particle Density (assumed)	2.70 t/m³
Loss in Pretreatment (%)	-	Type of Hydrometer	ASTM E100
Method of Dispersion	Mixer		
Test Procedure : AS 1289.3.6.3	- Variations to test method a)assumed particle density used b) testing up to 24 hours		
Prepared by : NF		Checked by : LH	

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26/8/13

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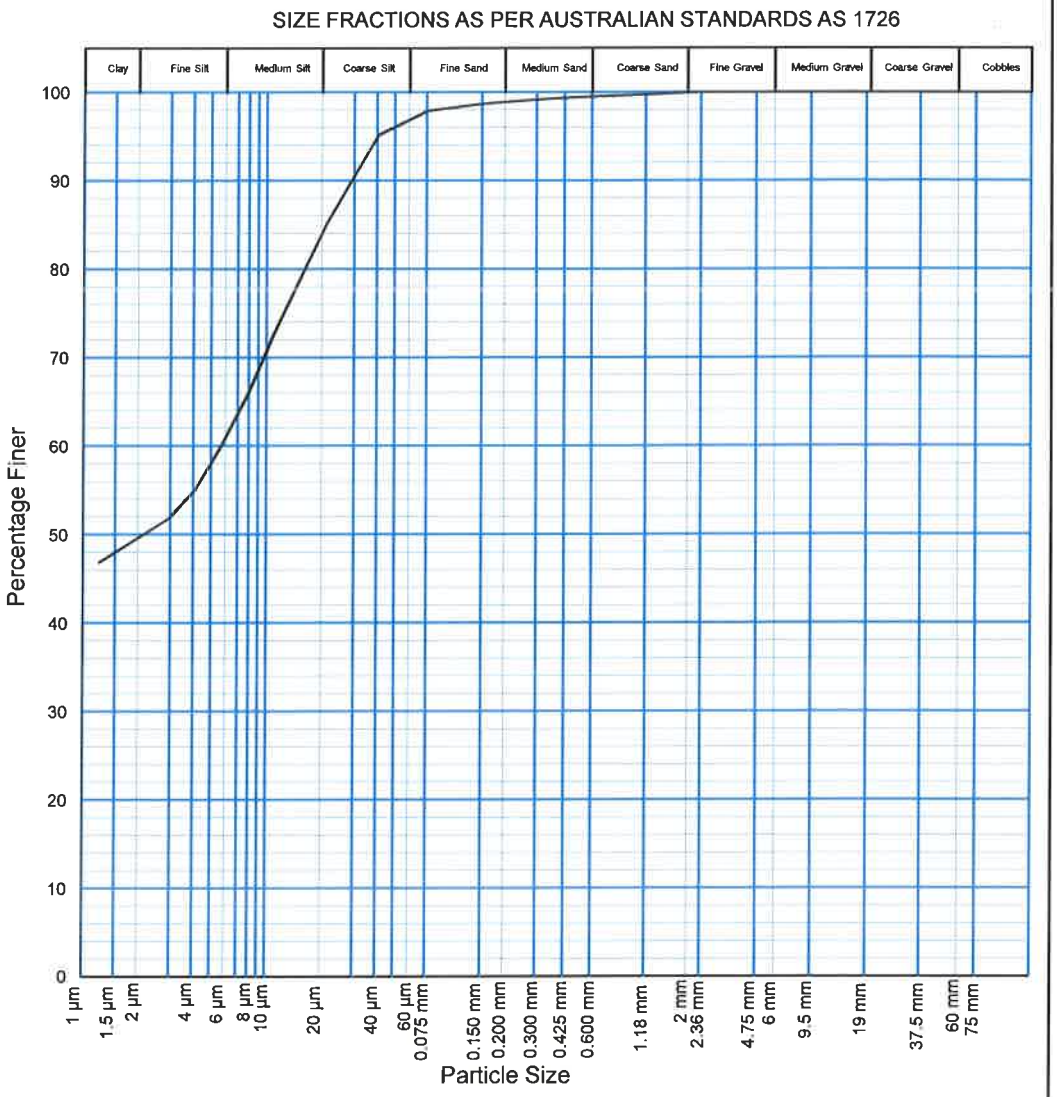
Email : bnelab@golder.com.au

PARTICLE SIZE DISTRIBUTION BY HYDROMETER

Client :	Ports North	Report No. :	R16147
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122-4000
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303500
Location/Sample ID :	BH3 002 (1.40 - 1.80m)	Senders No. :	
		Date Received :	12/08/2013
		Sampled By :	Golder

Particle Size (mm)	Percent Passing
150	
75	
37.5	
19.0	
9.5	
4.75	
2.36	100.0
1.18	99.7
0.600	99.5
0.425	99.3
0.300	99.1
0.150	98.7
0.075	97.9
Particle Size (Microns)	**Percent Passing**
40.5	95.2
29.3	90.2
21.1	85.2
11.0	72.7
7.9	66.0
5.7	60.2
4.1	55.2
3.0	51.9
1.2	46.9



Pretreatment	Tested as received	Soil Particle Density (assumed)	2.70 t/m³
Loss in Pretreatment (%)	-	Type of Hydrometer	ASTM E100
Method of Dispersion	Mixer		
Test Procedure : AS 1289.3.6.3	- Variations to test method a)assumed particle density used b) testing up to 24 hours		
Prepared by : NF		Checked by : CH	

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Nick Farrer
Approved Signatory

Senior Technical Officer
NATA Accred. No. : 1961

Golder Associates

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PO Box 3427 Sth Brisbane BC QLD 4101
Phone : (07) 3840 9500
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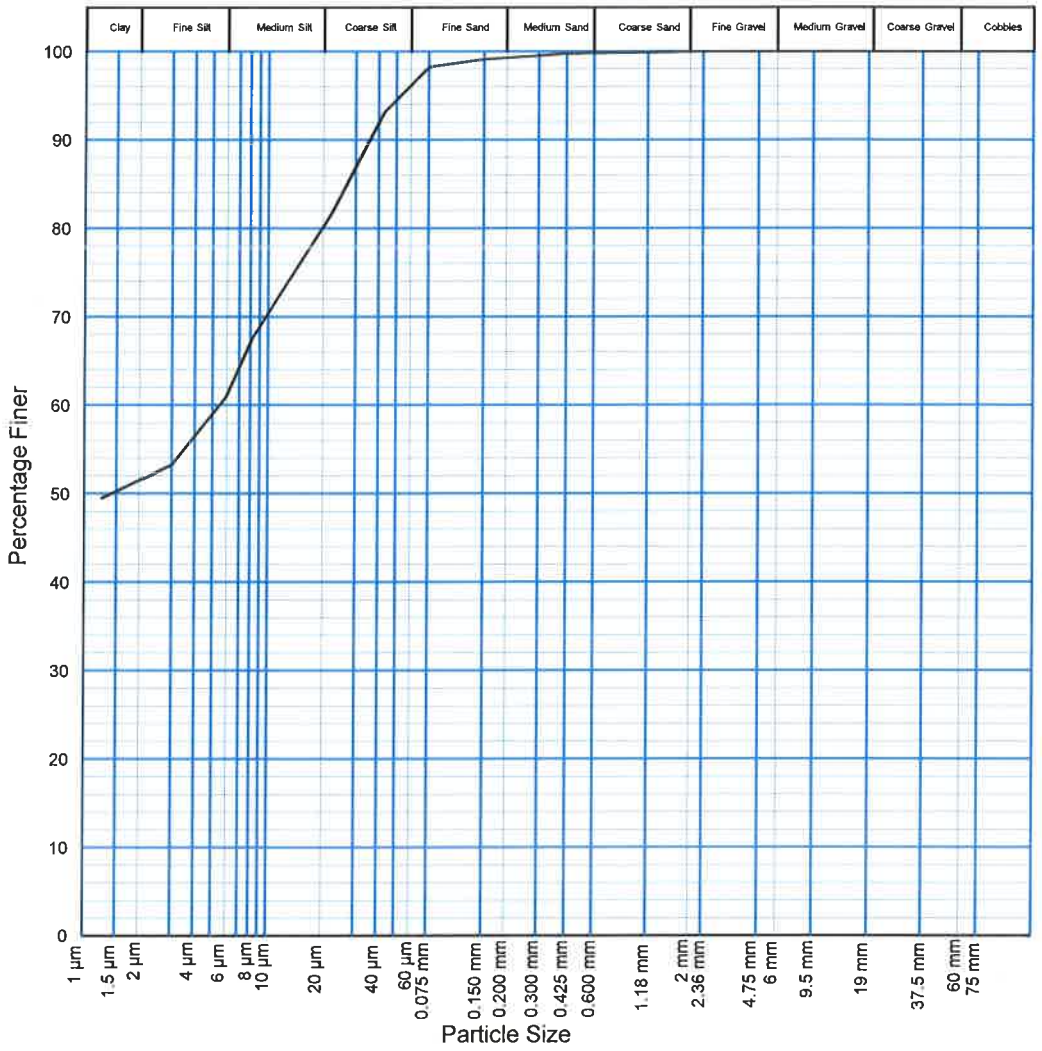
PARTICLE SIZE DISTRIBUTION BY HYDROMETER

Client :	Ports North	Report No. :	R16149
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122-4000
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303502
Location/Sample ID :	BH3 003 (2.40 - 2.63m)	Senders No. :	
		Date Received :	12/08/2013
		Sampled By :	Golder

SIZE FRACTIONS AS PER AUSTRALIAN STANDARDS AS 1726

Particle Size (mm)	Percent Passing
150	
75	
37.5	
19.0	
9.5	
4.75	
2.36	100.0
1.18	99.9
0.600	99.8
0.425	99.8
0.300	99.5
0.150	99.1
0.075	98.3
Particle Size (Microns)	Percent Passing
42.8	93.1
30.8	87.4
22.2	81.7
11.3	72.3
8.1	67.5
5.9	60.9
4.2	57.1
3.0	53.3
1.2	49.5



Pretreatment	Tested as received	Soil Particle Density (assumed)	2.70 t/m³
Loss in Pretreatment (%)	-	Type of Hydrometer	ASTM E100
Method of Dispersion	Mixer		
Test Procedure : AS 1289.3.6.3	- Variations to test method a)assumed particle density used b) testing up to 24 hours		
Prepared by : NF		Checked by : CH	

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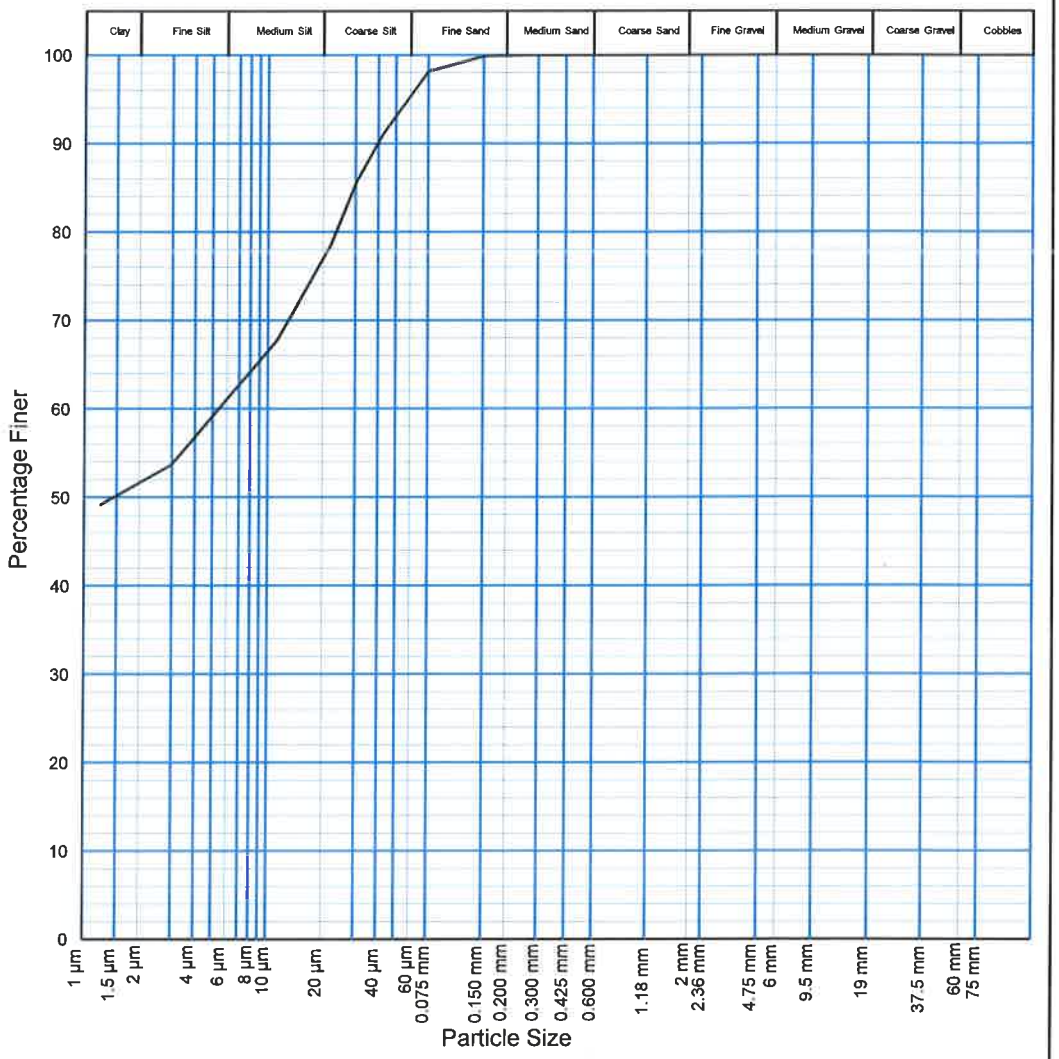
PARTICLE SIZE DISTRIBUTION BY HYDROMETER

Client :	Ports North	Report No. :	R16148
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122-4000
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303501
Location/Sample ID :	BH3 006 (4.80 - 5.25m)	Senders No. :	
		Date Received :	12/08/2013
		Sampled By :	Golder

SIZE FRACTIONS AS PER AUSTRALIAN STANDARDS AS 1726

Particle Size (mm)	Percent Passing
150	
75	
37.5	
19.0	
9.5	
4.75	
2.36	
1.18	
0.600	
0.425	
0.300	100.0
0.150	99.9
0.075	98.2
Particle Size (Microns)	Percent Passing
42.2	91.0
30.4	85.7
22.0	78.6
11.3	67.9
8.1	64.3
5.8	60.8
4.2	57.2
3.0	53.6
1.2	49.2



Pretreatment	Tested as received	Soil Particle Density (assumed)	2.70 t/m³
Loss in Pretreatment (%)	-	Type of Hydrometer	ASTM E100
Method of Dispersion	Mixer		
Test Procedure : AS 1289.3.6.3	- Variations to test method a)assumed particle density used b) testing up to 24 hours		
Prepared by : NF		Checked by : GN	

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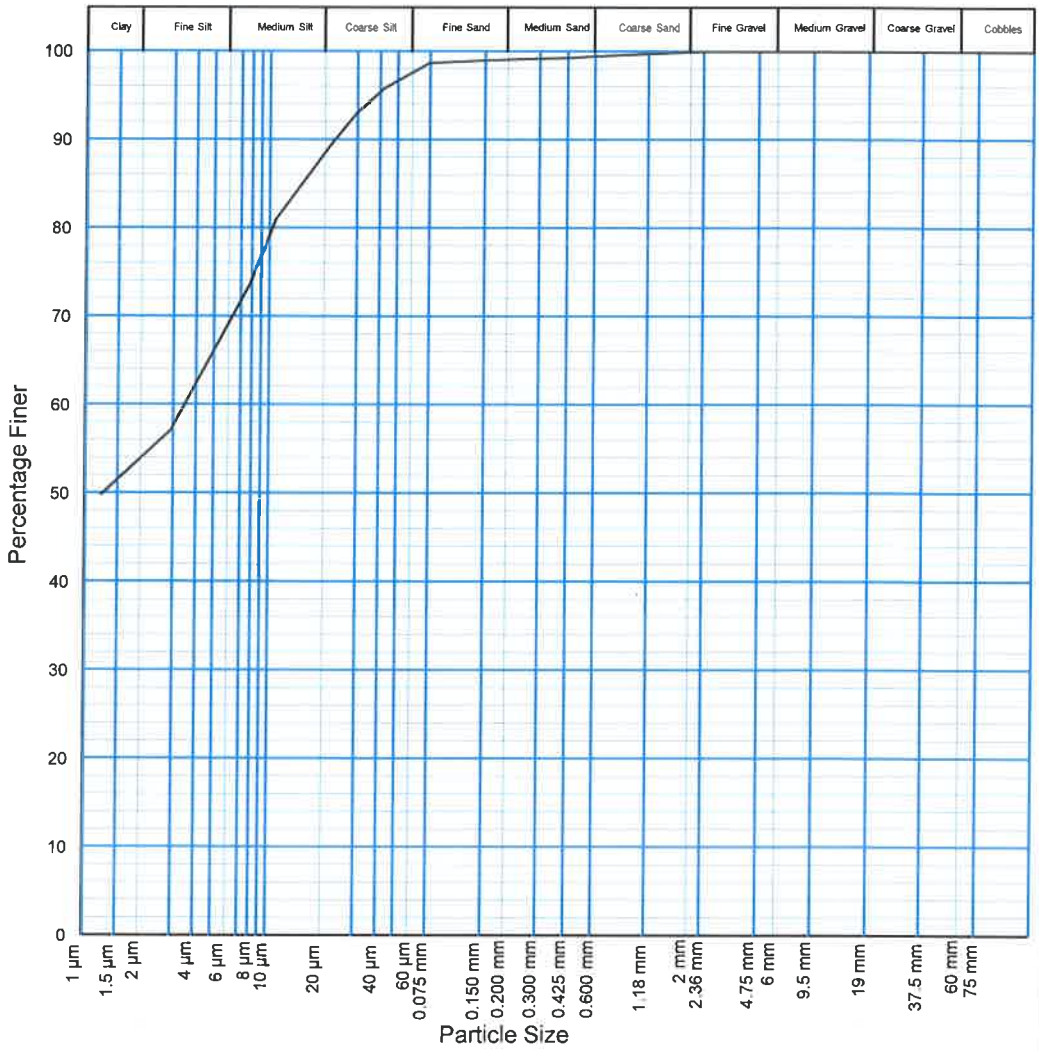
PARTICLE SIZE DISTRIBUTION BY HYDROMETER

Client :	Ports North	Report No. :	R16150
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122-4000
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303503
Location/Sample ID :	BH4 001 (2.40 - 2.80m)	Senders No. :	
		Date Received :	12/08/2013
Remarks : This replaces the report dated 26/08/2013		Sampled By :	Golder

SIZE FRACTIONS AS PER AUSTRALIAN STANDARDS AS 1726

Particle Size (mm)	Percent Passing
150	
75	
37.5	
19.0	
9.5	
4.75	
2.36	100.0
1.18	99.7
0.600	99.4
0.425	99.3
0.300	99.2
0.150	99.0
0.075	98.7
Particle Size (Microns)	Percent Passing
41.9	95.7
29.9	93.0
21.4	89.3
10.9	81.0
7.9	73.7
5.7	68.2
4.1	62.7
3.0	57.2
1.2	49.8



Pretreatment	Tested as received	Soil Particle Density (assumed)	2.70 t/m³
Loss in Pretreatment (%)	-	Type of Hydrometer	ASTM E100
Method of Dispersion	Mixer		
Test Procedure : AS 1289.3.6.3	- Variations to test method a)assumed particle density used b) testing up to 24 hours		
Prepared by :		Checked by :	

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23.5.13

Mike Sandilands
Approved Signatory

Laboratory Manager
NATA Accred. No. : 1961

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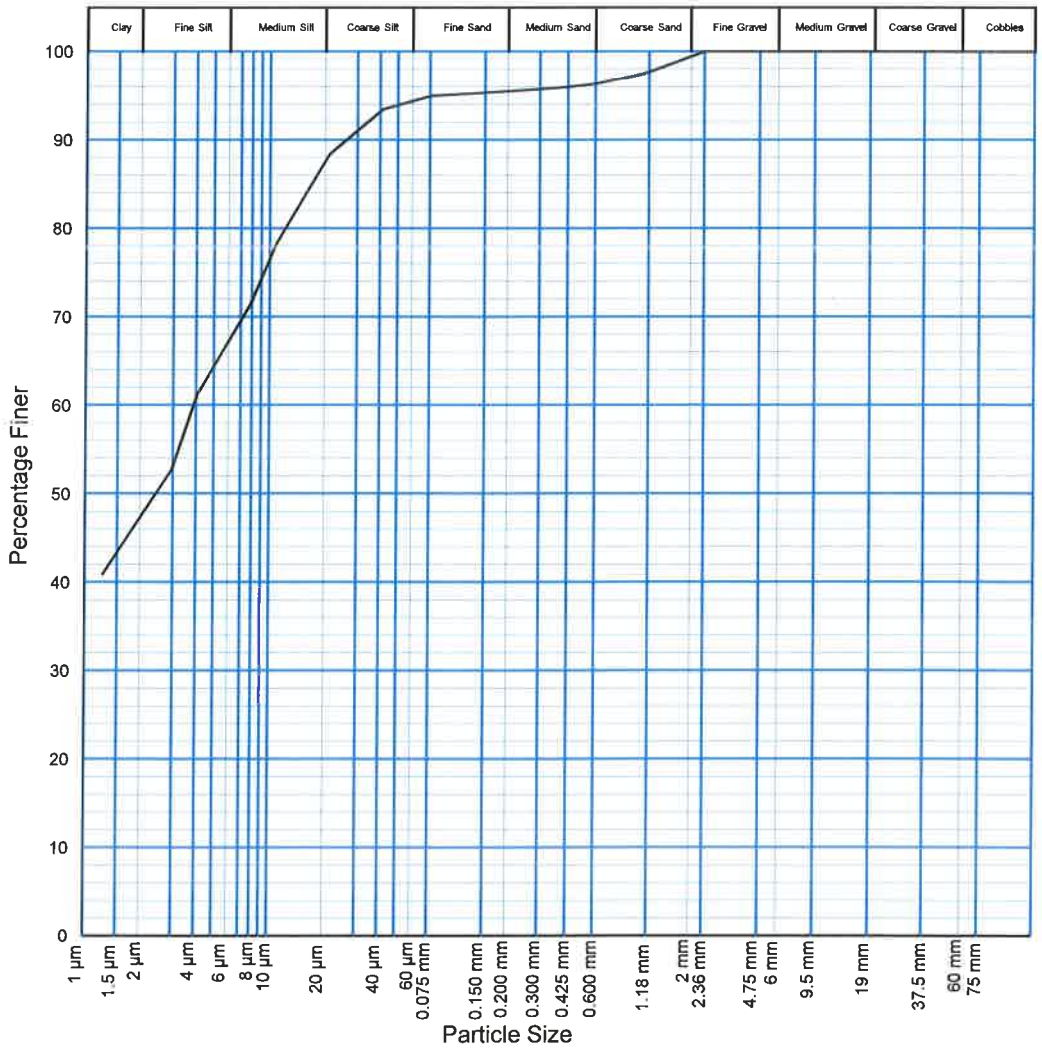
PARTICLE SIZE DISTRIBUTION BY HYDROMETER

Client :	Ports North	Report No. :	R16151
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122-4000
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303504
Location/Sample ID :	BH4 002 (3.40 - 3.80m)	Senders No. :	
		Date Received :	12/08/2013
		Sampled By :	Golder

SIZE FRACTIONS AS PER AUSTRALIAN STANDARDS AS 1726

Particle Size (mm)	Percent Passing
150	
75	
37.5	
19.0	
9.5	
4.75	
2.36	100.0
1.18	97.7
0.600	96.4
0.425	96.0
0.300	95.8
0.150	95.4
0.075	95.0
Particle Size (Microns)	Percent Passing
41.1	93.5
29.4	90.9
21.0	88.4
10.8	78.2
7.8	71.4
5.6	66.3
4.1	61.3
3.0	52.8
1.3	40.9



Pretreatment	Tested as received	Soil Particle Density (assumed)	2.70 t/m³
Loss in Pretreatment (%)	-	Type of Hydrometer	ASTM E100
Method of Dispersion	Mixer		
Test Procedure : AS 1289.3.6.3	- Variations to test method a)assumed particle density used b) testing up to 24 hours		
Prepared by : M		Checked by : CJH	

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Nick Farrer
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Senior Technical Officer
NATA Accred. No. : 1961

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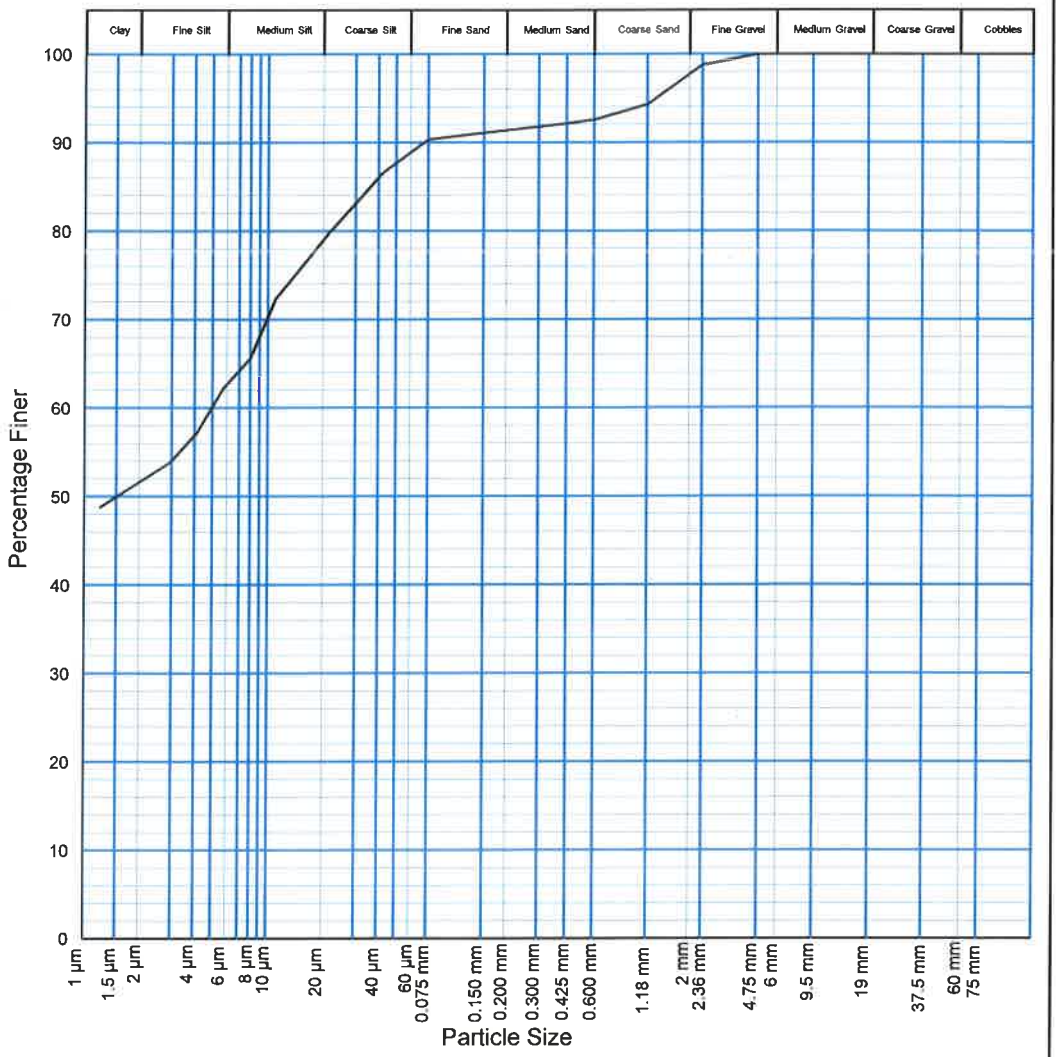
PARTICLE SIZE DISTRIBUTION BY HYDROMETER

Client :	Ports North	Report No. :	R16152
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122-4000
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303505
Location/Sample ID :	BH4 003 (4.40 - 4.80m)	Senders No. :	
		Date Received :	12/08/2013
		Sampled By :	Golder

Particle Size (mm)	Percent Passing
150	
75	
37.5	
19.0	
9.5	
4.75	100.0
2.36	98.8
1.18	94.3
0.600	92.6
0.425	92.2
0.300	91.8
0.150	91.1
0.075	90.3
Particle Size (Microns)	Percent Passing
42.1	86.5
30.1	83.2
21.6	79.8
11.0	72.3
8.0	65.6
5.7	62.2
4.1	57.2
2.9	53.9
1.2	48.8

SIZE FRACTIONS AS PER AUSTRALIAN STANDARDS AS 1726



Pretreatment	Tested as received	Soil Particle Density (assumed)	2.70 t/m³
Loss in Pretreatment (%)	-	Type of Hydrometer	ASTM E100
Method of Dispersion	Mixer		
Test Procedure : AS 1289.3.6.3	- Variations to test method a)assumed particle density used b) testing up to 24 hours		
Prepared by : NF		Checked by : GH	

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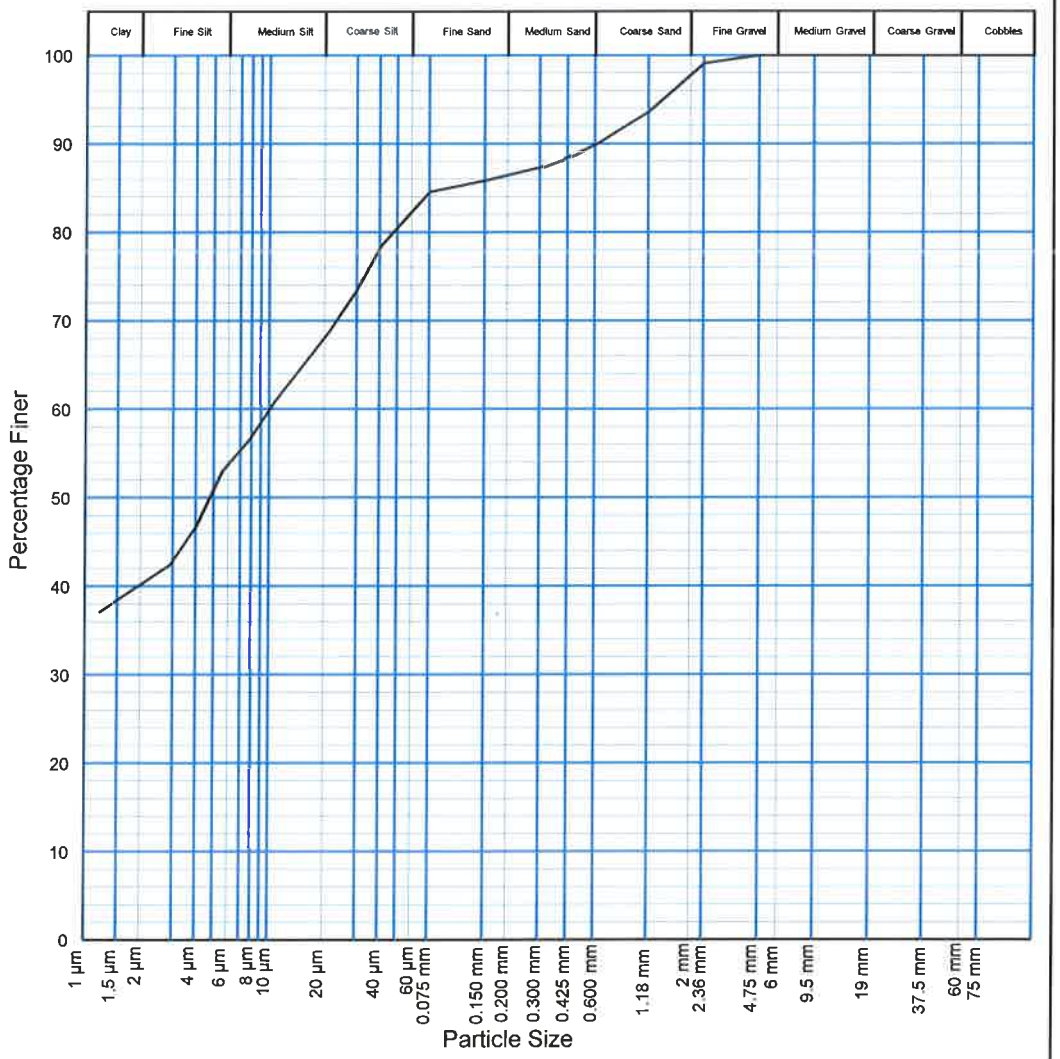
PARTICLE SIZE DISTRIBUTION BY HYDROMETER

Client :	Ports North	Report No. :	R16153
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122-4000
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303506
Location/Sample ID :	BH4 004 (5.40 - 5.85m)	Senders No. :	
		Date Received :	12/08/2013
		Sampled By :	Golder

Particle Size (mm)	Percent Passing
150	
75	
37.5	
19.0	
9.5	
4.75	100.0
2.36	99.1
1.18	93.6
0.600	89.9
0.425	88.5
0.300	87.3
0.150	85.9
0.075	84.6
Particle Size (Microns)	**Percent Passing**
40.9	78.5
29.6	73.3
21.3	68.9
10.8	60.9
7.8	56.5
5.6	53.0
4.0	46.9
2.9	42.5
1.2	37.2

SIZE FRACTIONS AS PER AUSTRALIAN STANDARDS AS 1726



Pretreatment	Tested as received	Soil Particle Density (assumed)	2.70 t/m³
Loss in Pretreatment (%)	-	Type of Hydrometer	ASTM E100
Method of Dispersion	Mixer		
Test Procedure : AS 1289.3.6.3	- Variations to test method a)assumed particle density used b) testing up to 24 hours		
Prepared by : NL		Checked by : CIT	

