Preliminary Site Investigation at 65-94A Scott Road, Te Kauwhata

Prepared for

Lakeside Developments 2017 Ltd

This report, dated 13 March 2017, has been divided into parts on instruction by Lakeside Developments 2017 Ltd to enable uploading to Waikato District Council website, and should be read in full.

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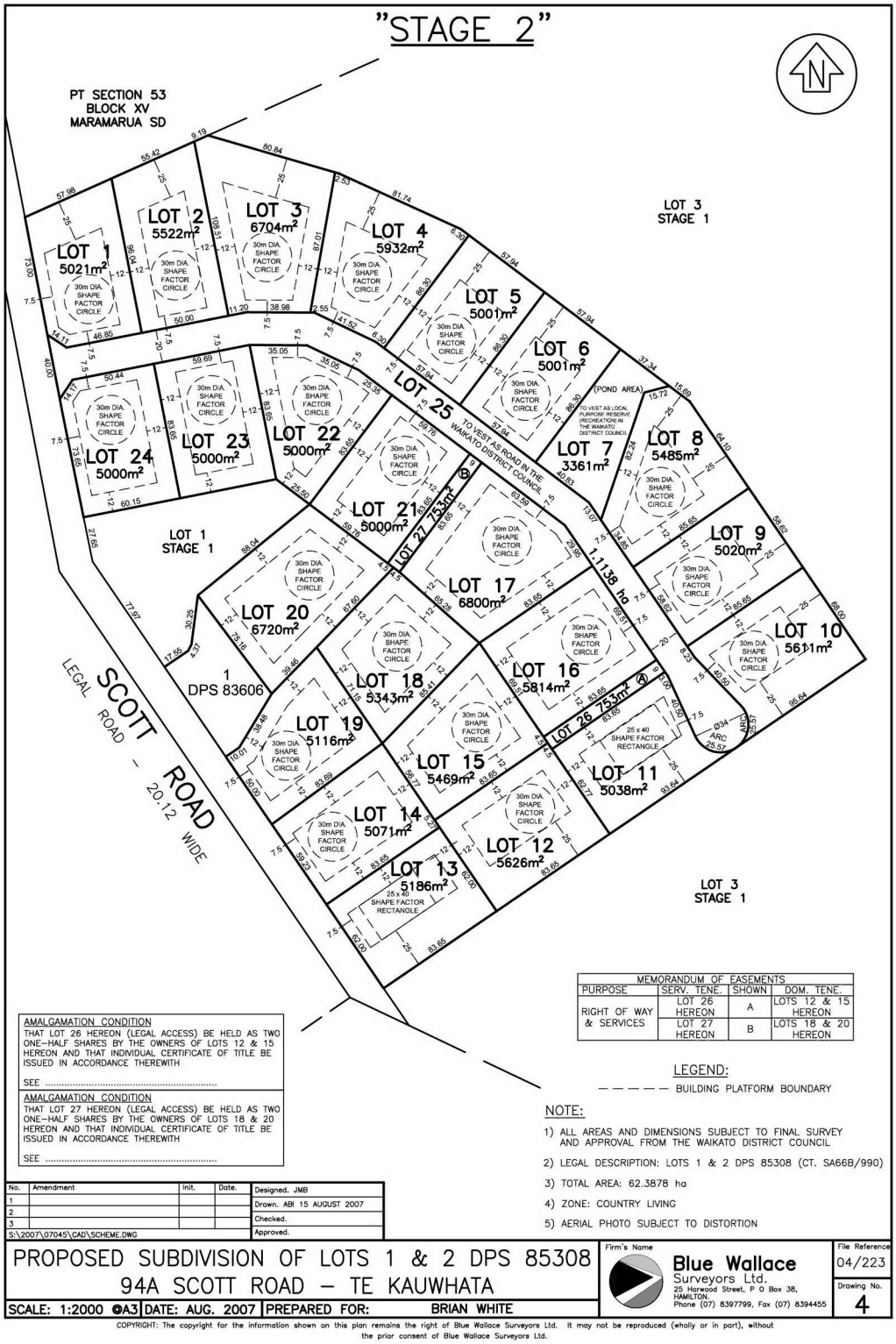
NORTH

CSI **Contaminated Site Investigations** **80 Cook Street** **Hamilton**	94A SCOTT ROAD TE KAUWHATA
	FIGURE 1
	SITE LOCATION

NORTH

CSI **Contaminated Site Investigations** **80 Cook Street** **Hamilton**	94A SCOTT ROAD TE KAUWHATA
	FIGURE 2
	SITE PLAN



MEMORANDUM OF EASEMENTS			
PURPOSE	SERV. TENE.	SHOWN	DOM. TENE.
RIGHT OF WAY & SERVICES	LOT 26 HEREON	A	LOTS 12 & 15 HEREON
	LOT 27 HEREON	B	LOTS 18 & 20 HEREON

AMALGAMATION CONDITION
THAT LOT 26 HEREON (LEGAL ACCESS) BE HELD AS TWO ONE–HALF SHARES BY THE OWNERS OF LOTS 12 & 15 HEREON AND THAT INDIVIDUAL CERTIFICATE OF TITLE BE ISSUED IN ACCORDANCE THEREWITH

SEE .....

AMALGAMATION CONDITION
THAT LOT 27 HEREON (LEGAL ACCESS) BE HELD AS TWO ONE–HALF SHARES BY THE OWNERS OF LOTS 18 & 20 HEREON AND THAT INDIVIDUAL CERTIFICATE OF TITLE BE ISSUED IN ACCORDANCE THEREWITH

SEE .....

LEGEND:

– – – – – BUILDING PLATFORM BOUNDARY

NOTE:

1) ALL AREAS AND DIMENSIONS SUBJECT TO FINAL SURVEY AND APPROVAL FROM THE WAIKATO DISTRICT COUNCIL
2) LEGAL DESCRIPTION: LOTS 1 & 2 DPS 85308 (CT. SA66B/990)
3) TOTAL AREA: 62.3878 ha
4) ZONE: COUNTRY LIVING
5) AERIAL PHOTO SUBJECT TO DISTORTION

No.	Amendment	Init.	Date.
1			
2			
3			

S:\2007\07045\CAD\SCHEME.DWG

Designed. JMB
Drawn. ABI 15 AUGUST 2007
Checked.
Approved.

PROPOSED SUBDIVISION OF LOTS 1 & 2 DPS 85308
94A SCOTT ROAD – TE KAUWHATA

SCALE: 1:2000 @A3 | DATE: AUG. 2007 | PREPARED FOR: BRIAN WHITE

Firm's Name
Blue Wallace Surveyors Ltd.
25 Harwood Street, P O Box 38, HAMILTON.
Phone (07) 8397799, Fax (07) 8394455

File Reference 04/223
Drawing No. 4

NORTH

CSI **Contaminated Site Investigations** **80 Cook Street** **Hamilton**	94A SCOTT ROAD TE KAUWHATA
	FIGURE 3
	PROPOSED DEVELOPMENT

NORTH

CSI **Contaminated Site Investigations** **80 Cook Street** **Hamilton**	94A SCOTT ROAD TE KAUWHATA
	FIGURE 4
	SAMPLING PLAN
	NOT TO SCALE

APPENDIX A

REPORT CONDITIONS

This report is prepared solely for the benefit of Mr. Kenneth Vincent and no liability is accepted for any reliance placed on it by any other party unless specifically agreed in writing otherwise.

This report refers, with the limitations stated, to the conditions of site at the time of the investigation. No warranty is given as to the possibility of future changes in the condition of the site.

This report is based on aerial photos, anecdotal information and a site investigation comprising a site walkover and the collection of soil samples. Some of the opinions are based on unconfirmed data and information and are presented as the best that can be obtained without further extensive research. The samples collected have been undertaken in accordance with recognised guidelines however, the possibility of the presence of contaminants, perhaps in higher concentrations, elsewhere on the site cannot be discounted.

Whilst the findings detailed in this report reflect our best assessment, we are unable to give categoric assurances that they will be accepted by regulatory authorities without questions as such authorities may have unpublished more stringent objectives. This report is prepared and written for the proposed uses stated in the report and should not be used in a different context without reference to CSI. In time approved practices or amended legislation may necessitate a re-assessment.

The report is limited to those aspects of land contamination specifically reported on and is necessarily restricted and no liability is accepted for any other aspects especially concerning gradual or sudden pollution incidents. The opinions expressed cannot be absolute due to the limitations of time and resources imposed by the agreed brief and the possibility of unrecorded previous use and abuse of the site and adjacent sites. The report concentrates on the site as defined in the report and provides an opinion on surrounding sites. If migrating pollution or contaminants (past or present) exists further research will be required before the effects can be better determined.

