

MEMORANDUM – UND-02-DES-MM-030

Email: [REDACTED] s 9(2)(a)

To	[REDACTED] s 9(2)(a)
From	[REDACTED] s 9(2)(a)
CC	[REDACTED] s 9(2)(a)
Date	22/08/13
Subject	Western Approach Subgrade CBR Analysis

INTRODUCTION

This memo sets out the anticipated subgrade conditions and undercutting requirements of the approaches to the underpass where the road is not piled or on a floor slab.

This memo supersedes recommendations made in UND/Memo/02/04 (dated 20/11/2012).

The approaches on grade are defined as follows:

- Western Approach (Taranaki Street End) – Chainage 210-248m;
- Eastern Approach (Basin Reserve End) – Chainage 476-540m.

The depth of the approaches below ground level where it is placed on grade will require cuts of between 0 and 3.5m below ground level.

ANTICIPATED GROUND CONDITIONS

The anticipated ground conditions are highly variable across the site, a summary of the anticipated geological conditions is below:

Western Approach (Taranaki Street End)

- 0-2m (variable) – Silt/Gravel Fill.
- 2-8m (variable) – mix of brown silt and gravel layers, layers vary between 0.3 and 2m thickness (Holocene).
- 8m+ - bluish grey interbedded sands, silts and gravels with infrequent organic layers (Pleistocene).

Eastern Approach (Basin Reserve End)

- 0-2m (variable) – Silt/Gravel Fill.
- 2-6m (variable) – mix of brown silt and gravel layers, layers vary between 0.3 and 4m thickness (Holocene)

- 6m+ - bluish grey interbedded sands, silts and gravels with infrequent organic layers (Pleistocene)

Investigation data is provided in the Factual Geotechnical Investigation Report (UND-02-DES-RP-001).

Site walkovers suggest that the cut surface in the western approach is predominantly moderately dense silty gravels with some silt layers.

CBR DESIGN

Scala penetrometers have been undertaken in the current excavation surface at the western approach. This area is currently cut down to 200mm (lower level) to 500mm (upper level) above the final excavation surface. The scala penetrometer details are outlined in table 1 below:

Table 1: Scala Penetrometer Test Details

Scala Test	Location	Approximate Level	Test Depth
SC1	CH235 South Wall	Lower Level	1.4m
SC2	CH235 Middle	Upper Level	0.85m
SC3	CH247 South Wall	Lower Level	1.55m
SC4	CH247 Middle	Upper Level	1.5m
SC5	CH248 North Wall	Upper Level	1.4m

The scala penetrometer results and CBR analysis are attached.

The scala CBR interpretation suggest that the CBR is above 15 below the proposed cut level. The geological cuts on site generally show silty gravels and a minimum CBR of 15 is realistic in this material. However, there may be sections of the road cut that may expose silt and silty clay layers. The subgrade CBR in this material could be as low as 3.

There are two options for the pavement design CBR for the site:

1. Design for a worst case subgrade of 3 across the whole site. Some areas of poor materials may need to be undercut 0.5m below subgrade and replaced with compacted granular fill. Expensive but conservative option.
2. Multi design road subgrade, design for a subgrade CBR of 15 and 3 across the site, the majority of the site should be CBR 15+ but there are likely to be areas with a subgrade CBR of 3. The subgrade CBR 3 pavement zone shall be extended 3m into the CBR 15 zone where encountered. Some areas of poor material may need to be undercut an additional 0.5m below subgrade and replaced with compacted granular fill.

Both these design options assume that good construction practices are used on site during construction, this includes:

- Leaving a protection layer of 150mm of cover over the final subgrade level and cutting to the final level only hours before placing drainage material.
- Final cut surface is not trafficked with construction machinery.
- Construction of the basecourse material is undertaken in dry conditions. Subgrade is not allowed to get wet.
- Geotechnical engineer inspects all +150mm cut surfaces to confirm any areas of soft material requiring additional undercut.
- Subgrade has good quality surface and subsoil drainage installed.

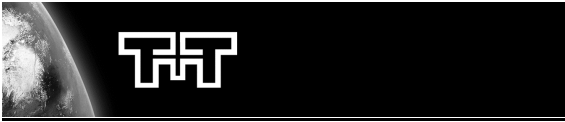
Good construction practices are particularly important for silt and clay subgrades that are very sensitive to deformation. The subgrade CBR could drop to 1 or 2 if poor construction practices are used.

These recommendations are for the western approach subgrade only. Once the excavation in the eastern approach is closer to the final subgrade level we will undertake additional subgrade analysis to confirm the suitability of CBR 15 for the east.

Attachments:

- Scala Logs
- Scala CBR analysis (MJ Stockwell 1977)