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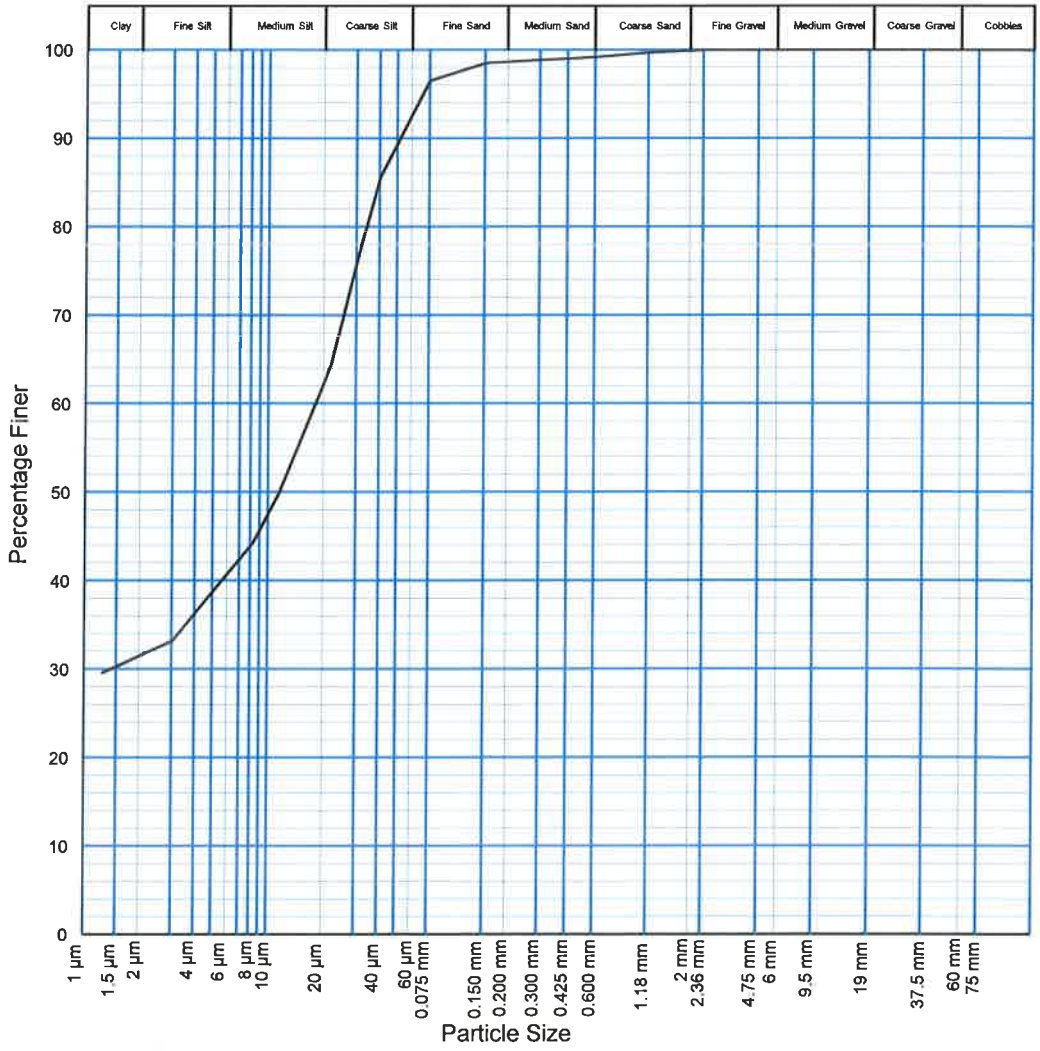
PARTICLE SIZE DISTRIBUTION BY HYDROMETER

Client :	Ports North	Report No. :	R16154
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122-4000
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303507
Location/Sample ID :	BH5 001 (2.40 - 2.80m)	Senders No. :	
		Date Received :	12/08/2013
		Sampled By :	Golder

SIZE FRACTIONS AS PER AUSTRALIAN STANDARDS AS 1726

Particle Size (mm)	Percent Passing
150	
75	
37.5	
19.0	
9.5	
4.75	
2.36	100.0
1.18	99.7
0.600	99.2
0.425	99.0
0.300	98.9
0.150	98.5
0.075	96.5
Particle Size (Microns)	**Percent Passing**
40.2	85.5
29.7	75.4
22.0	64.4
11.4	49.8
8.2	44.3
5.9	40.6
4.2	36.9
3.0	33.3
1.3	29.6



Pretreatment	Tested as received	Soil Particle Density (assumed)	2.70 t/m³
Loss in Pretreatment (%)	-	Type of Hydrometer	ASTM E100
Method of Dispersion	Mixer		
Test Procedure : AS 1289.3.6.3	- Variations to test method a)assumed particle density used b) testing up to 24 hours		
Prepared by : MF		Checked by : GH	

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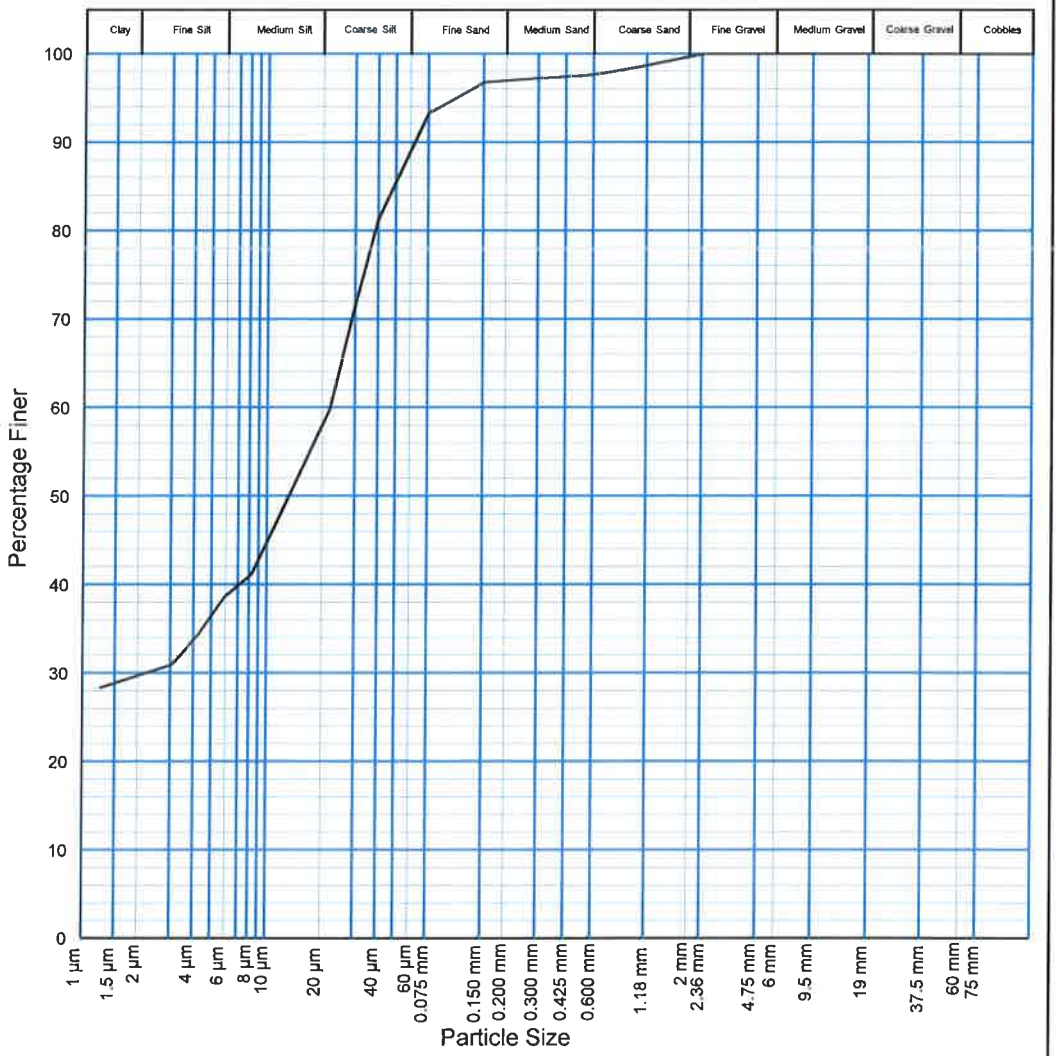
PARTICLE SIZE DISTRIBUTION BY HYDROMETER

Client :	Ports North	Report No. :	R16155
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122-4000
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303508
Location/Sample ID :	BH5 003 (4.40 - 4.80m)	Senders No. :	
		Date Received :	12/08/2013
		Sampled By :	Golder

SIZE FRACTIONS AS PER AUSTRALIAN STANDARDS AS 1726

Particle Size (mm)	Percent Passing
150	
75	
37.5	
19.0	
9.5	
4.75	
2.36	100.0
1.18	98.7
0.600	97.7
0.425	97.4
0.300	97.3
0.150	96.8
0.075	93.3
Particle Size (Microns)	**Percent Passing**
39.8	81.2
29.6	71.0
22.0	59.9
11.4	47.1
8.2	41.1
5.9	38.6
4.2	34.3
3.0	30.9
1.3	28.4



Pretreatment	Tested as received	Soil Particle Density (assumed)	2.70 t/m³
Loss in Pretreatment (%)	-	Type of Hydrometer	ASTM E100
Method of Dispersion	Mixer		
Test Procedure : AS 1289.3.6.3	- Variations to test method a)assumed particle density used b) testing up to 24 hours		
Prepared by : NF		Checked by : GH	

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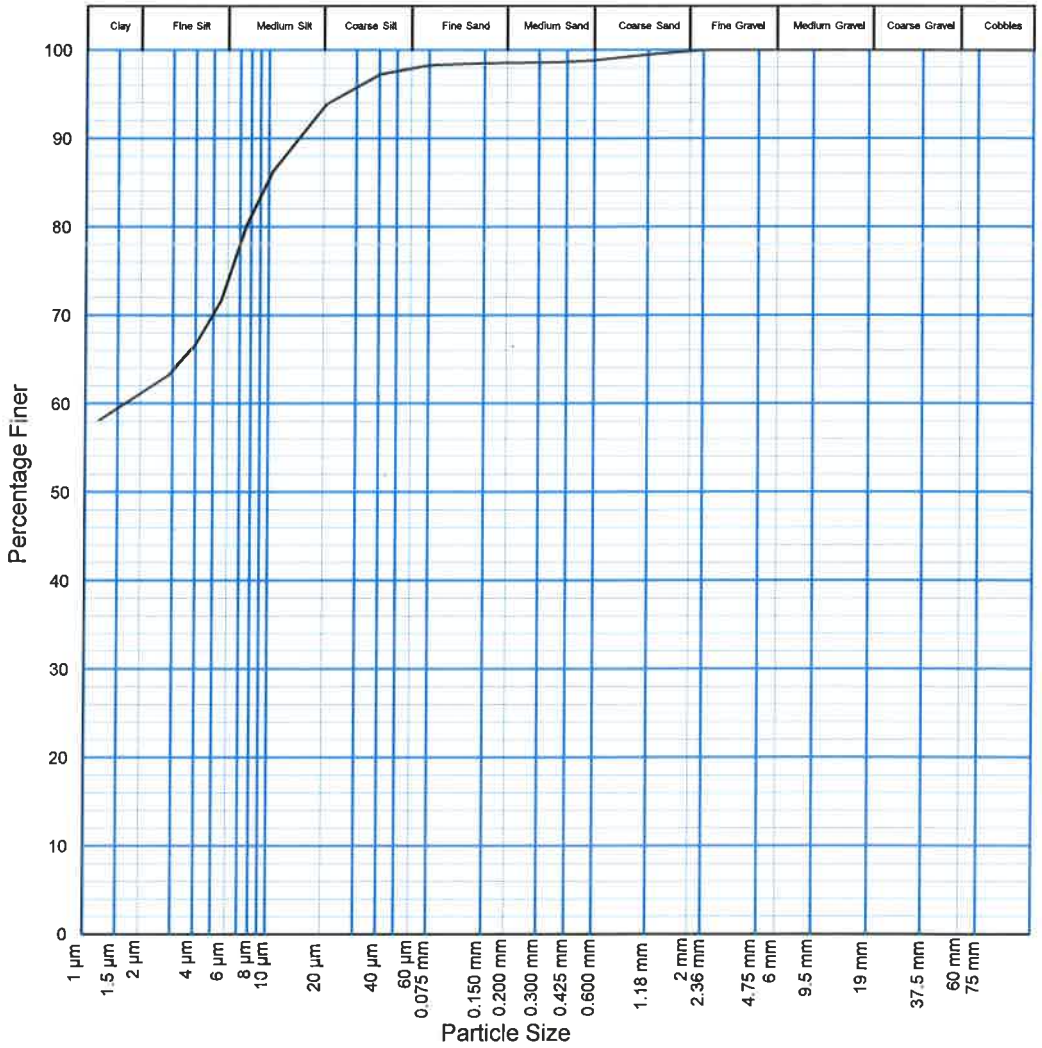
PARTICLE SIZE DISTRIBUTION BY HYDROMETER

Client :	Ports North	Report No. :	R16156
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122-4000
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303509
Location/Sample ID :	BH5 006 (7.40 - 7.90m)	Senders No. :	
		Date Received :	12/08/2013
		Sampled By :	Golder

SIZE FRACTIONS AS PER AUSTRALIAN STANDARDS AS 1726

Particle Size (mm)	Percent Passing
150	
75	
37.5	
19.0	
9.5	
4.75	
2.36	100.0
1.18	99.5
0.600	98.8
0.425	98.6
0.300	98.6
0.150	98.5
0.075	98.3
Particle Size (Microns)	Percent Passing
40.5	97.3
28.9	95.6
20.5	93.9
10.4	86.2
7.6	80.3
5.5	71.7
4.0	66.6
2.9	63.2
1.2	58.1



Pretreatment	Tested as received	Soil Particle Density (assumed)	2.70 t/m³
Loss in Pretreatment (%)	-	Type of Hydrometer	ASTM E100
Method of Dispersion	Mixer		
Test Procedure : AS 1289.3.6.3	- Variations to test method a)assumed particle density used b) testing up to 24 hours		
Prepared by : NT		Checked by : CH	

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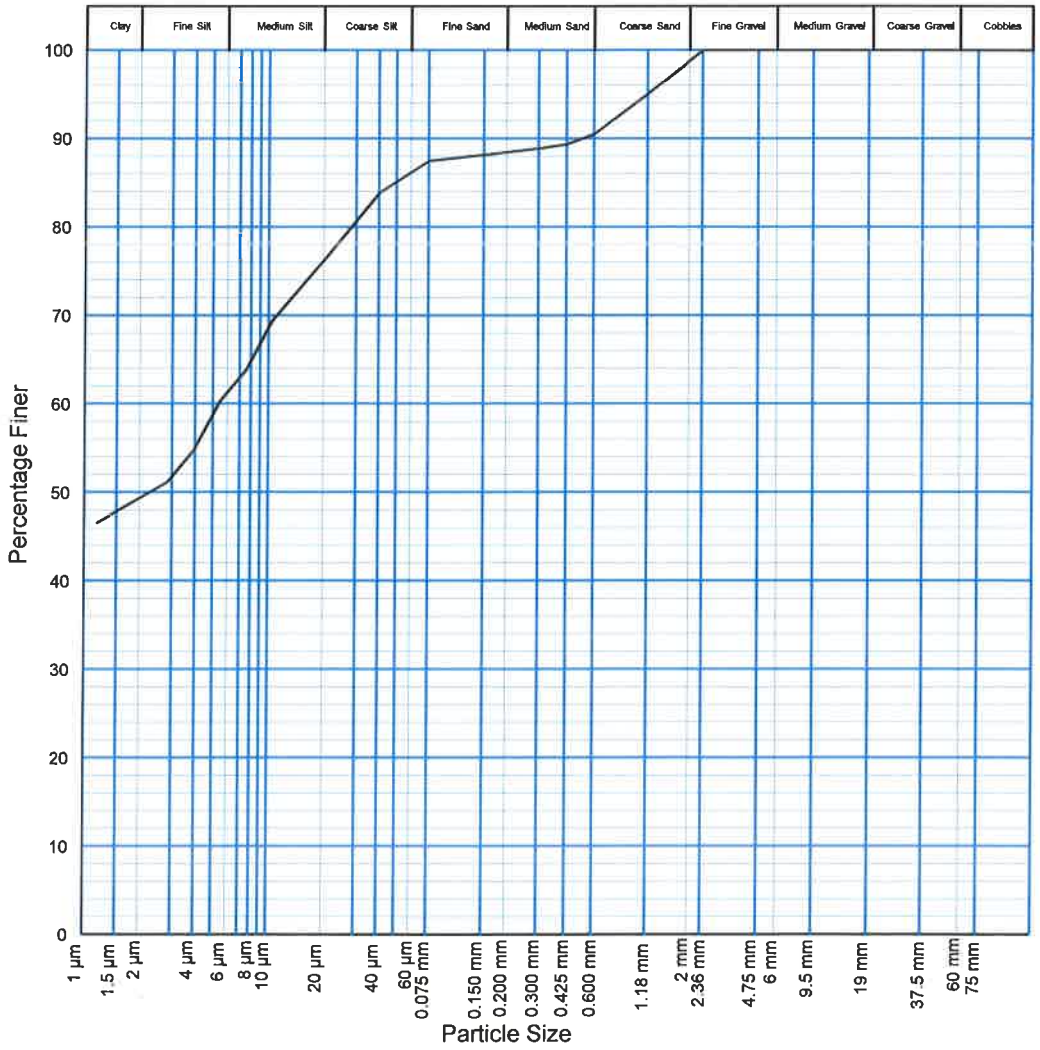
PARTICLE SIZE DISTRIBUTION BY HYDROMETER

Client :	Ports North	Report No. :	R16157
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122-4000
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303510
Location/Sample ID :	BH5 009 (10.40 - 10.80m)	Senders No. :	
		Date Received :	12/08/2013
		Sampled By :	Golder

SIZE FRACTIONS AS PER AUSTRALIAN STANDARDS AS 1726

Particle Size (mm)	Percent Passing
150	
75	
37.5	
19.0	
9.5	
4.75	
2.36	100.0
1.18	95.1
0.600	90.5
0.425	89.4
0.300	88.9
0.150	88.2
0.075	87.5
Particle Size (Microns)	**Percent Passing**
40.4	83.9
29.0	80.3
20.8	76.6
10.5	69.4
7.6	63.9
5.5	60.3
3.9	54.8
2.8	51.2
1.2	46.6



Pretreatment	Tested as received	Soil Particle Density (assumed)	2.70 t/m³
Loss in Pretreatment (%)	-	Type of Hydrometer	ASTM E100
Method of Dispersion	Mixer		
Test Procedure : AS 1289.3.6.3	- Variations to test method a)assumed particle density used b) testing up to 24 hours		
Prepared by : NF		Checked by : GH	

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NATA Accred. No. : 1961

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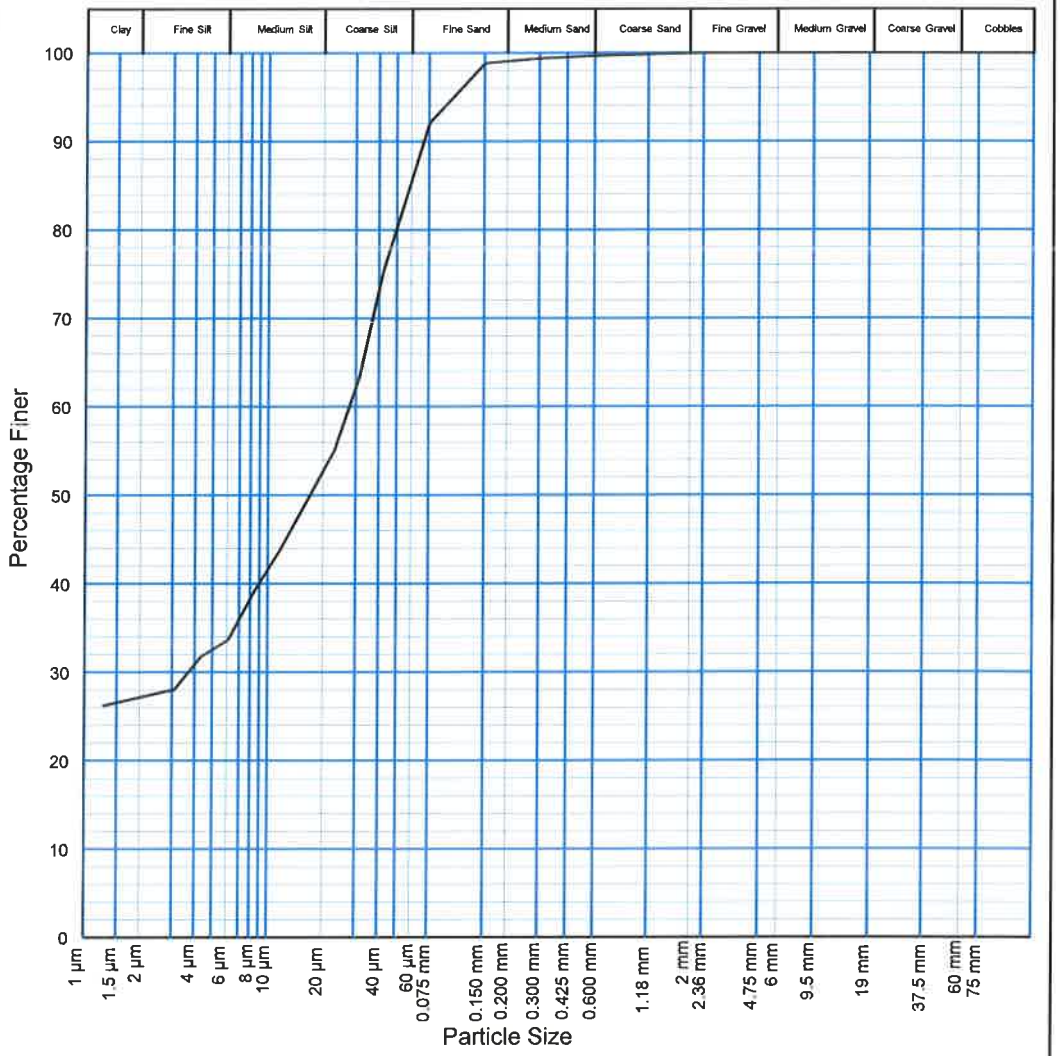
PARTICLE SIZE DISTRIBUTION BY HYDROMETER

Client :	Ports North	Report No. :	R16158
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122-4000
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303511
Location/Sample ID :	BH6 001 (0.00 - 0.40m)	Senders No. :	
		Date Received :	12/08/2013
		Sampled By :	Golder

SIZE FRACTIONS AS PER AUSTRALIAN STANDARDS AS 1726

Particle Size (mm)	Percent Passing
150	
75	
37.5	
19.0	
9.5	
4.75	
2.36	100.0
1.18	99.8
0.600	99.7
0.425	99.5
0.300	99.4
0.150	98.8
0.075	92.1
Particle Size (Microns)	**Percent Passing**
42.2	75.4
31.3	63.4
22.8	55.0
11.7	43.9
8.4	39.2
6.1	33.7
4.3	31.8
3.1	28.1
1.3	26.2



Pretreatment	Tested as received	Soil Particle Density (assumed)	2.70 t/m³
Loss in Pretreatment (%)	-	Type of Hydrometer	ASTM E100
Method of Dispersion	Mixer		
Test Procedure : AS 1289.3.6.3	- Variations to test method a)assumed particle density used b) testing up to 24 hours		
Prepared by : NF		Checked by : GB	

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Nick Farrer
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Senior Technical Officer
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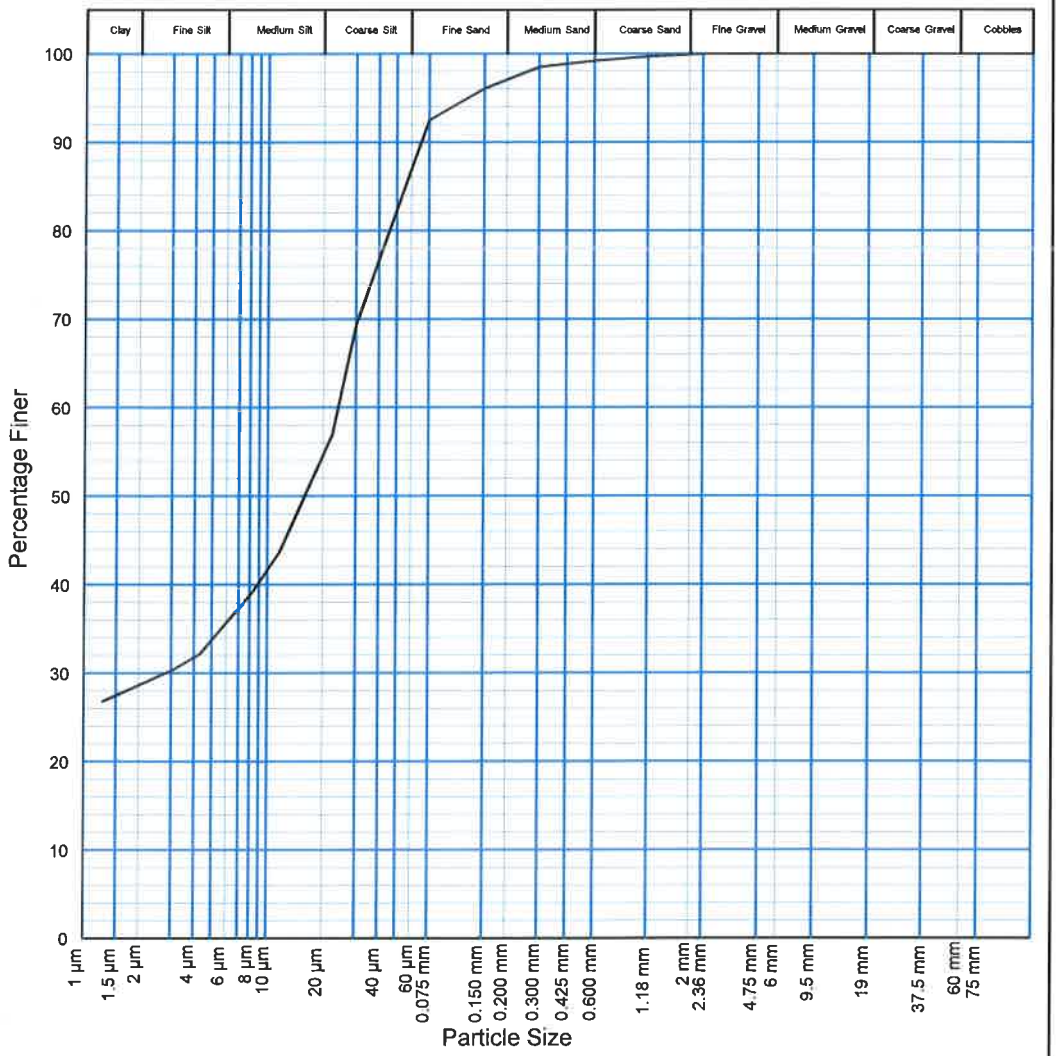
Phone : (07) 3840 9500
Email : bnelab@golder.com.au

PARTICLE SIZE DISTRIBUTION BY HYDROMETER

Client :	Ports North	Report No. :	R16159
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122-4000
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303512
Location/Sample ID :	BH6 003 (2.00 - 2.40m)	Senders No. :	
		Date Received :	12/08/2013
		Sampled By :	Golder

Particle Size (mm)	Percent Passing
150	
75	
37.5	
19.0	
9.5	
4.75	
2.36	100.0
1.18	99.7
0.600	99.2
0.425	98.9
0.300	98.5
0.150	96.1
0.075	92.5
Particle Size (Microns)	**Percent Passing**
41.2	77.4
30.2	69.4
22.4	57.0
11.6	43.7
8.4	39.3
6.0	35.7
4.3	32.2
3.1	30.4
1.3	26.8



Pretreatment	Tested as received	Soil Particle Density (assumed)	2.70 t/m³
Loss in Pretreatment (%)	-	Type of Hydrometer	ASTM E100
Method of Dispersion	Mixer		
Test Procedure : AS 1289.3.6.3	- Variations to test method a)assumed particle density used b) testing up to 24 hours		
Prepared by : NF		Checked by : AD	

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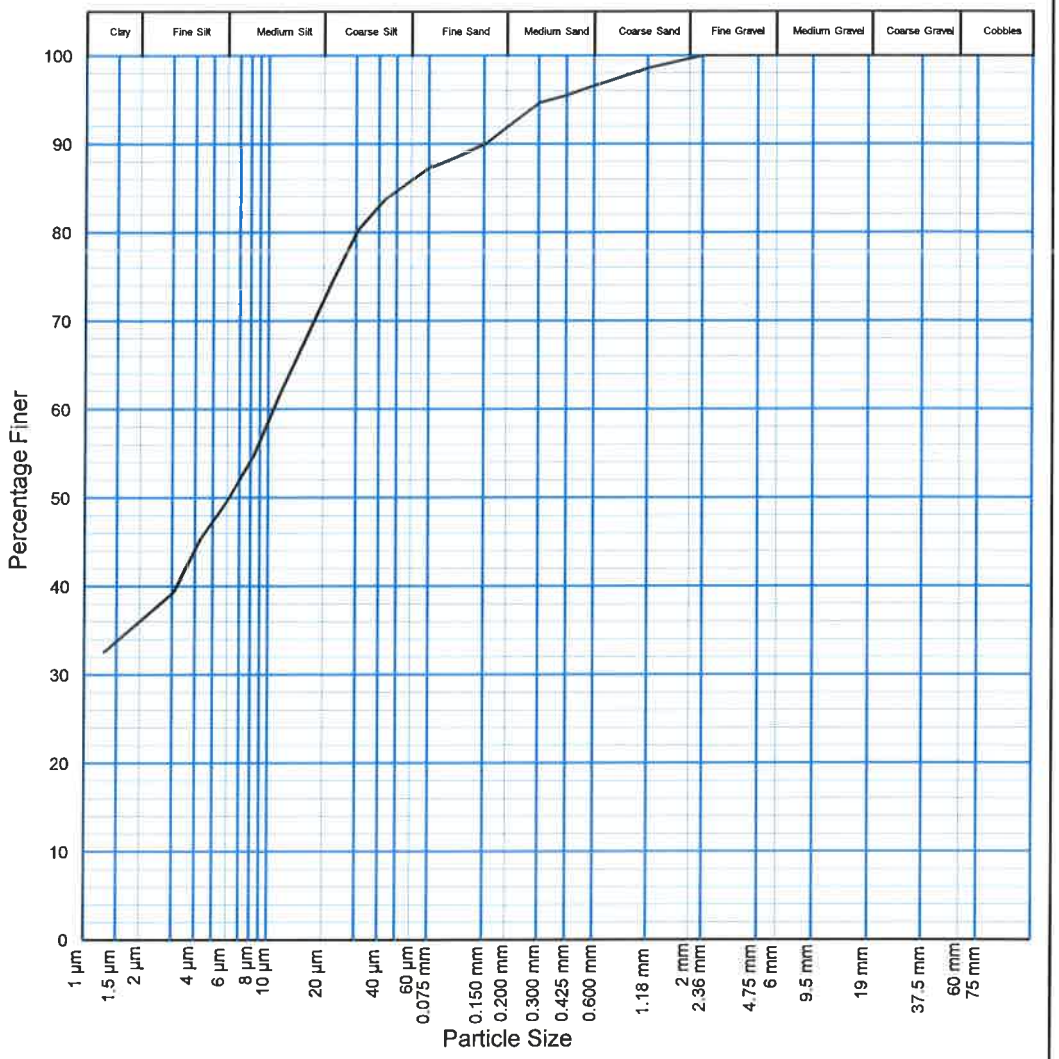
PARTICLE SIZE DISTRIBUTION BY HYDROMETER

Client :	Ports North	Report No. :	R16160
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122-4000
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303513
Location/Sample ID :	BH6 006 (5.00 - 5.40m)	Senders No. :	
		Date Received :	12/08/2013
		Sampled By :	Golder

SIZE FRACTIONS AS PER AUSTRALIAN STANDARDS AS 1726

Particle Size (mm)	Percent Passing
150	
75	
37.5	
19.0	
9.5	
4.75	
2.36	100.0
1.18	98.6
0.600	96.6
0.425	95.5
0.300	94.6
0.150	90.0
0.075	87.4
Particle Size (Microns)	**Percent Passing**
42.8	83.7
30.6	80.3
22.1	74.3
11.5	61.6
8.3	54.7
6.0	49.6
4.3	45.4
3.1	39.4
1.3	32.6



Pretreatment	Tested as received	Soil Particle Density (assumed)	2.70 t/m³
Loss in Pretreatment (%)	-	Type of Hydrometer	ASTM E100
Method of Dispersion	Mixer		
Test Procedure : AS 1289.3.6.3	- Variations to test method a)assumed particle density used b) testing up to 24 hours		
Prepared by : NF		Checked by : NF	

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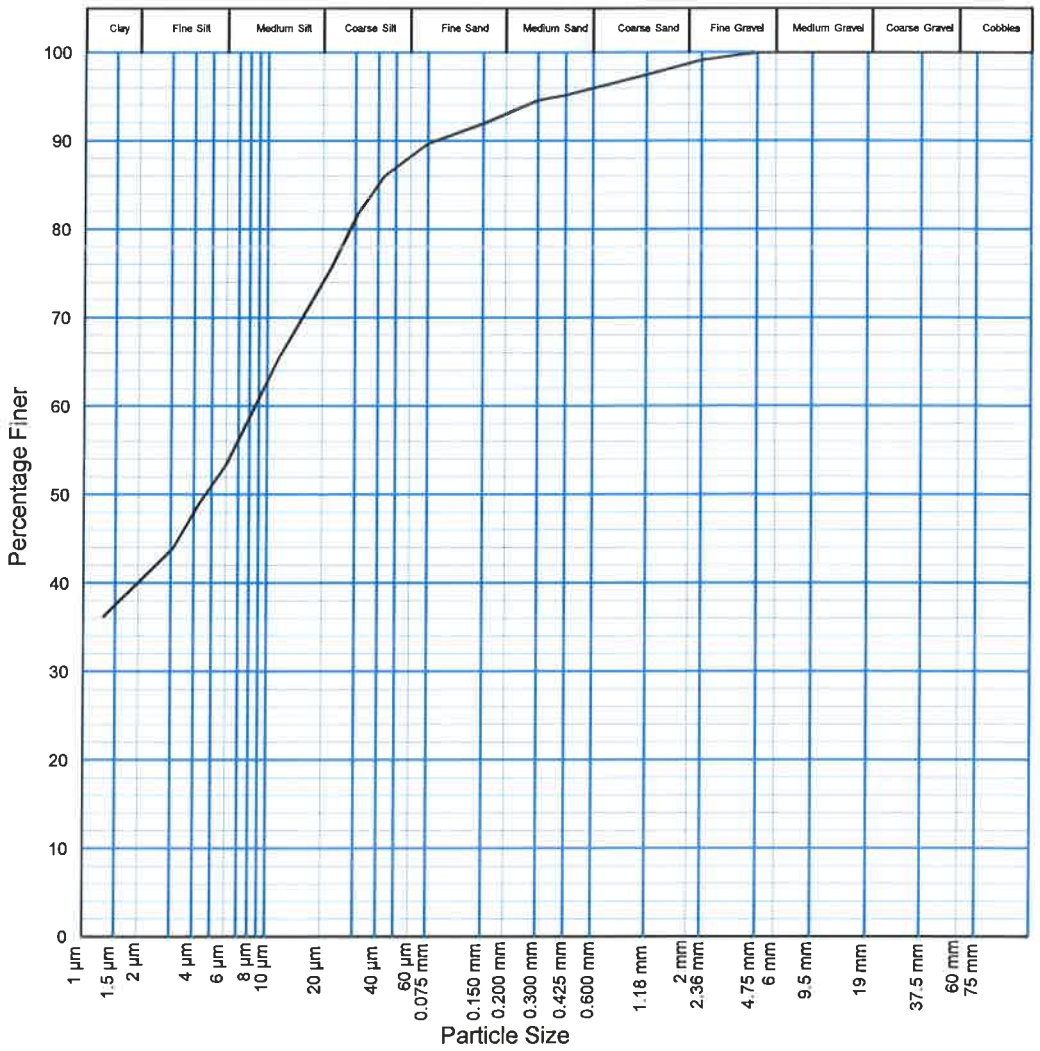
PARTICLE SIZE DISTRIBUTION BY HYDROMETER

Client :	Ports North	Report No. :	R16161
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122-4000
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303514
Location/Sample ID :	BH6 007 (6.00 - 6.40m)	Senders No. :	
		Date Received :	12/08/2013
		Sampled By :	Golder

SIZE FRACTIONS AS PER AUSTRALIAN STANDARDS AS 1726

Particle Size (mm)	Percent Passing
150	
75	
37.5	
19.0	
9.5	
4.75	100.0
2.36	99.1
1.18	97.5
0.600	96.0
0.425	95.2
0.300	94.6
0.150	91.9
0.075	89.7
Particle Size (Microns)	Percent Passing
43.0	86.0
30.9	81.7
22.3	75.7
11.5	65.4
8.3	59.4
6.0	53.4
4.3	49.1
3.1	44.0
1.3	36.3