APPENDIX B

AERIAL PHOTOS

NORTH

CSI **Contaminated Site Investigations** **80 Cook Street** **Hamilton**	94A SCOTT ROAD TE KAUWHATA
	SK01
	1952

NORTH

CSI **Contaminated Site Investigations** **80 Cook Street** **Hamilton**	94A SCOTT ROAD TE KAUWHATA
	SK02
	1975

NORTH

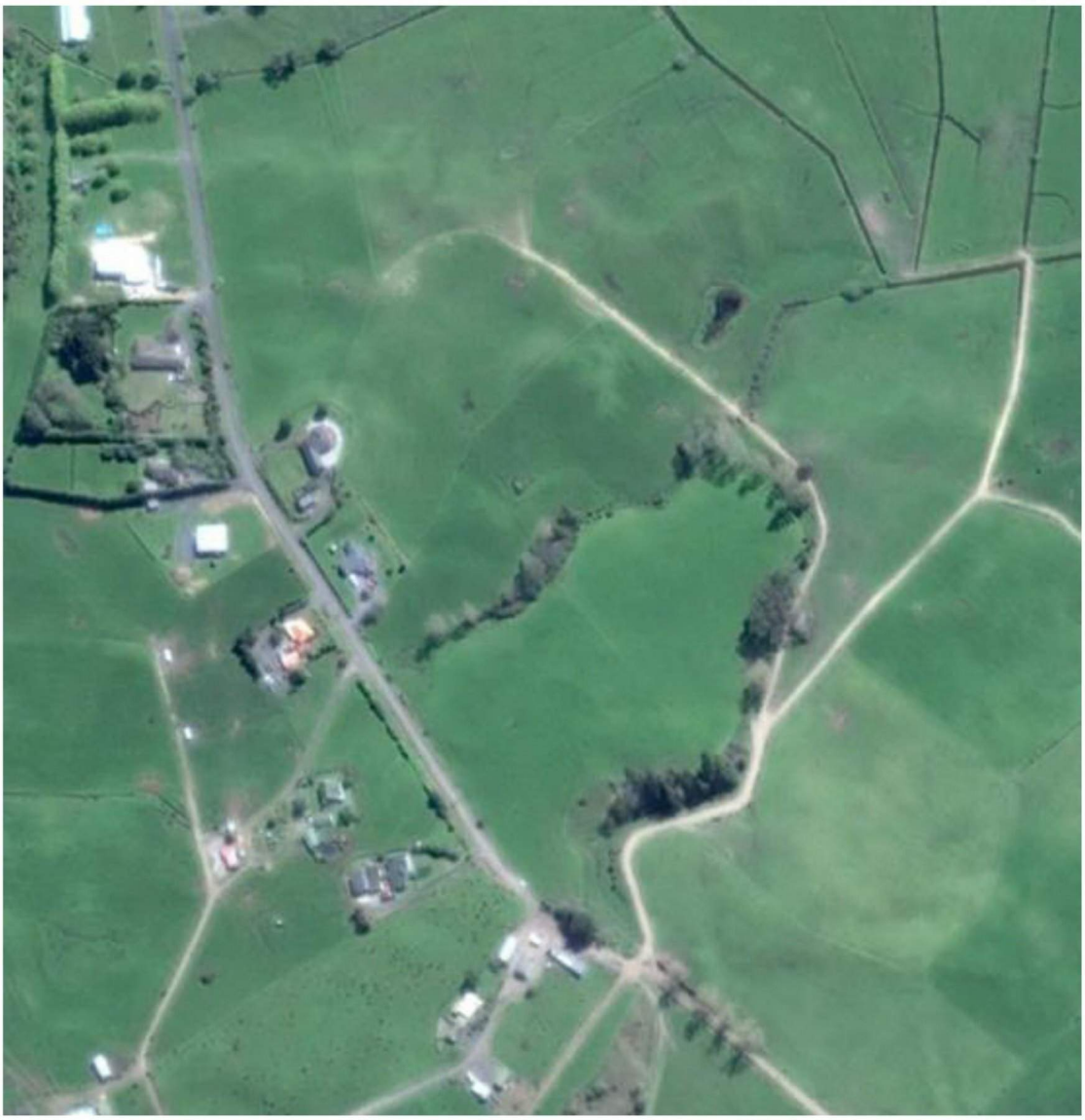
CSI **Contaminated Site Investigations** **80 Cook Street** **Hamilton**	94A SCOTT ROAD TE KAUWHATA
	SK03
	1983

NORTH

CSI **Contaminated Site Investigations** **80 Cook Street** **Hamilton**	94A SCOTT ROAD TE KAUWHATA
	SK04
	1986

NORTH

CSI **Contaminated Site Investigations** **80 Cook Street** **Hamilton**	94A SCOTT ROAD TE KAUWHATA
	SK05
	2002



NORTH

CSI **Contaminated Site Investigations** **80 Cook Street** **Hamilton**	94A SCOTT ROAD TE KAUWHATA
	SK06
	2012

APPENDIX C

LABORATORY RESULTS

Hill Laboratories
BETTER TESTING BETTER RESULTS

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Private Bag 3205
Hamilton 3240, New Zealand

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Fax +64 7 858 2001
Email mail@hill-labs.co.nz
Web www.hill-labs.co.nz

ANALYSIS REPORT

Client:	CSI Limited	**Lab No:**	1557163	SPv1
Contact:	G Sowry	**Date Registered:**	24-Mar-2016	
	C/- CSI Limited	**Date Reported:**	01-Apr-2016	
	80 Cook Street	**Quote No:**	75593	
	Hamilton 3216	**Order No:**		
		Client Reference:		
		Submitted By:	G Sowry	

Sample Type: Soil

	Sample Name:	SR.A 15-Mar-2016	SR.B 15-Mar-2016	SR.C 15-Mar-2016	SR.D 15-Mar-2016	SR.E 15-Mar-2016
	Lab Number:	1557163.1	1557163.2	1557163.3	1557163.4	1557163.5
Individual Tests						
Total Recoverable Arsenic	mg/kg dry wt	4	3	4	5	3
Total Recoverable Cadmium	mg/kg dry wt	0.58	0.55	0.56	0.63	0.47
Total Recoverable Zinc	mg/kg dry wt	59	58	72	80	48
DDT Screening in Soil						
2,4'-DDD	mg/kg dry wt	0.005	0.005	< 0.005	< 0.005	< 0.005
4,4'-DDD	mg/kg dry wt	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
2,4'-DDE	mg/kg dry wt	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
4,4'-DDE	mg/kg dry wt	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
2,4'-DDT	mg/kg dry wt	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
4,4'-DDT	mg/kg dry wt	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Total DDT Isomers	mg/kg dry wt	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03

	Sample Name:	SR.F 15-Mar-2016	SR.G 15-Mar-2016	SR.H 15-Mar-2016	SR.I 15-Mar-2016	SR.J 15-Mar-2016
	Lab Number:	1557163.6	1557163.7	1557163.8	1557163.9	1557163.10
Individual Tests						
Total Recoverable Arsenic	mg/kg dry wt	4	6	5	4	4
Total Recoverable Cadmium	mg/kg dry wt	0.60	0.81	0.59	0.50	0.38
Total Recoverable Zinc	mg/kg dry wt	57	122	76	44	39
DDT Screening in Soil						
2,4'-DDD	mg/kg dry wt	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
4,4'-DDD	mg/kg dry wt	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
2,4'-DDE	mg/kg dry wt	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
4,4'-DDE	mg/kg dry wt	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
2,4'-DDT	mg/kg dry wt	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
4,4'-DDT	mg/kg dry wt	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Total DDT Isomers	mg/kg dry wt	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03

	Sample Name:	SR.K 15-Mar-2016	SR.L 15-Mar-2016	SR.M 15-Mar-2016	SR.N 15-Mar-2016	SR.BACK 15-Mar-2016
	Lab Number:	1557163.11	1557163.12	1557163.13	1557163.14	1557163.15
Individual Tests						
Total Recoverable Arsenic	mg/kg dry wt	4	4	4	4	-
Total Recoverable Cadmium	mg/kg dry wt	0.57	0.58	0.38	0.41	-
Total Recoverable Zinc	mg/kg dry wt	110	71	73	50	-
pH*	pH Units	-	-	-	-	5.5
DDT Screening in Soil						
2,4'-DDD	mg/kg dry wt	< 0.005	< 0.005	< 0.005	< 0.005	-
4,4'-DDD	mg/kg dry wt	< 0.005	< 0.005	< 0.005	< 0.005	-

ilac-MRA IANZ ACCREDITED LABORATORY

This Laboratory is accredited by International Accreditation New Zealand (IANZ), which represents New Zealand in the International Laboratory Accreditation Cooperation (ILAC). Through the ILAC Mutual Recognition Arrangement (ILAC-MRA) this accreditation is internationally recognised.
The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked *, which are not accredited.

Sample Type: Soil						
Sample Name:		SR.K 15-Mar-2016	SR.L 15-Mar-2016	SR.M 15-Mar-2016	SR.N 15-Mar-2016	SR.BACK 15-Mar-2016
Lab Number:		1557163.11	1557163.12	1557163.13	1557163.14	1557163.15
DDT Screening in Soil						
2,4'-DDE	mg/kg dry wt	< 0.005	< 0.005	< 0.005	< 0.005	-
4,4'-DDE	mg/kg dry wt	< 0.005	< 0.005	< 0.005	< 0.005	-
2,4'-DDT	mg/kg dry wt	< 0.005	< 0.005	< 0.005	< 0.005	-
4,4'-DDT	mg/kg dry wt	< 0.005	< 0.005	< 0.005	< 0.005	-
Total DDT Isomers	mg/kg dry wt	< 0.03	< 0.03	< 0.03	< 0.03	-

SUMMARY OF METHODS

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

Sample Type: Soil			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Environmental Solids Sample Preparation	Air dried at 35°C and sieved, <2mm fraction. Used for sample preparation. May contain a residual moisture content of 2-5%.	-	1-14
Soil Prep Dry & Sieve for Agriculture	Air dried at 35°C and sieved, <2mm fraction.	-	15
DDT Screening in Soil*	Sonication extraction, Florisil cleanup, GC-ECD analysis. Tested on dried sample	0.005 - 0.03 mg/kg dry wt	1-14
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	1-14
Total Recoverable Arsenic	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	2 mg/kg dry wt	1-14
Total Recoverable Cadmium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	0.10 mg/kg dry wt	1-14
Total Recoverable Zinc	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	4 mg/kg dry wt	1-14
pH*	1:2 (v/v) soil : water slurry followed by potentiometric determination of pH.	0.1 pH Units	15