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OFFICIAL INFORMATION ACT



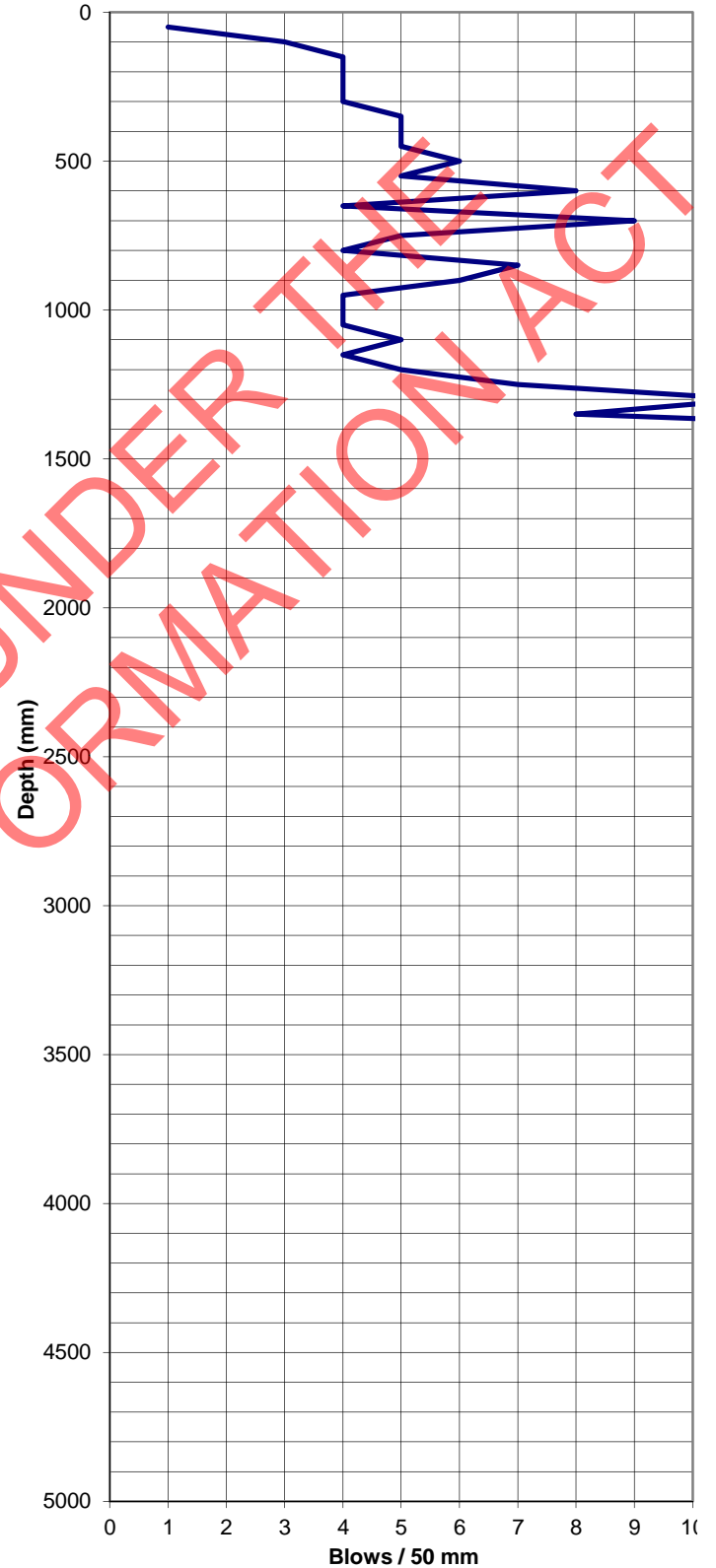
TONKIN & TAYLOR
SCALA PENETROMETER LOG

Job No: 85700.0000
 Project: MPA
 Location: 4.2m out from Post 216 to 140
 RL: Lower level

Date: 16/08/2013
 Operated by: DTG
 Logged by: DTG
 Checked by:

Test No.	SC1
Sheet of	1 / 1

mm Driven	No. of Blows	mm Driven	No. of Blows
50	1	2550	
100	3	2600	
150	4	2650	
200	4	2700	
250	4	2750	
300	4	2800	
350	5	2850	
400	5	2900	
450	5	2950	
500	6	3000	
550	5	3050	
600	8	3100	
650	4	3150	
700	9	3200	
750	5	3250	
800	4	3300	
850	7	3350	
900	6	3400	
950	4	3450	
1000	4	3500	
1050	4	3550	
1100	5	3600	
1150	4	3650	
1200	5	3700	
1250	7	3750	
1300	11	3800	
1350	8	3850	
1400	15	3900	
1450		3950	
1500		4000	
1550		4050	
1600		4100	
1650		4150	
1700		4200	
1750		4250	
1800		4300	
1850		4350	
1900		4400	
1950		4450	
2000		4500	
2050		4550	
2100		4600	
2150		4650	
2200		4700	
2250		4750	
2300		4800	
2350		4850	
2400		4900	
2450		4950	
2500		5000	



Test Method Used: NZS 4402:1988 Test 6.5.2 Dynamic Cone Penetrometer





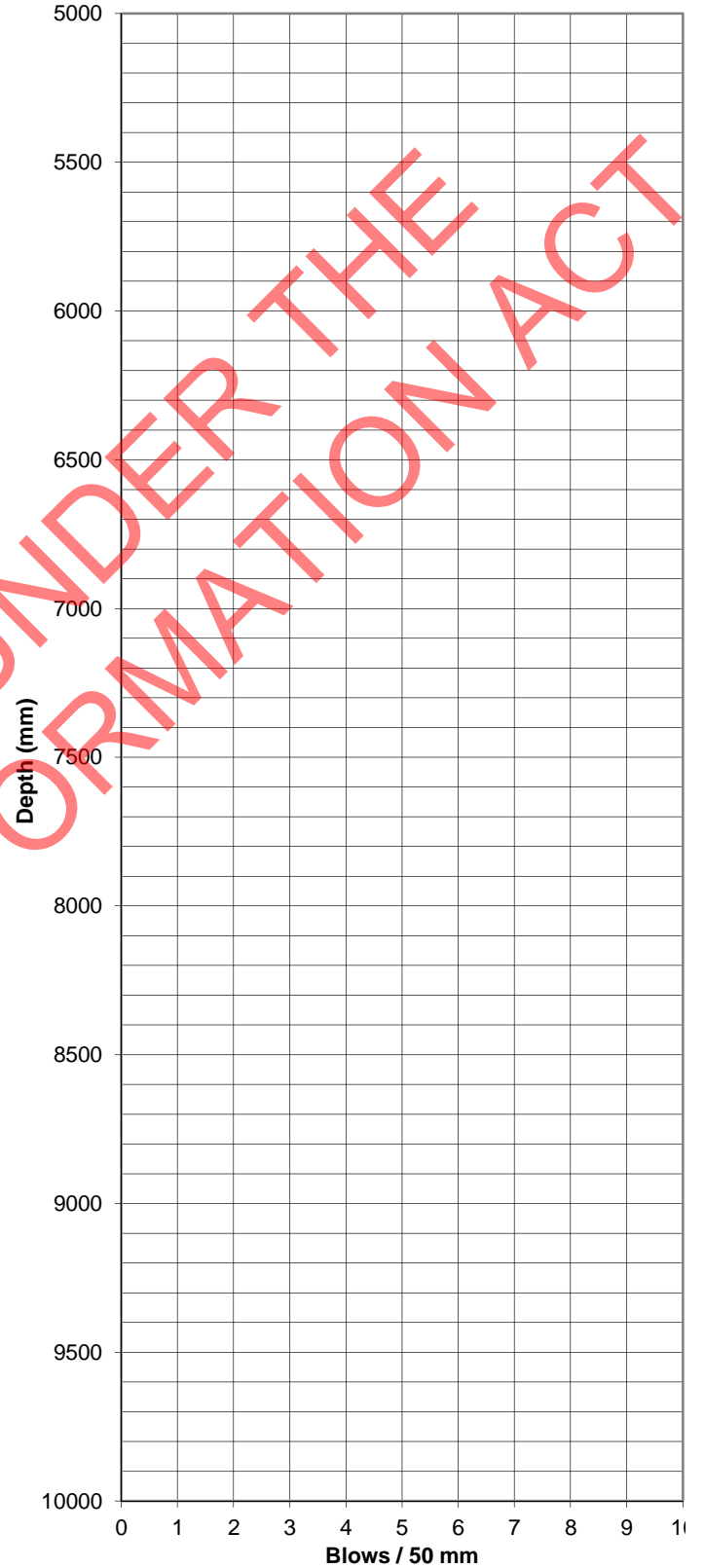
TONKIN & TAYLOR
SCALA PENETROMETER LOG

Job No: 85700.000
Project: MPA
Location: 4.2m out from Post 216 to 140
RL: Lower level