Pretreatment	Tested as received	Soil Particle Density (assumed)	2.70 t/m³
Loss in Pretreatment (%)	-	Type of Hydrometer	ASTM E100
Method of Dispersion	Mixer		
Test Procedure : AS 1289.3.6.3	- Variations to test method a)assumed particle density used b) testing up to 24 hours		
Prepared by : NF		Checked by : GH	

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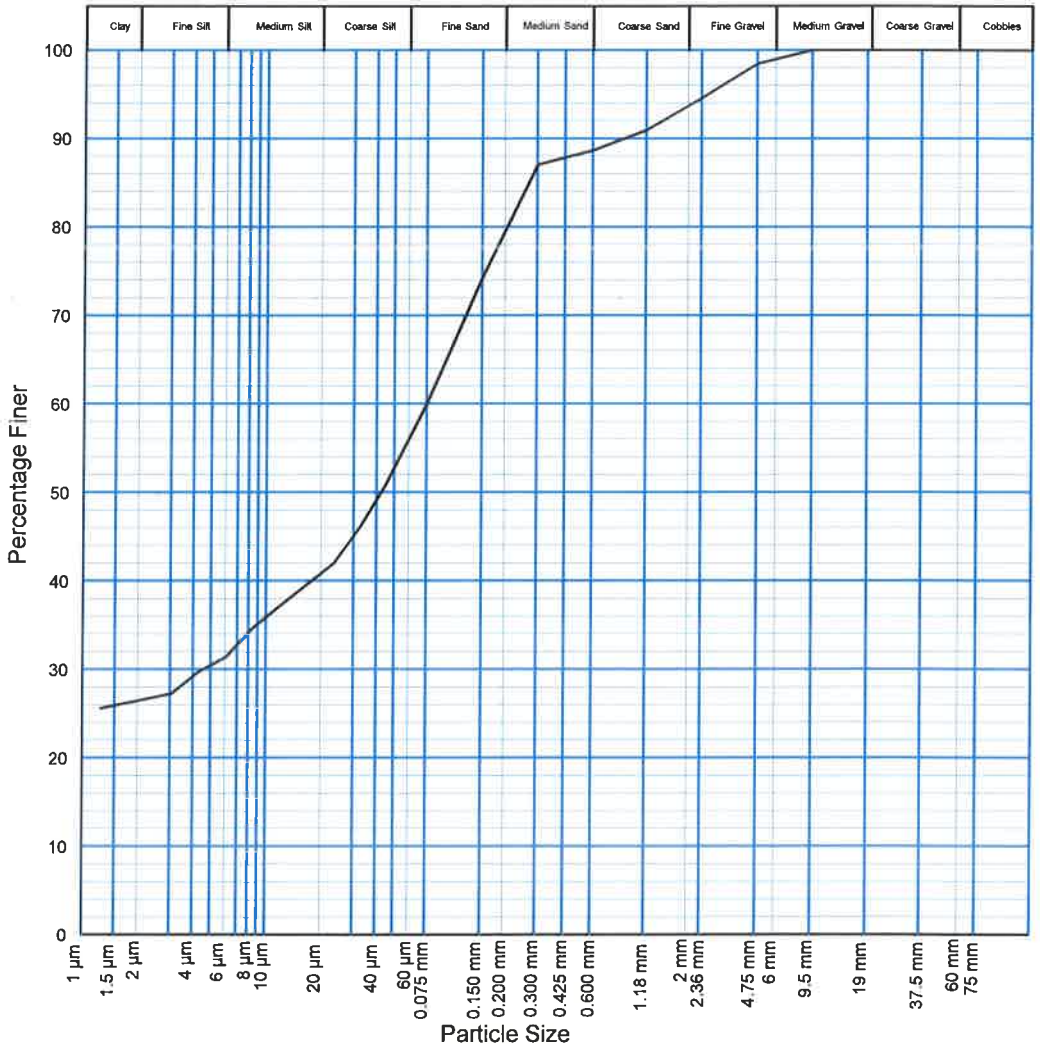
PARTICLE SIZE DISTRIBUTION BY HYDROMETER

Client :	Ports North	Report No. :	R16162
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122-4000
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303515
Location/Sample ID :	BH6 009 (8.00 - 8.45m)	Senders No. :	
		Date Received :	12/08/2013
		Sampled By :	Golder

Particle Size (mm)	Percent Passing
150	
75	
37.5	
19.0	
9.5	100.0
4.75	98.5
2.36	94.6
1.18	91.0
0.600	88.7
0.425	87.9
0.300	87.0
0.150	74.3
0.075	60.0
Particle Size (Microns)	Percent Passing
45.2	51.0
32.6	46.1
23.4	42.0
11.8	37.1
8.4	34.6
6.0	31.3
4.3	29.7
3.1	27.2
1.3	25.6

SIZE FRACTIONS AS PER AUSTRALIAN STANDARDS AS 1726



Pretreatment	Tested as received	Soil Particle Density (assumed)	2.70 t/m³
Loss in Pretreatment (%)	-	Type of Hydrometer	ASTM E100
Method of Dispersion	Mixer		
Test Procedure : AS 1289.3.6.3	- Variations to test method a)assumed particle density used b) testing up to 24 hours		
Prepared by : NF		Checked by : NFO	

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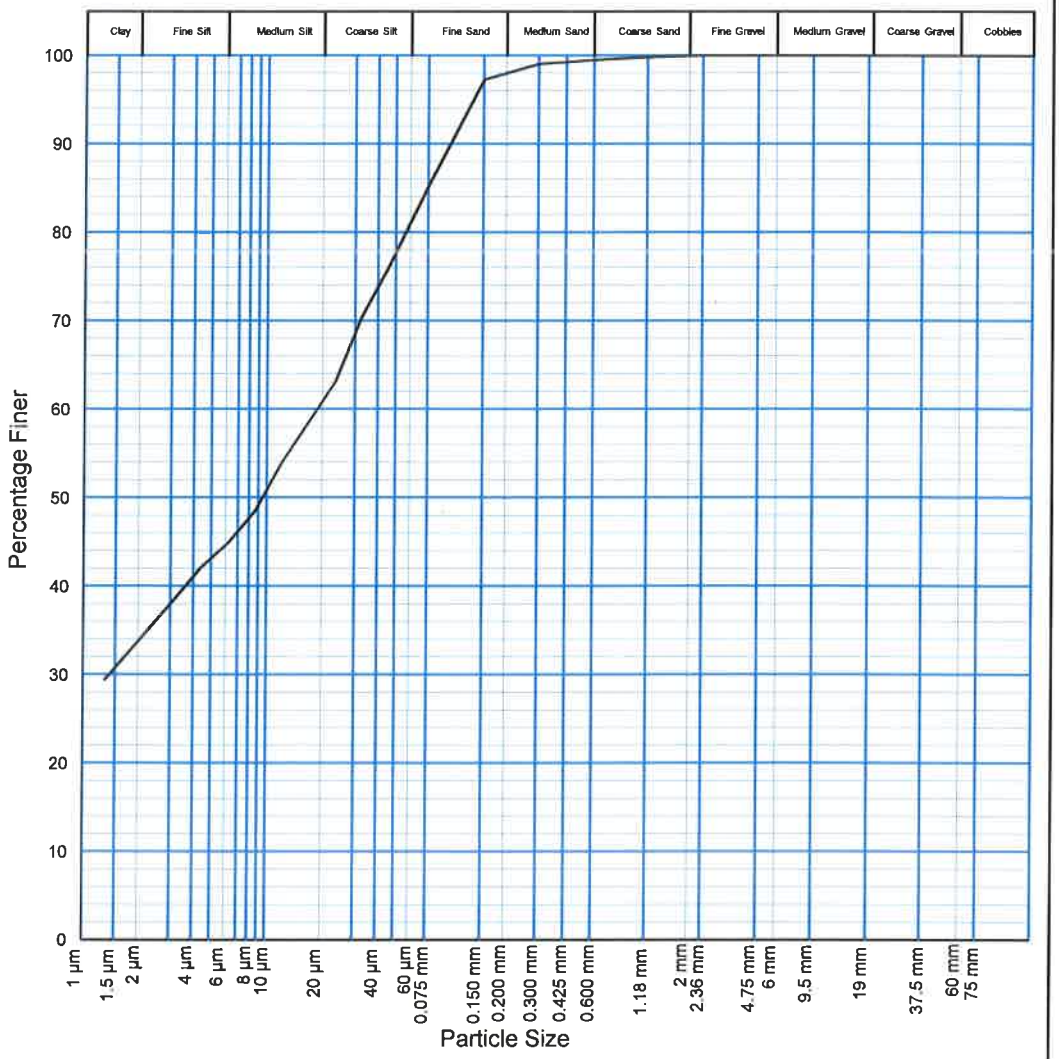
PARTICLE SIZE DISTRIBUTION BY HYDROMETER

Client :	Ports North	Report No. :	R16163
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122-4000
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303516
Location/Sample ID :	BH7 002 (3.20 - 3.60m)	Senders No. :	
		Date Received :	12/08/2013
		Sampled By :	Golder

SIZE FRACTIONS AS PER AUSTRALIAN STANDARDS AS 1726

Particle Size (mm)	Percent Passing
150	
75	
37.5	
19.0	
9.5	
4.75	
2.36	100.0
1.18	99.8
0.600	99.5
0.425	99.3
0.300	99.0
0.150	97.3
0.075	85.2
Particle Size (Microns)	**Percent Passing**
45.3	75.9
32.6	70.5
23.5	63.2
12.0	54.0
8.6	48.6
6.2	44.9
4.4	42.2
3.1	38.5
1.3	29.4



Pretreatment	Tested as received	Soil Particle Density (assumed)	2.70 t/m³
Loss in Pretreatment (%)	-	Type of Hydrometer	ASTM E100
Method of Dispersion	Mixer		
Test Procedure : AS 1289.3.6.3	- Variations to test method a)assumed particle density used b) testing up to 24 hours		
Prepared by : NF		Checked by : CH	

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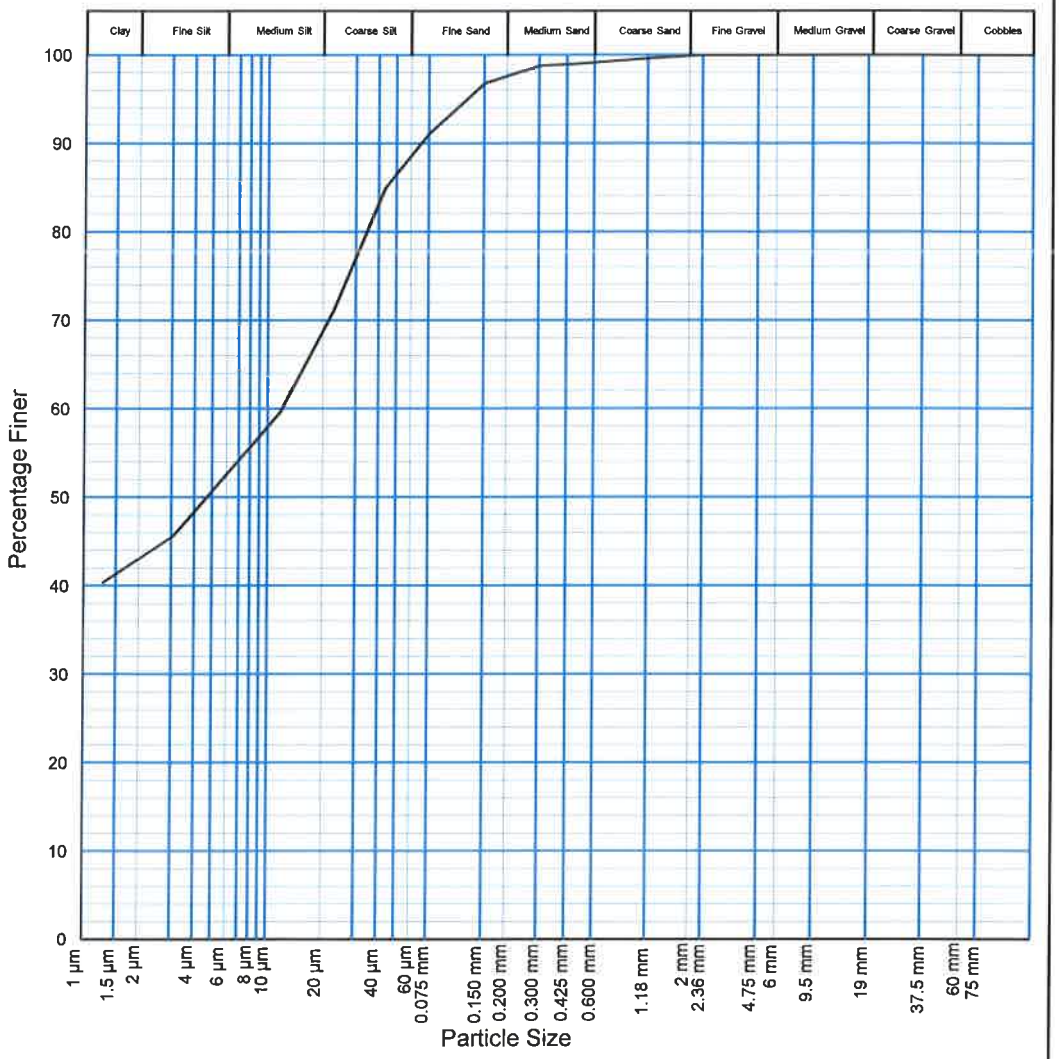
PARTICLE SIZE DISTRIBUTION BY HYDROMETER

Client :	Ports North	Report No. :	R16164
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122-4000
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303517
Location/Sample ID :	BH7 003 (4.20 - 4.60m)	Senders No. :	
		Date Received :	12/08/2013
		Sampled By :	Golder

Particle Size (mm)	Percent Passing
150	
75	
37.5	
19.0	
9.5	
4.75	
2.36	100.0
1.18	99.6
0.600	99.1
0.425	98.9
0.300	98.8
0.150	96.8
0.075	91.1
Particle Size (Microns)	**Percent Passing**
43.4	84.9
31.5	77.9
22.8	71.0
11.7	59.6
8.4	56.1
6.0	52.6
4.3	49.1
3.1	45.6
1.3	40.4



Pretreatment	Tested as received	Soil Particle Density (assumed)	2.70 t/m³
Loss in Pretreatment (%)	-	Type of Hydrometer	ASTM E100
Method of Dispersion	Mixer		
Test Procedure : AS 1289.3.6.3	- Variations to test method a)assumed particle density used b) testing up to 24 hours		
Prepared by : NF		Checked by : GAZ 26/8	

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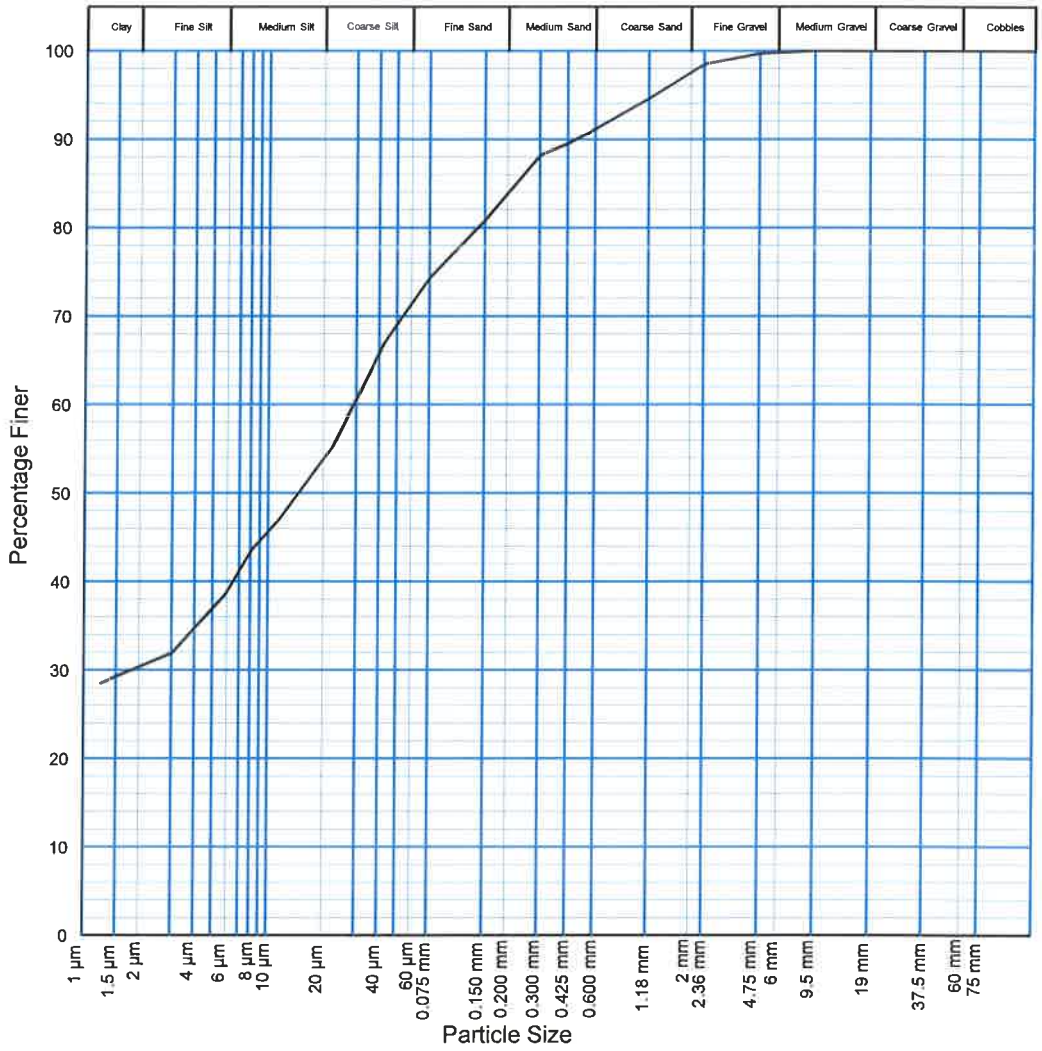
PARTICLE SIZE DISTRIBUTION BY HYDROMETER

Client :	Ports North	Report No. :	R16165
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122-4000
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303518
Location/Sample ID :	BH7 004 (5.45 - 5.90m)	Senders No. :	
		Date Received :	12/08/2013
		Sampled By :	Golder

SIZE FRACTIONS AS PER AUSTRALIAN STANDARDS AS 1726

Particle Size (mm)	Percent Passing
150	
75	
37.5	
19.0	
9.5	100.0
4.75	99.7
2.36	98.5
1.18	94.6
0.600	91.2
0.425	89.6
0.300	88.2
0.150	80.9
0.075	74.4
Particle Size (Microns)	Percent Passing
42.4	67.0
30.7	61.1
22.3	55.3
11.3	46.9
8.1	43.6
5.9	38.6
4.2	35.3
3.0	31.9
1.2	28.6



Pretreatment	Tested as received	Soil Particle Density (assumed)	2.70 t/m³
Loss in Pretreatment (%)	-	Type of Hydrometer	ASTM E100
Method of Dispersion	Mixer		
Test Procedure : AS 1289.3.6.3	- Variations to test method a)assumed particle density used b) testing up to 24 hours		
Prepared by : NF		Checked by : CH	

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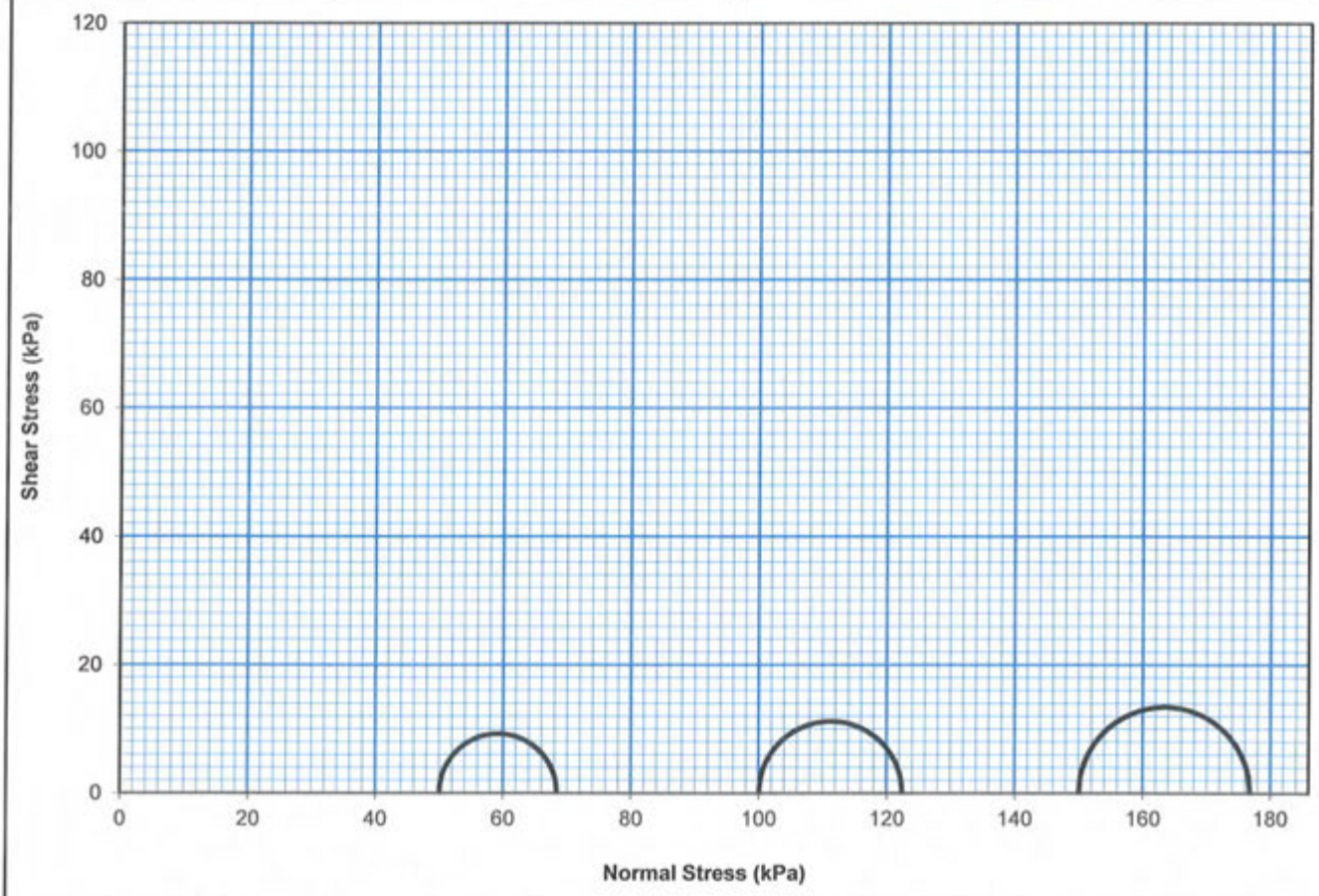
TRIAXIAL SHEAR TEST

Client :	Ports North	Report No. :	R16166
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303493
Location/Sample ID :	BH1 003 (2.10 - 2.50m)	Sample No. :	
Date of Test :	26/8/13	Sampled By :	Client

Type of test :	Unsaturated, Unconsolidated, Undrained, Staged		
Sample Type :	Undisturbed	Strain Rate :	0.50 mm/min
Specimen Diameter :	48.0 mm	Specimen Height :	94.5 mm
Initial Moisture Content :	69.3 %	Initial Saturation :	98 %
Initial Dry Density :	0.93 t/m³		



Stage	Initial Cell Pressure (kPa)	Maximum Principal Stress (kPa) σ_1	Minimum Principal Stress (kPa) σ_3	Maximum Deviator Stress (kPa)	Failure Strain (%)
1	50	68	50	18	1.3
2	100	122	100	22	2.6
3	150	177	150	27	4.8

Failure Criteria : Maximum Shear Stress
Remarks :

Test Procedure : AS1289.6.4.1

Prepared by NF | Checked by GH

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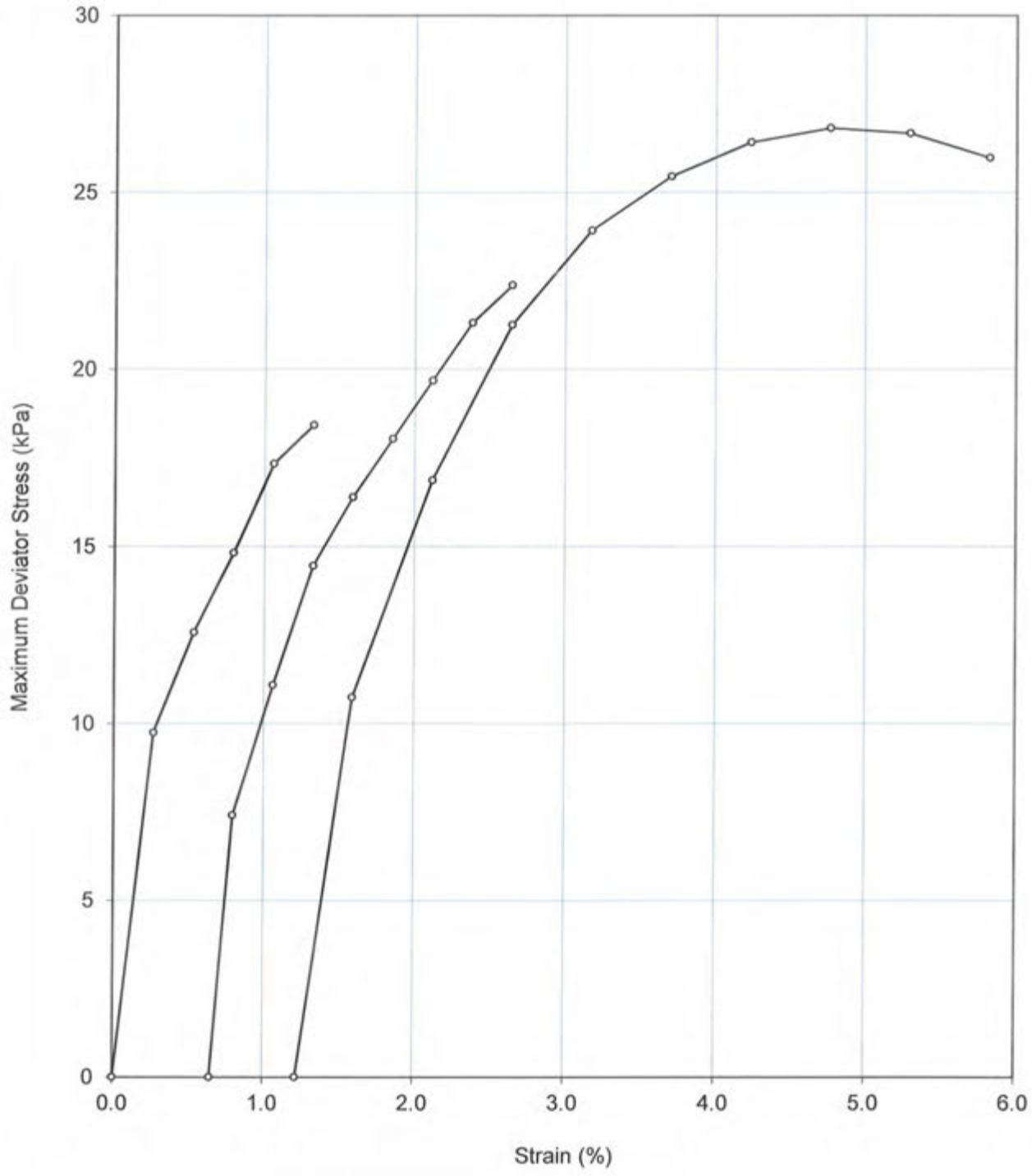
TRIAXIAL SHEAR TEST (STRESS STRAIN GRAPH)

Client :	Ports North	Report No. :	R16166
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303493
Location/Sample ID :	BH1 003 (2.10 - 2.50m)	Sample No. :	
		Sampled By :	Client



Prepared by	Checked by

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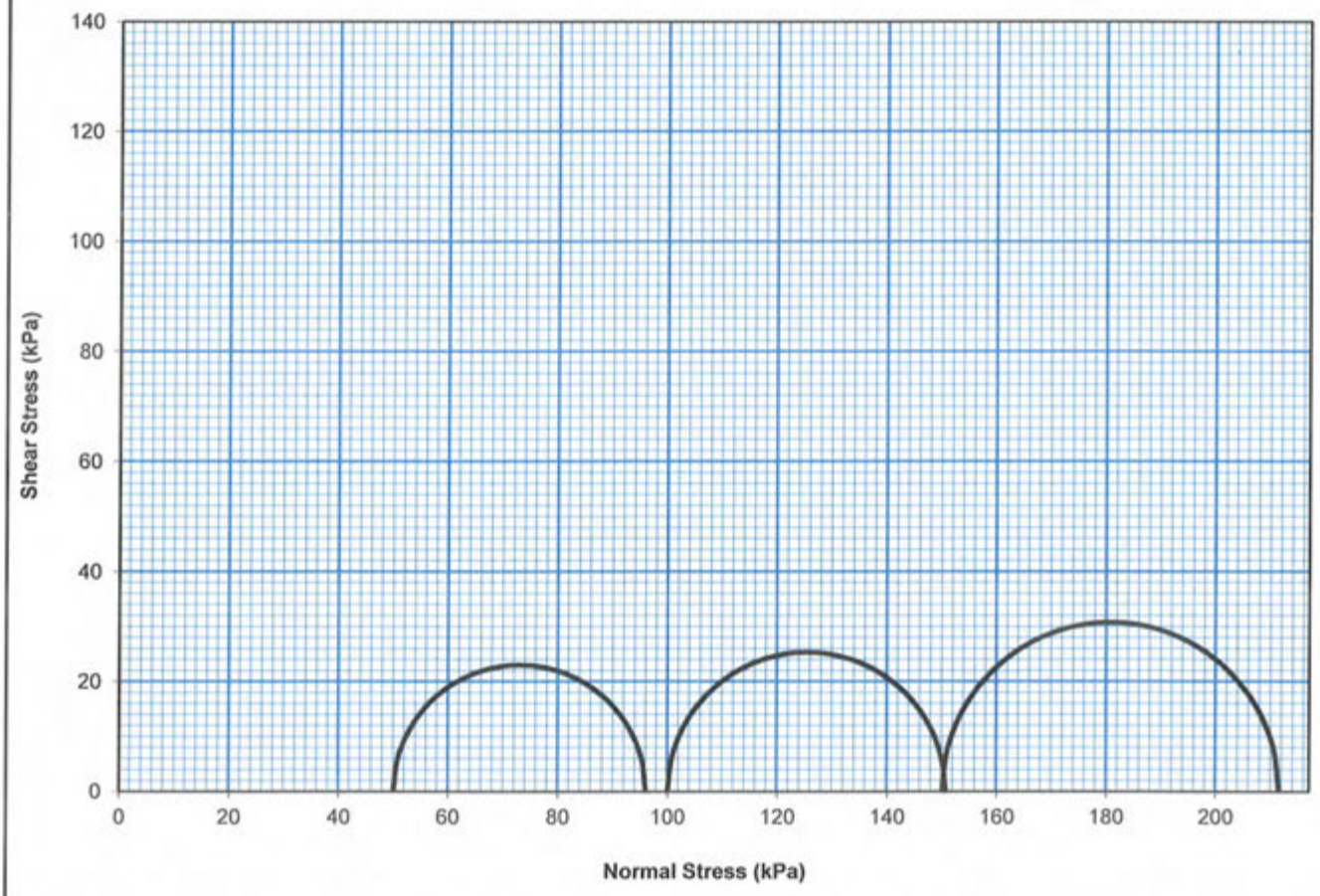
TRIAXIAL SHEAR TEST

Client :	Ports North	Report No. :	R16167
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303494
Location/Sample ID :	BH1 004 (3.10 - 3.50m)	Sample No. :	
Date of Test :	26/8/13	Sampled By :	Client

Type of test :	Unsaturated, Unconsolidated, Undrained, Staged		
Sample Type :	Undisturbed	Strain Rate :	0.50 mm/min
Specimen Diameter :	48.0 mm	Specimen Height :	94.5 mm
Initial Moisture Content :	77.9 %	Initial Saturation :	97 %
Initial Dry Density :	0.85 t/m³		



Stage	Initial Cell Pressure (kPa)	Maximum Principal Stress (kPa) σ_1	Minimum Principal Stress (kPa) σ_3	Maximum Deviator Stress (kPa)	Failure Strain (%)
1	50	96	50	46	2.4
2	100	151	100	51	3.2
3	150	212	150	62	5.3

Failure Criteria : Maximum Shear Stress
Remarks :

Test Procedure : AS1289.6.4.1

Prepared by NF | Checked by 'll'

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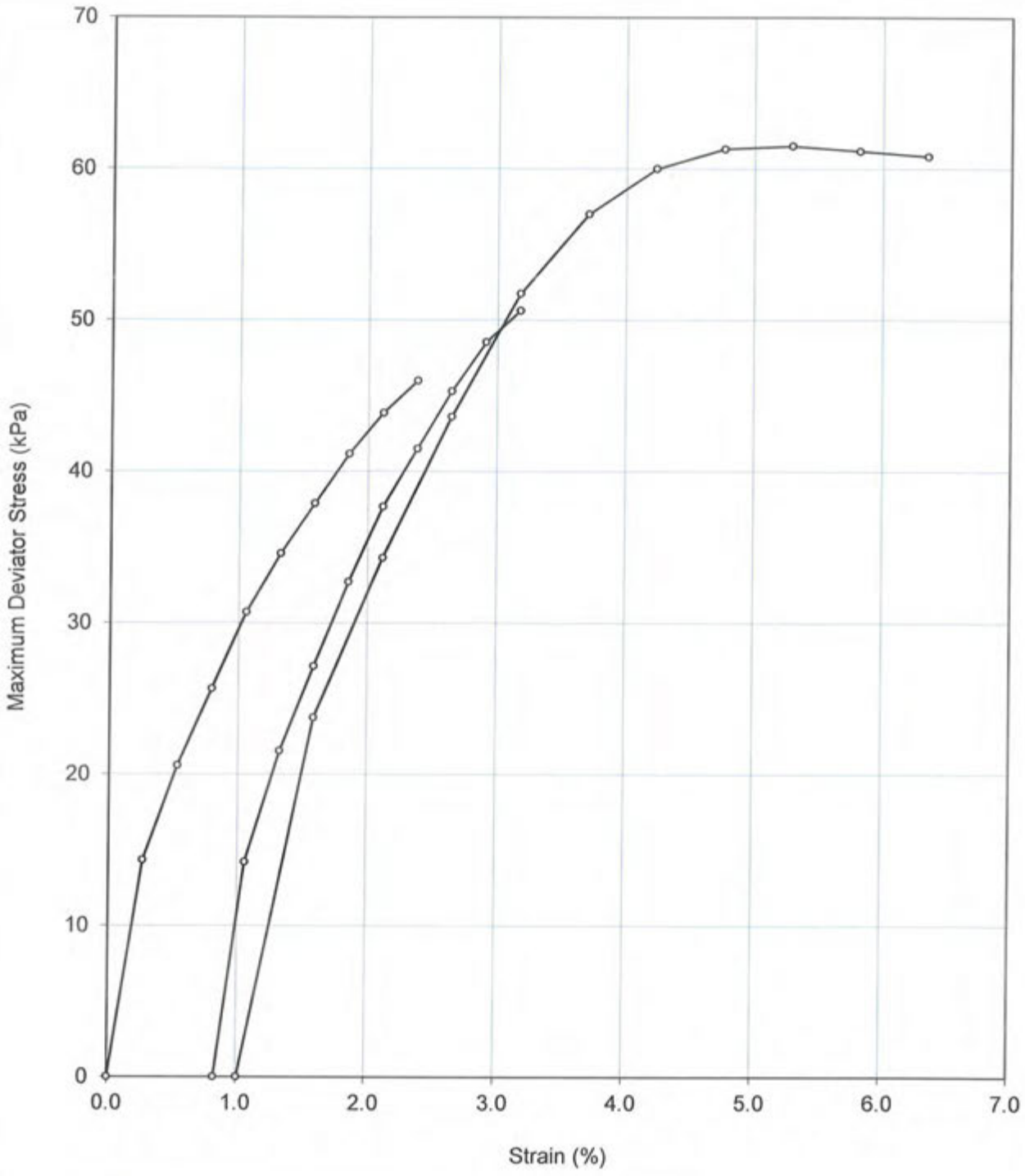
TRIAXIAL SHEAR TEST (STRESS STRAIN GRAPH)