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

Ara Heron BSc (Tech)
Client Services Manager - Environmental Division

APPENDIX D

SITE PHOTOS

THE SITE - NORTH

THE SITE - SOUTH

THE SITE - EAST

SHED RUBBLE

SHED

SHED

EARTHTECH CONSULTING LTD

WAIKATO DISTRICT COUNCIL

TE KAUWHATA
HEAVY VEHICLE BYPASS

Preliminary Geotechnical Report

FEBRUARY 2010

Report prepared for:
BLOXAM BURNETT & OLLIVER LTD

Report prepared by:
EARTHTECH CONSULTING LIMITED
P O Box 721, Pukekohe
Phone: 64-9-232 8500

Ref : R2760-1
Date : 25 February 2010

WAIKATO DISTRICT COUNCIL

TE KAUWHATA

HEAVY VEHICLE BYPASS

Preliminary Geotechnical Report

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Drawings

Appendices

WAIKATO DISTRICT COUNCIL
TE KAUWHATA
HEAVY VEHICLE BYPASS

Preliminary Geotechnical Report

1. INTRODUCTION

Waikato District Council (WDC) is designating a heavy vehicle bypass around the southern side of Te Kauwhata township. Bloxam Burnett and Olliver (BBO) have provided an alignment as shown on the aerial photograph (BBO drawing 135420/P09, Rev D), together with preliminary long sections (three sheets) and cross sections (seven sheets).

This report provides the results of geotechnical investigations undertaken to identify key constraints on the road corridor. Information has been compiled from published maps, aerial photographs, walkover surveys of part of the route, discussions with residents and council staff and site specific investigations of selected portions.

2. LANDFORMS

2.1 Ch0 to Ch780*m*, Te Kauwhata Road to North Island Main Trunk Line

No access was available to this section of the route. The alignment crosses gently sloping paddocks with proposed cut and fill depths of less than 1.5*m*.

A new roundabout may be located at Ch630*m*.

2.2 Ch780 to Ch880*m*, Main Trunk Line to Scott Road

Between the railway line and Scott Road, the proposed centerline of the bypass follows a natural low-lying gully. A small stream, approximately 1.5*m* wide, follows and crosses the proposed centerline. There is evidence that the land immediately to the south of the stream and along the proposed centerline of the bypass has been very wet during winter. The land on either side of the proposed centerline rises gently to both the north and the south. This area is fenced and well grassed.

2.3 Ch880 to Ch1700*m*, Scott Road to Treatment Ponds

Between Scott Road and the treatment ponds, there is a very gentle downward gradient towards the treatment ponds. The small stream, after passing under Scott Road, continues to approximately follow the proposed centerline of the bypass, and crosses it in two places. In this area, the stream widens to 2.5*m* in some places and becomes slow moving and stagnant with large amounts of weed and Carp fish. The bypass crosses Scott Road to the north of, and immediately next to, the stream. In this area the ground is gently undulating and rises gradually to the north. To the south of the stream, the ground is flat and was planted with crops at the time of the site walkover.

The bypass crosses the stream at station distances 1280*m* and 1440*m* approximately. In these areas to the north of the stream, the ground is very low-lying and swampy with water pooling on the surface. The stream is also enclosed by stop banks and appears to have been straightened in the past. To the south of the stream, along the centerline of the bypass, the ground is very wet. These paddocks have drainage channels and appear to be drained to the south. These areas are fenced and well grassed.

2.4 Ch1700 to Ch2020*m*, Treatment Ponds to Old Landfill

In the area between the treatment ponds and Rata Street, the ground is low-lying and swampy except where material has been placed to build-up access ways. Along the centerline of the bypass the land is covered with dense scrub and swamp vegetation.

To the south of Roto Street the land rises gently towards the east. This area is covered with scrub, small trees, blackberries and grass. It was planted with production pine until logged in the past five years. Old tree stumps can be found at regular intervals. The ground surface is very uneven, presumably from when heavy trucks were brought in to remove the trees. A man-made ditch, approximately 0.75*m* deep runs north to south from Roto Street, approximately 20*m* away from the gravel access road that exits off Roto Street. There was no water in the bottom of the ditch at the time of the site walkover, however it appears to have been wet during the winter months. The excavated material has been disposed of to either side of the ditch.

2.5 Ch2020 to Ch2050*m*, Old Landfill Area

This section crosses the old trench landfill area operated in the 1950's and 1960's. Details are discussed in Section 6.0 with site meeting notes about the landfilled area included in Appendix C.

2.6 Ch2050 to Ch2600m, Old Landfill to Waerenga Road

At the end of Roto Street, the ground dips moderately steeply towards the east where there is a small stream. At the time of the site walkover the stream was very shallow and contained a lot of swamp vegetation and grasses. The gully containing this stream runs north along the residential property boundaries. From its intersection with the bypass, the stream curves towards the east. To the north and east of the stream, the ground rises moderately steeply to where the centerline of the bypass follows a short ridge northward, before dipping down again to where it intersects another small stream. There is evidence of the land immediately to the south of the stream having been very wet during the winter months. From this stream, the ground again rises gradually towards Waerenga Road with a small gully to the east of the proposed bypass. All of these areas from the eastern end of Roto Street, up to Waerenga Road are fenced and well grassed. A collapsed tomo was identified on the road alignment near HA211.

3. HISTORIC AERIAL PHOTOGRAPHS

The following historic aerial photographs have been viewed:

- 1942–SN192 No. 287/43 – 1:16,000 dated February 1942

The 1942 photographs show vegetation extending from Lake Waikare to approximately half way between Scott Road and what are now the treatment ponds. This area corresponds to the length of stream where stop banks have been constructed; indicating that the lower half of the stream was formed after 1942, probably when the vegetation was cleared and the land drained.

The vegetation continues around the shores of Lake Waikare encompassing the area that is now the treatment ponds.

The aerial photographs also show that the area beginning at the stream south of the intersection of Waerenga Road and Swan Road was also covered with vegetation at the time of the 1942 photograph.

The 1942 aerial photographs show the positions of the railway line and Scott Road are unchanged since 1942.

There is no sign of either the trench landfill or the newer closed landfill on the 1943 photographs. This is consistent with verbal reports on filling dates.

4. GROUND CONDITIONS

4.1 Published Geologic Information

Local geology has been described on the Te Kauwhata Geology Sheet prepared by Kear and Schofield (1961).

The areas from Te Kauwhata Road extending to the railway line and including Scott Road are mapped as being Whangamarino Formation. This is typically described as:

> *"Mainly clay, lignite and some gravels and pumice sands."*

The area to the east of Scott Road extending to Lake Waikare and encompassing the treatment ponds is mapped as being alluvium. These areas roughly correspond to the areas shown as vegetated swamp on the 1942 historic aerial photograph.

The area immediately to the south and east of Roto Street, extending northward to Waerenga Road is mapped as being undifferentiated. This includes formations of the Walton Sub-group, as well as younger sediments.

The named formations of the Walton Sub-group include:

- Karapiro Formation
- Waerenga Gravels
- Whangamarino Formation (described above)
- Puketoka Formation.

Puketoka Formation is typically described as:

> *"Predominantly highly pumiceous silts and sands interbedded with peats."*

In the field, these formations were closely interbedded and characteristics of each were observed within the same layer.

4.2 Ground Conditions

Shallow ground conditions on the site are described in terms of the following units:

i. Topsoil
ii. Unit A (stiff silts)
iii. Unit B (alluvium)
iv. Unit C (brown ash)

i. Topsoil

Topsoil was intercepted in all hand auger investigations. Topsoil depths ranged between 0.1 to 0.5*m*.

ii. Unit A (stiff silts)

Unit A was intercepted in all the hand auger investigations conducted on site. Unit A can typically be described as:

> *"Very stiff, coarse pumiceous sandy SILT, SILT with some coarse pumiceous sand, and CLAY with some coarse pumiceous sand. Containing interbedded organics."*

Unit A is typically very stiff, with undrained shear strengths that average S_u = 141*kPa* and range between 78 and >200*kPa*.

Unit A was also observed in an outcrop within 10*m* of CPT108, and also in road cuttings near the intersection of Waerenga and Swan Roads. Both locations are shown on the site map.

In HA202 and HA204, Unit A can be described as firm with measured undrained shear strengths that average S_u = 41.5*kPa* and range between 37 and 46*kPa*. These strengths were atypical of the strengths encountered in other hand auger investigations.

iii. Unit B (alluvium)

Alluvium was intercepted in HA202 and HA204. The alluvium consists of a sequence of:

> *Very soft to stiff, ORGANIC SILT, coarse pumiceous sandy SILT, and SILT with some coarse pumiceous sand.*

Containing wood fragments and other organic matter. S_u range = 37 to 93kPa.

Stiff CLAY, with some coarse pumiceous sand and organics. S_u = 78kPa.

The alluvial soils were overlain by firm Unit A in both instances.

iv. Unit C (brown ash)

Brown ash was intercepted in HA206, 207, 208, 209 and 212. The ash can typically be described as:

"Very stiff, dark orange brown, sandy SILT."

The ash is very strong, with measured undrained shear strengths that average S_u = 182*kPa* and range between 152 and >200*kPa*.

The brown ash was also observed in road cuttings on the corner of Roto Street and Waerenga Road, and near the intersection of Waerenga Road and Swan Road where it was overlying Unit A.

