



Borehole No.
JK1P
1/2

BOREHOLE LOG

Client: CRADLE COAST WATER
Project: GEOTECHNICAL INVESTIGATION OF LANDSLIDE
Location: 9ML BIG KELCEY RESERVOIR, NEAR DEVONPORT, TASMANIA

Job No. 21508WH2 **Method:** SPIRAL AUGER HYDROPOWER SCOUT **R.L. Surface:** 111.76m
Date: 19-1-09 **Datum:** AHD
Logged/Checked by: A.J.H./BAO

Groundwater Record	SAMPLES			Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
	ES	U50	DB DS									
					0			<p>TOPSOIL: Silty sand, fine to medium grained, dark brown, with root fibres.</p> <p>FILL: Clayey silt, low plasticity, light brown and grey, with fine to coarse grained angular siltstone gravel.</p>	D			GRASS COVER
					1			<p>FILL: Clayey silt/silty clay, low plasticity, brown and grey, with a trace of fine grained angular sub angular and angular siltstone and shale gravel.</p>	MC < PL			
					2			<p>as above, but with angular siltstone and shale gravel, and a trace of siltstone cobbles (to 70mm size).</p>				
					3			<p>FILL: Clayey silt, low plasticity, grey and brown, with fine to coarse grained angular siltstone gravel, with a trace of ash.</p>				
					4							
					5							POSSIBLE INFERRED LANDSLIDE DEBRIS BELOW 5m DEPTH
					6				MC ≈ PL			
					6.25			<p>SILTSTONE: light grey and brown, with L-M strength seams.</p>	XW	EL		INFERRED LANDSLIDE DEBRIS BELOW 6.25m DEPTH
					7			REFER TO CORED BOREHOLE LOG				

ON COMPLETION OF CORING

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Borehole No.
JK 1P
2/2

CORED BOREHOLE LOG

Client:	CRADLE COAST WATER	
Project:	GEOTECHNICAL INVESTIGATION OF LANDSLIDE	
Location:	9ML BIG KELCEY RESERVOIR, NEAR DEVONPORT, TASMANIA	
Job No. 21508WH2	Core Size: HQ	R.L. Surface: 111.76m
Date: 14&15-1-09	Inclination: VERTICAL	Datum: AHD
Drill Type: HYDROPOWER SCOUT	Bearing: -	Logged/Checked by: A.J.H. /

Water Loss/Level	Barrel Lift	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, structure, minor components.	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$	DEFECT DETAILS	
								DEFECT SPACING (mm)	DESCRIPTION Type, inclination, thickness, planarity, roughness, coating.
							EL VL L M H VH EH	500 300 100 50 30 10	Specific General
		6		START CORING AT 6.60m					
50% RETURN		7		SILTSTONE: light grey and brown, with clay bands. No evidence of horizontal bedding.	XW	EL			INFERRED LANDSLIDE DEBRIS TO APPROXIMATELY 10.1m DEPTH - L-M SEAM, 70mm.t
		8		SILTY CLAY/CLAYEY SILT: low low plasticity, light brown and grey. Inferred remoulded siltstone.	MC < PL	(H)			
				CORE LOSS 0.40m					
		9		SILTY CLAY/CLAYEY SILT: low plasticity, brown and grey, with XW, EL siltstone seams. Inferred remoulded siltstone.	MC < PL	(H)			
				as above, but dark grey.					
NO RETURN		10		SILTY CLAY: low plasticity, orange brown, with light grey seams.					
				CORE LOSS 0.40m					
		11		SILTSTONE: light grey, bedded at 0-5°.	XW	EL			- CS, 10mm.t - CS, 30mm.t - Cr, 70mm.t
				SILTY CLAY: low plasticity, light grey, with XW, EL siltstone seams.	MC < PL	(H)	X		- J, SUBVERTICAL, P, R, IS
				SILTSTONE: light grey and brown, bedded at 0-5°.	XW	EL			- CS, 20mm.t - J, 45°, P, R, IS
		12			DW	L-M	X		- J, SUBVERTICAL, Un, R, IS
				END OF BOREHOLE AT 12.70m			X		VW PIEZOMETER INSTALLED TO 10.0m DEPTH. REFER TO TABLE E FOR INSTALLATION DETAILS