Client :	Ports North	Report No. :	R16167
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303494
Location/Sample ID :	BH1 004 (3.10 - 3.50m)	Sample No. :	
		Sampled By :	Client



Prepared by

Checked by

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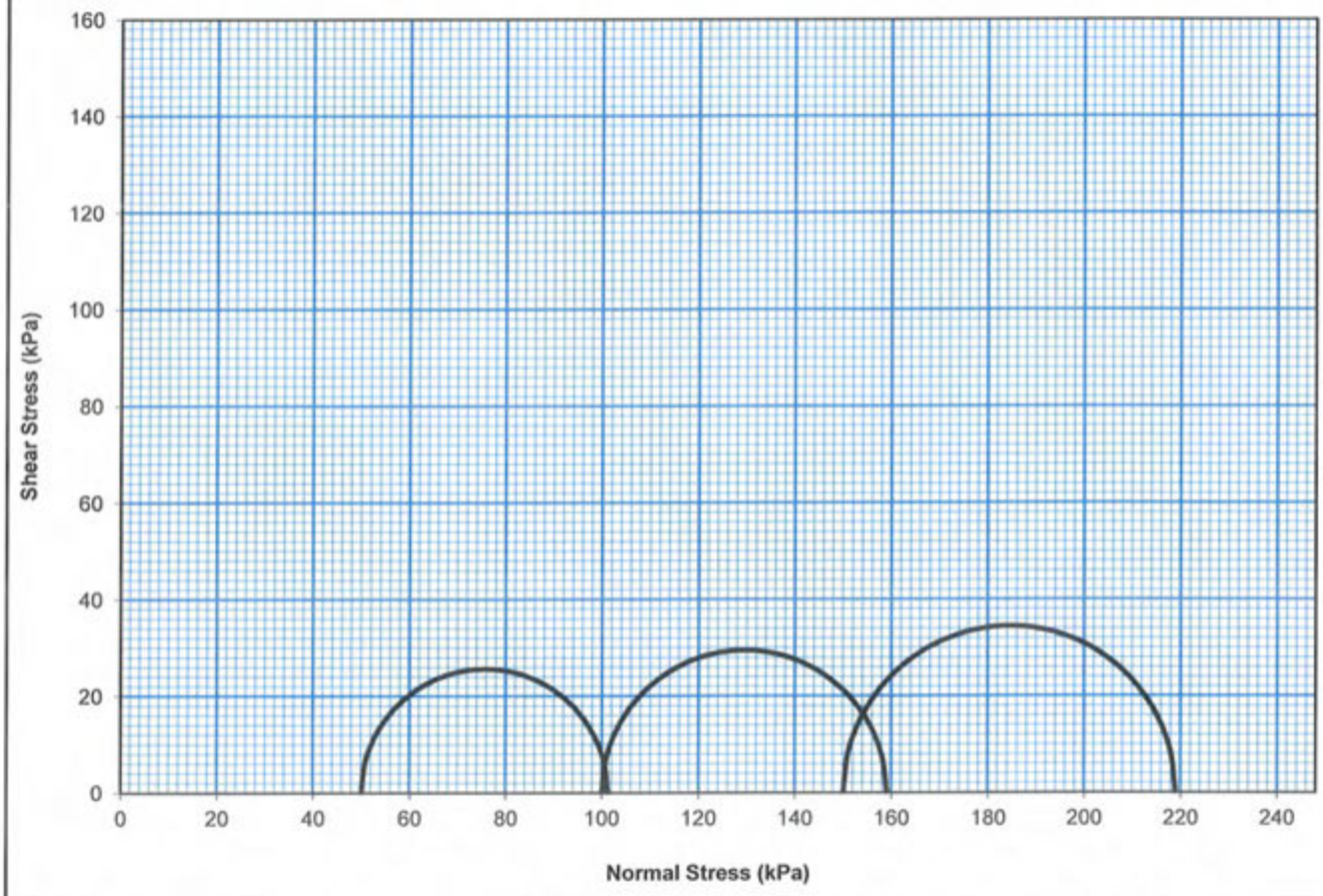
TRIAXIAL SHEAR TEST

Client :	Ports North	Report No. :	R16168
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303495
Location/Sample ID :	BH1 005 (4.10 - 4.50m)	Sample No. :	
Date of Test :	27/8/13	Sampled By :	Client

Type of test :	Unsaturated, Unconsolidated, Undrained, Staged		
Sample Type :	Undisturbed	Strain Rate :	0.50 mm/min
Specimen Diameter :	47.7 mm	Specimen Height :	95.2 mm
Initial Moisture Content :	25.9 %	Initial Saturation :	100 %
Initial Dry Density :	1.61 t/m³		



Stage	Initial Cell Pressure (kPa)	Maximum Principal Stress (kPa) σ_1	Minimum Principal Stress (kPa) σ_3	Maximum Deviator Stress (kPa)	Failure Strain (%)
1	50	101	50	51	1.1
2	100	159	100	59	1.6
3	150	219	150	69	3.7

Failure Criteria : Maximum Shear Stress
Remarks :

Test Procedure : AS1289.6.4.1

Prepared by MA | Checked by GN

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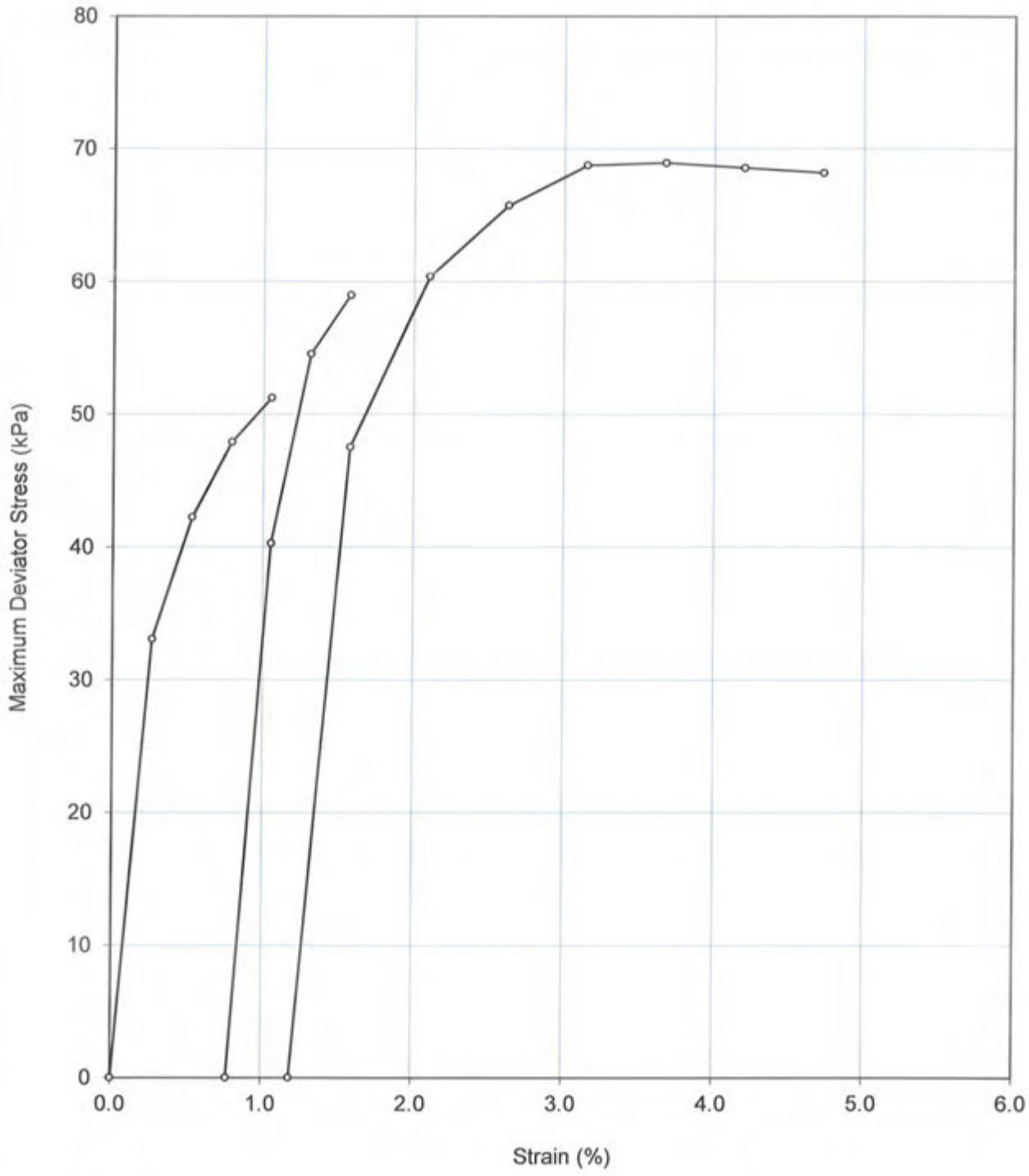
TRIAXIAL SHEAR TEST (STRESS STRAIN GRAPH)

Client :	Ports North	Report No. :	R16168
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303495
Location/Sample ID :	BH1 005 (4.10 - 4.50m)	Sample No. :	
		Sampled By :	Client



Prepared by MF

Checked by CH

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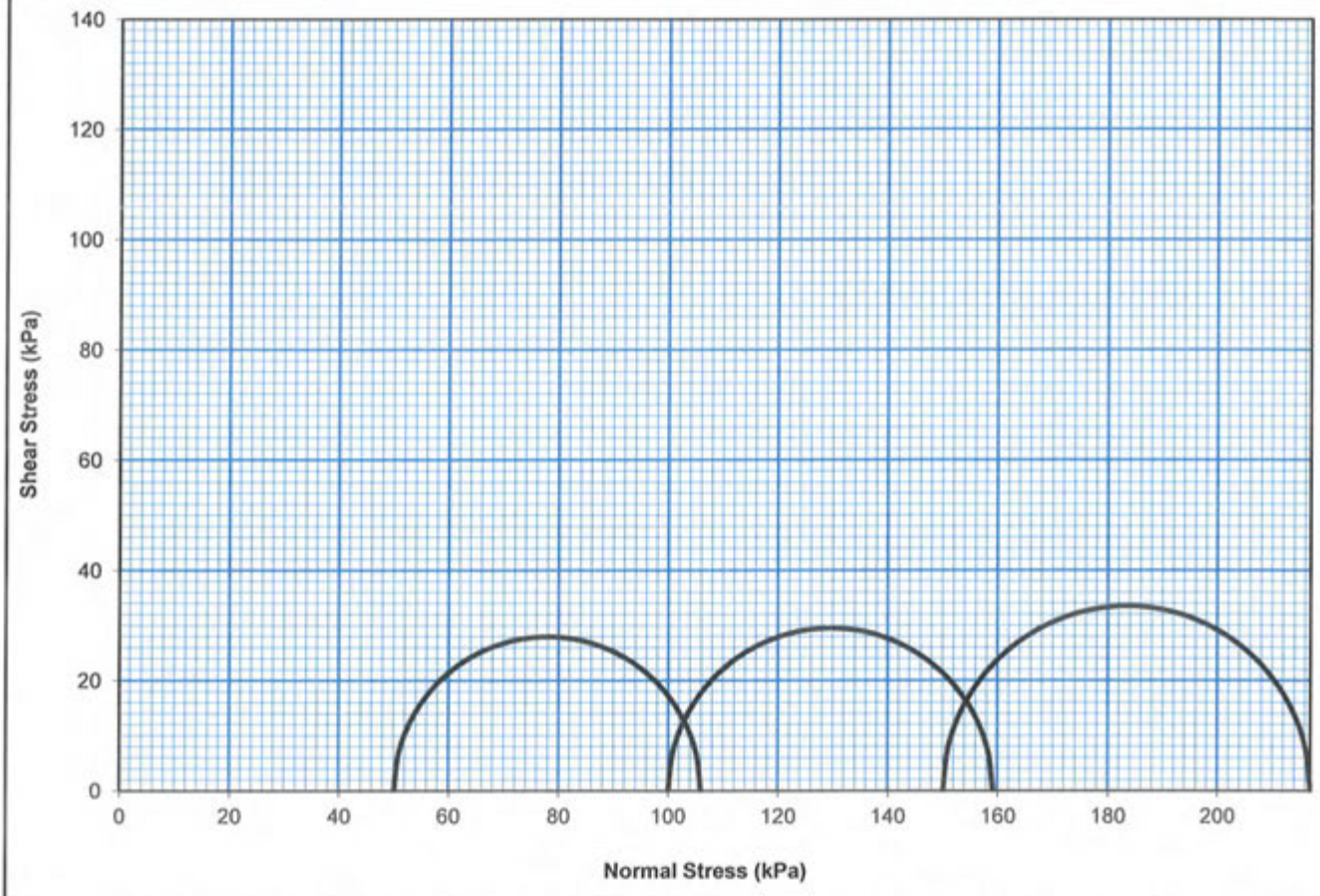
TRIAXIAL SHEAR TEST

Client :	Ports North	Report No. :	R16169
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303497
Location/Sample ID :	BH2 002 (2.10 - 2.50m)	Sample No. :	
Date of Test :	27/8/13	Sampled By :	Client

Type of test :	Unsaturated, Unconsolidated, Undrained, Staged		
Sample Type :	Undisturbed	Strain Rate :	0.50 mm/min
Specimen Diameter :	47.6 mm	Specimen Height :	95.2 mm
Initial Moisture Content :	31.1 %	Initial Saturation :	100 %
Initial Dry Density :	1.47 t/m³		



Stage	Initial Cell Pressure (kPa)	Maximum Principal Stress (kPa) σ_1	Minimum Principal Stress (kPa) σ_3	Maximum Deviator Stress (kPa)	Failure Strain (%)
1	50	106	50	56	1.3
2	100	159	100	59	1.8
3	150	217	150	67	3.7

Failure Criteria : Maximum Shear Stress
Remarks :

Test Procedure : AS1289.6.4.1

Prepared by NF | Checked by GH

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Approved Signatory

Senior Technical Officer
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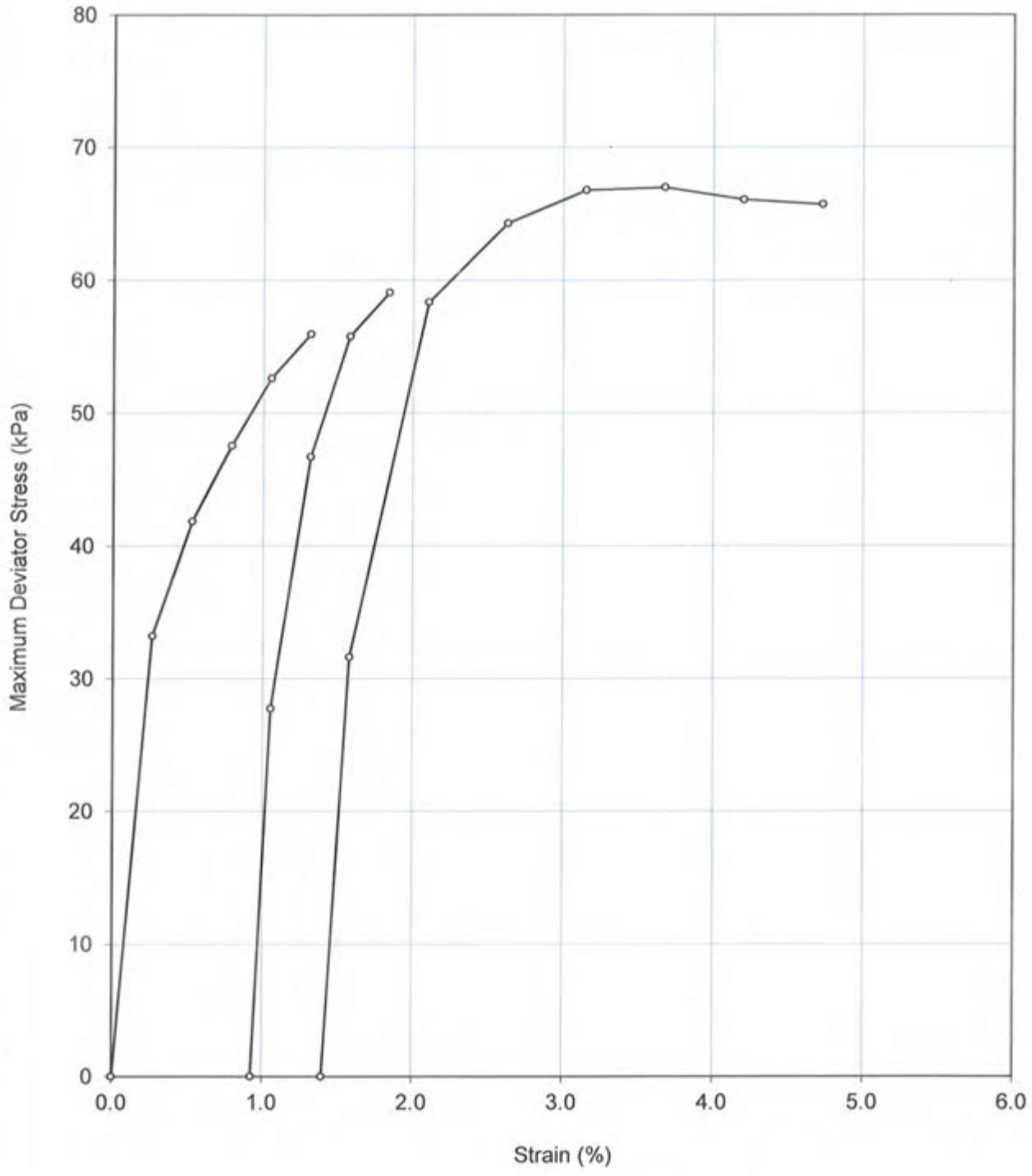
TRIAXIAL SHEAR TEST (STRESS STRAIN GRAPH)

Client :	Ports North	Report No. :	R16169
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303497
Location/Sample ID :	BH2 002 (2.10 - 2.50m)	Sample No. :	
		Sampled By :	Client



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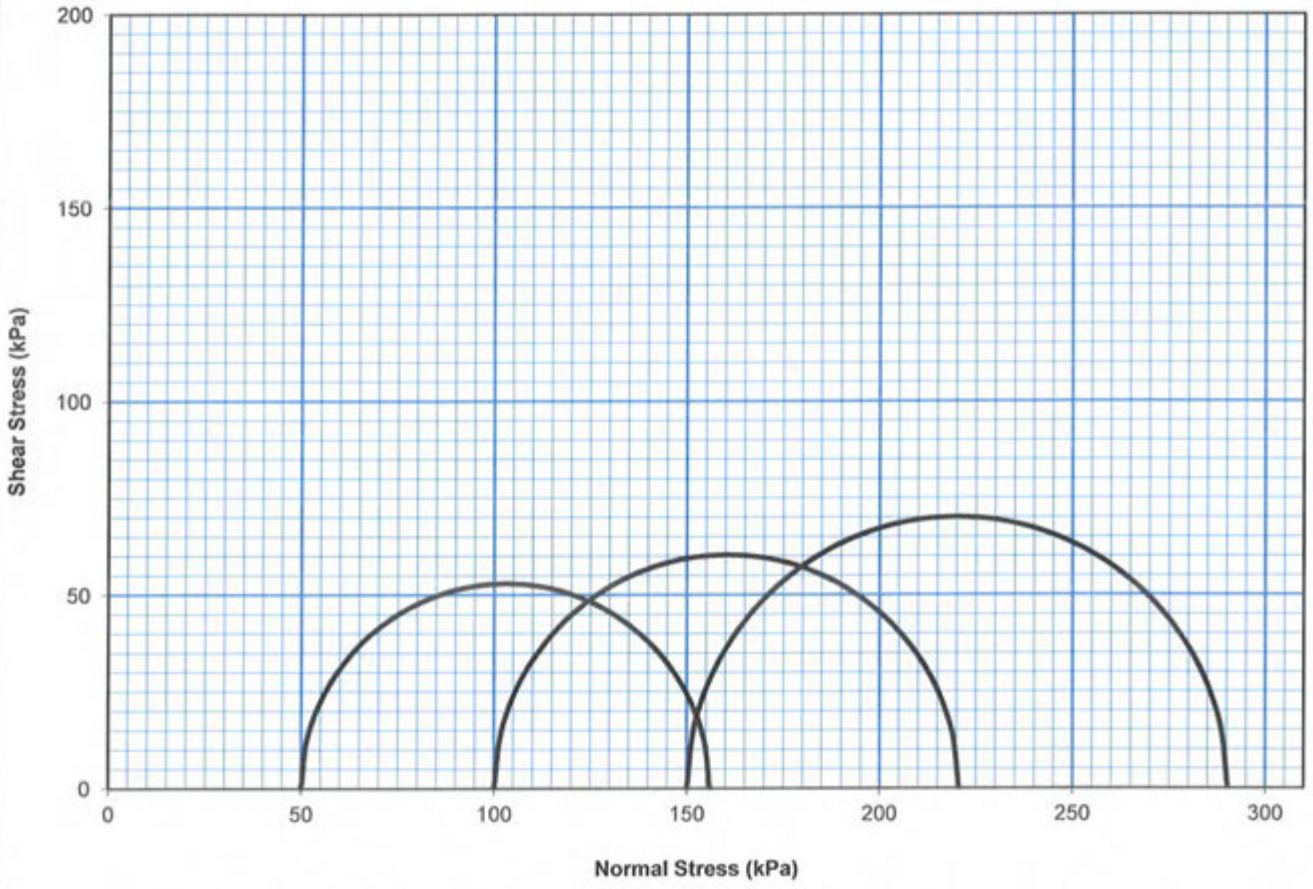
TRIAXIAL SHEAR TEST

Client :	Ports North	Report No. :	R16170
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303499
Location/Sample ID :	BH3 001 (0.40 - 0.80m)	Sample No. :	
Date of Test :	27/8/13	Sampled By :	Client

Type of test :	Unsaturated, Unconsolidated, Undrained, Staged		
Sample Type :	Undisturbed	Strain Rate :	0.50 mm/min
Specimen Diameter :	47.9 mm	Specimen Height :	95.3 mm
Initial Moisture Content :	27.4 %	Initial Saturation :	99 %
Initial Dry Density :	1.54 t/m³		



Stage	Initial Cell Pressure (kPa)	Maximum Principal Stress (kPa) σ_1	Minimum Principal Stress (kPa) σ_3	Maximum Deviator Stress (kPa)	Failure Strain (%)
1	50	156	50	106	1.3
2	100	221	100	121	1.8
3	150	290	150	140	4.7

Failure Criteria : Maximum Shear Stress
Remarks :

Test Procedure : AS1289.6.4.1

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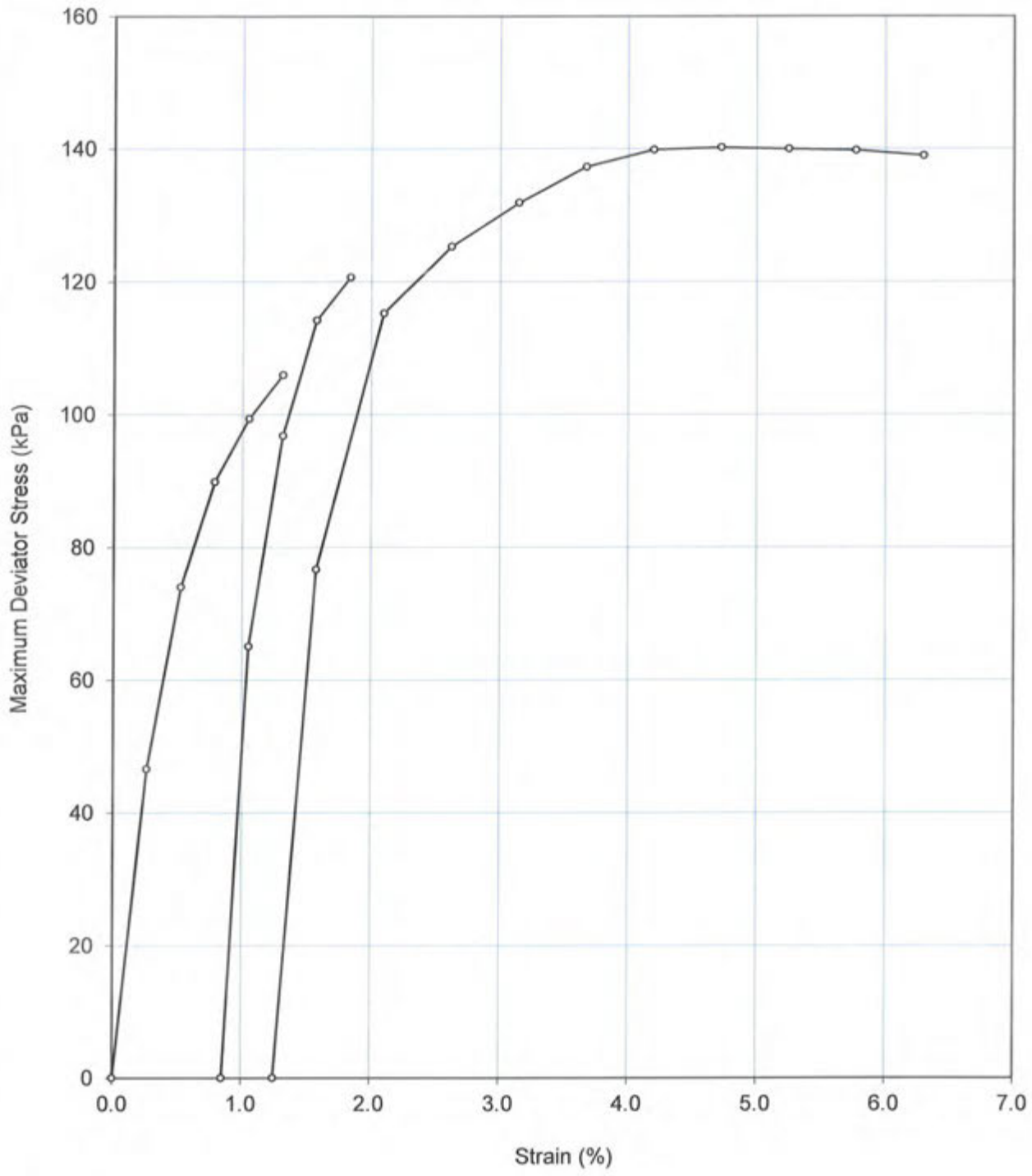
TRIAXIAL SHEAR TEST (STRESS STRAIN GRAPH)

Client :	Ports North	Report No. :	R16170
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303499
Location/Sample ID :	BH3 001 (0.40 - 0.80m)	Sample No. :	
		Sampled By :	Client



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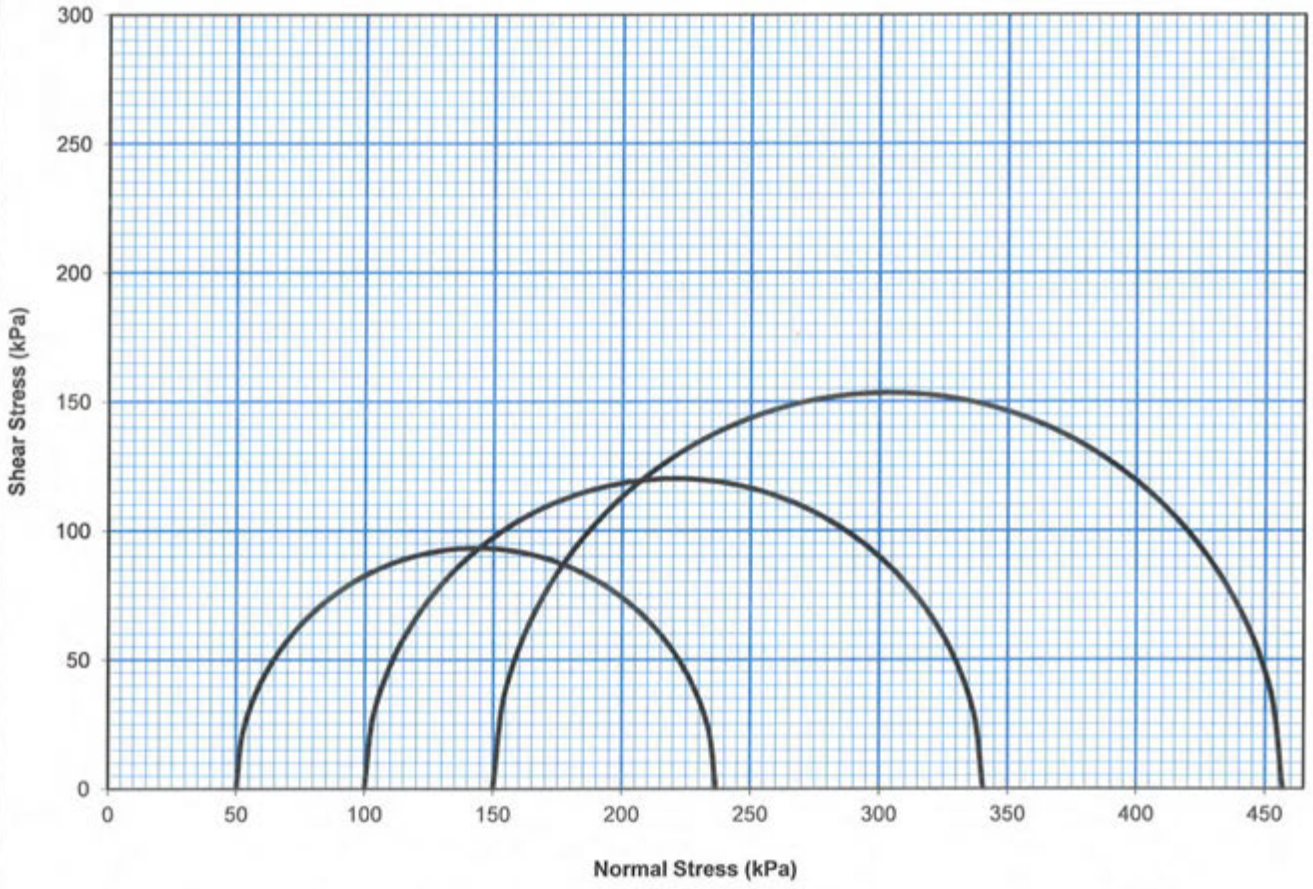
TRIAXIAL SHEAR TEST

Client :	Ports North	Report No. :	R16171
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303500
Location/Sample ID :	BH3 002 (1.40 - 1.80m)	Sample No. :	
Date of Test :	27/8/13	Sampled By :	Client

Type of test :	Unsaturated, Unconsolidated, Undrained, Staged		
Sample Type :	Undisturbed	Strain Rate :	0.50 mm/min
Specimen Diameter :	47.8 mm	Specimen Height :	95.0 mm
Initial Moisture Content :	24.5 %	Initial Saturation :	100 %
Initial Dry Density :	1.63 t/m³		



Stage	Initial Cell Pressure (kPa)	Maximum Principal Stress (kPa) σ_1	Minimum Principal Stress (kPa) σ_3	Maximum Deviator Stress (kPa)	Failure Strain (%)
1	50	237	50	187	1.8
2	100	340	100	240	2.6
3	150	457	150	307	5.8

Failure Criteria : Maximum Shear Stress
Remarks :

Test Procedure : AS1289.6.4.1

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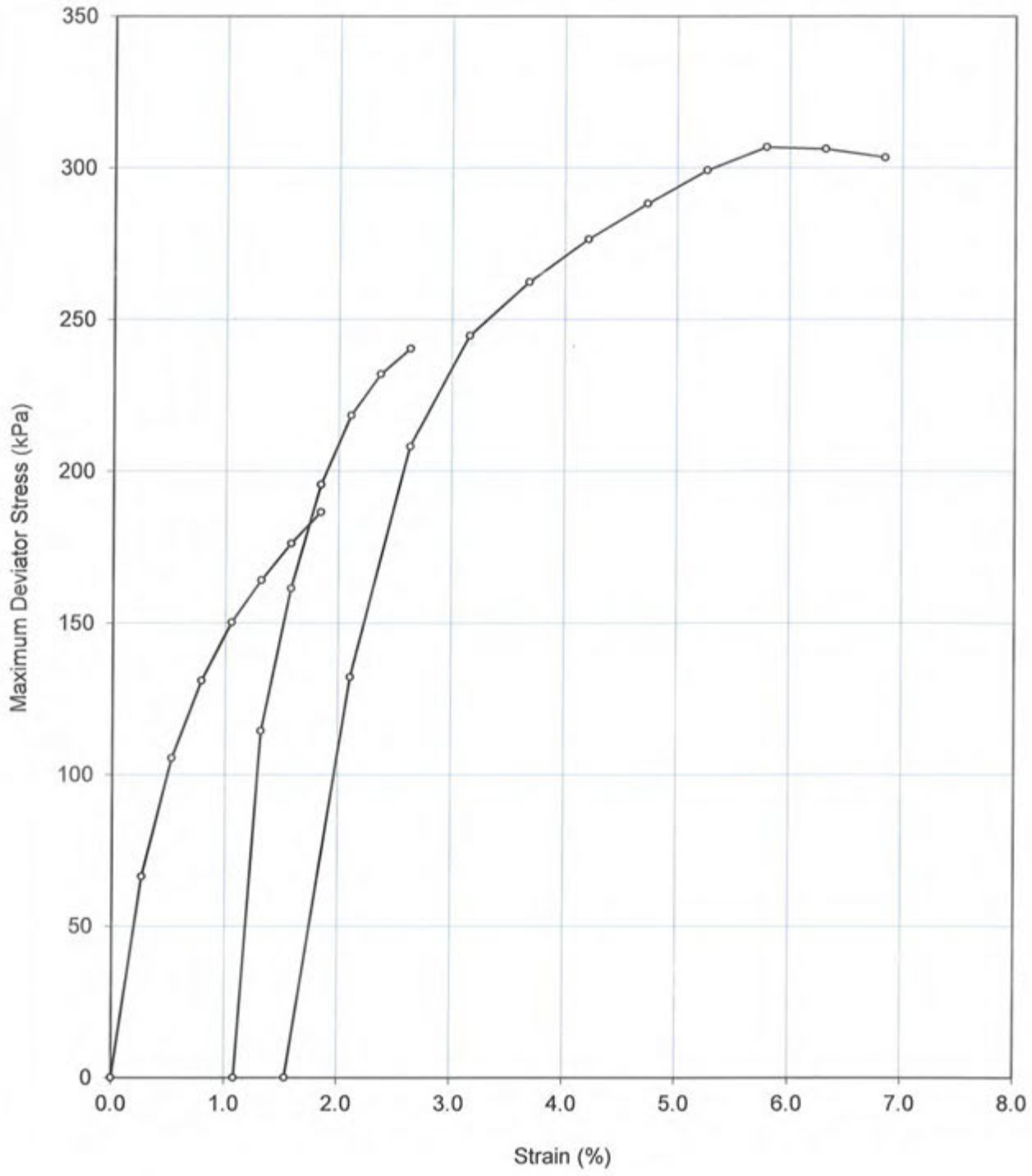
TRIAXIAL SHEAR TEST (STRESS STRAIN GRAPH)