In all instances, the brown ash overlaid formations of the Walton Sub-group.

Deeper ground conditions have been investigated with the cone penetrometer up to refusal depths to 30*m*. Interpretation of the CPT data is based on published correlations and experience from other sites in the Waikato area.

5. Groundwater Conditions

Groundwater levels were observed within open hand auger bores and CPT bores. For the majority of these bores, groundwater levels were recorded approximately 24 hours following augering and drilling to allow equilibrium conditions to be reached. Groundwater levels are presented on the attached field logs. The following groundwater levels were observed:

- Area between Railway Line and Scott Road:
  - Groundwater table at the exiting ground level (EGL) to 0.6*m* below the EGL.

- Area east of Scott Road and west of Treatment Ponds:
  - Groundwater at 0.82 to 1.35*m* below EGL.

- Area around Water Treatment Ponds (CPT's 104, 105, 106A):
  - Groundwater at 0.35 to 0.5*m* below EGL.

- Area south of Roto Street:
  - Groundwater at 0.4 to 0.8*m* below EGL (in HA205 and HA207).
  - No groundwater was encountered in HA206.

- Area east of Roto Street to intersection of Waerenga Road and Swan Road:
  - Groundwater at 0.1 to 3.1*m* below EGL.
  - No groundwater was encountered in HA209, 210 and 212.

6. ROAD CONSTRUCTION CONSTRAINTS AND DETAILS

6.1 Cut and Fill Batter Slopes

Cuts up to 2*m* deep are only expected in the stronger ash or Unit A soils. Cut batters should be designed for 1 on 2 (vertical on horizontal), or 1 on 3 if grassed and mowed.

Fill batters should be designed for 1 on 3 on the undulating and higher ground areas. In swampy areas and especially in the old lake bed areas, fill batters may need to be as flat as 1 on 6 unless reinforced. Refer typical details discussed in Section 6.4.

6.2 Railway Underpass to Scott Road (Figure 2)

CPT's 101, 102 and 103 provide ground condition information in this area. The stream will need to be culverted and diverted. As the railway embankment is in fill, the underpass only requires a further 2*m* cut – this removes most of the organic silts and a further 1*m* undercut would provide reasonable founding conditions on the stiff silts identified in CPT101 at 3.2*m*.

The underpass could be constructed as a bridge or large diameter culvert. If shallow footings are not considered adequate, friction piles may be driven into the stiff silts. Groundwater controls will be required during construction and longer term.

CPT103 indicates weak soils to a depth of 6*m* and preloading of the roundabout on Scott Road is recommended.

6.3 Scott Road to Treatment Plant

The alignment is largely in fill up to 2.5*m* deep and will require diversion of the existing stream. Deeper investigations than the present 2*m* hand auger bores will be required for detailed design, however the conditions appear significantly stronger than the sewage treatment plant areas. Staged filling ahead of road construction should remove any major settlement effects.

6.4 Swamp Crossing at Sewage Treatment Plant (Figure 3)

The low-lying area past the present sewage treatment plant crosses the perimeter margins of the lakebed. The area is low-lying and swampy. CPT's 104, 105 and 106 indicate soft organic silts to approximately 3*m* depth, overlying firm silts to 20*m*+.

Undercutting is not practical and the road formation will need to be "floated" over the top. Two options are sketched on Figure 4.

Option 1 provides a conventional solution with a 400*mm* thick hardfill layer placed on top of a geotextile separation layer (Bidim A44 or similar). This is followed by compacted fill placed in two or more lifts. Stability along the edges will need to be checked and lift heights limited to avoid causing slumping of the side slopes. Two or more lifts are likely to be required to achieve the fill depth of approximately 2.5*m*. A 1*m* preload should be placed for a minimum period of six months prior to sealing to reduce ongoing settlements.

Total applied loads for this option have been estimated as follows:

• 0.4*m* hardfill	= 0.4 x 22*kN*/*m*³	=	8.8
• 2.5*m* fill	= 2.5 x 20	=	50.0
• 0.2*m* fill settlement	= 0.2 x 20	=	4.0
• 1*m* preload	= 1.0 x 20	=	20.0
			82.8 say 80*kPa*

Settlements have been estimated for each of the three CPT locations for an applied load of 80*kPa*.

CPT	Calculated Settlement (*mm*)	Notes
104	100	-
105	110	CPT did not penetrate the lower silts identified in CPT104
106	75	CPT did not penetrate the lower silts identified in CPT104

Secondary settlements are likely to be in the order of 100*mm* over 20 years.

Option 2 allows for steeper side slopes with 1 on 3 for grassed slopes and 1 on 1.5 for planted slopes. This option includes a geogrid reinforcing layer across the base and on either side to provide stable slopes at all stages. Filling in more than one stage may still be required. Total settlements are expected to be similar to Option 1 with up to 200*mm* predicted.

6.5. Old Landfill Section (Figure 3)

From Ch2030 to Ch2050 the alignment crosses part of the old landfill. Filling details have been identified as far as possible from a walkover survey, WDC records and a site meeting with Mr Stanley Walker of Te Kauwhata Contractors. Mr Walker worked on the site throughout the various stages and his information is consistent with other observations and records. Notes of this meeting are attached in Appendix C.

It is reasonably certain that the road alignment only crosses the original "trench fill" area. Trenches were reported to be about 2*m* deep (excavated with a dragline, not a digger) and 3*m* to 4*m* wide. The preferred option would be to over-excavate and remove the old refuse (placing it on top of the newer landfill which would benefit from surface mounding).

Alternatively the clay cover could be stripped and the old refuse recompacted using a heavy roller, followed by placement of a geotextile separation layer, 400*mm* of GAP100 hardfill and replacement of the clay fill. If the road alignment is in cut, limited over-excavation may be required along the side slopes to ensure a minimum clean soil cover depth of 0.6*m* (plus 100*mm* topsoil) is replaced over any exposed refuse. Refuse is stable at steep cut slopes but a maximum cut slope of 1 on 3 is recommended to allow for mowing of the final cut batter. A subsoil drain should be included at the toe of the slope – designed as a leachate drain with discharge to the leachate sewer or to a soakaway in the newer landfill area.

6.6 Roto Street to Waerenga Road

The road crosses undulating country with two gullies which are likely to include weak organic soils similar to those identified at the sewage treatment plant. CPT107 indicates particularly weak soils to a depth of 2.8*m*.

Construction of fills across these gullies would be similar to the options shown on Figure 4.

Cuts and fills of limited depths on the higher ground are expected to be straightforward.

7. CONCLUSIONS AND RECOMMENDATIONS

7.1 The road is not expected to be constructed for many years. Preliminary investigations have identified the key constraints which include:

a. Railway underpass – weak organic soils over stiff silts.
b. Railway underpass to sewage treatment plant – weak organic soils in lakebed areas.
c. Old landfill area – trenches filled with refuse to 2*m* deep.
d. Gully crossings – weak organic soils in lakebed areas.

7.2 Groundwater is typically at or very close to the surface in the old lakebed areas.

7.3 Construction options are available to deal with the difficult ground condition areas. Reinforcing geotextiles and preloading is recommended for fills in the weak ground areas.

7.4 Cut areas are likely to be limited to short lengths on higher ground. Where cuts are in brown ash, the material should provide excellent fill materials.

7.5 There is likely to be a shortage of fill materials and additional fill will need to be imported. Sources include quarry overburden and rotten rock.

7.6 Given the time till construction, it would be feasible to prepare some of the swamp crossing areas and to place cleanfill over the next 10 to 20 years, instead of importing fill at the time of road construction.

7.7 Detailed design will require further investigations but sufficient work has been done at this stage to identify the key constraints and provide preliminary design details for structures and fill embankments.

Report prepared by:

M WILLIS Ref: R2760-1
Geotechnical Engineer Date: 25 February 2010

A H NELSON
Senior Geotechnical Engineer
EARTHTECH CONSULTING LTD

This report has been prepared solely for the benefit of you as our client with respect to the particular brief given to us, and data or opinions contained in it may not be used in other contexts or for any other purpose without our prior review and agreement.