Date: 16/08/2013
Operated by: DTG
Logged by: DTG
Checked by:

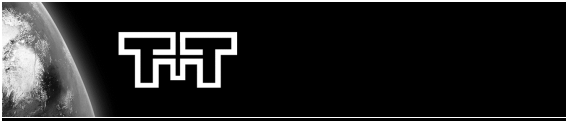
Test No.	SC1
Sheet	2
of	2

mm Driven	No. of Blows	mm Driven	No. of Blows
5050		7550	
5100		7600	
5150		7650	
5200		7700	
5250		7750	
5300		7800	
5350		7850	
5400		7900	
5450		7950	
5500		8000	
5550		8050	
5600		8100	
5650		8150	
5700		8200	
5750		8250	
5800		8300	
5850		8350	
5900		8400	
5950		8450	
6000		8500	
6050		8550	
6100		8600	
6150		8650	
6200		8700	
6250		8750	
6300		8800	
6350		8850	
6400		8900	
6450		8950	
6500		9000	
6550		9050	
6600		9100	
6650		9150	
6700		9200	
6750		9250	
6800		9300	
6850		9350	
6900		9400	
6950		9450	
7000		9500	
7050		9550	
7100		9600	
7150		9650	
7200		9700	
7250		9750	
7300		9800	
7350		9850	
7400		9900	
7450		9950	
7500		10000	



Test Method Used: NZS 4402:1988 Test 6.5.2 Dynamic Cone Penetrometer





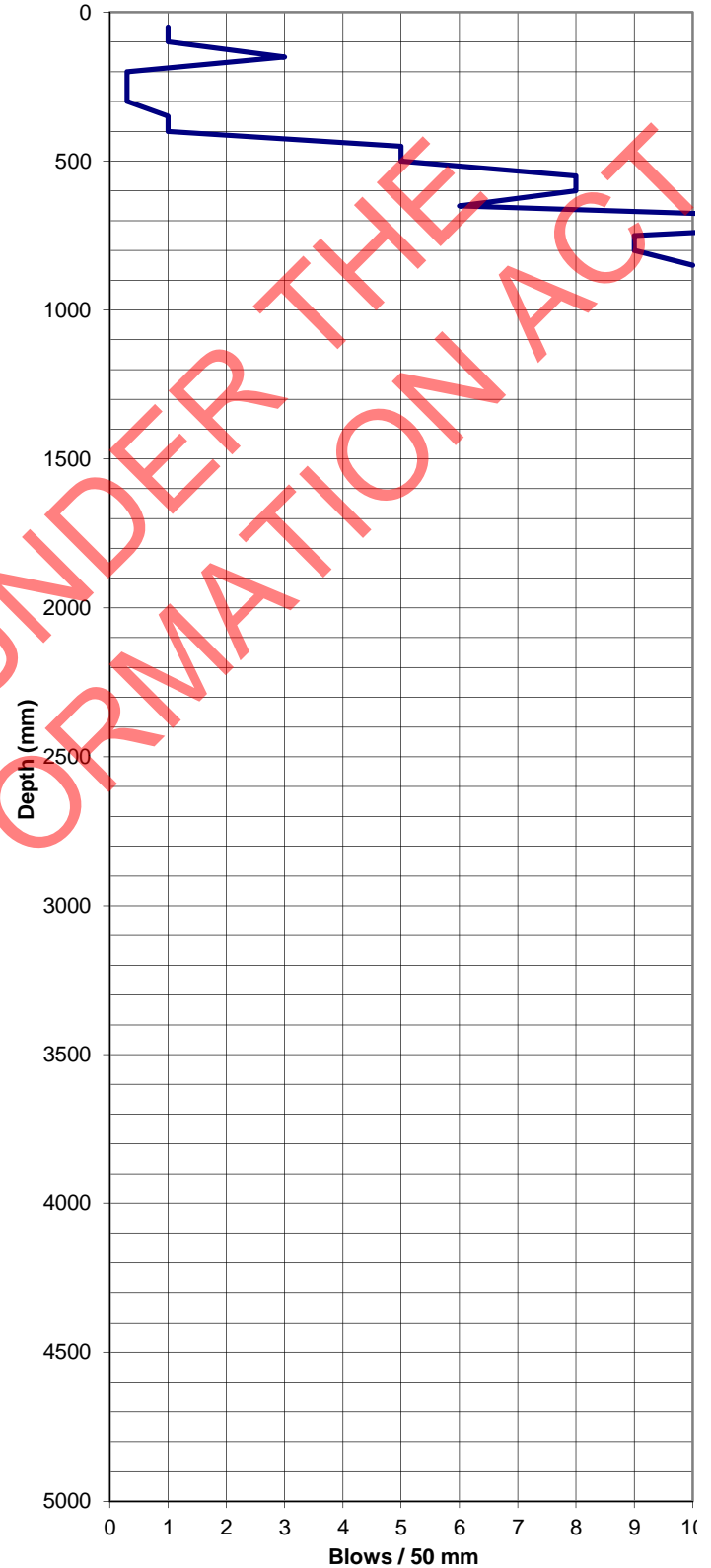
TONKIN & TAYLOR
SCALA PENETROMETER LOG

Job No: 85700.000
Project: MPA
Location: 6.1m from SC1
RL: Upper level

Date: 16/08/2013
Operated by: DTG
Logged by: DTG
Checked by:

Test No.	SC2
Sheet of	1 / 1

mm Driven	No. of Blows	mm Driven	No. of Blows
50	1	2550	
100	1	2600	
150	3	2650	
200	0.3	2700	
250	0.3	2750	
300	0.3	2800	
350	1	2850	
400	1	2900	
450	5	2950	
500	5	3000	
550	8	3050	
600	8	3100	
650	6	3150	
700	14	3200	
750	9	3250	
800	9	3300	
850	10	3350	
900		3400	
950		3450	
1000		3500	
1050		3550	
1100		3600	
1150		3650	
1200		3700	
1250		3750	
1300		3800	
1350		3850	
1400		3900	
1450		3950	
1500		4000	
1550		4050	
1600		4100	
1650		4150	
1700		4200	
1750		4250	
1800		4300	
1850		4350	
1900		4400	
1950		4450	
2000		4500	
2050		4550	
2100		4600	
2150		4650	
2200		4700	
2250		4750	
2300		4800	
2350		4850	
2400		4900	
2450		4950	
2500		5000	