Client :	Ports North	Report No. :	R16171
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303500
Location/Sample ID :	BH3 002 (1.40 - 1.80m)	Sample No. :	
		Sampled By :	Client



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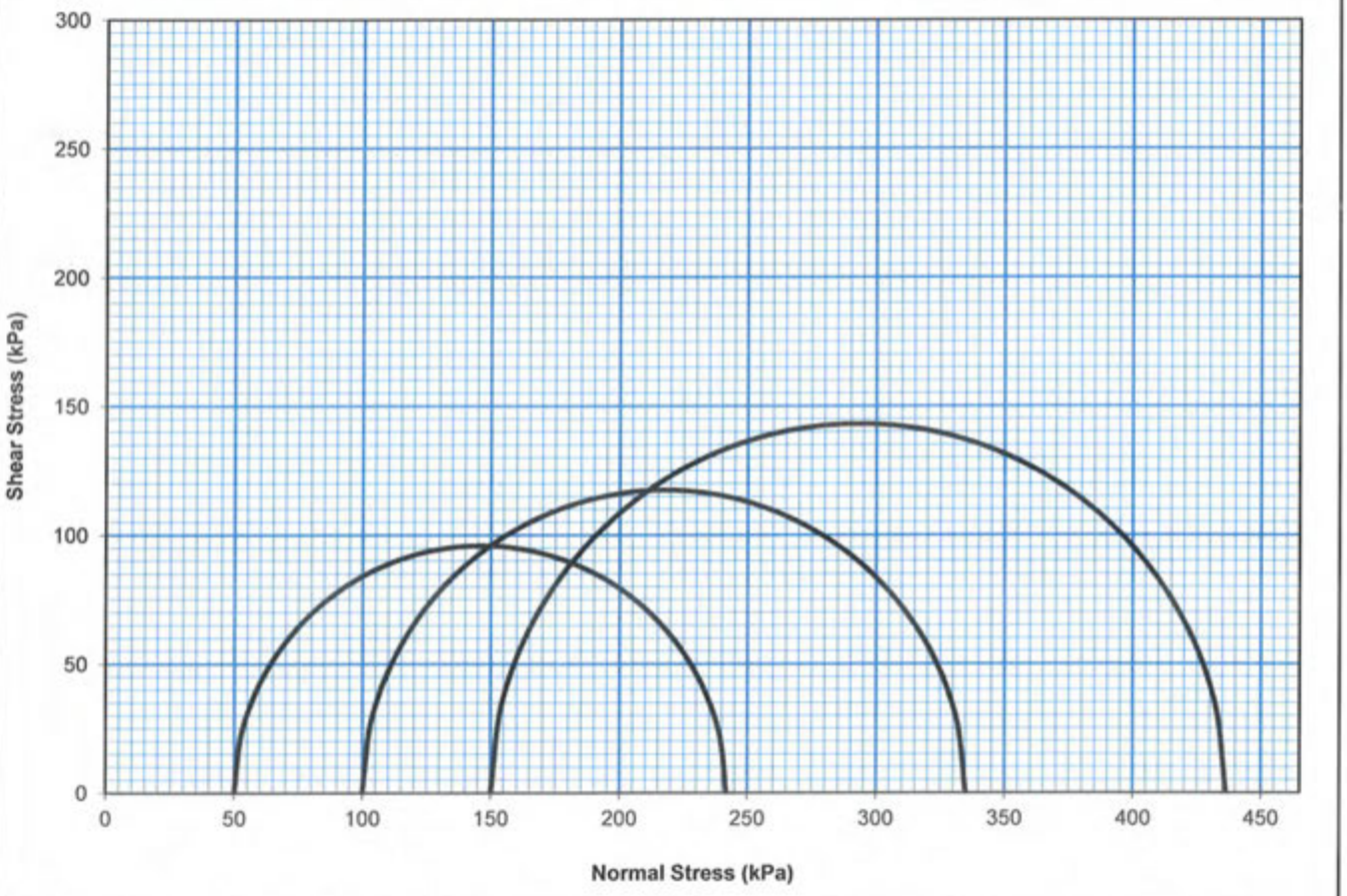
TRIAXIAL SHEAR TEST

Client :	Ports North	Report No. :	R16172
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303502
Location/Sample ID :	BH3 003 (2.40 - 2.63m)	Sample No. :	
Date of Test :	28/8/13	Sampled By :	Client

Type of test :	Unsaturated, Unconsolidated, Undrained, Staged		
Sample Type :	Undisturbed	Strain Rate :	0.50 mm/min
Specimen Diameter :	47.9 mm	Specimen Height :	95.0 mm
Initial Moisture Content :	24.7 %	Initial Saturation :	98 %
Initial Dry Density :	1.61 t/m³		



Stage	Initial Cell Pressure (kPa)	Maximum Principal Stress (kPa) σ_1	Minimum Principal Stress (kPa) σ_3	Maximum Deviator Stress (kPa)	Failure Strain (%)
1	50	242	50	192	1.3
2	100	335	100	235	2.4
3	150	436	150	286	4.2

Failure Criteria : Maximum Shear Stress
Remarks :

Test Procedure : AS1289.6.4.1

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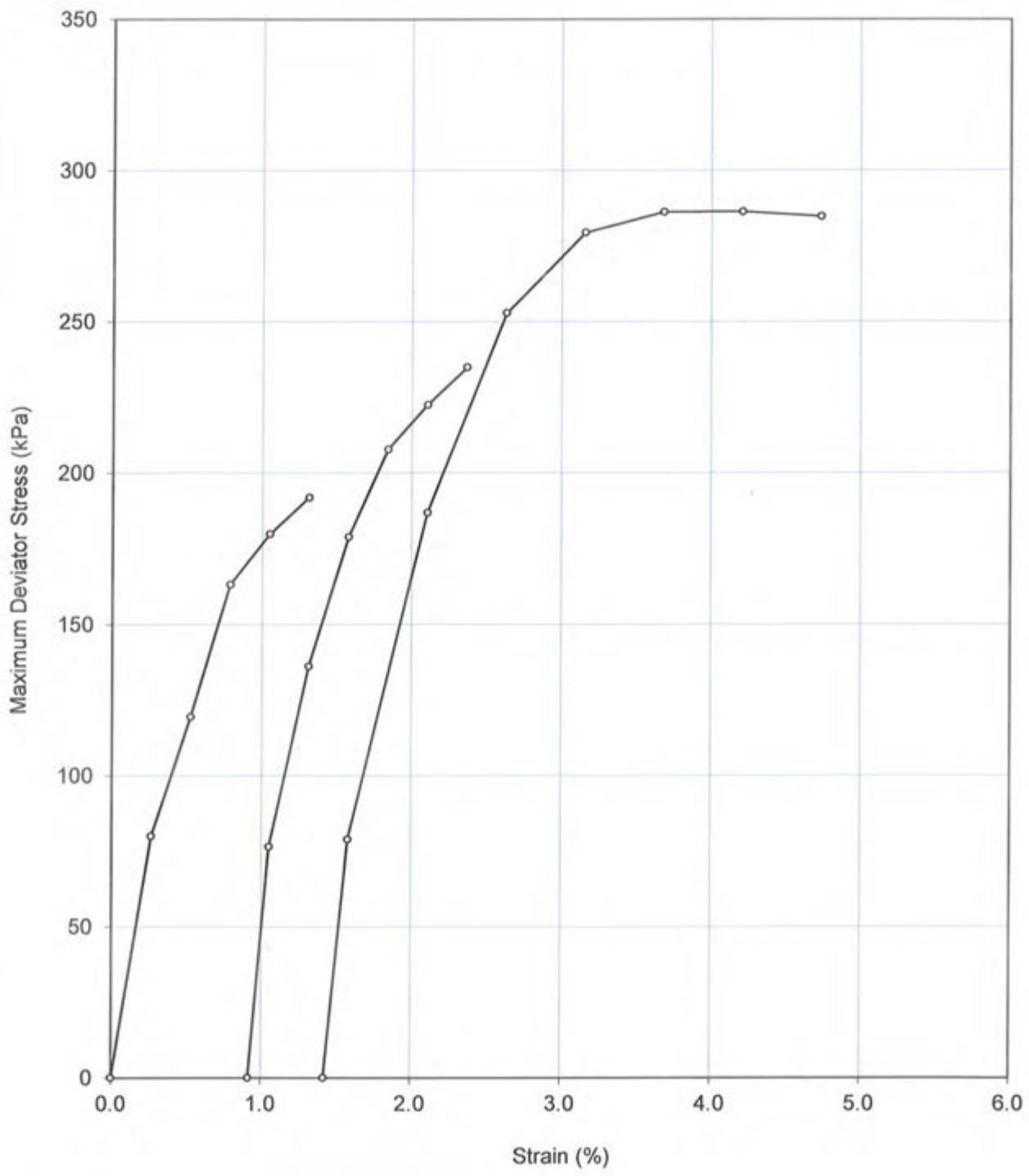
TRIAXIAL SHEAR TEST (STRESS STRAIN GRAPH)

Client :	Ports North	Report No. :	R16172
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303502
Location/Sample ID :	BH3 003 (2.40 - 2.63m)	Sample No. :	
		Sampled By :	Client



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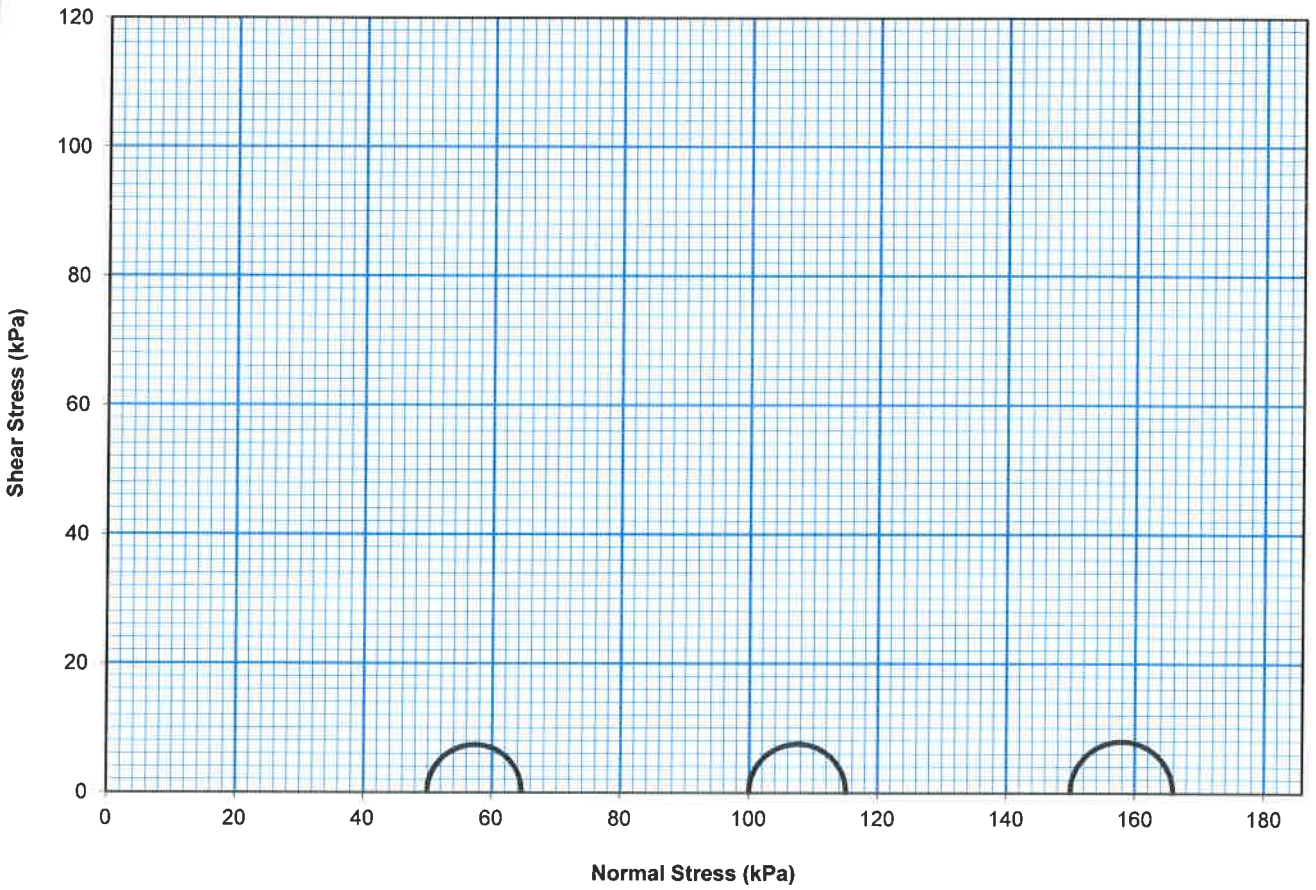
TRIAXIAL SHEAR TEST

Client :	Ports North	Report No. :	R16173
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303503
Location/Sample ID :	BH4 001 (2.40 - 2.80m)	Sample No. :	
Date of Test :	28/8/13	Sampled By :	Client

Type of test :	Unsaturated, Unconsolidated, Undrained, Staged		
Sample Type :	Undisturbed	Strain Rate :	0.50 mm/min
Specimen Diameter :	48.0 mm	Specimen Height :	93.8 mm
Initial Moisture Content :	59.7 %	Initial Saturation :	98 %
Initial Dry Density :	1.02 t/m³		



Stage	Initial Cell Pressure (kPa)	Maximum Principal Stress (kPa) σ_1	Minimum Principal Stress (kPa) σ_3	Maximum Deviator Stress (kPa)	Failure Strain (%)
1	50	65	50	15	1.3
2	100	115	100	15	2.7
3	150	166	150	16	4.3

Failure Criteria :	Maximum Shear Stress
Remarks :	This amended report replaces the Report No. R16173 page 1 of 2 dated 29/08/2013
Test Procedure :	AS1289.6.4.1
Prepared by	Checked by

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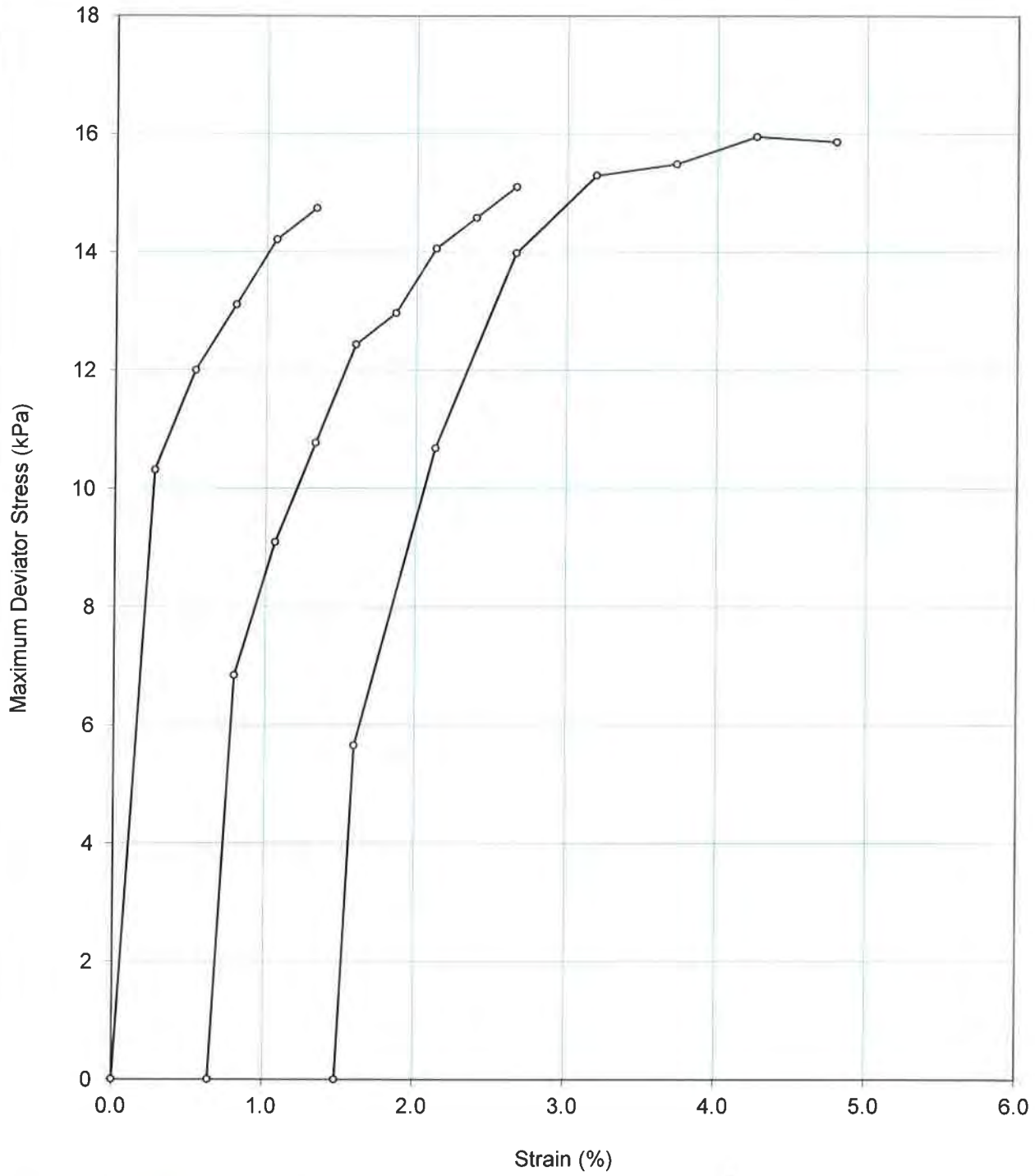
TRIAXIAL SHEAR TEST (STRESS STRAIN GRAPH)

Client :	Ports North	Report No. :	R16173
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303503
Location/Sample ID :	BH4 001 (2.40 - 2.80m)	Sample No. :	
		Sampled By :	Client



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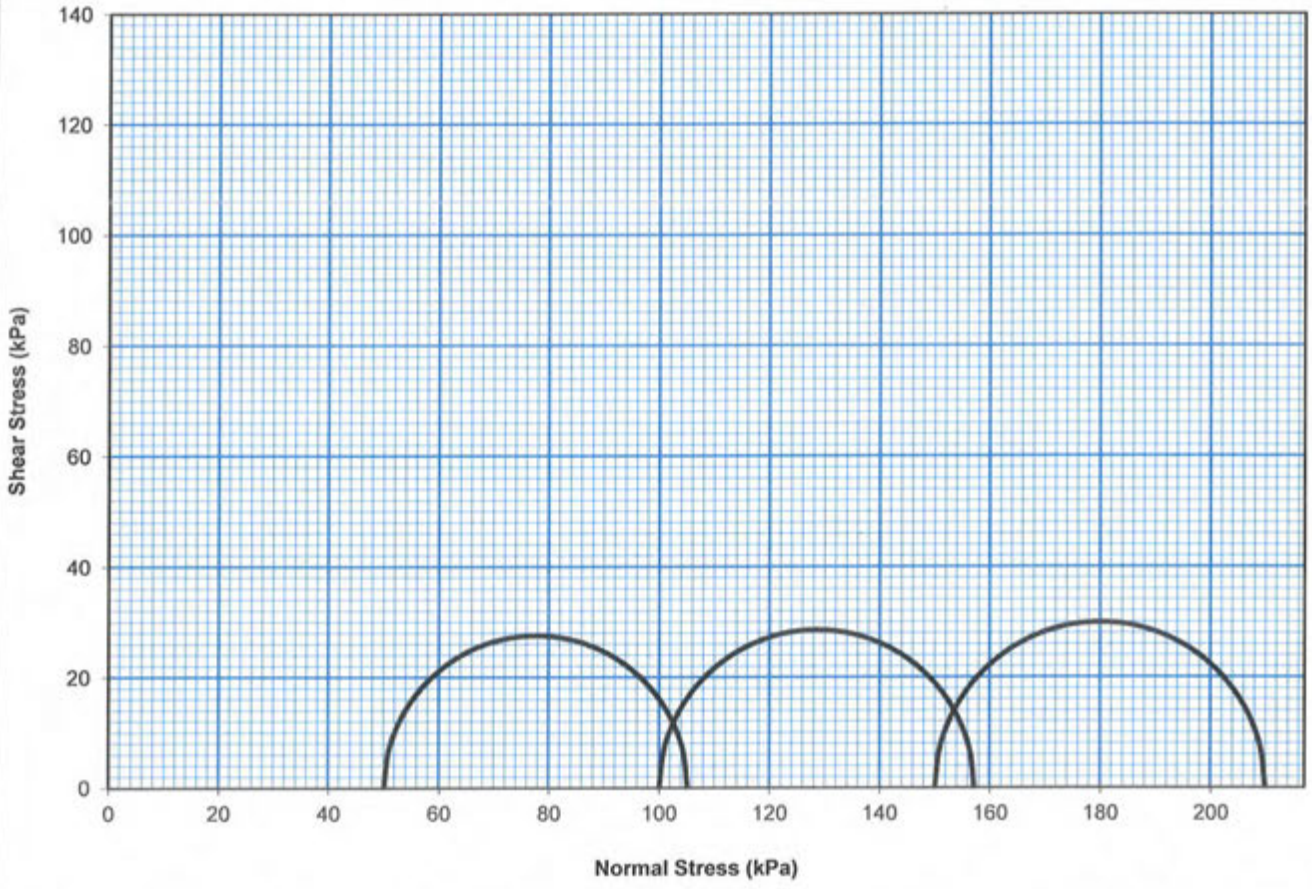
TRIAXIAL SHEAR TEST

Client :	Ports North	Report No. :	R16174
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303505
Location/Sample ID :	BH4 003 (4.40 - 4.80m)	Sample No. :	
Date of Test :	28/8/13	Sampled By :	Client

Type of test :	Unsaturated, Unconsolidated, Undrained, Staged		
Sample Type :	Undisturbed	Strain Rate :	0.50 mm/min
Specimen Diameter :	47.7 mm	Specimen Height :	95.0 mm
Initial Moisture Content :	24.2 %	Initial Saturation :	100 %
Initial Dry Density :	1.65 t/m³		



Stage	Initial Cell Pressure (kPa)	Maximum Principal Stress (kPa) σ_1	Minimum Principal Stress (kPa) σ_3	Maximum Deviator Stress (kPa)	Failure Strain (%)
1	50	105	50	55	1.3
2	100	157	100	57	1.8
3	150	210	150	60	4.7

Failure Criteria :	Maximum Shear Stress
Remarks :	
Test Procedure :	AS1289.6.4.1
Prepared by MF	Checked by GB

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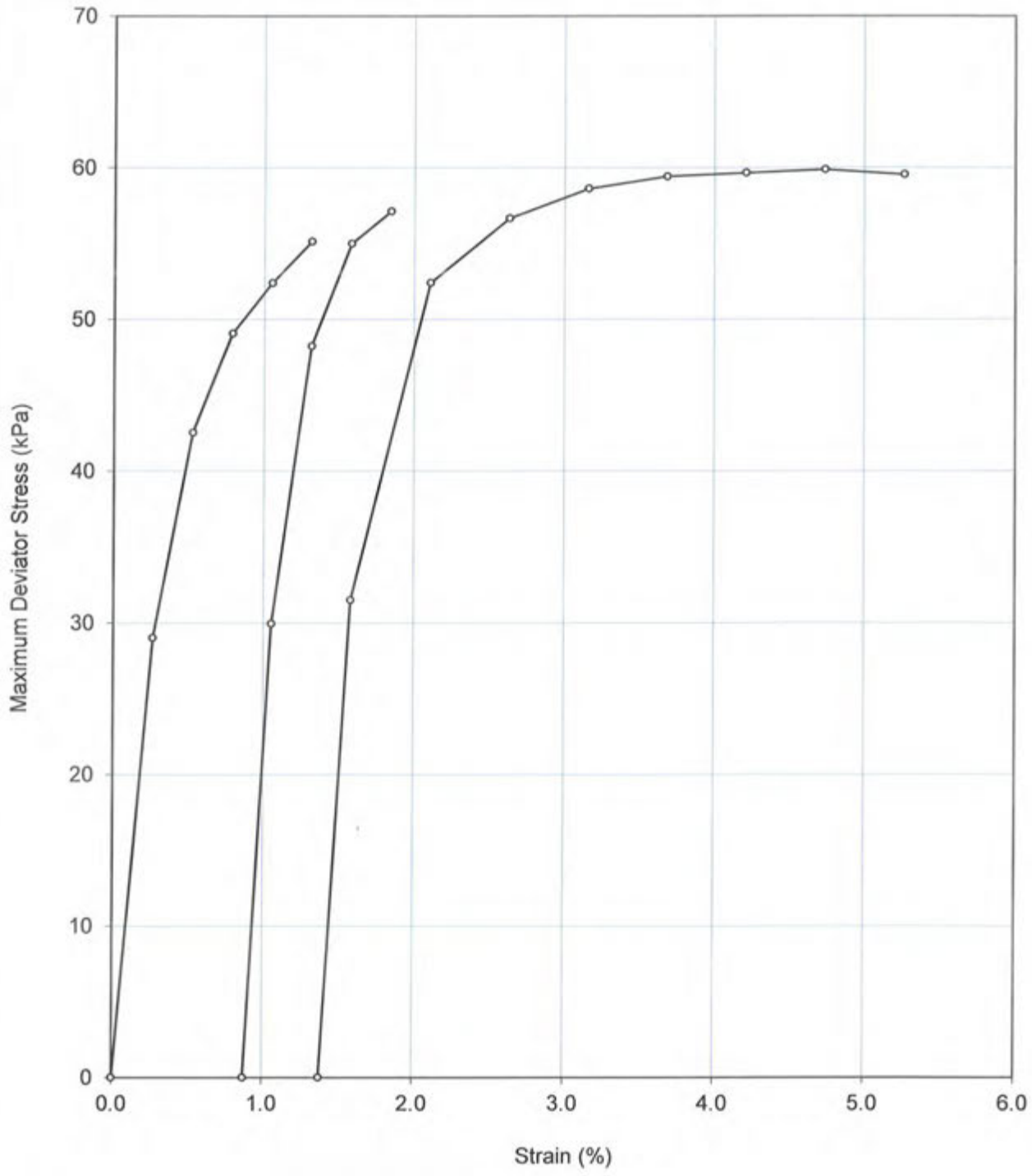
TRIAXIAL SHEAR TEST (STRESS STRAIN GRAPH)

Client :	Ports North	Report No. :	R16174
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303505
Location/Sample ID :	BH4 003 (4.40 - 4.80m)	Sample No. :	
		Sampled By :	Client



Prepared by NF	Checked by G

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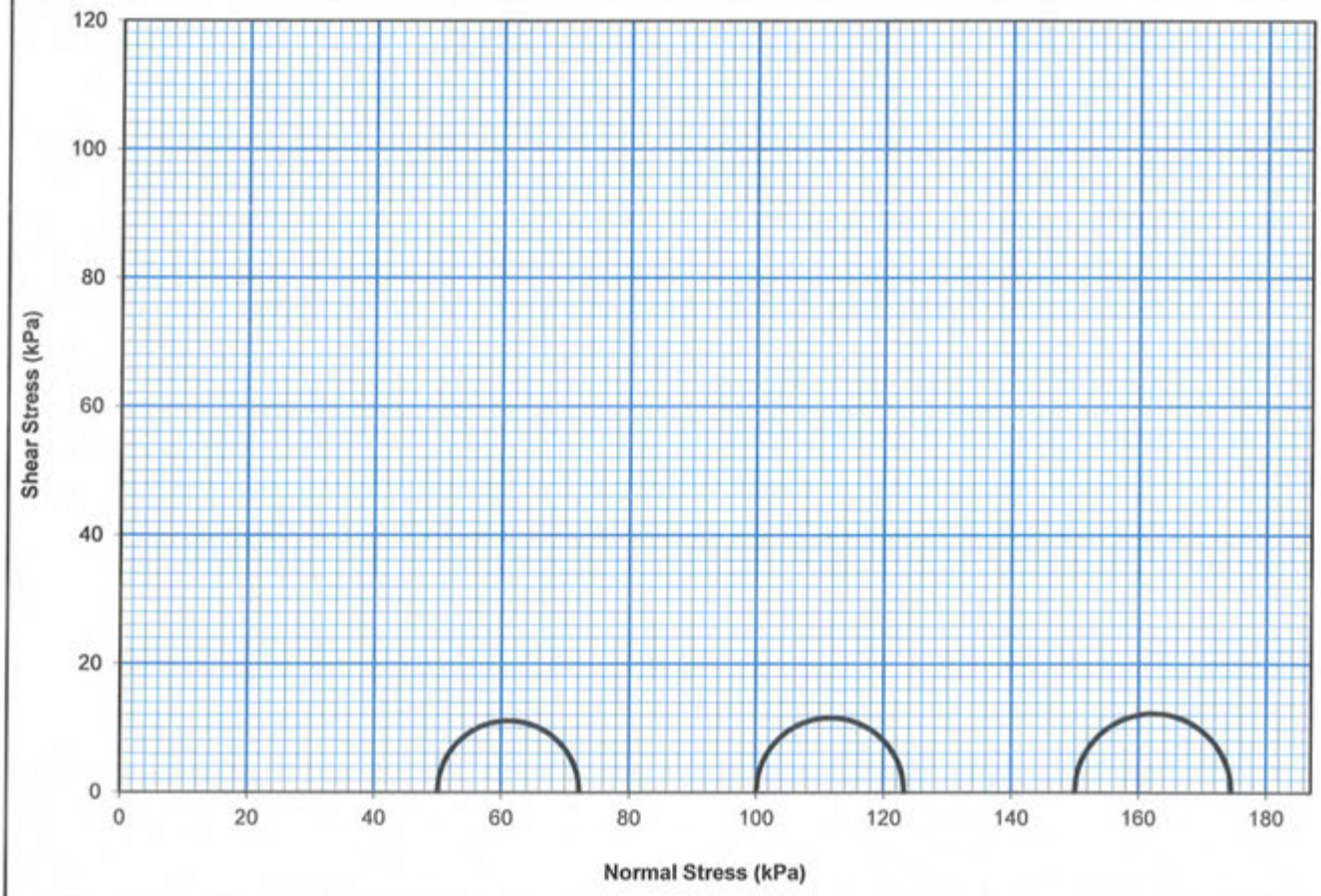
TRIAXIAL SHEAR TEST

Client :	Ports North	Report No. :	R16175
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303509
Location/Sample ID :	BH5 006 (7.40 - 7.90m)	Sample No. :	
Date of Test :	28/8/13	Sampled By :	Client
Type of test :	Unsaturated, Unconsolidated, Undrained, Staged		
Sample Type :	Undisturbed	Strain Rate :	0.50 mm/min
Specimen Diameter :	47.9 mm	Specimen Height :	94.8 mm
Initial Moisture Content :	66.8 %	Initial Saturation :	98 %
Initial Dry Density :	0.95 t/m³		



Stage	Initial Cell Pressure (kPa)	Maximum Principal Stress (kPa) σ_1	Minimum Principal Stress (kPa) σ_3	Maximum Deviator Stress (kPa)	Failure Strain (%)
1	50	72	50	22	1.3
2	100	123	100	23	1.8
3	150	175	150	25	3.2

Failure Criteria : Maximum Shear Stress
Remarks :

Test Procedure : AS1289.6.4.1

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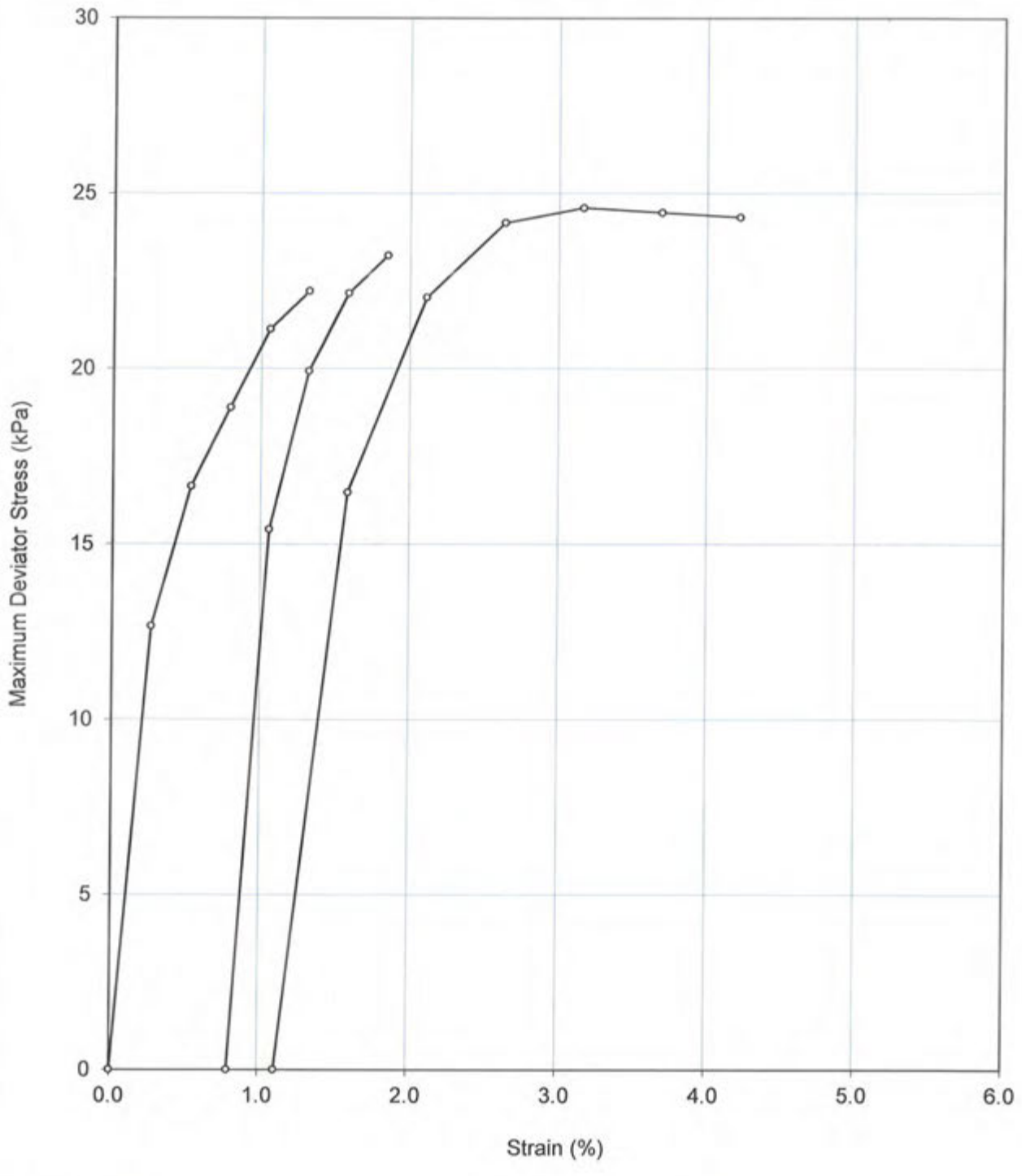
TRIAXIAL SHEAR TEST (STRESS STRAIN GRAPH)