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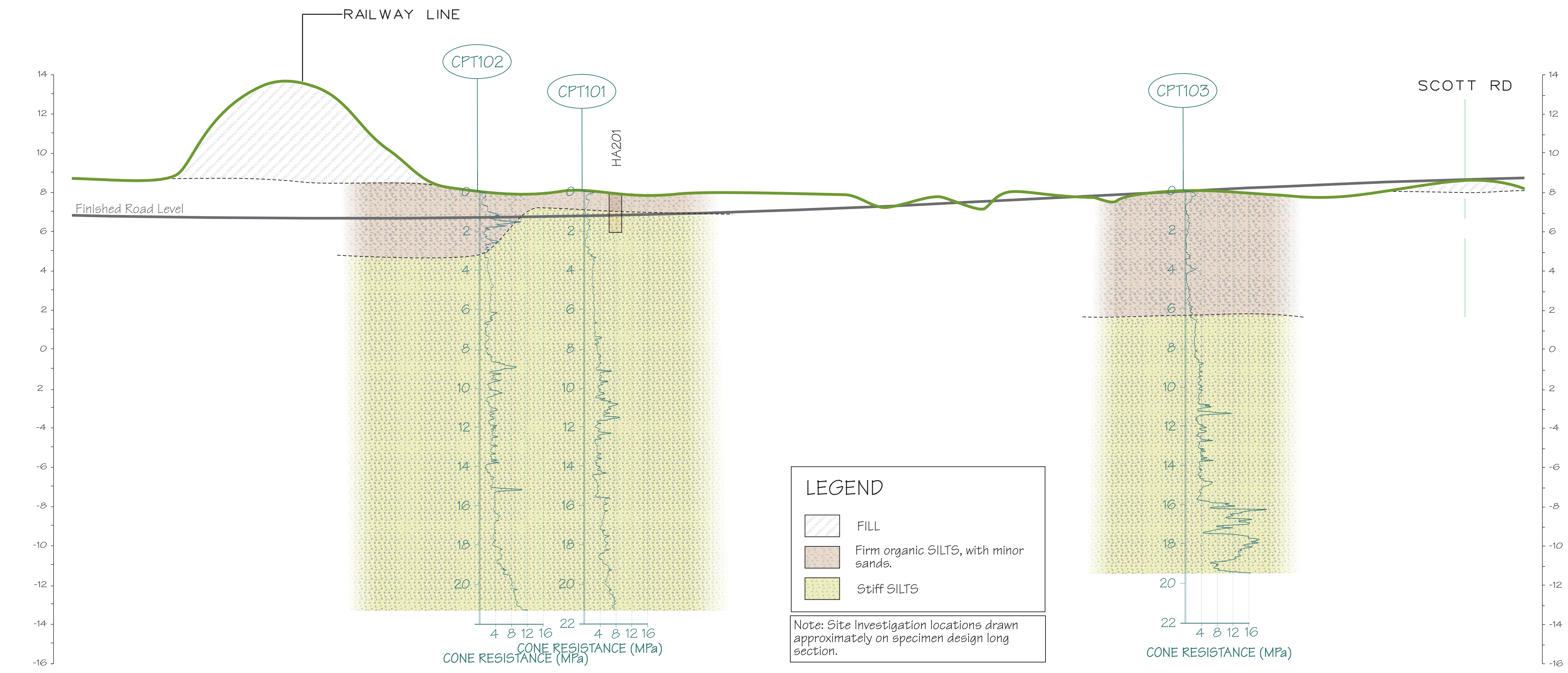
TE KAUWHATA HEAVY VEHICLE BYPASS

Bloxam Burnett & Olliver

Te Kauwhata Heavy Vehicle Bypass Site Investigation Plan

DRAWN	MW	CHECKED	AHN	SCALE 1:5000	SHEET FIG. 1
TRACED	MW	DATE	7 Dec. 2009		VERSION A
					REF 2760



DESIGN LEVELS		6.6		6.8		7.112		7.489	7.563		8.073	8.135	8.218		8.522	
EXISTING GROUND	13.449	9.457	7.926	7.898	7.659	7.923	7.684		7.599	7.623	7.962			7.763	8.038	8.590
CUT / FILL	-6.770	-2.772	-1.194	-1.079	-0.713	-0.811	-0.365		-0.035	0.196	0.112			0.554	0.483	0.097
STATION		780.000		800.000		820.000		837.097	840.000		860.000	862.428	865.770		880.000	

Horizontal Scale 1:400 0m 20m

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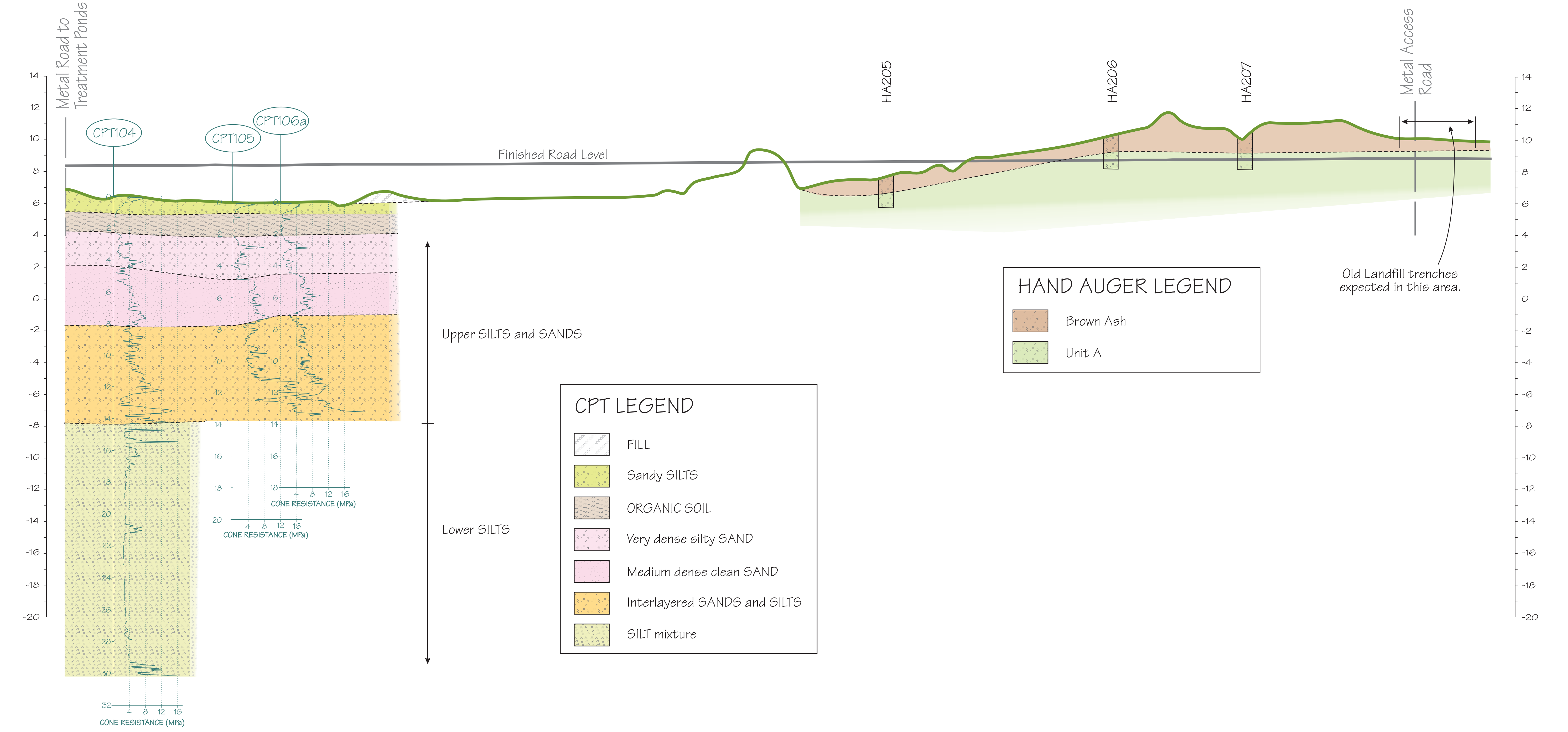
TE KAUWHATA HEAVY VEHICLE BYPASS

Bloxam Burnett & Olliver

Long-section Ch780 to Ch880m

SHEET	FIG. 2				
DRAWN	MW	CHECKED	AHN	SCALE 1:400(h) 1:200(v)	VERSION A
TRACED	MW	DATE	7 Dec. 09		REF 2760



STATION	DESIGN LEVELS	EXISTING GROUND	CUT / FILL
1700.000	8.366	6.380	1.985
		6.605	1.776
1720.000	8.396	6.192	2.203
1728.478	8.409	6.271	2.139
1740.000	8.426	6.148	2.277
		6.148	2.293
1760.000	8.456	6.203	2.253
		6.687	1.784
1780.000	8.486	6.413	2.073
		6.379	2.121
1800.000 1800.642	8.516 8.517	6.349	2.166
		6.387	2.144
1820.000	8.546	6.440	2.105
		6.428	2.132
1840.000	8.576	6.624	1.952
		7.409	1.182
1860.000	8.606	8.076	0.529
		9.016	-0.395
1880.000	8.636	7.058	1.577
		7.482	1.169
1900.000	8.666	7.741	0.924
		8.329	0.352
1916.931 1920.000	8.691 8.696	8.634	0.061
		9.228	-0.517
1940.000	8.726	9.404	-0.678
		10.009	-1.269
1960.000	8.756	10.585	-1.829
1968.090	8.768	11.137	-2.366
1980.000	8.786	10.813	-2.027
		10.576	-1.775
2000.000	8.816	10.926	-2.111
		11.162	-2.331
2018.039 2020.000	8.843 8.846	10.524	-1.679
		10.028	-1.175
2040.000	8.849	9.863	-1.013

Note: Site Investigation locations drawn approximately on specimen design long section.