Test Method Used: NZS 4402:1988 Test 6.5.2 Dynamic Cone Penetrometer





TONKIN & TAYLOR
SCALA PENETROMETER LOG

Job No: 85700.000
Project: MPA
Location: 6.1m from SC1
RL: Upper level

Date: 16/08/2013
Operated by: DTG
Logged by: DTG
Checked by:

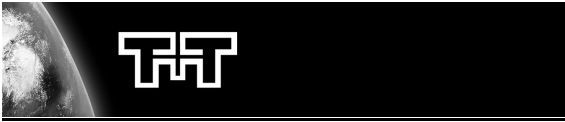
Test No.	SC2
Sheet	2
of	2

mm Driven	No. of Blows	mm Driven	No. of Blows
5050		7550	
5100		7600	
5150		7650	
5200		7700	
5250		7750	
5300		7800	
5350		7850	
5400		7900	
5450		7950	
5500		8000	
5550		8050	
5600		8100	
5650		8150	
5700		8200	
5750		8250	
5800		8300	
5850		8350	
5900		8400	
5950		8450	
6000		8500	
6050		8550	
6100		8600	
6150		8650	
6200		8700	
6250		8750	
6300		8800	
6350		8850	
6400		8900	
6450		8950	
6500		9000	
6550		9050	
6600		9100	
6650		9150	
6700		9200	
6750		9250	
6800		9300	
6850		9350	
6900		9400	
6950		9450	
7000		9500	
7050		9550	
7100		9600	
7150		9650	
7200		9700	
7250		9750	
7300		9800	
7350		9850	
7400		9900	
7450		9950	
7500		10000	



Test Method Used: NZS 4402:1988 Test 6.5.2 Dynamic Cone Penetrometer



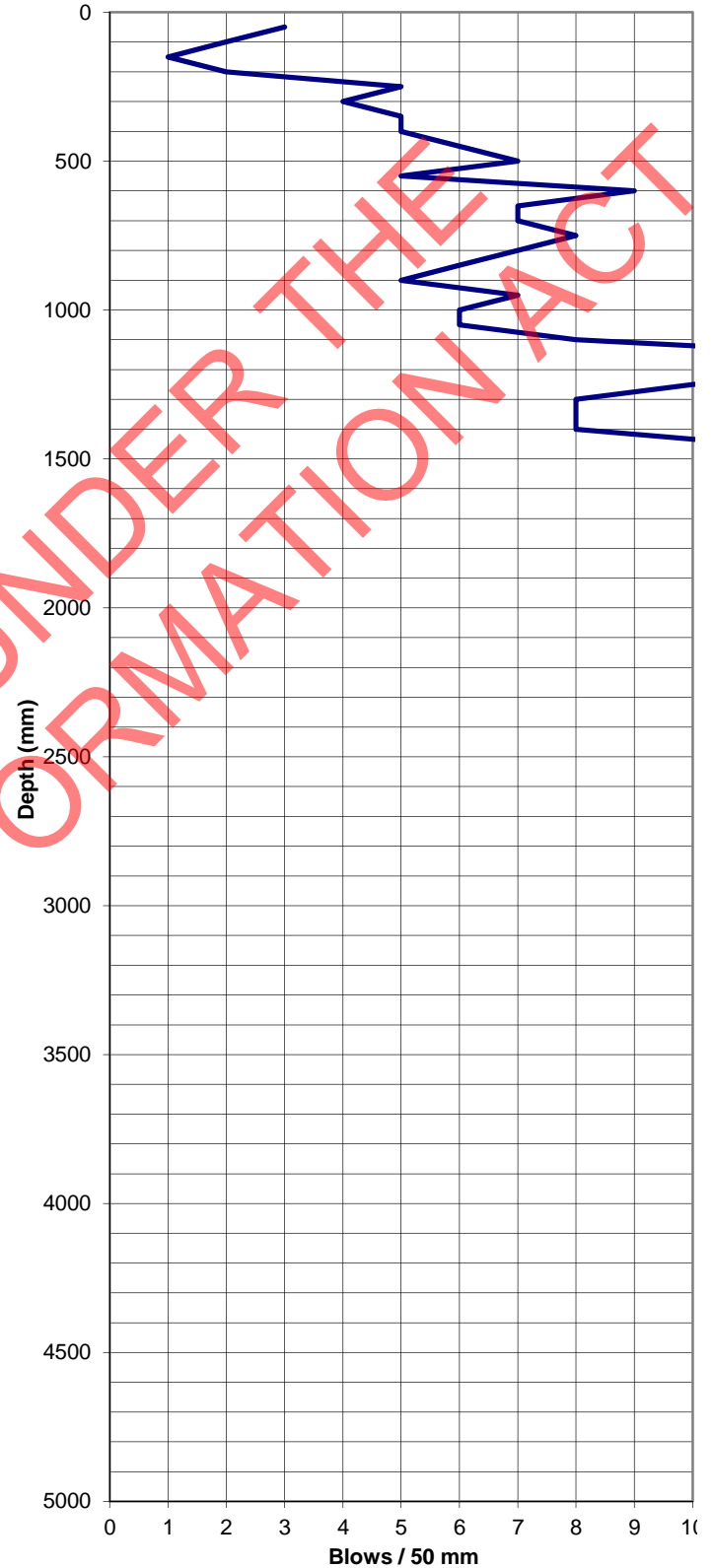


TONKIN & TAYLOR
SCALA PENETROMETER LOG

Job No: 85700.000 Date: 16/08/2013
 Project: MPA Operated by: DTG
 Location: 2.9m from Post 224 in line with 132 Logged by: DTG
 RL: Lower level Checked by:

Test No.	SC3
Sheet of	1 / 1

mm Driven	No. of Blows	mm Driven	No. of Blows
50	3	2550	
100	2	2600	
150	1	2650	
200	2	2700	
250	5	2750	
300	4	2800	
350	5	2850	
400	5	2900	
450	6	2950	
500	7	3000	
550	5	3050	
600	9	3100	
650	7	3150	
700	7	3200	
750	8	3250	
800	7	3300	
850	6	3350	
900	5	3400	
950	7	3450	
1000	6	3500	
1050	6	3550	
1100	8	3600	
1150	13	3650	
1200	13	3700	
1250	10	3750	
1300	8	3800	
1350	8	3850	
1400	8	3900	
1450	11	3950	
1500	14	4000	
1550	16	4050	
1600		4100	
1650		4150	
1700		4200	
1750		4250	
1800		4300	
1850		4350	
1900		4400	
1950		4450	
2000		4500	
2050		4550	
2100		4600	
2150		4650	
2200		4700	
2250		4750	
2300		4800	
2350		4850	
2400		4900	
2450		4950	
2500		5000	



Test Method Used: NZS 4402:1988 Test 6.5.2 Dynamic Cone Penetrometer





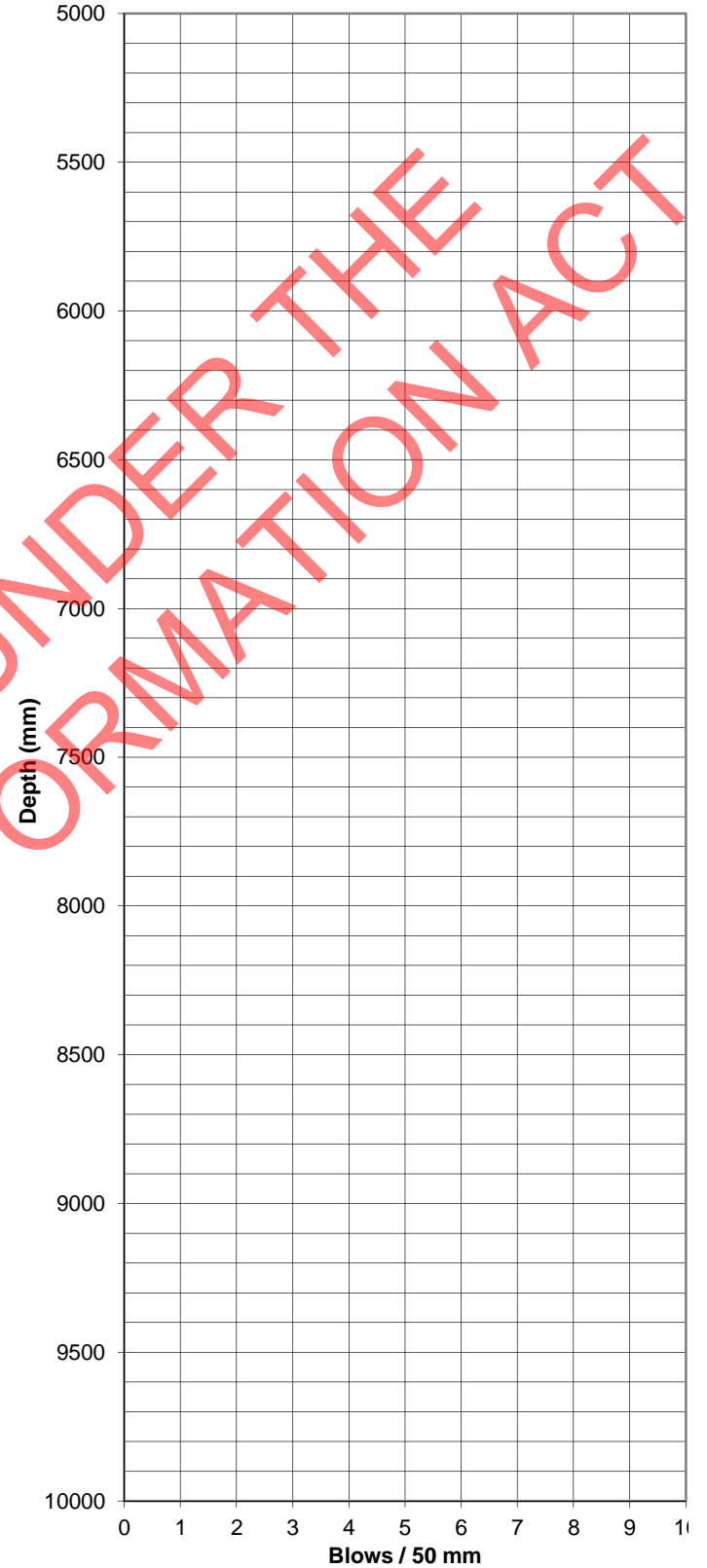
TONKIN & TAYLOR
SCALA PENETROMETER LOG

Job No: 85700.000
Project: MPA
Location: 2.9m from Post 224 in line with 132
RL: Lower level

Date: 16/08/2013
Operated by: DTG
Logged by: DTG
Checked by:

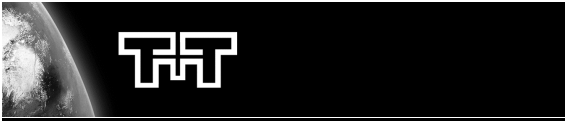
Test No.	SC3
Sheet	2
of	2

mm Driven	No. of Blows	mm Driven	No. of Blows
5050		7550	
5100		7600	
5150		7650	
5200		7700	
5250		7750	
5300		7800	
5350		7850	
5400		7900	
5450		7950	
5500		8000	
5550		8050	
5600		8100	
5650		8150	
5700		8200	
5750		8250	
5800		8300	
5850		8350	
5900		8400	
5950		8450	
6000		8500	
6050		8550	
6100		8600	
6150		8650	
6200		8700	
6250		8750	
6300		8800	
6350		8850	
6400		8900	
6450		8950	
6500		9000	
6550		9050	
6600		9100	
6650		9150	
6700		9200	
6750		9250	
6800		9300	
6850		9350	
6900		9400	
6950		9450	
7000		9500	
7050		9550	
7100		9600	
7150		9650	
7200		9700	
7250		9750	
7300		9800	
7350		9850	
7400		9900	
7450		9950	
7500		10000	