Client :	Ports North	Report No. :	R16175
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303509
Location/Sample ID :	BH5 006 (7.40 - 7.90m)	Sample No. :	
		Sampled By :	Client



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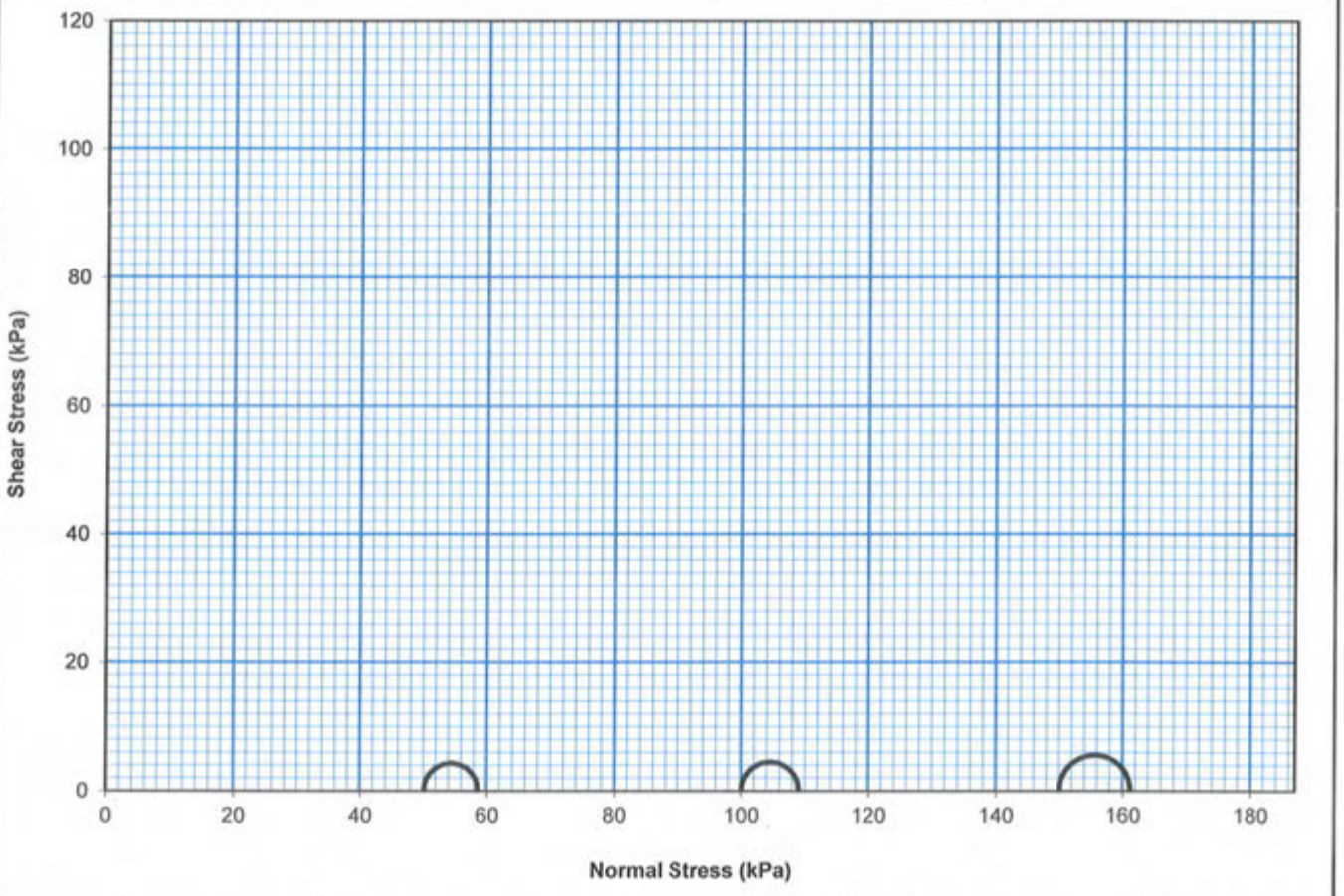
TRIAXIAL SHEAR TEST

Client :	Ports North	Report No. :	R16176
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303512
Location/Sample ID :	BH6 003 (2.00 - 2.40m)	Sample No. :	
Date of Test :	28/8/13	Sampled By :	Client
Type of test :	Unsaturated, Unconsolidated, Undrained, Staged		
Sample Type :	Undisturbed	Strain Rate :	0.50 mm/min
Specimen Diameter :	47.9 mm	Specimen Height :	94.5 mm
Initial Moisture Content :	48.3 %	Initial Saturation :	100 %
Initial Dry Density :	1.18 t/m³		



Stage	Initial Cell Pressure (kPa)	Maximum Principal Stress (kPa) σ_1	Minimum Principal Stress (kPa) σ_3	Maximum Deviator Stress (kPa)	Failure Strain (%)
1	50	59	50	9	1.1
2	100	109	100	9	2.4
3	150	161	150	11	3.7

Failure Criteria : Maximum Shear Stress
Remarks :

Test Procedure : AS1289.6.4.1

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RL1 - 29/01/08

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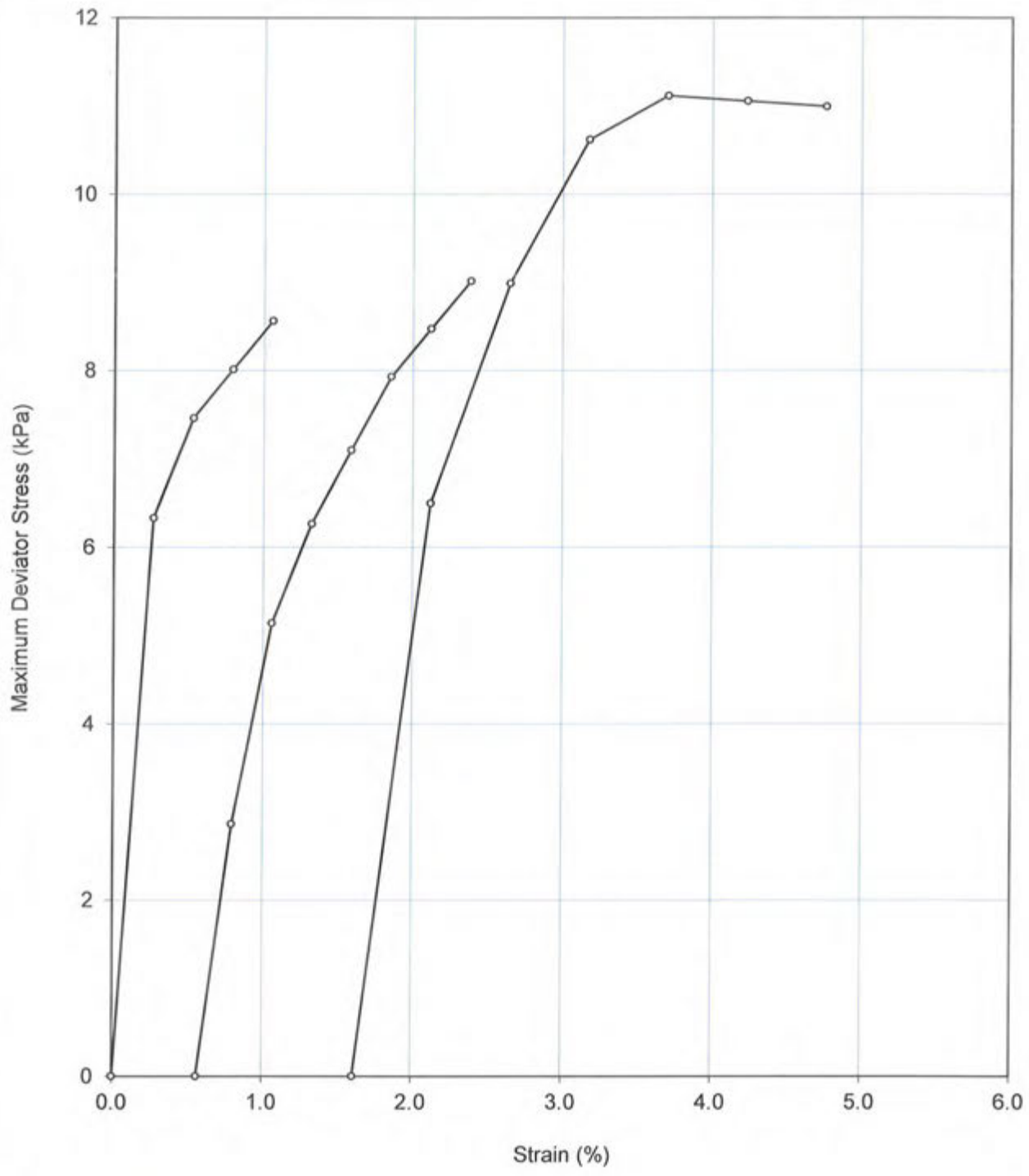
TRIAXIAL SHEAR TEST (STRESS STRAIN GRAPH)

Client :	Ports North	Report No. :	R16176
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303512
Location/Sample ID :	BH6 003 (2.00 - 2.40m)	Sample No. :	
		Sampled By :	Client



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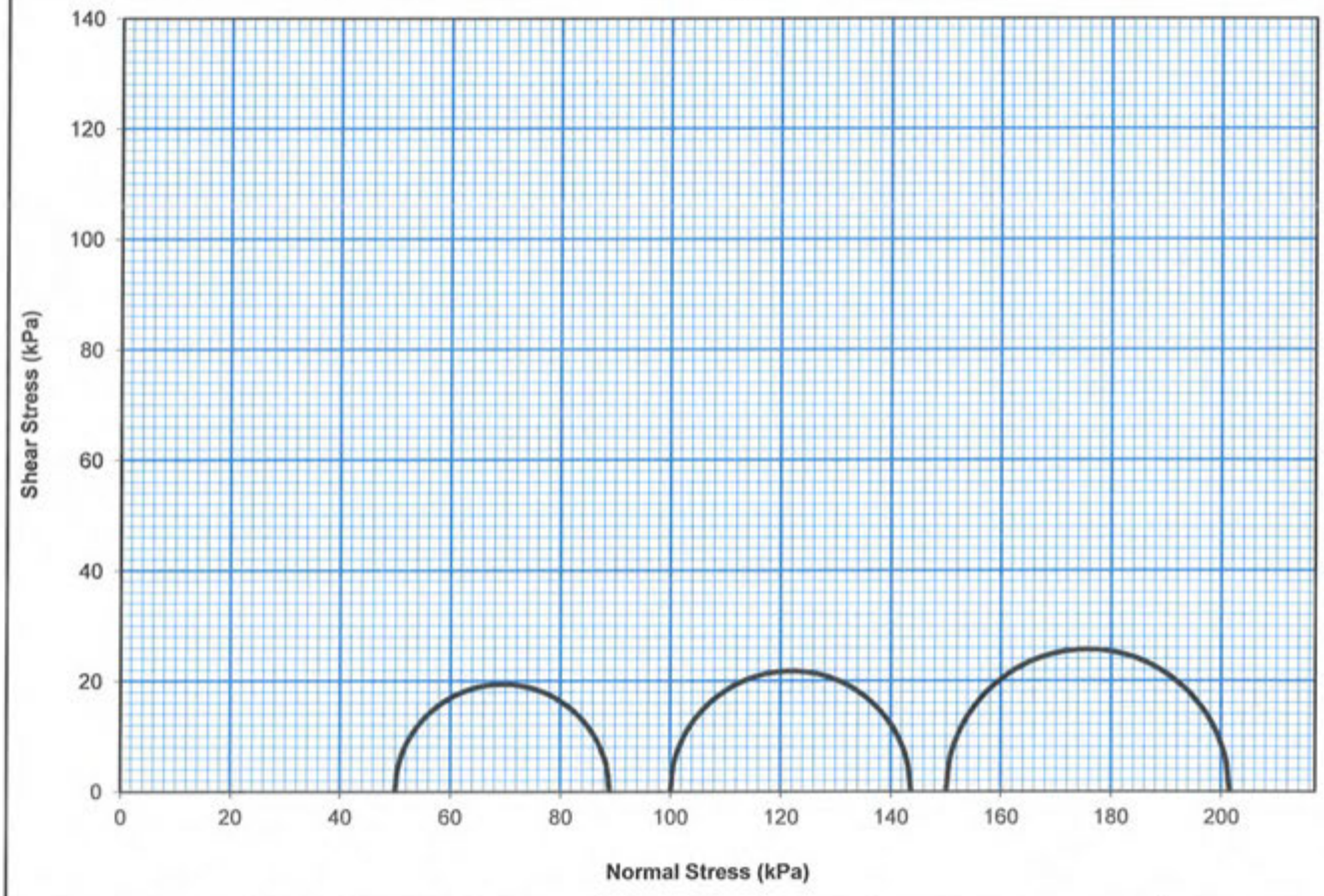
TRIAXIAL SHEAR TEST

Client :	Ports North	Report No. :	R16177
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303513
Location/Sample ID :	BH6 006 (5.00 - 5.40m)	Sample No. :	
Date of Test :	28/8/13	Sampled By :	Client

Type of test :	Unsaturated, Unconsolidated, Undrained, Staged		
Sample Type :	Undisturbed	Strain Rate :	0.50 mm/min
Specimen Diameter :	48.0 mm	Specimen Height :	94.4 mm
Initial Moisture Content :	80.8 %	Initial Saturation :	98 %
Initial Dry Density :	0.84 t/m³		



Stage	Initial Cell Pressure (kPa)	Maximum Principal Stress (kPa) σ_1	Minimum Principal Stress (kPa) σ_3	Maximum Deviator Stress (kPa)	Failure Strain (%)
1	50	89	50	39	1.9
2	100	144	100	44	2.6
3	150	201	150	51	4.8

Failure Criteria : Maximum Shear Stress
Remarks :

Test Procedure : AS1289.6.4.1

Prepared by MF | Checked by CH

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NATA

29/8/13

Nick Farrer
Approved Signatory

Senior Technical Officer
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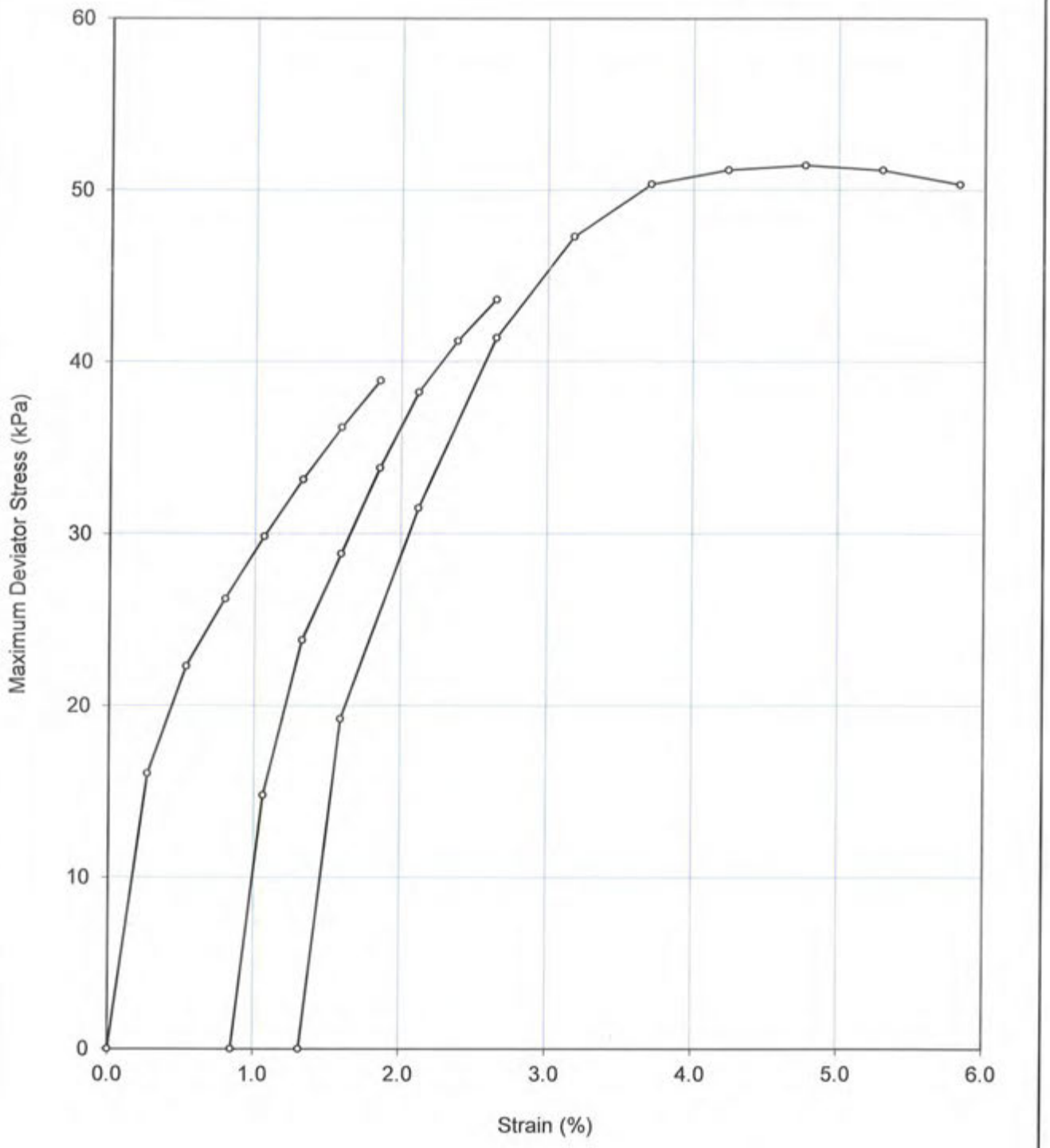
TRIAXIAL SHEAR TEST (STRESS STRAIN GRAPH)

Client :	Ports North	Report No. :	R16177
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303513
Location/Sample ID :	BH6 006 (5.00 - 5.40m)	Sample No. :	
		Sampled By :	Client



Prepared by NK

Checked by GH

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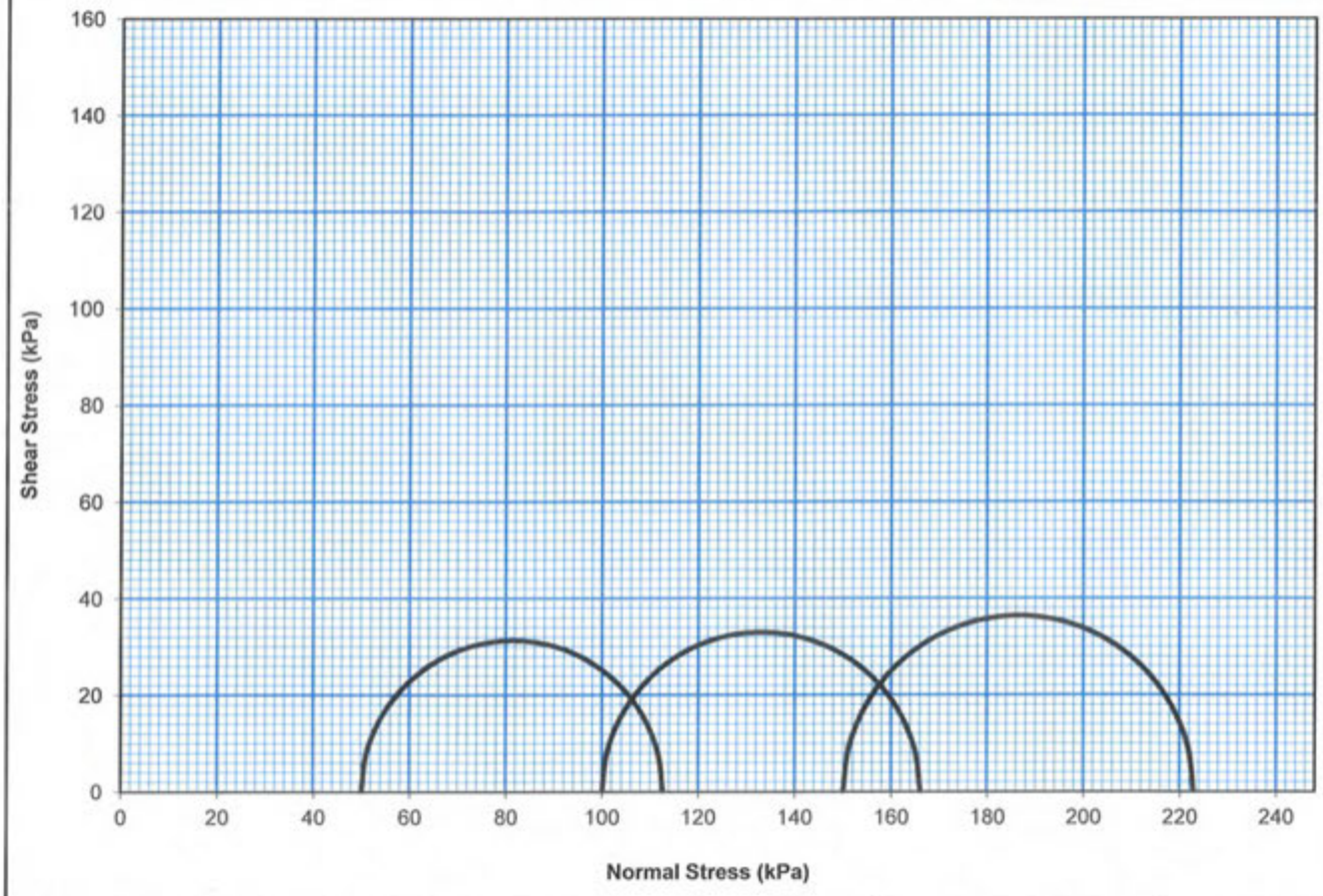
TRIAXIAL SHEAR TEST

Client :	Ports North	Report No. :	R16178
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303514
Location/Sample ID :	BH6 007 (6.00 - 6.40m)	Sample No. :	
Date of Test :	28/8/13	Sampled By :	Client

Type of test :	Unsaturated, Unconsolidated, Undrained, Staged		
Sample Type :	Undisturbed	Strain Rate :	0.50 mm/min
Specimen Diameter :	48.0 mm	Specimen Height :	96.0 mm
Initial Moisture Content :	29.5 %	Initial Saturation :	96 %
Initial Dry Density :	1.48 t/m³		



Stage	Initial Cell Pressure (kPa)	Maximum Principal Stress (kPa) σ_1	Minimum Principal Stress (kPa) σ_3	Maximum Deviator Stress (kPa)	Failure Strain (%)
1	50	113	50	63	1.8
2	100	166	100	66	2.6
3	150	223	150	73	4.7

Failure Criteria : Maximum Shear Stress
Remarks :

Test Procedure : AS1289.6.4.1

Prepared by MF | Checked by LN

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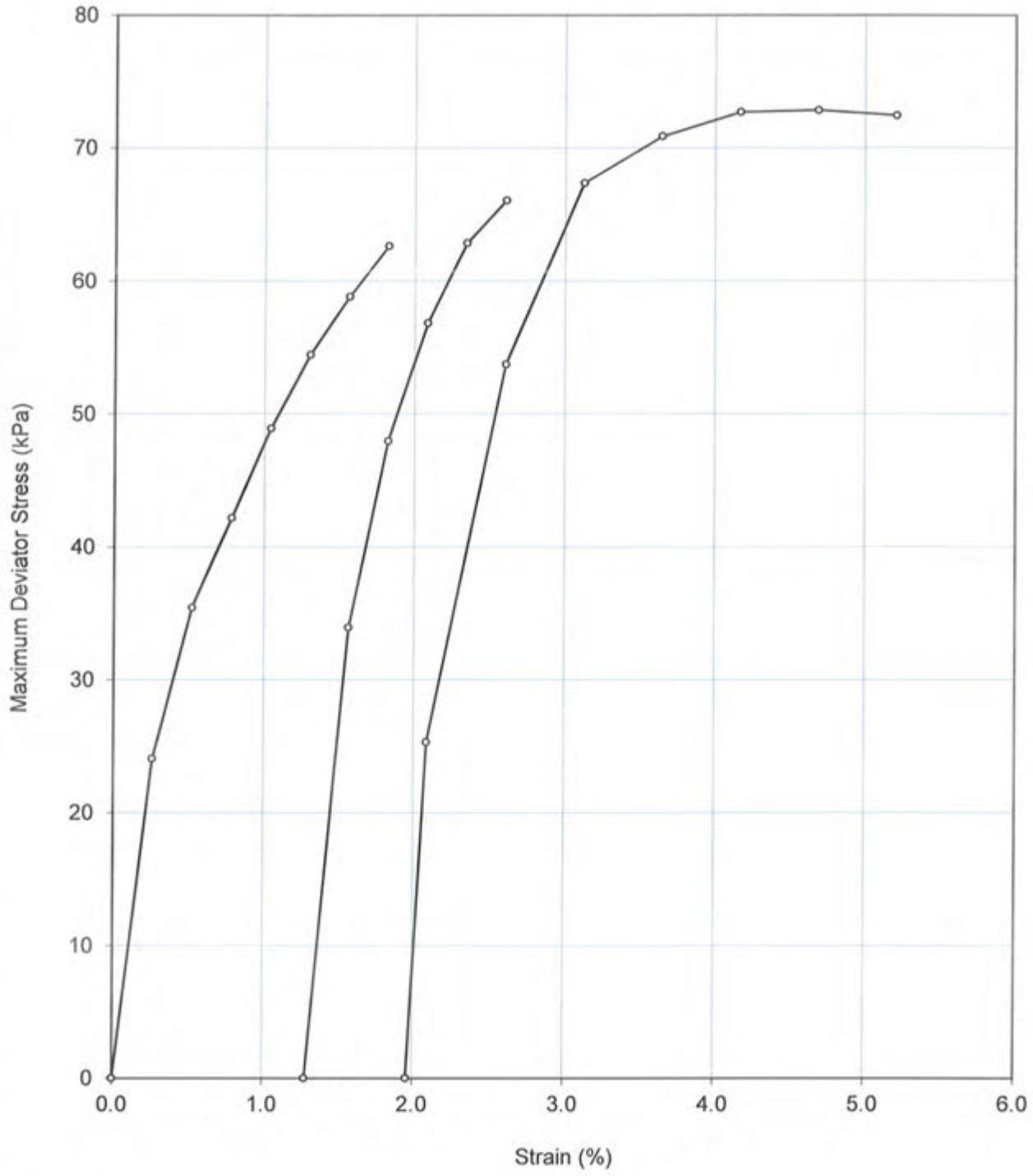
TRIAXIAL SHEAR TEST (STRESS STRAIN GRAPH)

Client :	Ports North	Report No. :	R16178
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303514
Location/Sample ID :	BH6 007 (6.00 - 6.40m)	Sample No. :	
		Sampled By :	Client



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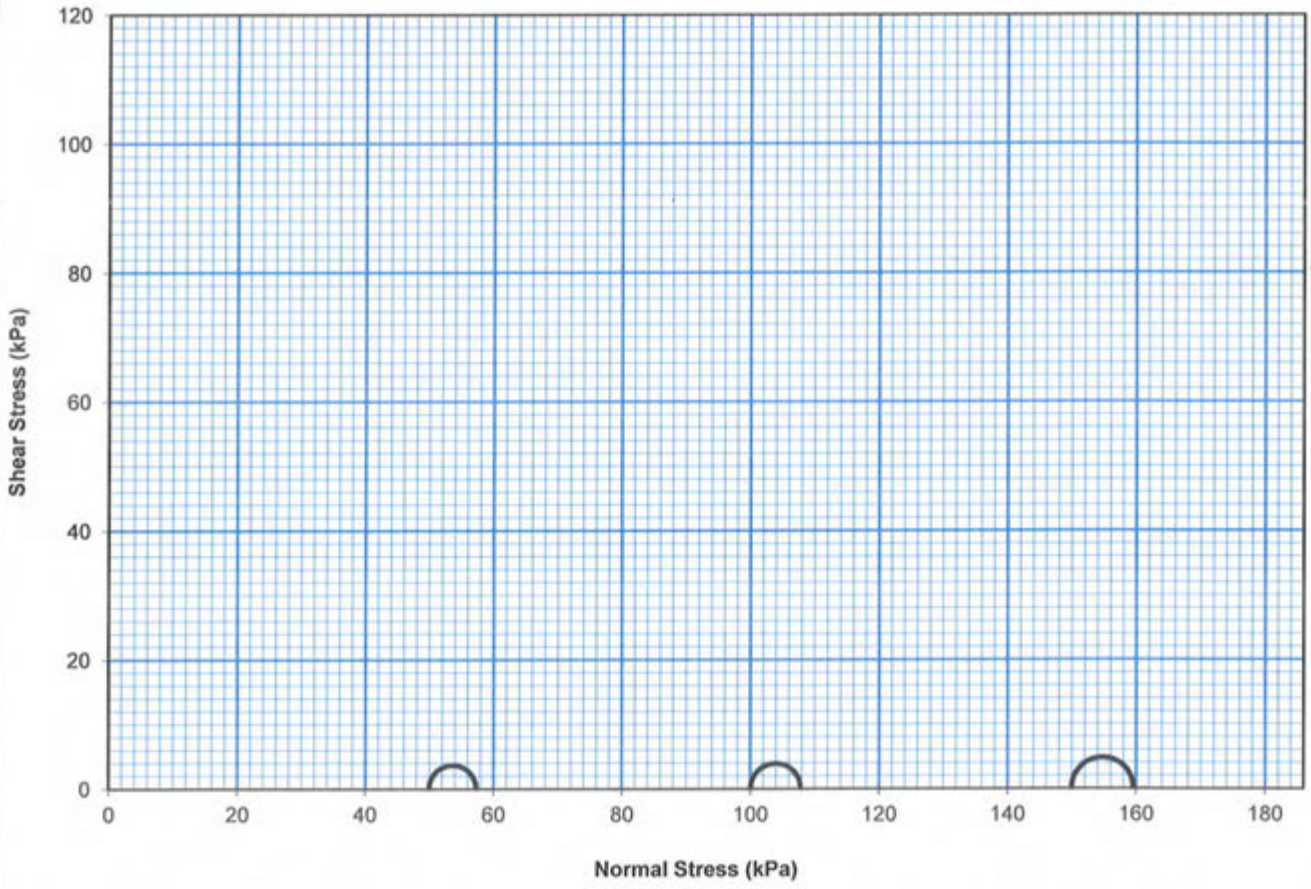
TRIAXIAL SHEAR TEST

Client :	Ports North	Report No. :	R16179
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303516
Location/Sample ID :	BH7 002 (3.20 - 3.60m)	Sample No. :	
Date of Test :	28/8/13	Sampled By :	Client

Type of test :	Unsaturated, Unconsolidated, Undrained, Staged		
Sample Type :	Undisturbed	Strain Rate :	0.50 mm/min
Specimen Diameter :	48.0 mm	Specimen Height :	96.0 mm
Initial Moisture Content :	54.1 %	Initial Saturation :	99 %
Initial Dry Density :	1.09 t/m³		



Stage	Initial Cell Pressure (kPa)	Maximum Principal Stress (kPa) σ_1	Minimum Principal Stress (kPa) σ_3	Maximum Deviator Stress (kPa)	Failure Strain (%)
1	50	57	50	7	1.6
2	100	108	100	8	3.1
3	150	160	150	10	4.7

Failure Criteria : Maximum Shear Stress
Remarks :

Test Procedure : AS1289.6.4.1

Prepared by MF | Checked by MH

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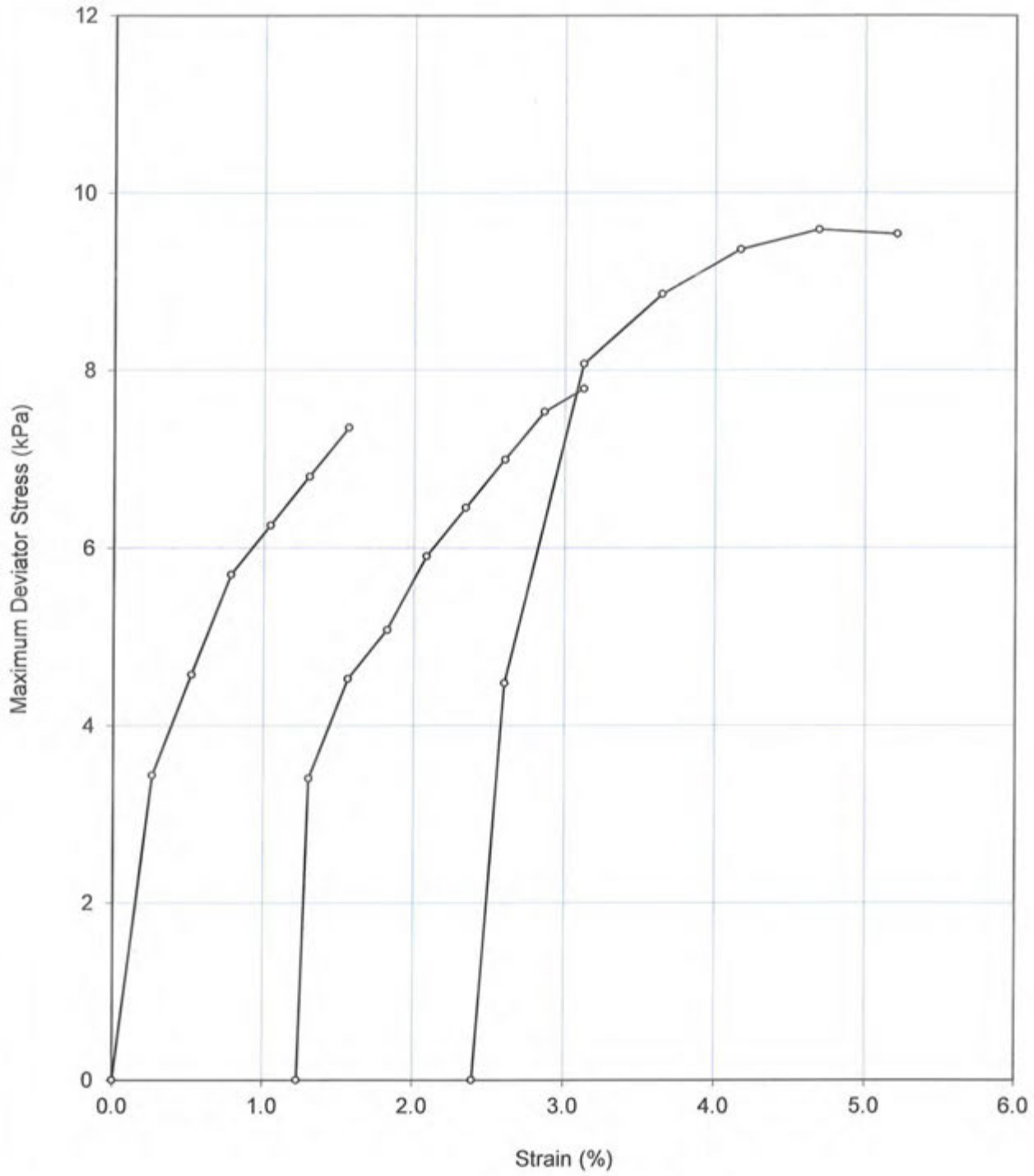
TRIAXIAL SHEAR TEST (STRESS STRAIN GRAPH)

Client :	Ports North	Report No. :	R16179
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303516
Location/Sample ID :	BH7 002 (3.20 - 3.60m)	Sample No. :	
		Sampled By :	Client