Horizontal Scale 1:1000 0m 50m

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TE KAUWHATA HEAVY VEHICLE BYPASS
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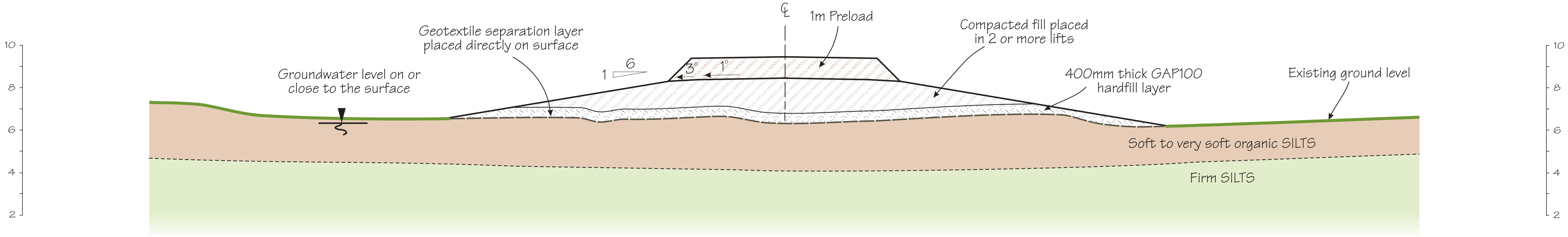
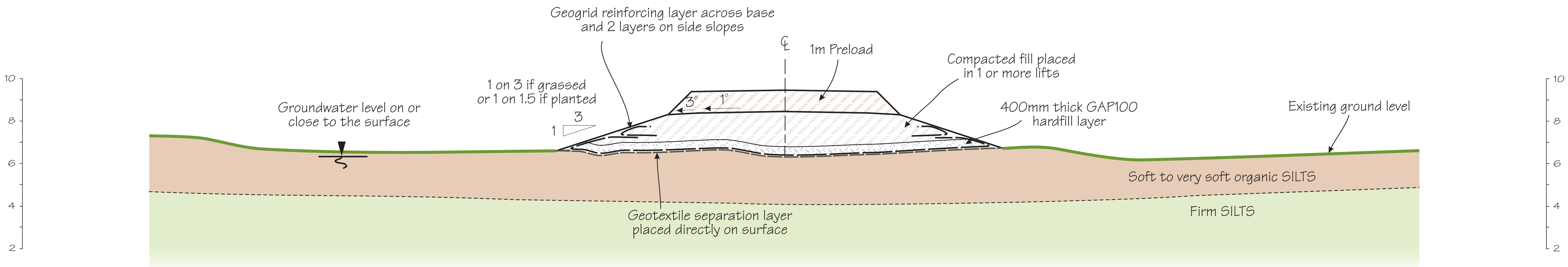
Long-section Ch1700 to Ch2050m

SHEET **FIG. 3**

DRAWN	MW	CHECKED	AHN	SCALE	VERSION A
TRACED	MW	DATE	7 Dec. 09	1:1000(h) 1:250(v)	REF 2760



OPTION 1 - WITHOUT REINFORCED LAYER



OPTION 2 - WITH GEOGRID REINFORCEMENT LAYER

LEVEL	6.531, 7.269, 8.186, 8.366, 8.216, 7.466, 6.171
OFFSET	-15.932, -11.500, -6.000, 0.000, 5.000, 9.500, 17.269
GROUND	7.289, 7.160, 7.090, 6.970, 6.708, 6.703, 6.650, 6.626, 6.616, 6.585, 6.597, 6.589, 6.581, 6.580, 6.574, 6.560, 6.537, 6.467, 6.487, 6.474, 6.492, 6.539, 6.540, 6.577, 6.575, 6.610, 6.586, 6.537, 6.381, 6.550, 6.567, 6.516, 6.532, 6.555, 6.558, 6.540, 6.625, 6.655, 6.552, 6.356, 6.418, 6.395, 6.429, 6.622, 6.624, 6.659, 6.741, 6.776, 6.766, 6.737, 6.736, 6.751, 6.753, 6.634, 6.306, 6.261, 6.184, 6.188, 6.172, 6.161, 6.223, 6.228, 6.239, 6.324, 6.342, 6.399, 6.421, 6.445, 6.569, 6.572, 6.608, 6.654, 6.648, 6.657, 6.677

Sta. 1700.0

Scale 1:200 0m 10m

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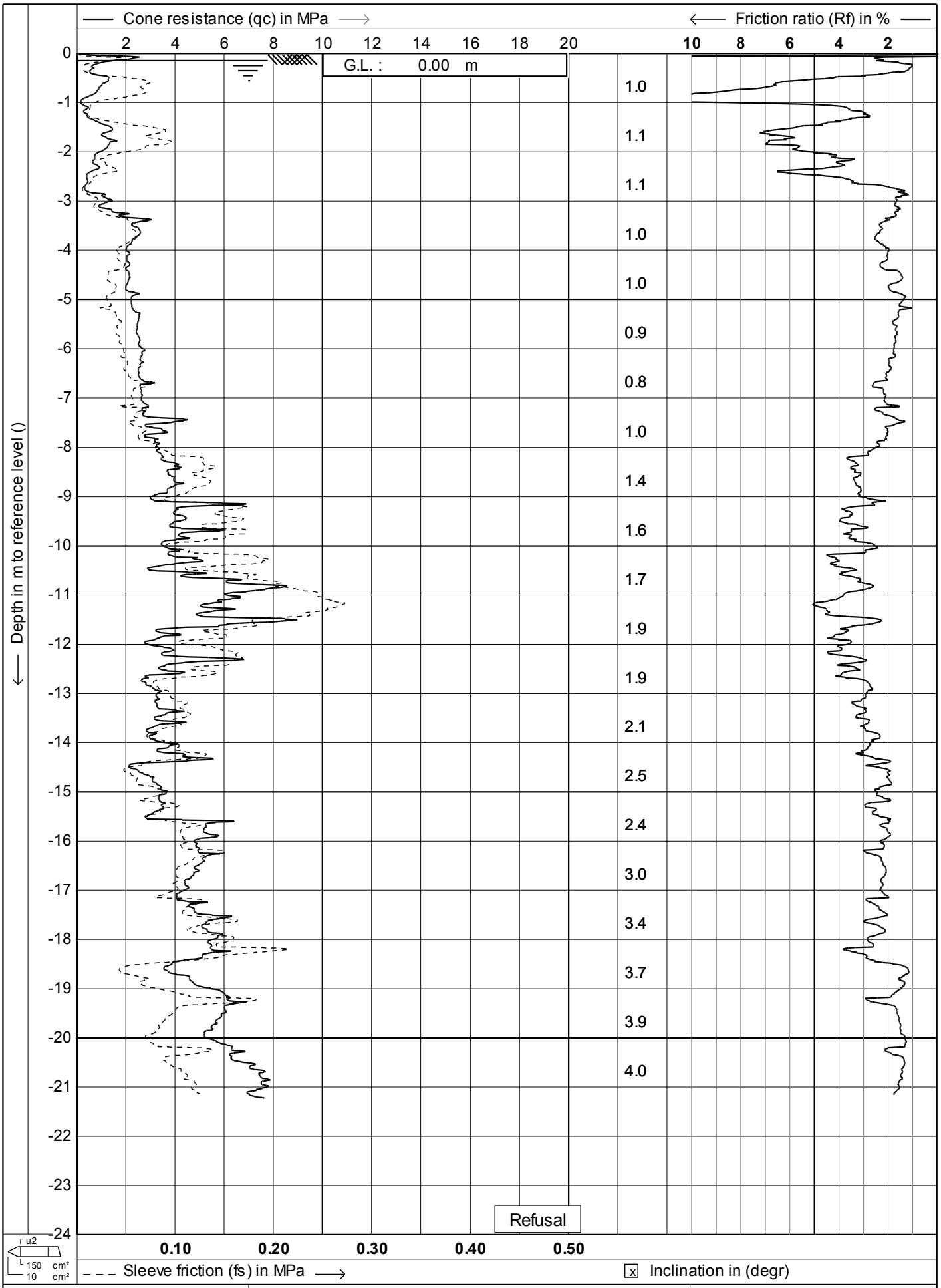
TE KAUWHATA HEAVY VEHICLE BYPASS
Bloxam Burnett & Olliver