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JOB No. 21508WH2 JK1P START CORING AT 6.60m

6

6.60m

7

7.60m

8

CORE LOSS 0.40m

8.10m

8.50m

9

9.60m

10

CORE LOSS 0.40m

10.14m

10.54m

11

11.10m

11.50m

12

END OF BH
AT 12.70m

GRAPHIC LOG SYMBOLS FOR SOILS AND ROCKS

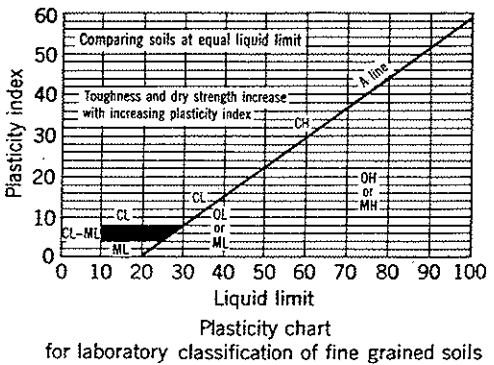
SOIL		ROCK		DEFECTS AND INCLUSIONS	
	FILL		CONGLOMERATE		CLAY SEAM
	TOPSOIL		SANDSTONE		SHEARED OR CRUSHED SEAM
	CLAY (CL, CH)		SHALE		BRECCIATED OR SHATTERED SEAM/ZONE
	SILT (ML, MH)		SILTSTONE, MUDSTONE, CLAYSTONE		IRONSTONE GRAVEL
	SAND (SP, SW)		LIMESTONE		ORGANIC MATERIAL
	GRAVEL (GP, GW)		PHYLLITE, SCHIST	OTHER MATERIALS	
	SANDY CLAY (CL, CH)		TUFF		CONCRETE
	SILTY CLAY (CL, CH)		GRANITE, GABBRO		BITUMINOUS CONCRETE, COAL
	CLAYEY SAND (SC)		DOLERITE, DIORITE		COLLUVIUM
	SILTY SAND (SM)		BASALT, ANDESITE		
	GRAVELLY CLAY (CL, CH)		QUARTZITE		
	CLAYEY GRAVEL (GC)				
	SANDY SILT (ML)				
	PEAT AND ORGANIC SOILS				