Prepared by NF

Checked by GL

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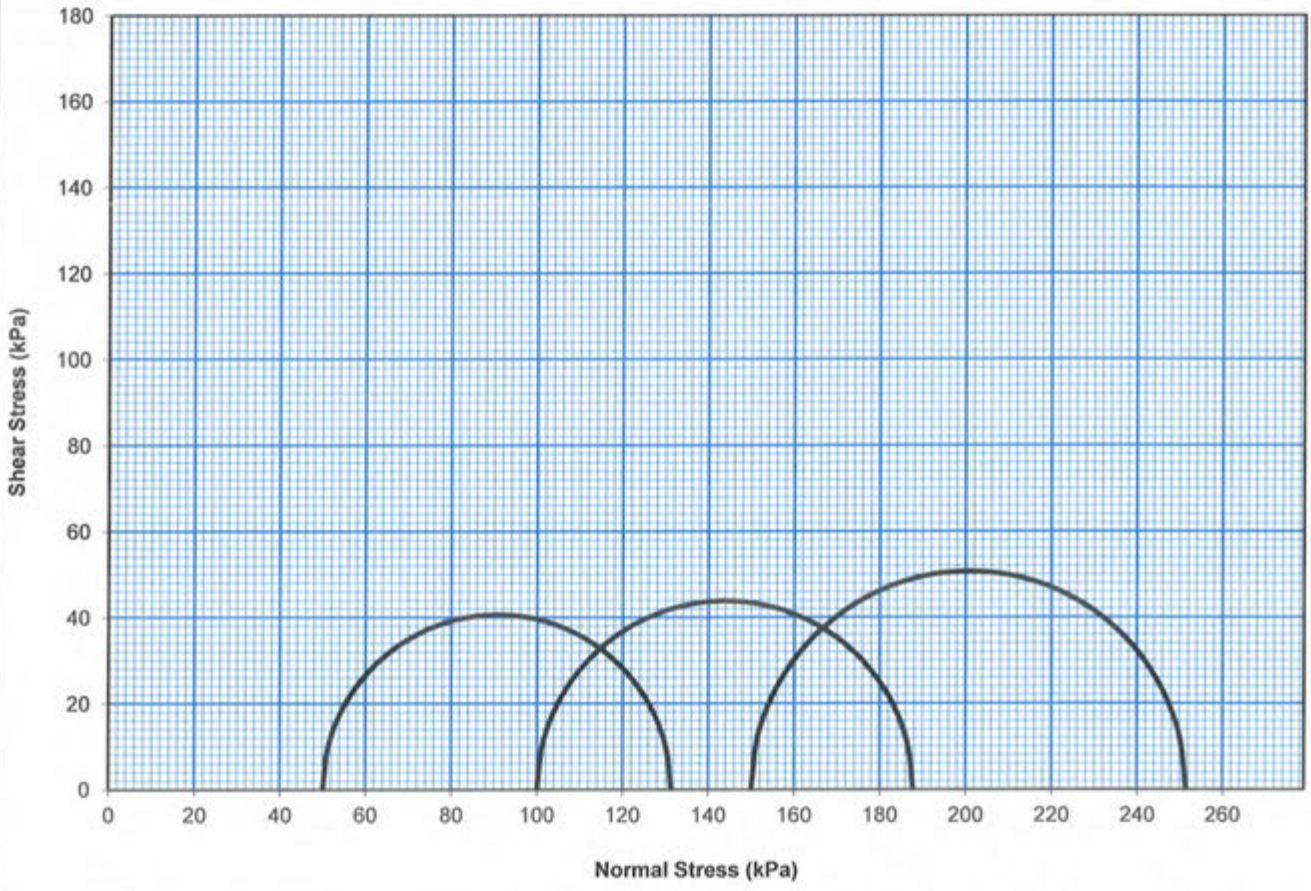
TRIAXIAL SHEAR TEST

Client :	Ports North	Report No. :	R16180
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303517
Location/Sample ID :	BH7 003 (4.20 - 4.60m)	Sample No. :	
Date of Test :	28/8/13	Sampled By :	Client

Type of test :	Unsaturated, Unconsolidated, Undrained, Staged		
Sample Type :	Undisturbed	Strain Rate :	0.50 mm/min
Specimen Diameter :	47.7 mm	Specimen Height :	95.0 mm
Initial Moisture Content :	30.5 %	Initial Saturation :	100 %
Initial Dry Density :	1.49 t/m³		



Stage	Initial Cell Pressure (kPa)	Maximum Principal Stress (kPa) σ_1	Minimum Principal Stress (kPa) σ_3	Maximum Deviator Stress (kPa)	Failure Strain (%)
1	50	131	50	81	1.6
2	100	188	100	88	2.1
3	150	251	150	101	4.2

Failure Criteria : Maximum Shear Stress
Remarks :

Test Procedure : AS1289.6.4.1

Prepared by NF | Checked by GH

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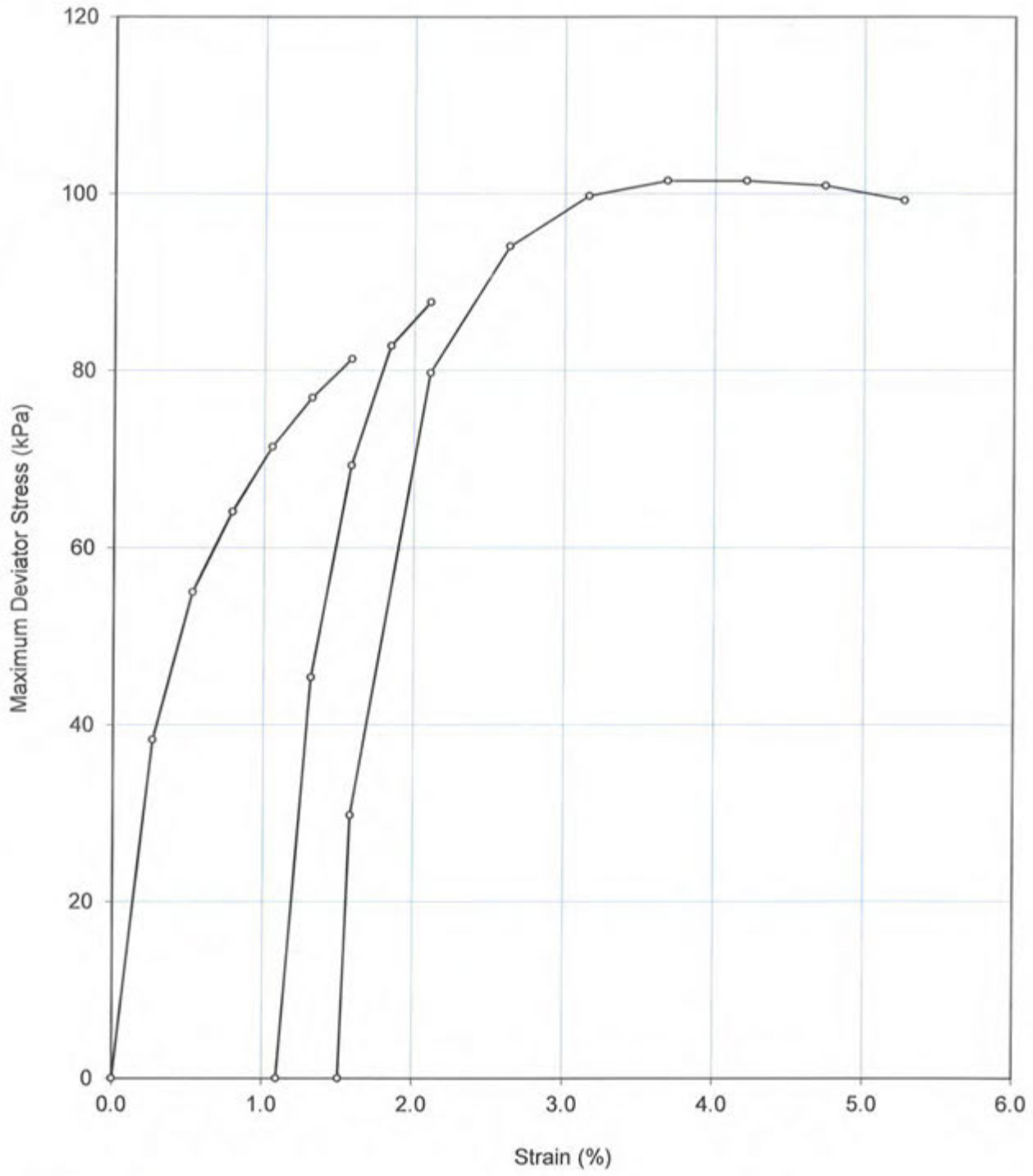
TRIAXIAL SHEAR TEST (STRESS STRAIN GRAPH)

Client :	Ports North	Report No. :	R16180
Address :	Cnr Grafton & Hartley Streets, Cairns	Job No. :	137632122
Project :	Cairns Shipping Development Project EIS	Reg'n No. :	13303517
Location/Sample ID :	BH7 003 (4.20 - 4.60m)	Sample No. :	
		Sampled By :	Client



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APPENDIX C

Limitations

LIMITATIONS

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12 February 2014 Project No. 137632122-005-L-Rev1

Alan Vico
Ports North
~Transmission Via Email: Alan.Vico@portsnorth.com.au~

ASSESSMENT OF DMPA LAND BASED OPTIONS - CAIRNS SHIPPING DEVELOPMENT PROJECT EIS

Dear Alan

INTRODUCTION

This letter presents our comments on geotechnical issues associated with DMPA land based options for the CSD Project EIS.

Current indications are that this project will require removal of a total of about 4.4 million m^3 (insitu) of materials predominantly comprised of:

- 2.95 million m^3 of very soft clays and silts
- 0.3 million m^3 of soft clays and silts
- 0.49 million m^3 of firm clays and silts
- 0.39 million m^3 of stiff clays
- 0.27 million m^3 of very stiff clays

Our comments on land based options are based our previous experience with onshore disposal of dredge materials, and in particular, three local projects, namely:

- Portsmith, where dredge material was deposited into a bunded area at Tingira Street in the early 1980's.
- East Trinity, where disposal of dredge material was proposed in the early 1990's:
- Trinity Park, where dredge materials from a canal estate were treated for reuse as engineered fill for subdivision construction in the mid 2000's.

ASSESSMENT OF ASS LIMING RATES

Preliminary level ASS assessments have been conducted for this project on the materials to be dredged comprising:

- Golder 2012 - 8 samples (collected from 5 test pits) were analysed using the Chromium Suite of tests. Samples covered depth range bed level to 3.6m below bed level.
- WBM-BT 2013 – 100 samples (collected from about 40 sediment sample locations) were analysed using the Chromium Suite of tests. Samples covered depth range bed level to 2.9m below bed level – with the majority of samples from less than 1m below bed level.

- Golder 2014 – 5 samples (collected from 7 geotechnical boreholes, drilled in September 2013) were analysed using the Chromium Suite of tests. Samples covered depth range 1m below bed level to 8.9m below bed level.

Our interpretation of the results of these limited preliminary investigations are summarised below:

- PASS is only expected to be present in the very soft to soft clay and silt materials (about 3.2 million cubic metres). Firm, stiff and very stiff materials are unlikely to be PASS or require lime treatment.
- The majority of the samples tested by WBM-BT during the EIS indicated self-neutralizing PASS within the top 1m along most of the channel (ie. these samples had shell or other neutralising material). This would suggest no treatment required for these materials. Although our experience on other dredging projects involving "self-neutralizing " materials has shown that some acidity is released from these materials and therefore a nominal lime treatment rate of about 3 to 5 kg lime/m^3 is recommended (in the absence of more detailed investigation/assessment) for these materials. At this liming rate, it would be feasible to add a lime slurry into the pumped spoil to effectively "treat" these materials as they are placed.
- PASS materials (that are not self-neutralising were detected in a total of 17 samples results from all investigations to date (including the EIS results). These "positive" samples were typically from depths of more than 1m below the existing surface. Lime neutralisation rates typically range from about 30 kg lime/m^3 to 270 kg lime/m^3 with an average liming rate of about 90 kg lime/m^3. At these liming rates addition of a lime slurry into the pumped spoil is not considered feasible and physical blending of lime into the spoil post placement will be required.
- Whilst the amount of data is still at a preliminary level, we consider that it would be reasonable to adopt a nominal liming rate of 75 kg lime/m^3 for PASS treatment of the very soft to soft dredged spoil, assuming that dredging processes will not be conducted in a manner which segregates the top 1m of soft materials from underlying PASS materials. This will need to be confirmed either through additional more rigorous assessment or could be confirmed at the time of treatment.

AVAILABILITY OF LIME

Aglime (fine ground limestone – $CaCO_3$) is generally used for treatment of PASS. This is a relatively cheap neutralising agent (about $90/tonne) but provides minimal strength improvement to the treated soil compared to the use of hydrated lime (CaOH) or quicklime (CaO)(about $400/tonne).

At a nominal liming rate of 75 kg/m^3, the total lime requirement for PASS spoil from the CSD Project would be in the order of 240,000 tonnes. This equates to:

- Double B trucks have a capacity of 84 m^3 and therefore this would require about 2,900 of these truck movements to deliver lime to the treatment site; or
- Semi- trailers can carry about 30 tonnes and therefore this would require about 8,000 of these truck movements to deliver lime to the treatment site.

Extensive limestone deposits are present on the Tablelands west of Cairns including:

- Mirriwinni Lime has leases at several locations and currently produces 100,000 tonnes of aglime per year. Mirriwinni Lime has confirmed that they have the capacity to increase tonnage if required for this project.
- Phoenix Lime has leases across a 3.5 million tonne deposit at Ootann. Phoenix Lime are currently seeking approval to supply 350,000 tonnes of lime per annum to the NORNICO nickel project.
- Additional smaller operators supply lime out of leases in the Mt Garnet, Almaden and Ootann regions.

Storage hoppers and/or a storage shed will be required at the treatment site to enable safe/dry storage of lime.

ASS TREATMENT METHODOLOGIES

As indicated above, in-line addition of lime slurry into pumped spoil is not considered feasible as a treatment method at rates above about 5 kg/m^3. At higher rates the lime is unlikely to mix uniformly throughout the deposited spoil and may result in alkaline tailwater discharges.

There are a range of lime treatment methodologies available, two options landfarming and pugmill treatment are summarised below. Both of these options require excavation of PASS materials from the spoil pond.

Land Farming

The area required for landfarming is dependent upon the required production rate for treated materials. For example, about 300,000 m^3 of dredge spoil at Trinity Park was excavated, spread/dried, lime treated, excavated and compacted as subdivision fill over the period of about 1 year. This required a land farming area of about 5 hectares. The required lime treatment rates for this material ranged from about 4 to 40 kg/m^3 (with pockets of up to 125 kg/m^3). The entire process from excavation and treatment to placement of compacted fill was completed at a cost of about \$25/m^3 in 2006/2007.

A land farming lime treatment process would typically comprise:

- Construction of a treatment facility complying with the requirements of the *Queensland Acid Sulfate Soils Technical – Soil Management Guidelines V3.8* (2008).
- In addition to the guidelines requirements, an automatic pH dosing pump would be installed to treat water collected in the facility prior to discharge.
- Materials excavated from the dredge pond is placed and spread to a thickness of approximately 0.3m to 0.5m in identifiable treatment “cells”.
- Where required, the spread soil is worked with a swamp dozer and/or tilled with a rotary hoe to assist in drying prior to incorporation of lime.
- Lime is spread at the required rate across the surface of the soil using conventional lime spreader trucks.
- Lime is incorporated through the soil using a rotary hoe or other mechanical mixer.
- Validation samples are collected at a rate agreed with the regulator to confirm neutralisation of each treatment cell.
- Following validation, treated soils is excavated and removed from the treatment facility and can be reused as fill.

Based on previous experience at Trinity Park, each treatment cell would require a 5 day cycle:

Day 1-3 - Typically one cell would be filled and air dried over a 3 day period.

Day 4 – Lime added and blended into a cell and validation samples collected.

Day 5 – Validation results available and removal of material commences.

On this basis, at least 6 cells would be required to accommodate this treatment regime. An additional contingency cell is considered prudent to allow for contingency and delays.

If it is assumed that the dredge spoil is treated during the dry season for a 5 year period, then production rates in the order of 6000m^3 per day would be required. This equates to a land area of about 1.2 hectares per treatment cell, or a total land requirement of about 7.2 hectares.

It is noted that to our knowledge and for the liming rates required, the total volume of material to be treated is at least an order of magnitude higher than previously attempted in Queensland. Additionally, the production rates indicated above may be ambitious and difficult to achieve in reality. Therefore some allowance for program slippage and additional costs associated with such delays should be included in planning and budgeting.

Pug Mill Treatment

Pug mills are suited to processing of finer grained soils but dredge materials will require some initial drying prior to treatment. Storage and processing of ASS by the pug mill process should occur within a bunded facility with similar construction requirements to the land farming facility described above. Treatment costs for pug milling operations are expected to be at least double those of landfarming.

Pug mills have production rates in the order of 150 m^3/hr. To accommodate a production rate of 6,000 m^3 per day about 4 pug mills would be required. To our knowledge no project in Australia has had more than one pugmill in use for treatment of PASS, up to this time.

DREDGE PONDS

It is understood that the proposed dredging operation uses a combination of mechanical and hydraulic excavation processes, with the end result being that the dredged material is a slurry mixture of soil and salt water. Typically the slurry contains about four times the volume of the soils (solids) as water.

An onshore disposal option will require dredge materials to be pumped into ponds where the solids settle and water is decanted and returned to the sea (or a marine environment). Sufficient land area will be required to accommodate the volume of dredge material, plus to manage tailwaters prior to disposal.

Following disposal into ponds, the processes of settling and decanting, plus solar drying will reduce the moisture content significantly to provide a soil material that can be excavated and reworked to enable ASS treatment and produce a soil suitable for reuse as fill material, if proposed.

Disposal within Ponds (without Lime Treatment)

It is not expected that approvals would be granted for long term storage or disposal of PASS dredge materials without treatment. However, this may be an option for “self-neutralising” PASS and non-PASS dredge spoil, if these can be separated from PASS spoil. The following comments are provided as a general discussion on consolidation and insitu reuse of materials placed in dredge ponds (this option does not consider the need to lime treat these soils).

There is a perception that with time dredged materials will consolidate and increase in strength to create a “platform” for later development. Technically this is feasible and the process can be quickened by surcharging with imported fill materials and further quickened with the installation of wick drains if the layer of material is thick enough.

Our experience at Tingira Street Portsmith indicates that although the dredge material was placed as a relatively thin layer (less than 1m) the material still has the properties of soft marine clays after more than 30 years, even though parts of the site have been surcharged with more than 2m of imported fill materials.

The thickness of dredge material created using this approach would depend on the area available; however a thickness of about 3m is envisaged. Without surcharging with imported fill this material would not increase in strength enough to allow development even after 30 years, let alone the 2, 5 and 10 years periods proposed above. With surcharging, development may be feasible with appropriate engineering to accommodate settlements after a period of about 2 years. Use of wick drains to quicken consolidation is not technically viable for the relatively shallow thickness of dredge material envisaged.

Disposal into Ponds (for future Lime Treatment)

The disposal of material from maintenance dredging in Trinity Inlet to ponds for subsequent drying and lime treatment and use as fill was proposed at East Trinity in the early 1990’s. With dredging being an ongoing operation, it had been proposed that this would provide material on an annual basis. This would therefore allow about a 12 month period for “processing” of the dredge material from slurry to usable fill material. It is noted that the volume of dredge material to be treated was much smaller than the volume of proposed capital dredging. Irrespective of the volume of dredge material the sizing of the dredge ponds is a critical factor in optimising the processes of deposition of material, decanting of water and drying of the material for lime treatment. On this basis a maximum depth of deposition of 1.5m would be recommended.

STRENGTH IMPROVEMENT OF DREDGE SPOIL

Previous laboratory testing for the East Trinity project (outlined above) indicated that, after drying dredge spoil to about its optimum moisture content for Standard Compaction, a soaked CBR of 3% was achieved.

Similarly, previous experience on the Trinity Park project (outlined above) indicated similarly dried and compacted dredge spoil (following PASS treatment with aglime) achieved CBRs of 5%. This material was utilised as subdivisional fill.

The above suggests that simply drying out the dredge spoil to near its optimum moisture content should allow this material to be reworked as a fill material that would generally be suitable for use as bulk fill in development of residential and commercial areas. Although, some consideration would need to be made of salt content, particularly in relation to revegetation on these soils. A “landfarming” process similar to that indicated above for treatment of PASS could be adopted to aid drying of materials.

Lime can be added to soil to further improve the strength characteristics of dredge spoil. At the East Trinity project, addition of 2% hydrated lime, resulted in a soaked CBR of 10%, albeit under laboratory conditions. We consider that a CBR of 10% should be achievable/feasible with the addition of between 2% and 5% lime (hydrated or quicklime) for the dredge spoil from the CSD project. Although we recommend- laboratory trials be conducted to confirm this. Where of hydrated lime or quicklime are used for neutralisation and to improve strength characteristics, caution is required as some of the lime will be progressively be utilised as a neutralising agent for acid generated over time. Therefore the initial strength gain from addition of lime (for treatment purposes) will reduce as this lime is utilised in the treatment of acid.

OTHER ENGINEERING ISSUES

The topography and ground conditions at the site proposed for onshore disposal will impact the design of the facility. Obviously a very gently sloping and relatively even ground surface (as was the case at Trinity Park) is preferable for both the pond facilities and drying/treatment facilities. Similarly ground conditions comprising stiff clayey soils (as was also the case at Trinity Park) are preferable from a constructability point of view.

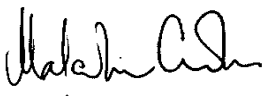
At sites underlain by soft clays (as is the case at East Trinity) issues relating to settlement, stability and trafficability will need to be addressed. Additionally construction of the pond walls would most likely require the use of imported materials as the onsite materials may not be suitable.

Release of saltwater and leaching of acid will need to be considered for the dredge ponds. These issues may require construction of low permeable (or lined) base and walls. The cost of a compacted clay liner would be dependent upon the availability of a source of suitable material. There was insufficient economical viable clay material available in the Cairns area 2 years ago to provide a source of low permeable capping for the Portsmith Landfill (about a 10 hectare area). Alternative geosynthetic liners (LLDPE or HDPE) typically will cost about \$15/m^2 to \$20/m^2 to install.

Surface water runoff from dried spoil is likely to generate acid. This will need to be monitored and managed. Automated pH dosing pumps may be required to treat runoff from these dried areas prior to discharge.

We trust that the above information satisfies your current requirements. Please do not hesitate to contact the undersigned if you require further information or have any questions.

GOLDER ASSOCIATES PTY LTD



Malcolm Cook
Principal Engineer

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MSC/PKS/hlb

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TECHNICAL MEMORANDUM

DATE 9 May 2014 **DOCUMENT No.** 137632122-006-TM-Rev0

TO Jeff Bunt
Ports North

CC Alan Vico (Ports North)

FROM Ignacio Ortega **EMAIL** iortega@golder.com.au

CAIRNS SHIPPING DEVELOPMENT PROJECT – PRELIMINARY DREDGE CHANNEL BATTER STABILITY ASSESSMENT

1.0 EXECUTIVE SUMMARY

Ports North (PN) commissioned Golder Associates Pty Ltd (Golder) to undertake further assessment of the stability of the proposed dredged channel batter slopes related to the Cairns Shipping Development Project (CSDP). The stability of the proposed channel batter slopes had been previously assessed in Golder's Report 117672052-004-Rev1 dated May 2012. The previous report was based on a preliminary channel design and on the geotechnical information available at that time.

Since issue of the 2012 report, the channel design has progressed and based on the recent information provided to Golder by PN it is proposed to construct channel batters typically at 1V:4H. Based on updated bathymetry, it is apparent that the existing dredge channel batters are steeper than 1V:5H, and in some cases steeper than 1V:4H.

In July 2013, Golder was commissioned by PN to undertake additional geotechnical investigation along the proposed alignment of the channel, with the outcomes of the investigation documented in Golder Report 137632122-001-R-Rev0, dated September 2013. The additional investigation comprised the drilling of 7 boreholes to depths corresponding to levels in the range of -10.25 m LAT and -14.25 m LAT at locations nominated by PN. The investigation provided a better understanding of the major geotechnical units along the proposed channel alignment, and disturbed and undisturbed samples for subsequent laboratory testing. The laboratory testing carried out for the 2013 investigation comprised a series of material classification tests (Atterberg Limits and particle size distribution) and undrained triaxial tests.

Following a request by PN in December 2013 to update the 2012 stability assessment for the revised proposed channel profile, updated bathymetry and subsurface information from the 2013 investigation, Golder proposed for drained shear strength testing to be undertaken on remaining undisturbed samples collected in the 2013 investigation. The proposed scope of works was authorised by PN by email dated 28 February 2014. The objectives of the work were to assess the stability of the proposed channel batters, to comment on areas of geotechnical uncertainty and to provide recommendations to reduce the level of uncertainty.

The main conclusions of our assessment can be summarised as follows:

- Stability analysis has been undertaken for two profiles – Ch 17,500 and Ch 20,000 – where new geotechnical information was available to refine the ground models used in previous assessments.
- The channel section corresponding to Ch 17,500 of the proposed dredge channel alignment was assessed as a worst case stratigraphy with respect to slope stability, due to the presence of a surficial soft clay layer with a thickness in excess of 12 m.
- Results of the stability analysis indicate that channel batters along the alignment can be profiled at a maximum slope gradient of 1V:4H.

- Additional investigation and laboratory testing would allow an increased level of confidence regarding the extent and strength of major geotechnical units along the alignment and may permit further optimisation of channel batter slopes along the alignment, particularly on the approach to the “inner harbour” where batters are likely to be formed in firm/stiff clays.

The following sections present the results of the current assessment.

2.0 PREVIOUS GOLDER STUDIES

Golder has previously undertaken a number of geotechnical studies for PN in relation to the CSDP. The information contained in the following documents has been used in the current assessment:

- Cairns Shipping Channel, Dredge Material Assessment – Golder Associates, June 2012 (107672522-008-Rev1).
- Cairns Cruise Ship Development Strategy, Geotechnical Review – Golder Associates, May 2012 (117672052-004-R-Rev0).
- Cairns Shipping Development Project, Preliminary Geotechnical Investigation (Factual Report) – Golder Associates, September 2013 (137632122-001-R-Rev0).

3.0 ASSESSMENT METHODOLOGY

The assessment comprised the following:

- Review of available geotechnical data and design information.
- Direct shear testing on soil samples recovered during the 2013 geotechnical investigation to assess the drained material strength characteristics of the soil for input into stability analysis.
- Stability analysis using Slope/W on existing and proposed dredge channel batter profiles.

4.0 REVIEW OF AVAILABLE INFORMATION

4.1 Outcomes of previous stability assessment (Golder Report, June 2012)

A preliminary stability assessment was undertaken in 2012 on three proposed dredge batter profiles (Golder Report 117672052-004-Rev1).

Results of this assessment indicated that a factor of safety above the normal industry value of 1.5 was achieved at the assessed profiles with 1V:5H batter slopes under “normal” conditions. The potential effects of the ship propellers on the batter slopes were assessed using a horizontal ground acceleration of 0.02g. , Based on these results, it was recommended that a batter slope of 1V:5H be adopted for preliminary design purposes.

4.2 Subsurface conditions at chainages Ch 17,500 and Ch 20,000

Geotechnical information obtained from the test pits and boreholes carried out for the 2012 and 2013 investigations was used to update ground models at the channel sections considered in this assessment. The ground conditions inferred at sections corresponding to chainages Ch 17,500 and Ch 20,000 can be broadly summarised in Table 1.

Table 1: Inferred ground conditions at sections corresponding to Ch 17,500 and Ch 20,000

Chainage	Relevant investigations*	Major geotechnical unit	Consistency	Top level (m LAT)	Bottom level (m LAT)	Approx. unit thickness (m)
Ch 17,500	BH5, PN-TP3	Silty Clay	Very soft/ soft	-1.7	-13.8**	≥12.1
Ch 20,000	BH6, PN-TP4	Silty Clay	Very soft	-4.0	-9.0	5.0
			Firm	-9.0	-10.0	1.0
			Stiff	-10.0	-13.5**	≥ 3.5

* Designations correspond to the 2012 and 2013 reports (refer to Section 2.0).
** Level corresponding to the maximum of depth of investigation at each respective location.

5.0 LABORATORY DIRECT SHEAR TESTING

Four undisturbed (U75) samples obtained during the 2013 investigation were submitted to a NATA accredited laboratory for direct shear testing in accordance with AS1289.6.2.2. The shearing speed was less than 0.008 mm/min to provide drained conditions. The results of the testing are summarised in Table 2.

Table 2: Summary of laboratory direct shear test results

Sample location*	Sample depth (m)	Direct shear test results (AS1289.6.2.2)		
		Stage	Normal stress (kPa)	Maximum shear stress (kPa)
BH1	1.1 – 1.5 m	1	100	60
		2	200	150
		3	300	197
BH5	3.4 – 3.8 m	1	100	82
		2	200	172
		3	300	223
BH6	1.0 – 1.4 m	1	100	71
		2	200	160
		3	300	212
BH6	3.0 – 3.4 m	1	100	78
		2	200	144
		3	300	216

* Designations correspond to the 2012 and 2013 reports (refer to Section 2.0).

6.0 STABILITY ANALYSIS

6.1 Channel profile selection

As outlined previously, two sections (Ch 17,500 and Ch 20,000) were selected to assess the stability of the channel batters. Information relating to each section is presented in Table 3. The two sections were selected primarily due to the following:

- Both sections are in relatively close proximity to geotechnical borehole/ test pit locations from previous investigations which provides information on the depth range of the major geotechnical units (i.e. very soft/ soft clay and underlying stiff clay). Furthermore, laboratory direct shear testing was carried out on samples obtained from boreholes BH5 and BH6, which are located close to sections Ch 17,500 and Ch 20,000, respectively.
- The thickness of the very soft/ soft clay layer was in the order of about 12 m in the vicinity of Ch 17,500 (as encountered within BH5). On this basis, stability analysis for this section is likely to be representative for the design of channel batter profiles formed predominantly in the very soft/soft clay unit.

Table 3: Profile design information

Chainage	Proposed dredge level (m LAT)	Sea floor level (m LAT)	Maximum batter height (m)
CH 17500	-10.1	-1.6	8.5
CH 20000	-11.1	-3.3	7.8

6.2 Geotechnical model

Ground models for each of the sections assessed were developed based on geotechnical data obtained in the previous geotechnical investigations – specifically BH5 and PN-TP3 for Section Ch 17,500 and BH6 and PN-TP4 for Section Ch 20,000 (refer to Table 1).

Lower bound and upper bound strength parameters for the very soft/ soft clay were assessed based on the results of direct shear testing. A strength reduction factor of 1.5 was applied to the laboratory shear strength parameters based on the following:

- Small sample pool (i.e. testing only carried out on four samples).
- Variability in material composition (i.e. presence of interbedded sand lenses within the very soft/ soft clay unit).
- Chemical cementation of soil particles due to the presence of calcareous shell fragments (shell grit).
- Desiccation of the samples over time (i.e. even though samples are sealed they are still prone to drying out over the extended time period since collection).

The assessed geotechnical parameters for the different units involved in the stability analysis are summarized in Table 4.

Table 4: Assessed geotechnical parameters

Material	Friction angle, ϕ' (degrees)	Cohesion, c' (kPa)	Bulk unit weight, γ (kN/m^3)
Very Soft/ Soft CLAY Sediment – Lower Bound	24	0	16
Very Soft/ Soft CLAY Sediment – Upper Bound	24	10	16
Soft to Firm CLAY	24	10	17
>Stiff CLAY	24	15	18

A complementary assessment of material strength parameters for the very soft/ soft clay was carried out by performing back analysis on the existing dredge geometry profile at Ch 17,500. The shear strength parameters achieved by back analysis to give a factor of safety in the order of 1.0 (i.e. the minimum required for stability) were consistent with the lower bound material strength parameters assessed from laboratory testing (i.e. ϕ' = 24 degrees and c' = 0 kPa).

In accordance with methods adopted in previous assessments (Golder, 2012), the potential influence of vessel movements within the channel on long term batter stability were simulated by using a horizontal acceleration of 0.02g acting on the slope. A water level at LAT was adopted for the analysis.

6.3 Results of stability analysis

Results of the slope stability analysis for long term (drained) shear strength parameters are summarized in Tables 5 and 6. Following on from previous assessments and as per normal industry standards, a factor of safety >1.5 is acceptable for long term batter stability.

Table 5: Results of stability analysis for existing and proposed dredge channel profile at Ch 17,500

Section	Channel batter profile	Case considered	Horizontal acceleration	Factor of safety (1st major slip plane)	Comment
Ch 17,500	Existing	Back analysis	0.02*g*	1.06	
			Nil	1.11	
		Lower bound parameters	0.02*g*	1.06	
			Nil	1.11	
		Upper bound parameters	0.02*g*	2.94	
			Nil	3.39	
	1V:4H	Lower bound parameters	0.02*g*	1.58	
			Nil	1.92	
		Upper bound parameters	0.02*g*	3.21	
			Nil	3.92	
	1V:3H	Lower bound parameters	0.02*g*	1.22	Unsatisfactory
			Nil	1.43	Unsatisfactory
		Upper bound parameters	0.02*g*	2.84	
			Nil	3.33	

Table 6: Results of stability analysis for existing and proposed dredge channel profile Ch 20,000

Section	Channel batter profile	Case considered	Horizontal acceleration	Factor of safety (1st major slip plane)	Comment
Ch 20,000	Existing	Lower bound parameters	0.02*g*	1.1	
			Nil	1.27	
		Upper bound parameters	0.02*g*	3.76	
			Nil	4.44	
	1V:4H	Lower bound parameters	0.02*g*	1.58	
			Nil	1.92	
		Upper bound parameters	0.02*g*	4.01	
			Nil	4.91	
	1V:3H	Lower bound parameters	0.02*g*	1.43	Unsatisfactory
			Nil	1.52	
		Upper bound parameters	0.02*g*	3.53	
			Nil	4.16	
	Composite profile - lower batter at 1:2.5H; upper batter at 1V:4H	Lower bound parameters	0.02*g*	1.58	
			Nil	1.92	
		Upper bound parameters	0.02*g*	3.83	
			Nil	4.64	

Selected results of stability analysis are presented in Attachment A.

7.0 ENGINEERING COMMENTS

The results of the assessment can be summarised as follows:

- Stability analysis has been undertaken for two profiles – Ch 17,500 and Ch 20,000 – where new geotechnical information was available to refine the ground models used in previous assessments.

- The channel section corresponding to Ch 17,500 of the proposed dredge channel alignment was assessed as a worst case stratigraphy with respect to slope stability, due to the presence of a surficial soft clay layer with a thickness in excess of 12 m.
- Results of the stability analysis indicate that channel batters along the alignment can be profiled at a maximum slope gradient of 1V:4H.
- Additional investigation and laboratory testing would allow an increased level of confidence regarding the extent and strength of major geotechnical units along the alignment and may permit further optimisation of channel batter slopes along the alignment, particularly on the approach to the "inner harbour" where batters are likely to be formed in firm/stiff clays.
- Figure 1 presents the spatial distribution of the geotechnical investigation locations and their relative depth range in comparison to the proposed dredging depths required. As indicated in the figure, there are still parts of the alignment with a significant level of uncertainty with regards to subsurface conditions – specifically the extent, depth and strength of major geotechnical units and associated drained characteristic strengths.