Swamp Crossing Design Options

SHEET	**FIG. 4**				
DRAWN	AHN	CHECKED	AHN	SCALE 1:200	VERSION A
TRACED	MW	DATE	7 Dec. 09		REF 2760

APPENDIX A

CONE PENETROMETER TEST PROFILES
CPT101 TO 109



Test according A.S.T.M. Standard D 5778-95

Project : **Te Kauwhata Bypass**

Location: **Scott Road - Te Kauwhata**

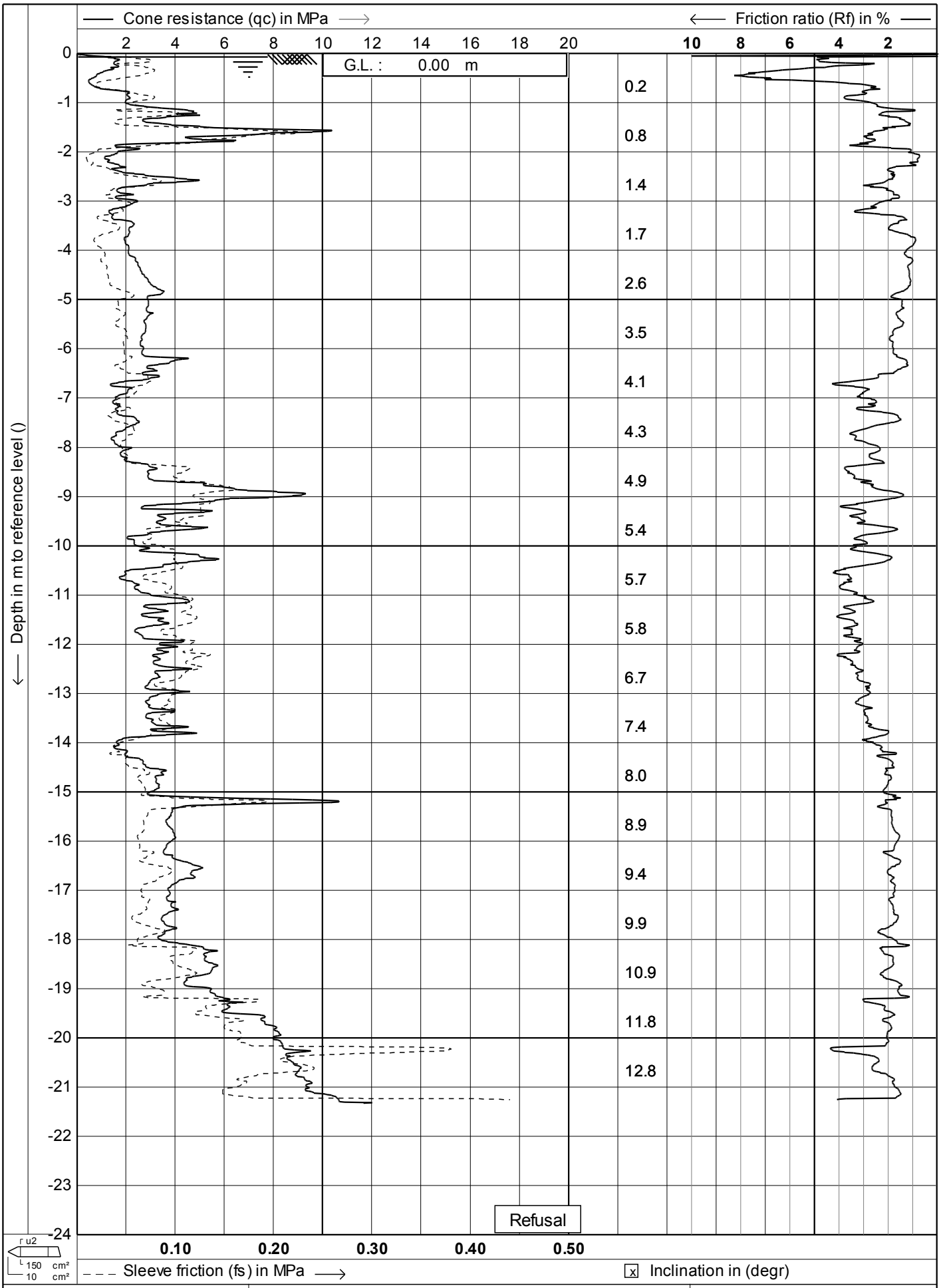
Date : **19-11-2009**

Cone no. : **C10CFIIP.F57**

Project no. : **02ET3**

CPT no. : **101**

CPTask V1.14a



Test according A.S.T.M. Standard D 5778-95

Project : **Te Kauwhata Bypass**

Location: **Scott Road - Te Kauwhata**

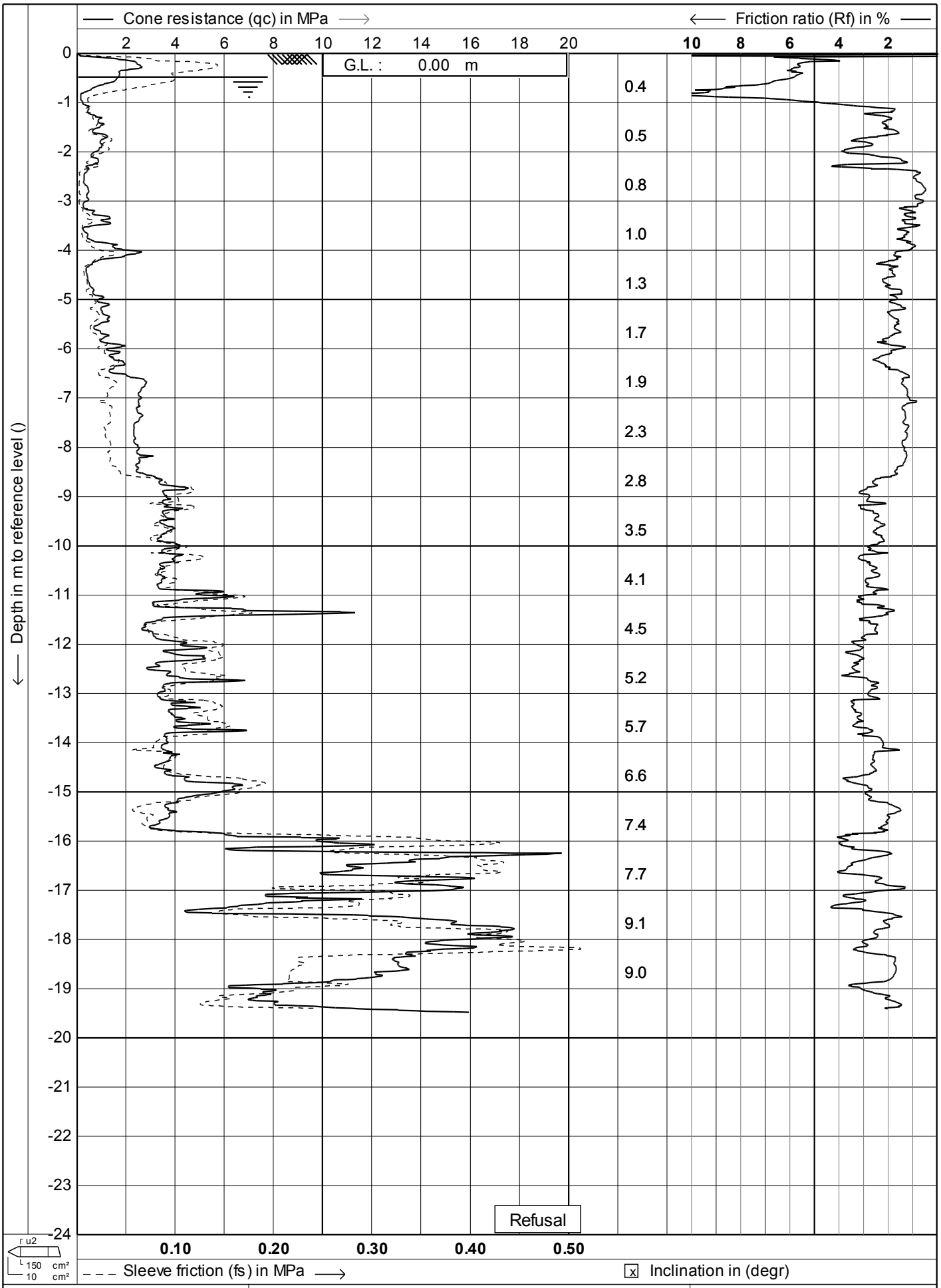
Date : **19-11-2009**

Cone no. : **C10CFIIP.F57**

Project no. : **02ET3**

CPT no. : **102**

CPTask V1.14a



Test according A.S.T.M. Standard D 5778-95

Project : **Te Kauwhata Bypass**

Location: **Scott Road - Te Kauwhata**

Date : **19-11-2009**

Cone no. : **C10CFIIP.F57**

Project no. : **02ET3**

CPT no. : **103**

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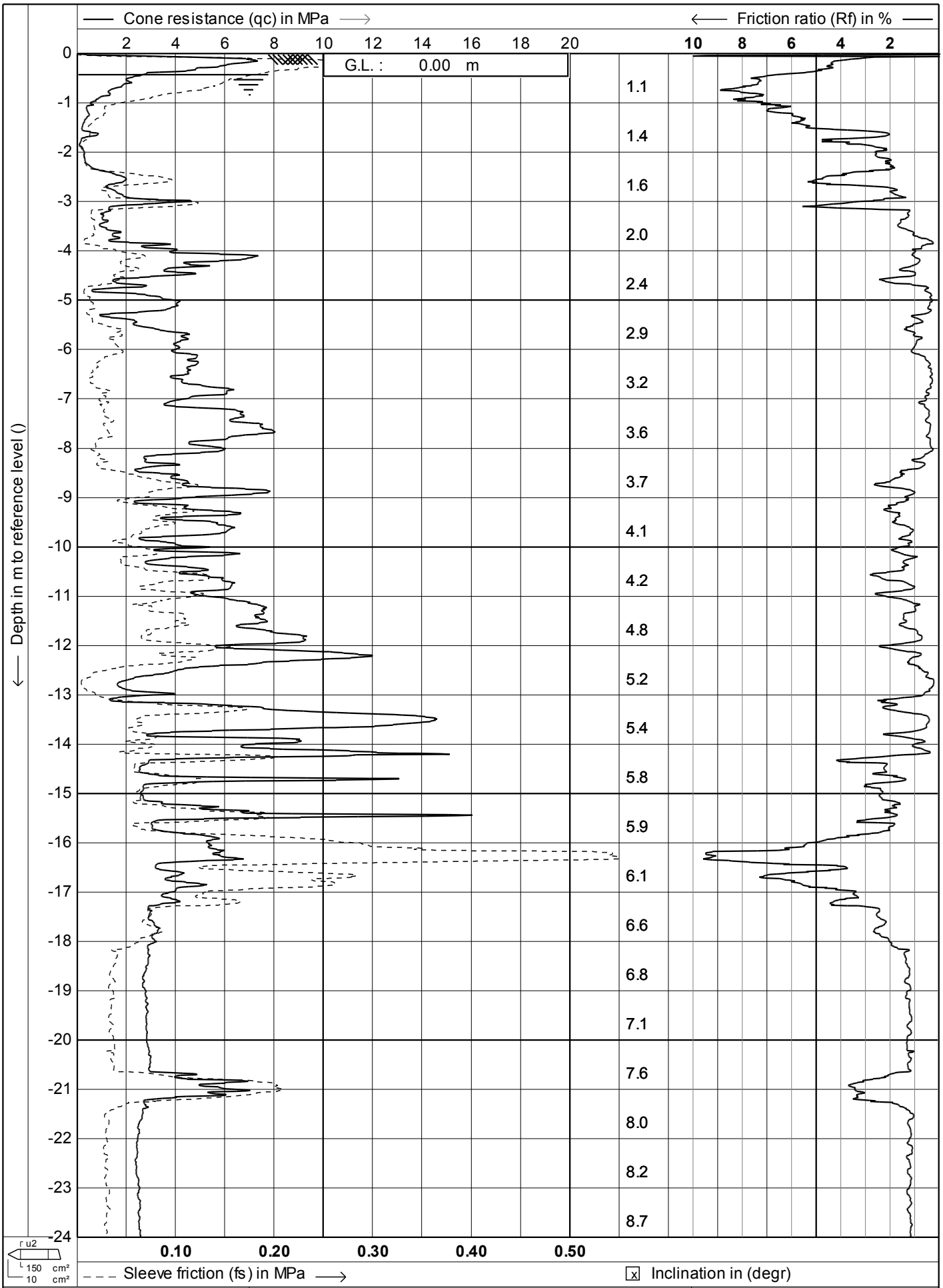
CPTask V1.14a