Test Method Used: NZS 4402:1988 Test 6.5.2 Dynamic Cone Penetrometer





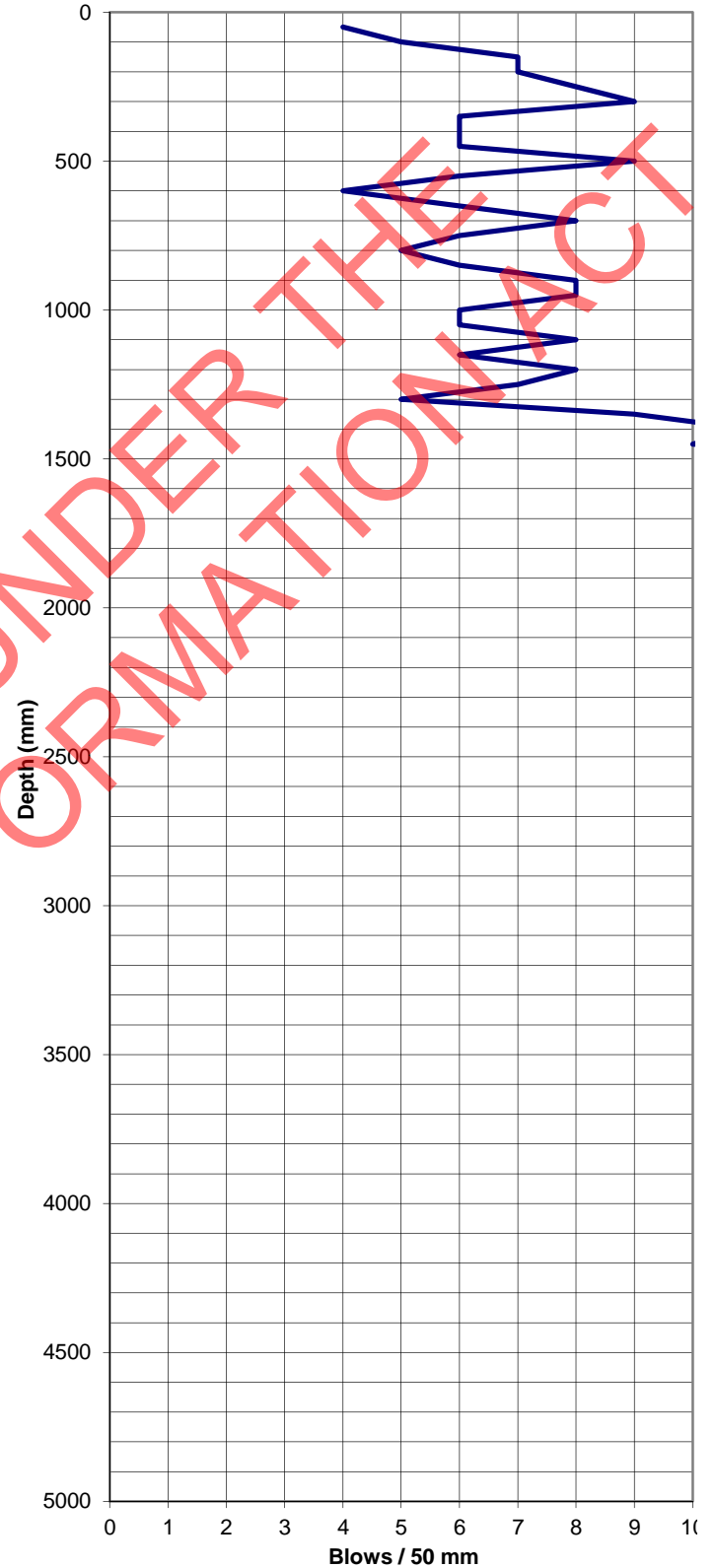
TONKIN & TAYLOR
SCALA PENETROMETER LOG

Job No: 85700.000
Project: MPA
Location: 7.1m from SC3
RL: Upper level

Date: 16/08/2013
Operated by: DTG
Logged by: DTG
Checked by:

Test No.	SC4
Sheet of	1 / 1

mm Driven	No. of Blows	mm Driven	No. of Blows
50	4	2550	
100	5	2600	
150	7	2650	
200	7	2700	
250	8	2750	
300	9	2800	
350	6	2850	
400	6	2900	
450	6	2950	
500	9	3000	
550	6	3050	
600	4	3100	
650	6	3150	
700	8	3200	
750	6	3250	
800	5	3300	
850	6	3350	
900	8	3400	
950	8	3450	
1000	6	3500	
1050	6	3550	
1100	8	3600	
1150	6	3650	
1200	8	3700	
1250	7	3750	
1300	5	3800	
1350	9	3850	
1400	11	3900	
1450	10	3950	
1500	15	4000	
1550		4050	
1600		4100	
1650		4150	
1700		4200	
1750		4250	
1800		4300	
1850		4350	
1900		4400	
1950		4450	
2000		4500	
2050		4550	
2100		4600	
2150		4650	
2200		4700	
2250		4750	
2300		4800	
2350		4850	
2400		4900	
2450		4950	
2500		5000	