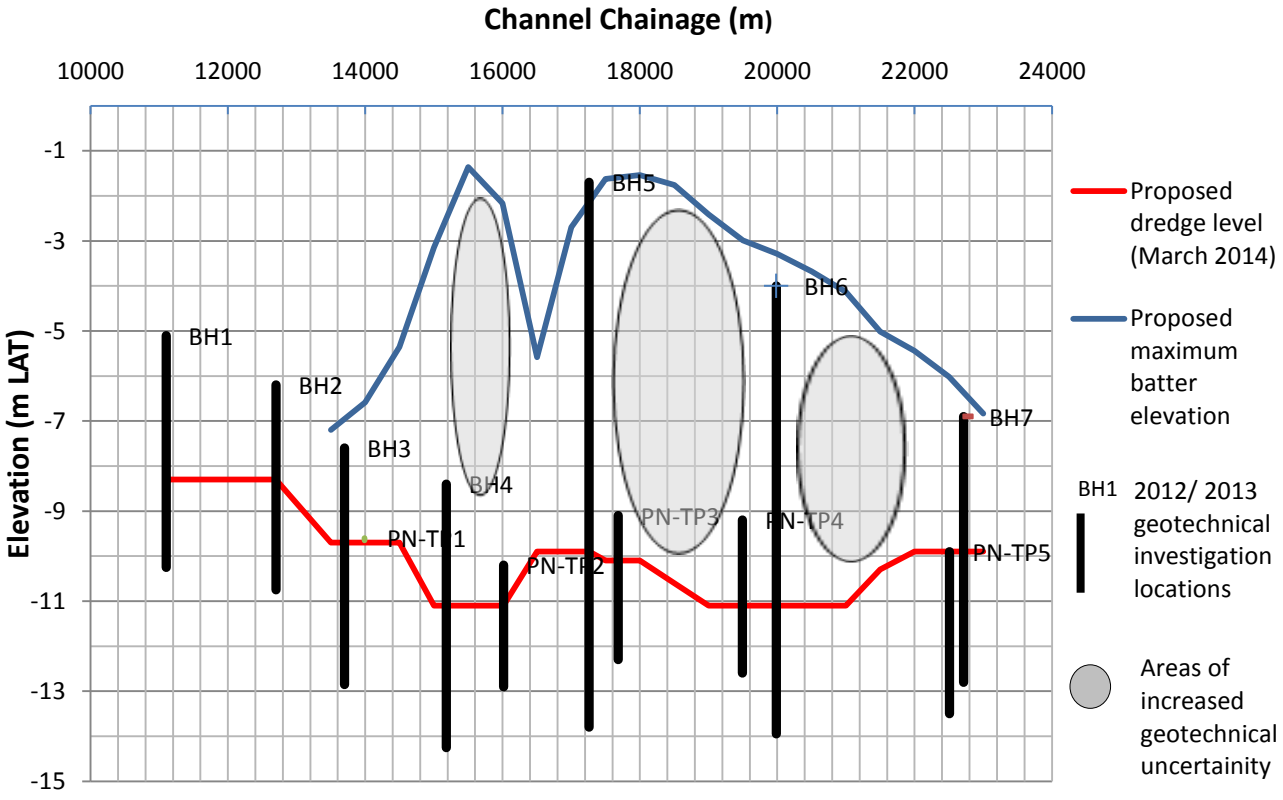

Figure 1: Comparison of proposed dredge level to maximum channel batter height along the proposed channel alignment and approximate location of the available geotechnical investigations.

- We note that no drained shear strength testing has been carried out on the firm and stiff clays underlying the surficial very soft to soft clays. This is recommended for the next stages of the channel design.
- For the purposes of this and previous assessments, the potential effects of vessel movements on the batter slopes has been modelled assuming an equivalent horizontal ground acceleration of 0.02*g*. Consideration should be given to a more complex assessment of these potential effects when more detailed design information becomes available (e.g. channel geometry, subsurface information, number of vessels, size of vessels, engine power, propeller geometry etc.)

We trust this memorandum meets your current project requirements, please contact the undersigned if you require clarification or further information.

GOLDER ASSOCIATES PTY LTD

Joseph Parisi
Engineer

Ignacio Ortega
Senior Engineer

Malcolm Cook
Principal Engineer (RPEQ)

Attachments: Attachment A – Selected results of stability analysis

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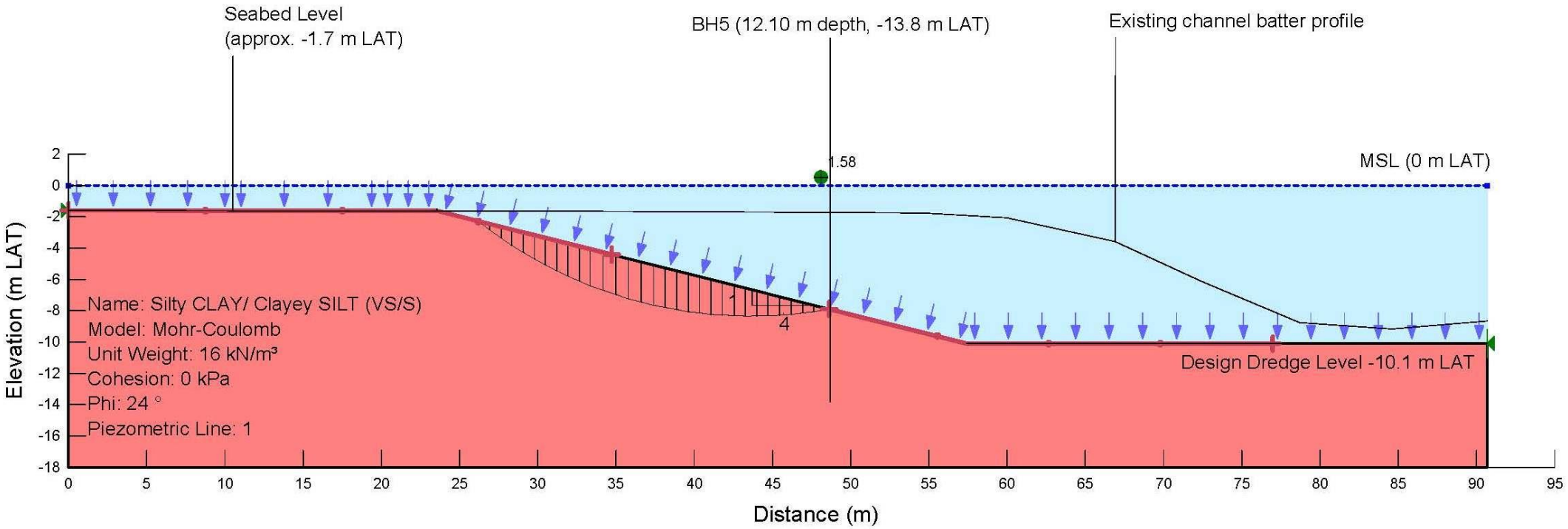
ATTACHMENT A
Selected results of stability analysis



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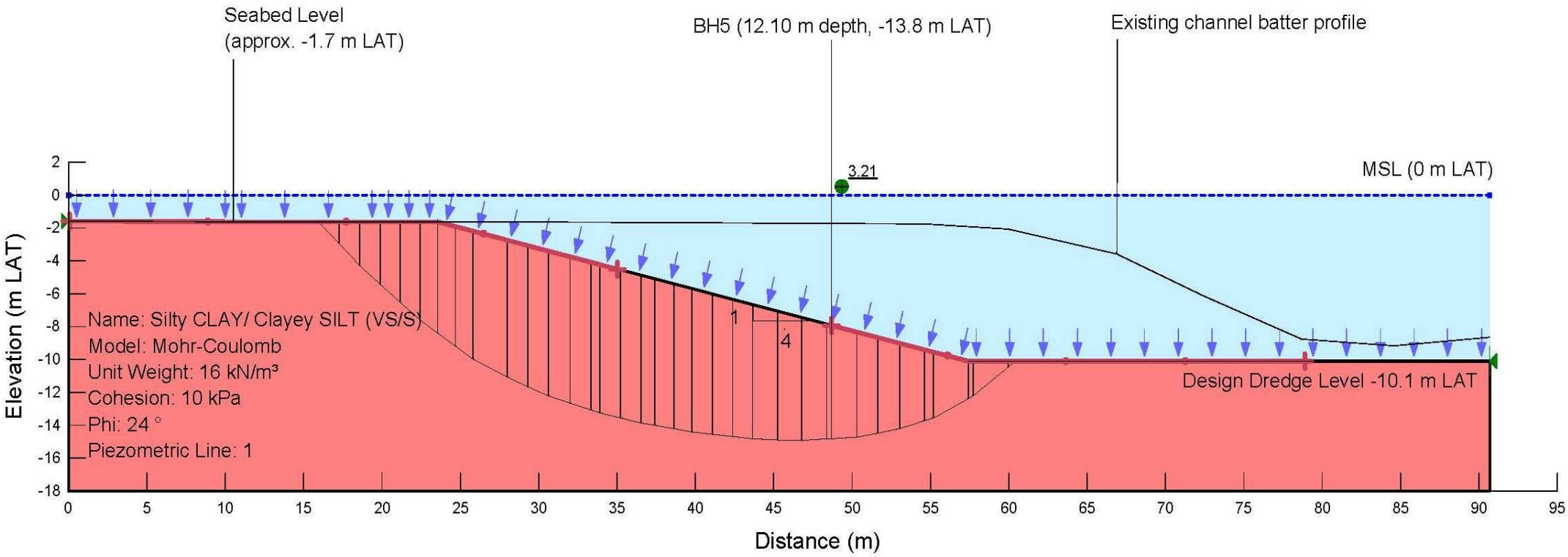

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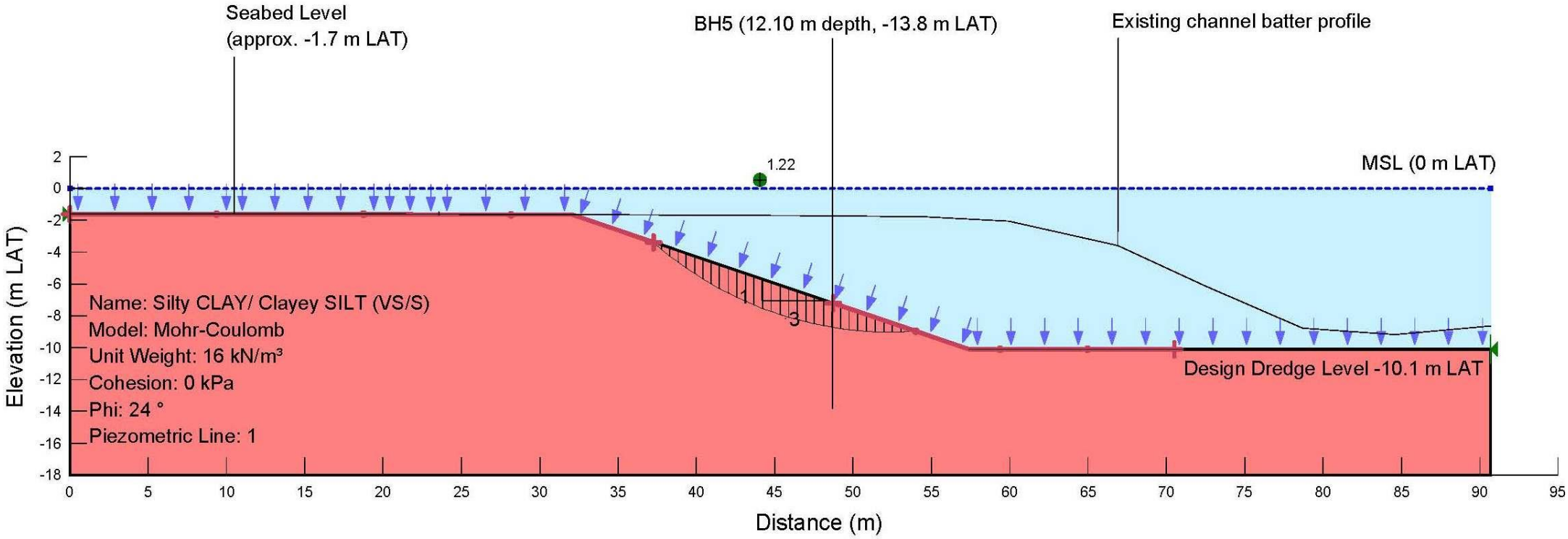

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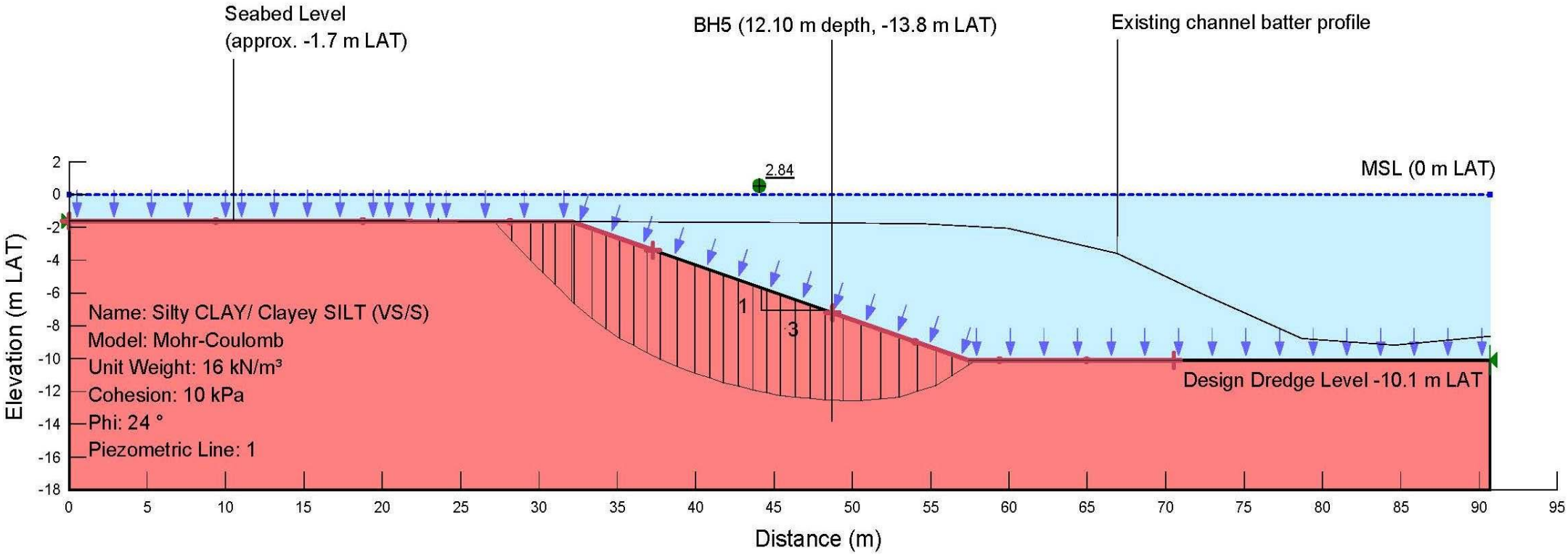

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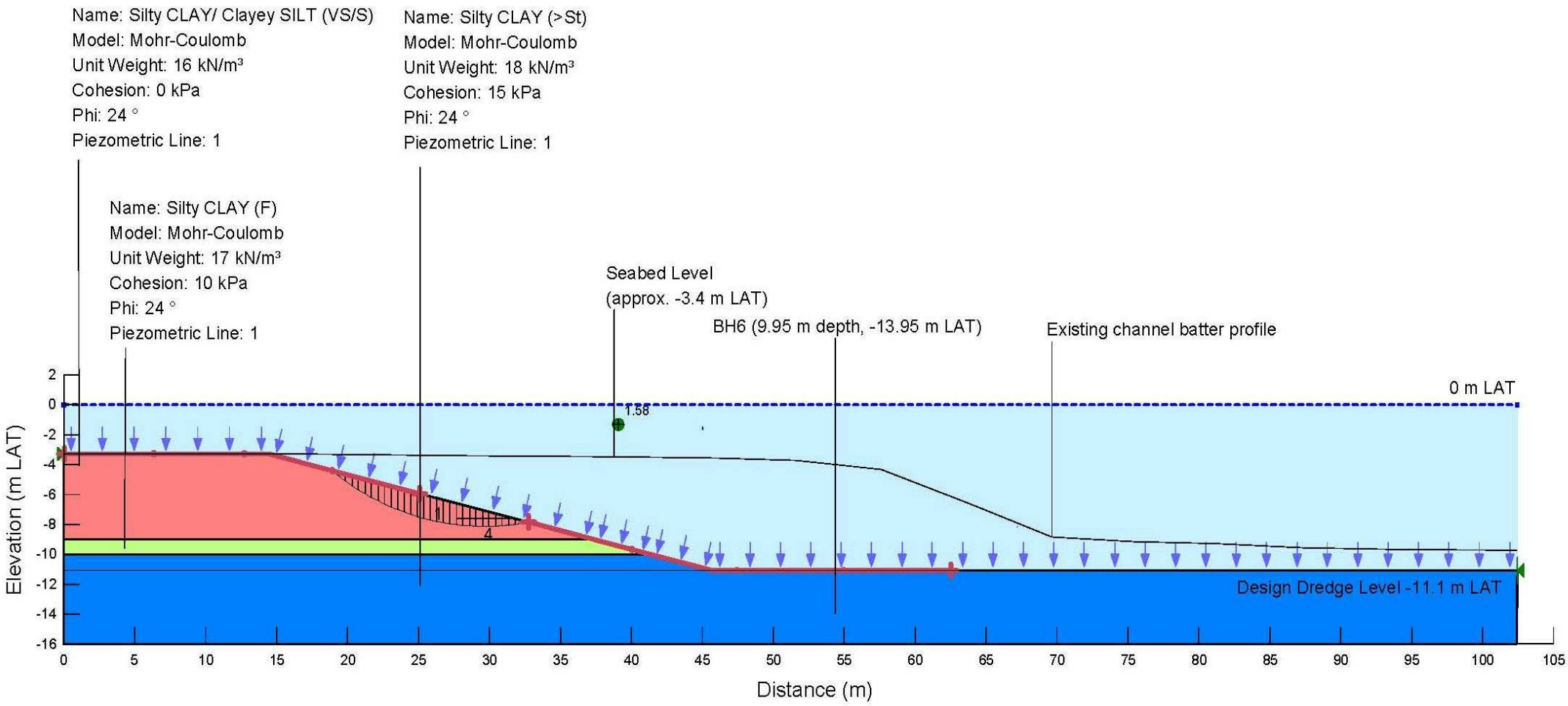

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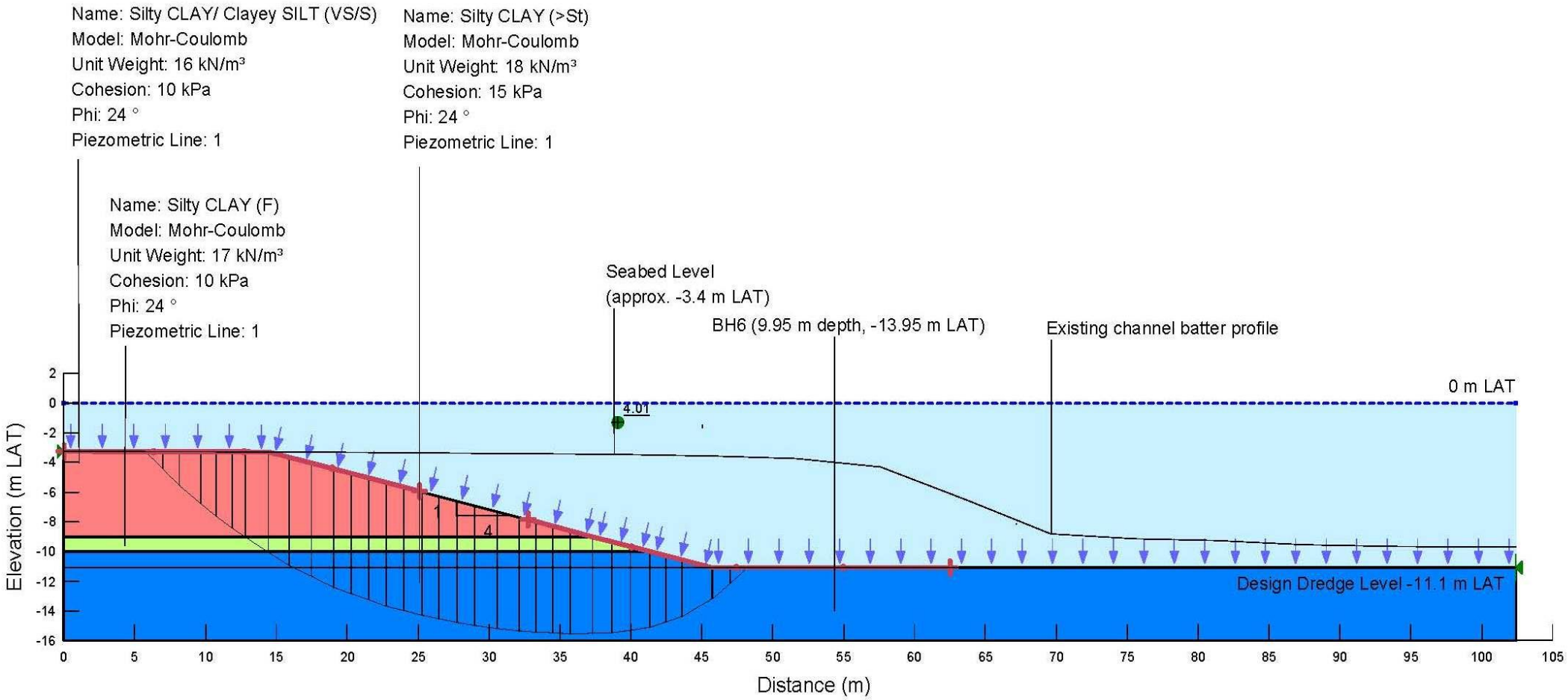

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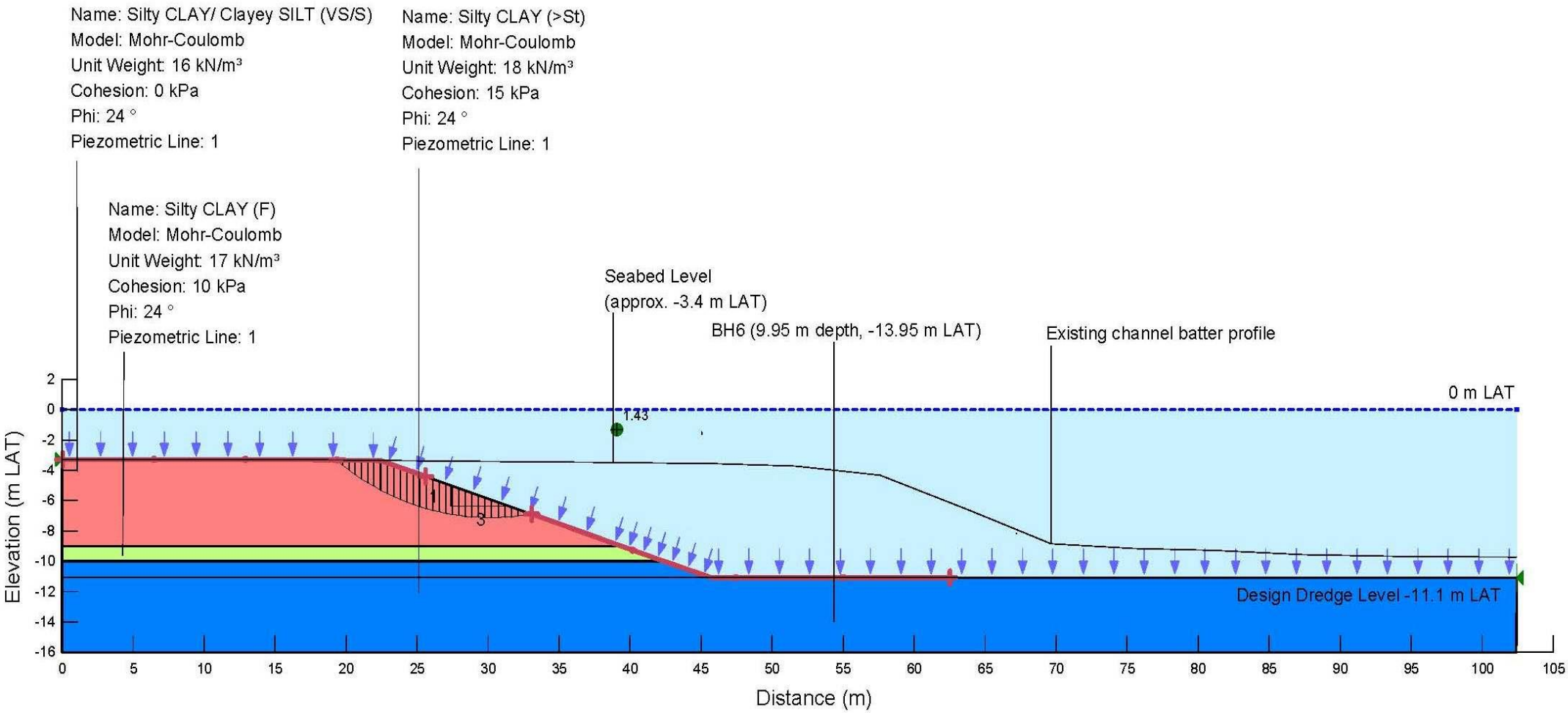

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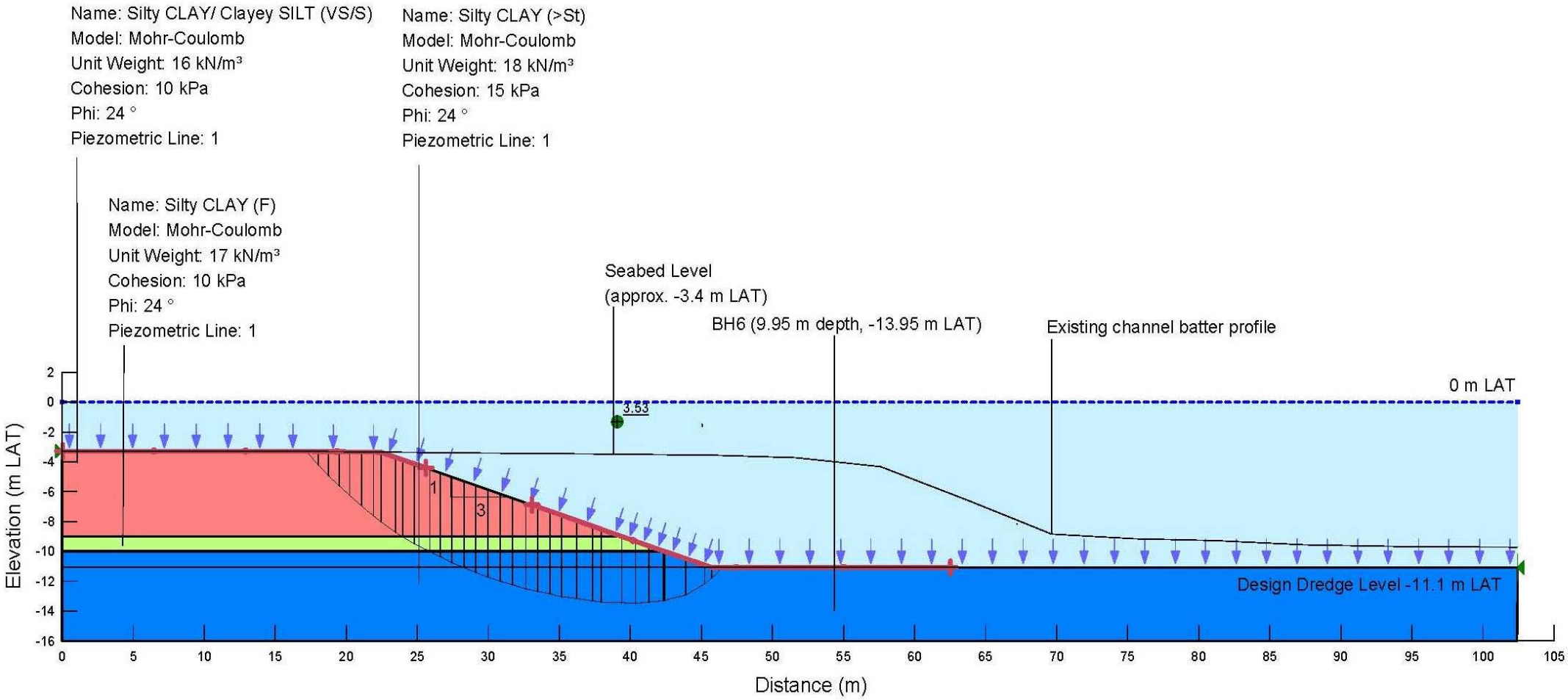

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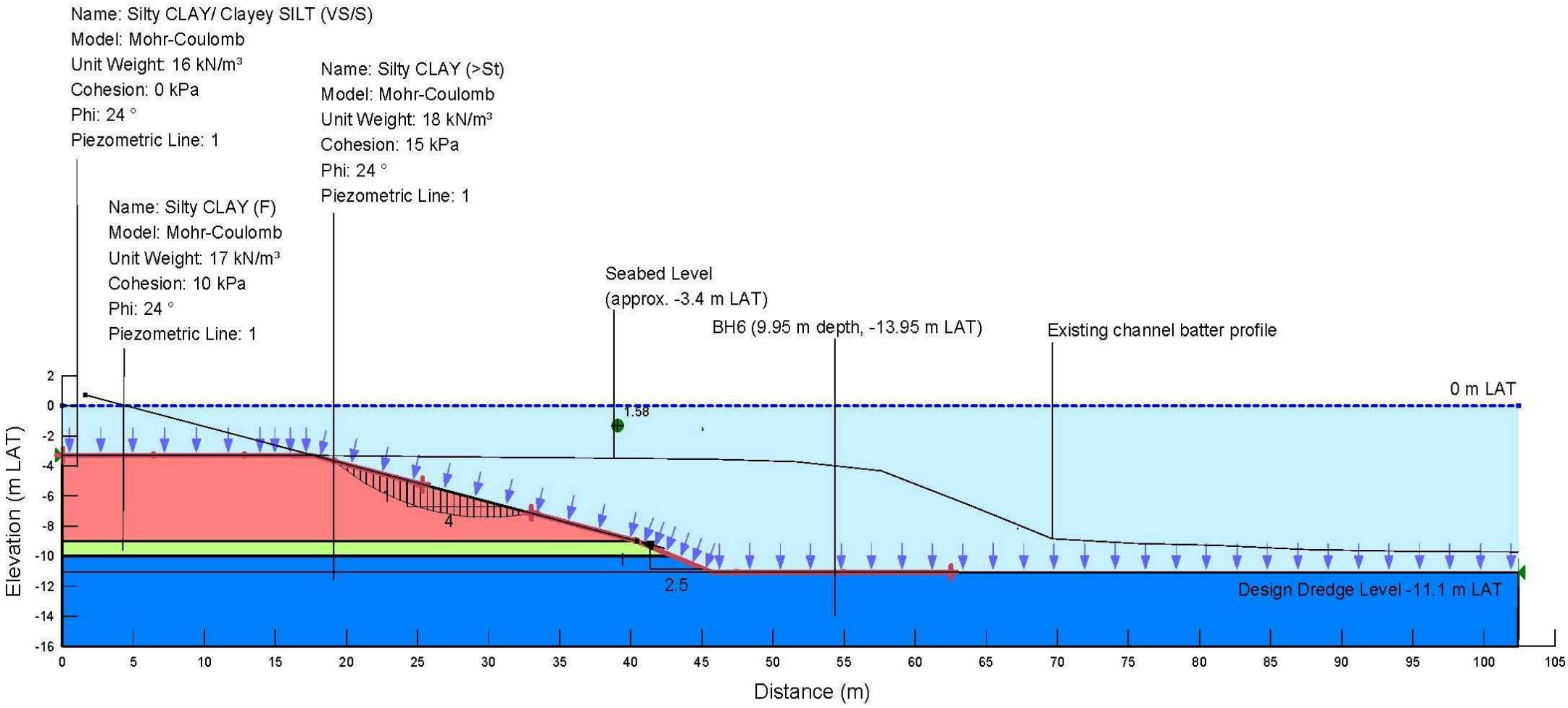

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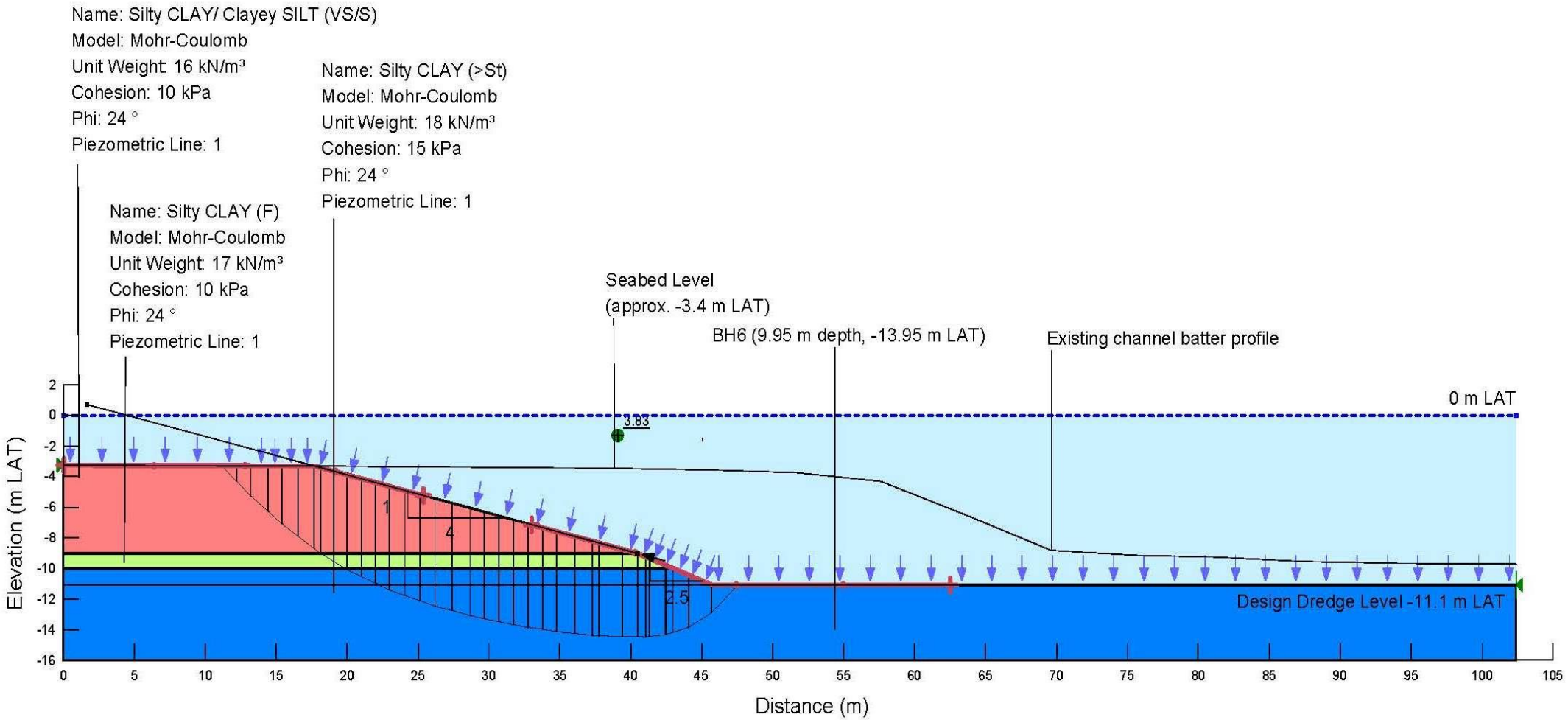

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