UNIFIED SOIL CLASSIFICATION TABLE

Field Identification Procedures (Excluding particles larger than 75 µm and basing fractions on estimated weights)		Group Symbols	Typical Names	Information Required for Describing Soils	Laboratory Classification Criteria					
Coarse-grained soils More than half of material is larger than 75 µm sieve size (The 75 µm sieve size is about the smallest particle visible to naked eye)	Gravels More than half of coarse fraction is larger than 4 mm sieve size	Clean gravels (little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes	GW	Well graded gravels, gravel-sand mixtures, little or no fines	<p>Determine percentages of gravel and sand from grain size curve Depending on percentage of fines (fraction smaller than 75 µm sieve size) coarse grained soils are classified as follows: Less than 5% GW, GP, SW, SP More than 5% GM, GC, SM, SC Borderline cases requiring use of that symbols</p> $C_U = \frac{D_{60}}{D_{10}} \text{ Greater than 4}$ $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}} \text{ Between 1 and 3}$ <p>Not meeting all gradation requirements for GW</p> <table border="1"> <tr> <td>Atterberg limits below "A" line, or PI less than 4</td> <td>Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols</td> </tr> </table> $C_U = \frac{D_{60}}{D_{10}} \text{ Greater than 6}$ $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}} \text{ Between 1 and 3}$ <p>Not meeting all gradation requirements for SW</p> <table border="1"> <tr> <td>Atterberg limits below "A" line or PI less than 5</td> <td>Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols</td> </tr> </table>	Atterberg limits below "A" line, or PI less than 4	Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols	Atterberg limits below "A" line or PI less than 5	Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols
		Atterberg limits below "A" line, or PI less than 4	Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols							
		Atterberg limits below "A" line or PI less than 5	Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols							
		Predominantly one size or a range of sizes with some intermediate sizes missing	GP	Poorly graded gravels, gravel-sand mixtures, little or no fines						
	Nonplastic fines (for identification procedures see ML below)	GM	Silty gravels, poorly graded gravel-sand-silt mixtures							
	Plastic fines (for identification procedures, see CL below)	GC	Clayey gravels, poorly graded gravel-sand-clay mixtures							
	Sands More than half of coarse fraction is smaller than 4 mm sieve size	Clean sands (little or no fines)	Wide range in grain sizes and substantial amounts of all intermediate particle sizes	SW	Well graded sands, gravelly sands, little or no fines					
			Predominantly one size or a range of sizes with some intermediate sizes missing	SP	Poorly graded sands, gravelly sands, little or no fines					
		Sands with fines (appreciable amount of fines)	Nonplastic fines (for identification procedures, see ML below)	SM	Silty sands, poorly graded sand-silt mixtures					
			Plastic fines (for identification procedures, see CL below)	SC	Clayey sands, poorly graded sand-clay mixtures					
Identification Procedures on Fraction Smaller than 380 µm Sieve Size										
Silt and clays liquid limit less than 50			Dry Strength (crushing characteristics)	Dilatancy (reaction to shaking)	Toughness (consistency near plastic limit)					
	None to slight	Quick to slow	None	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity					
Silt and clays liquid limit greater than 50	Medium to high	None to very slow	Medium	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays					
	Slight to medium	Slow	Slight	OL	Organic silts and organic silt-clays of low plasticity					
	Slight to medium	Slow to none	Slight to medium	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts					
	High to very high	None	High	CH	Inorganic clays of high plasticity, fat clays					
	Medium to high	None to very slow	Slight to medium	OH	Organic clays of medium to high plasticity					
	Highly Organic Soils		Readily identified by colour, odour, spongy feel and frequently by fibrous texture		Pt	Peat and other highly organic soils				

Use grain size curve in identifying the fractions as given under field identification



NOTE: 1) Soils possessing characteristics of two groups are designated by combinations of group symbols (e.g. GW-GC, well graded gravel-sand mixture with clay fines).
2) Soils with liquid limits of the order of 35 to 50 may be visually classified as being of medium plasticity.



LOG SYMBOLS

LOG COLUMN	SYMBOL	DEFINITION	
Groundwater Record		Standing water level. Time delay following completion of drilling may be shown.	
		Extent of borehole collapse shortly after drilling.	
		Groundwater seepage into borehole or excavation noted during drilling or excavation.	
Samples	ES	Soil sample taken over depth indicated, for environmental analysis.	
	U50	Undisturbed 50mm diameter tube sample taken over depth indicated.	
	DB	Bulk disturbed sample taken over depth indicated.	
	DS	Small disturbed bag sample taken over depth indicated.	
	ASB	Soil sample taken over depth indicated, for asbestos screening.	
	ASS	Soil sample taken over depth indicated, for acid sulfate soil analysis.	
	SAL	Soil sample taken over depth indicated, for salinity analysis.	
Field Tests	N = 17 4, 7, 10	Standard Penetration Test (SPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration. 'R' as noted below.	
	N _c =	5	Solid Cone Penetration Test (SCPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration for 60 degree solid cone driven by SPT hammer. 'R' refers to apparent hammer refusal within the corresponding 150mm depth increment.
		7	
		3R	
VNS = 25 PID = 100	Vane shear reading in kPa of Undrained Shear Strength. Photoionisation detector reading in ppm (Soil sample headspace test).		
Moisture Condition (Cohesive Soils) (Cohesionless Soils)	MC > PL	Moisture content estimated to be greater than plastic limit.	
	MC ≈ PL	Moisture content estimated to be approximately equal to plastic limit.	
	MC < PL	Moisture content estimated to be less than plastic limit.	
	D	DRY - runs freely through fingers.	
	M	MOIST - does not run freely but no free water visible on soil surface.	
	W	WET - free water visible on soil surface.	
Strength (Consistency) Cohesive Soils	VS	VERY SOFT - Unconfined compressive strength less than 25kPa	
	S	SOFT - Unconfined compressive strength 25-50kPa	
	F	FIRM - Unconfined compressive strength 50-100kPa	
	St	STIFF - Unconfined compressive strength 100-200kPa	
	VSt	VERY STIFF - Unconfined compressive strength 200-400kPa	
	H	HARD - Unconfined compressive strength greater than 400kPa	
	()	Bracketed symbol indicates estimated consistency based on tactile examination or other tests.	
Density Index/ Relative Density (Cohesionless Soils)	VL	Very Loose < 15	
	L	Loose 15-35	
	MD	Medium Dense 35-65	
	D	Dense 65-85	
	VD	Very Dense > 85	
	()	Bracketed symbol indicates estimated density based on ease of drilling or other tests.	
Hand Penetrometer Readings	300	Numbers indicate individual test results in kPa on representative undisturbed material unless noted otherwise.	
	250		
Remarks	'V' bit	Hardened steel 'V' shaped bit.	
	'TC' bit	Tungsten carbide wing bit.	
	T 60	Penetration of auger string in mm under static load of rig applied by drill head hydraulics without rotation of augers.	