Test Method Used: NZS 4402:1988 Test 6.5.2 Dynamic Cone Penetrometer





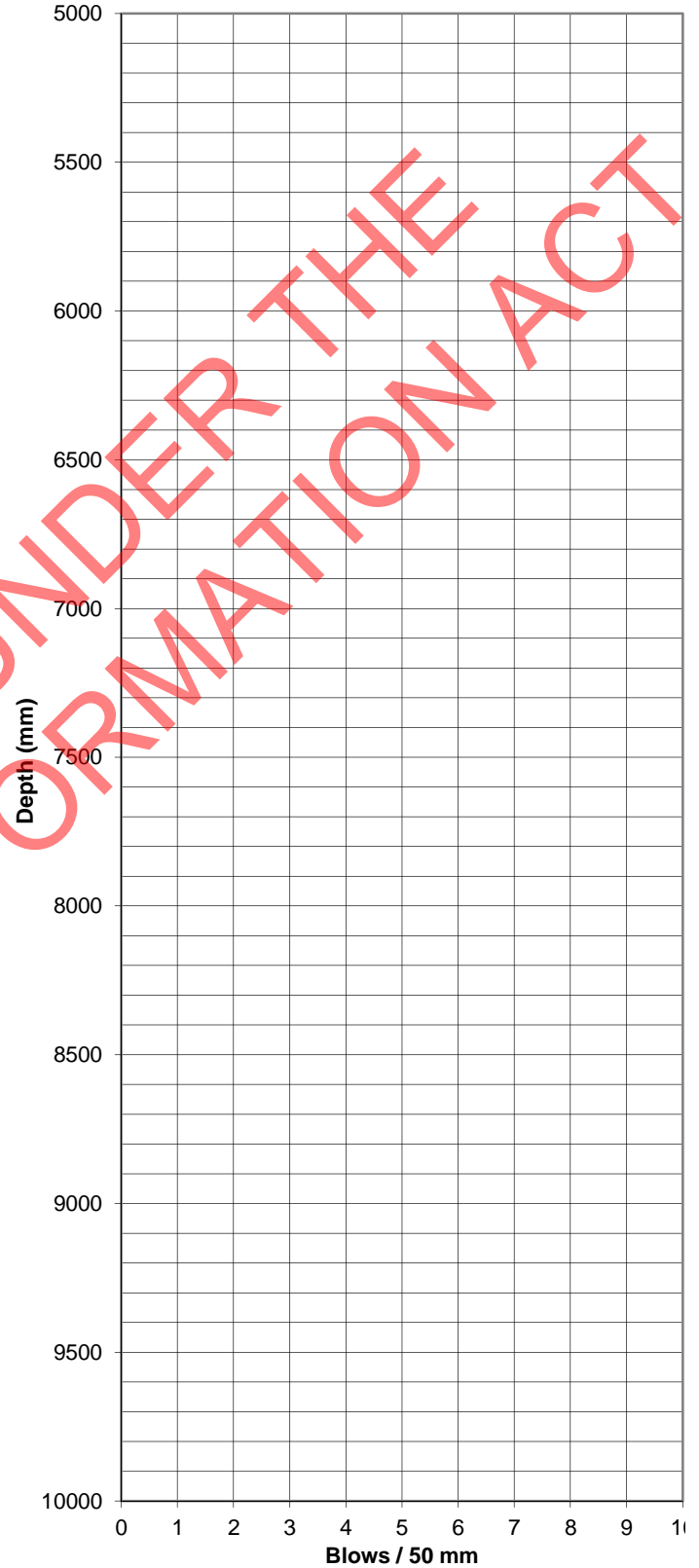
TONKIN & TAYLOR
SCALA PENETROMETER LOG

Job No: 85700.000
Project: MPA
Location: 7.1m from SC3
RL: Upper level

Date: 16/08/2013
Operated by: DTG
Logged by: DTG
Checked by:

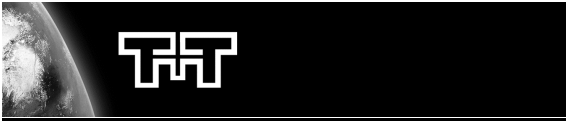
Test No.	SC4
Sheet	2
of	2

mm Driven	No. of Blows	mm Driven	No. of Blows
5050		7550	
5100		7600	
5150		7650	
5200		7700	
5250		7750	
5300		7800	
5350		7850	
5400		7900	
5450		7950	
5500		8000	
5550		8050	
5600		8100	
5650		8150	
5700		8200	
5750		8250	
5800		8300	
5850		8350	
5900		8400	
5950		8450	
6000		8500	
6050		8550	
6100		8600	
6150		8650	
6200		8700	
6250		8750	
6300		8800	
6350		8850	
6400		8900	
6450		8950	
6500		9000	
6550		9050	
6600		9100	
6650		9150	
6700		9200	
6750		9250	
6800		9300	
6850		9350	
6900		9400	
6950		9450	
7000		9500	
7050		9550	
7100		9600	
7150		9650	
7200		9700	
7250		9750	
7300		9800	
7350		9850	
7400		9900	
7450		9950	
7500		10000	



Test Method Used: NZS 4402:1988 Test 6.5.2 Dynamic Cone Penetrometer





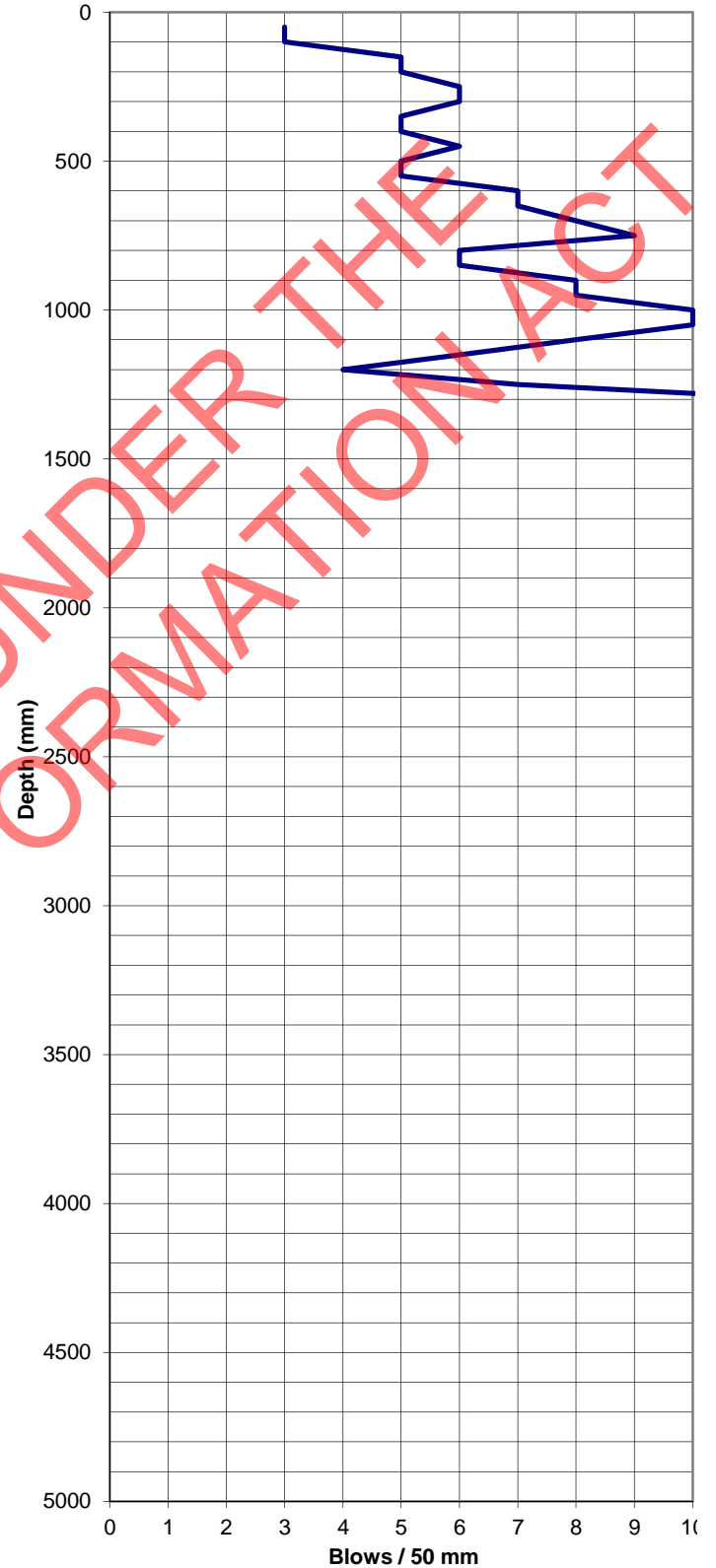
TONKIN & TAYLOR
SCALA PENETROMETER LOG

Job No: 85700.000
Project: MPA
Location: 2.5m from post 132
RL: Upper level

Date: 16/08/2013
Operated by: DTG
Logged by: DTG
Checked by:

Test No.	SC5
Sheet of	1 / 1

mm Driven	No. of Blows	mm Driven	No. of Blows
50	3	2550	
100	3	2600	
150	5	2650	
200	5	2700	
250	6	2750	
300	6	2800	
350	5	2850	
400	5	2900	
450	6	2950	
500	5	3000	
550	5	3050	
600	7	3100	
650	7	3150	
700	8	3200	
750	9	3250	
800	6	3300	
850	6	3350	
900	8	3400	
950	8	3450	
1000	10	3500	
1050	10	3550	
1100	8	3600	
1150	6	3650	
1200	4	3700	
1250	7	3750	
1300	12	3800	
1350	14	3850	
1400	15	3900	
1450		3950	
1500		4000	
1550		4050	
1600		4100	
1650		4150	
1700		4200	
1750		4250	
1800		4300	
1850		4350	
1900		4400	
1950		4450	
2000		4500	
2050		4550	
2100		4600	
2150		4650	
2200		4700	
2250		4750	
2300		4800	
2350		4850	
2400		4900	
2450		4950	
2500		5000	



Test Method Used: NZS 4402:1988 Test 6.5.2 Dynamic Cone Penetrometer





TONKIN & TAYLOR
SCALA PENETROMETER LOG

Job No: 85700.000
Project: MPA
Location: 2.5m from post 132
RL: Upper level

Date: 16/08/2013
Operated by: DTG
Logged by: DTG
Checked by:

Test No.	SC5
Sheet	2
of	2

mm Driven	No. of Blows	mm Driven	No. of Blows
5050		7550	
5100		7600	
5150		7650	
5200		7700	
5250		7750	
5300		7800	
5350		7850	
5400		7900	
5450		7950	
5500		8000	
5550		8050	
5600		8100	
5650		8150	
5700		8200	
5750		8250	
5800		8300	
5850		8350	
5900		8400	
5950		8450	
6000		8500	
6050		8550	
6100		8600	
6150		8650	
6200		8700	
6250		8750	
6300		8800	
6350		8850	
6400		8900	
6450		8950	
6500		9000	
6550		9050	
6600		9100	
6650		9150	
6700		9200	
6750		9250	
6800		9300	
6850		9350	
6900		9400	
6950		9450	
7000		9500	
7050		9550	
7100		9600	
7150		9650	
7200		9700	
7250		9750	
7300		9800	
7350		9850	
7400		9900	
7450		9950	
7500		10000	



Test Method Used: NZS 4402:1988 Test 6.5.2 Dynamic Cone Penetrometer



CBR and Soil Bearing Pressure given Scala data

SC1				SC2				SC3				SC4				SC5										
Depth mm	Scala mm/blow	WS Bearing kPa	CBR	Depth mm	Scala mm/blow	WS Bearing kPa	CBR	Depth mm	Scala mm/blow	WS Bearing kPa	CBR	Depth mm	Scala mm/blow	WS Bearing kPa	CBR	Depth mm	Scala mm/blow	WS Bearing kPa	CBR	Depth mm	Scala mm/blow	WS Bearing kPa	CBR			
50	50	69	3	50	50	69	3	50	16.7	178	12	50	12.5	229	17	50	16.7	178	12					#DIV/0!	####	
100	16.7	178	12	100	50	69	3	100	25	126	7	100	10	278	22	100	16.7	178	12					#DIV/0!	####	
150	12.5	229	17	150	16.7	178	12	150	50	69	3	150	7.1	374	35	150	10	278	22					#DIV/0!	####	
200	12.5	229	17	200	166.7	24	1	200	25	126	7	200	7.1	374	35	200	10	278	22					#DIV/0!	####	
250	12.5	229	17	250	166.7	24	1	250	10	278	22	250	6.25	418	41	250	8.3	327	28					#DIV/0!	####	
300	12.5	229	17	300	166.7	24	1	300	12.5	229	17	300	5.5	467	49	300	8.3	327	28					#DIV/0!	####	
350	10	278	22	350	50	69	3	350	10	278	22	350	8.3	327	28	350	10	278	22					#DIV/0!	####	
400	10	278	22	400	50	69	3	400	10	278	22	400	8.3	327	28	400	10	278	22					#DIV/0!	####	
450	10	278	22	450	10	278	22	450	8.3	327	28	450	8.3	327	28	450	8.3	327	28					#DIV/0!	####	
500	8.3	327	28	500	10	278	22	500	7.1	374	35	500	5.5	467	49	500	10	278	22					#DIV/0!	####	
550	10	278	22	550	6.25	418	41	550	10	278	22	600	10	278	22	550	10	278	22					#DIV/0!	####	
600	6.25	418	41	600	6.25	418	41	650	6.25	418	41	700	7.1	374	35	600	7.1	374	35					#DIV/0!	####	
650	12.5	229	17	650	8.3	327	28	750	6.7	394	38	800	9.1	302	25	700	6.7	394	38					#DIV/0!	####	
700	5.6	460	47	700	3.6	674	84	850	7.7	349	31	900	7.1	374	35	800	6.7	394	38					#DIV/0!	####	
750	10	278	22	750	5.6	460	47	950	8.3	327	28	1000	7.1	374	35	900	7.1	374	35					#DIV/0!	####	
800	12.5	229	17	800	5.6	460	47	1050	8.3	327	28	1100	7.1	374	35	1000	5.5	467	49					#DIV/0!	####	
900	7.7	349	31	850	5	507	55	1150	4.8	525	56	1200	7.1	374	35	1100	5.5	467	49					#DIV/0!	####	
1000	12.5	229	17					1250	4.3	578	67	1300	8.3	327	28	1200	10	278	22							
1100	11.1	254	20					1350	6.25	418	41	1400	5	507	55	1300	5.3	482	51							
1200	11.1	254	20					1450	5.3	482	51	1500	4	615	73	1400	3.4	708	91							
1300	5.6	460	47					1550	3.3	727	94															
1400	4.4	566	65																							

RELEASED UNDER FOIA OFFICIAL INFORMATION

CBR with Depth derived from Scala Penetrometer