Jeffery and Katauskas Pty Ltd

CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS
 ABN 17 003 550 801



LOG SYMBOLS

ROCK MATERIAL WEATHERING CLASSIFICATION

TERM	SYMBOL	DEFINITION
Residual Soil	RS	Soil developed on extremely weathered rock; the mass structure and substance fabric are no longer evident; there is a large change in volume but the soil has not been significantly transported.
Extremely weathered rock	XW	Rock is weathered to such an extent that it has "soil" properties, ie it either disintegrates or can be remoulded, in water.
Distinctly weathered rock	DW	Rock strength usually changed by weathering. The rock may be highly discoloured, usually by ironstaining. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores.
Slightly weathered rock	SW	Rock is slightly discoloured but shows little or no change of strength from fresh rock.
Fresh rock	FR	Rock shows no sign of decomposition or staining.

ROCK STRENGTH

Rock strength is defined by the Point Load Strength Index (Is 50) and refers to the strength of the rock substance in the direction normal to the bedding. The test procedure is described by the International Journal of Rock Mechanics, Mining, Science and Geomechanics. Abstract Volume 22, No 2, 1985.

TERM	SYMBOL	Is (50) MPa	FIELD GUIDE
Extremely Low:	EL	0.03	Easily remoulded by hand to a material with soil properties.
-----	-----		
Very Low:	VL	0.1	May be crumbled in the hand. Sandstone is "sugary" and friable.
-----	-----		
Low:	L	0.3	A piece of core 150mm long x 50mm dia. may be broken by hand and easily scored with a knife. Sharp edges of core may be friable and break during handling.
-----	-----		
Medium Strength:	M	1	A piece of core 150mm long x 50mm dia. can be broken by hand with difficulty. Readily scored with knife.
-----	-----		
High:	H	3	A piece of core 150mm long x 50mm dia. core cannot be broken by hand, can be slightly scratched or scored with knife; rock rings under hammer.
-----	-----		
Very High:	VH	10	A piece of core 150mm long x 50mm dia. may be broken with hand-held pick after more than one blow. Cannot be scratched with pen knife; rock rings under hammer.
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Extremely High:	EH		A piece of core 150mm long x 50mm dia. is very difficult to break with hand-held hammer. Rings when struck with a hammer.

ABBREVIATIONS USED IN DEFECT DESCRIPTION

ABBREVIATION	DESCRIPTION	NOTES
Be	Bedding Plane Parting	Defect orientations measured relative to the normal to the long core axis (ie relative to horizontal for vertical holes)
CS	Clay Seam	
J	Joint	
P	Planar	
Un	Undulating	
S	Smooth	
R	Rough	
IS	Ironstained	
XWS	Extremely Weathered Seam	
Cr	Crushed Seam	
60t	Thickness of defect in millimetres	