Test according A.S.T.M. Standard D 5778-95

Project : **Te Kauwhata Bypass**

Location: **Rimu Road - Te Kauwhata**

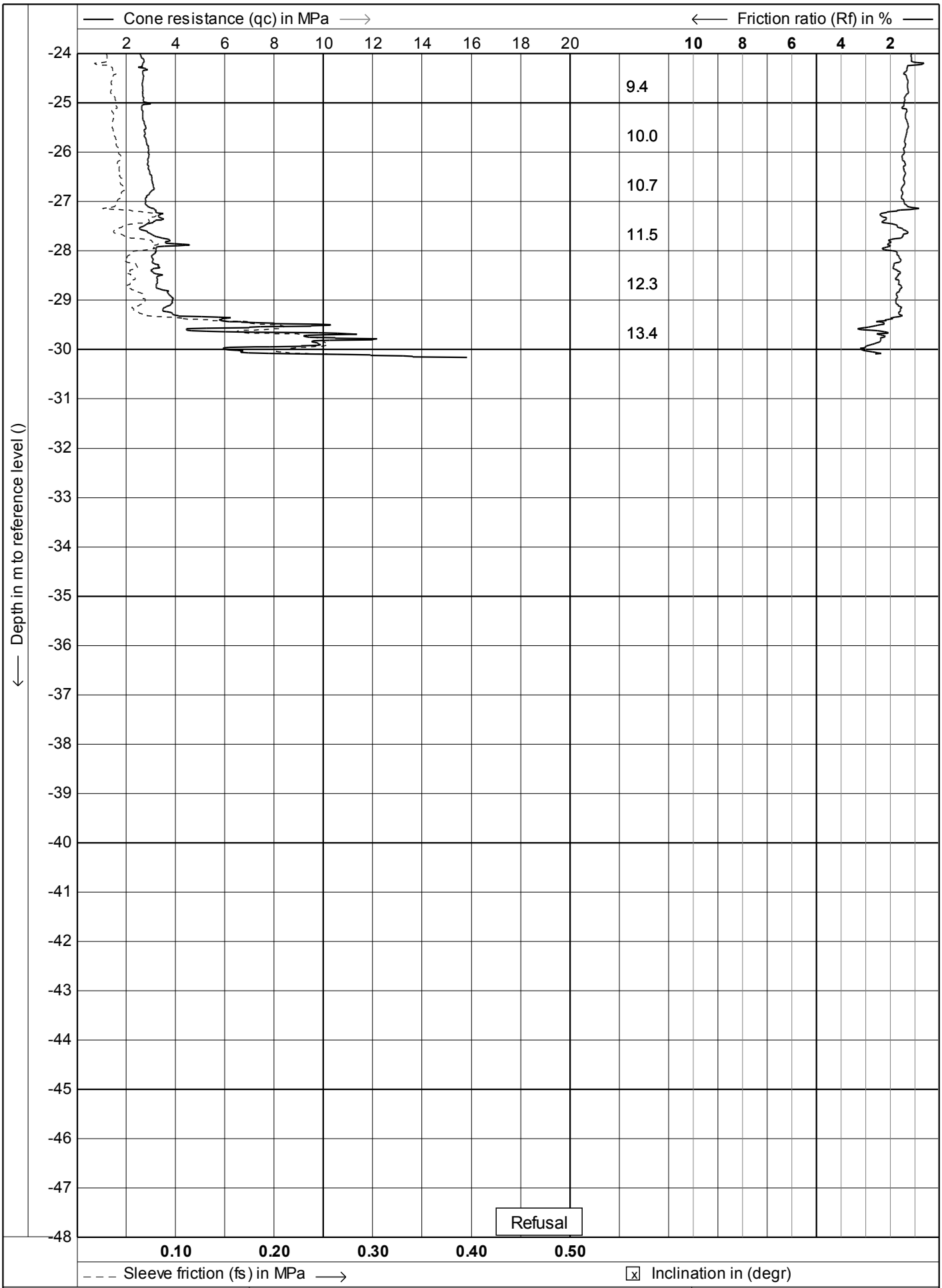
Date : **19-11-2009**

Cone no. : **C10CFIIP.F57**

Project no. : **02ET3**

CPT no. : **104**

CPTask V1.14a



Test according A.S.T.M. Standard D 5778-95

Project : **Te Kauwhata Bypass**

Location: **Rimu Road - Te Kauwhata**

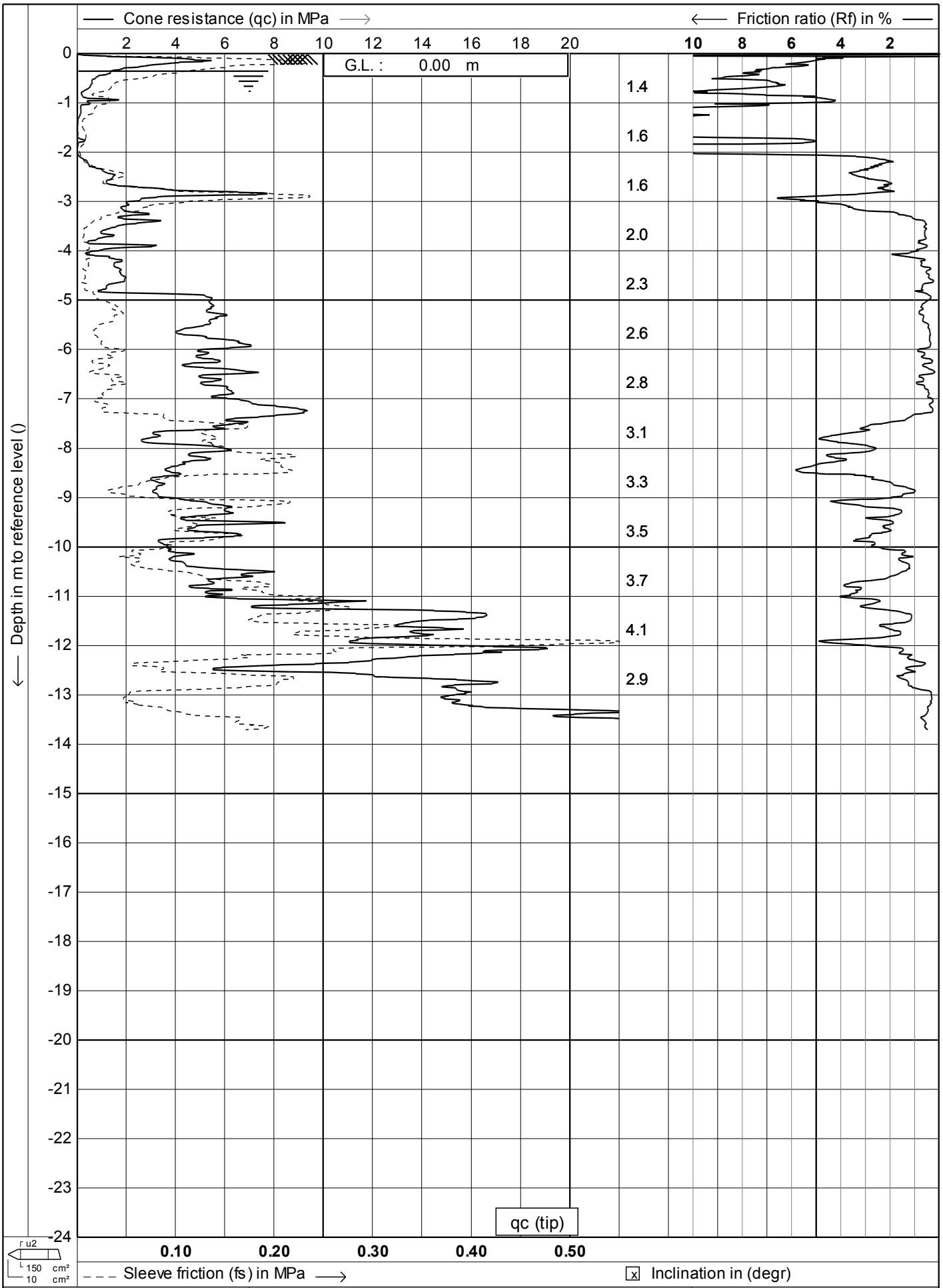
Date : **19-11-2009**

Cone no. : **C10CFIIP.F57**

Project no. : **02ET3**

CPT no. : **104**

CPTask V1.14a



Test according A.S.T.M. Standard D 5778-95

Project : **Te Kauwhata Bypass**

Location: **Rimu Road - Te Kauwhata**

Date : **19-11-2009**

Cone no. : **C10CFIIP.F57**

Project no. : **02ET3**

CPT no. : **105**

1/14

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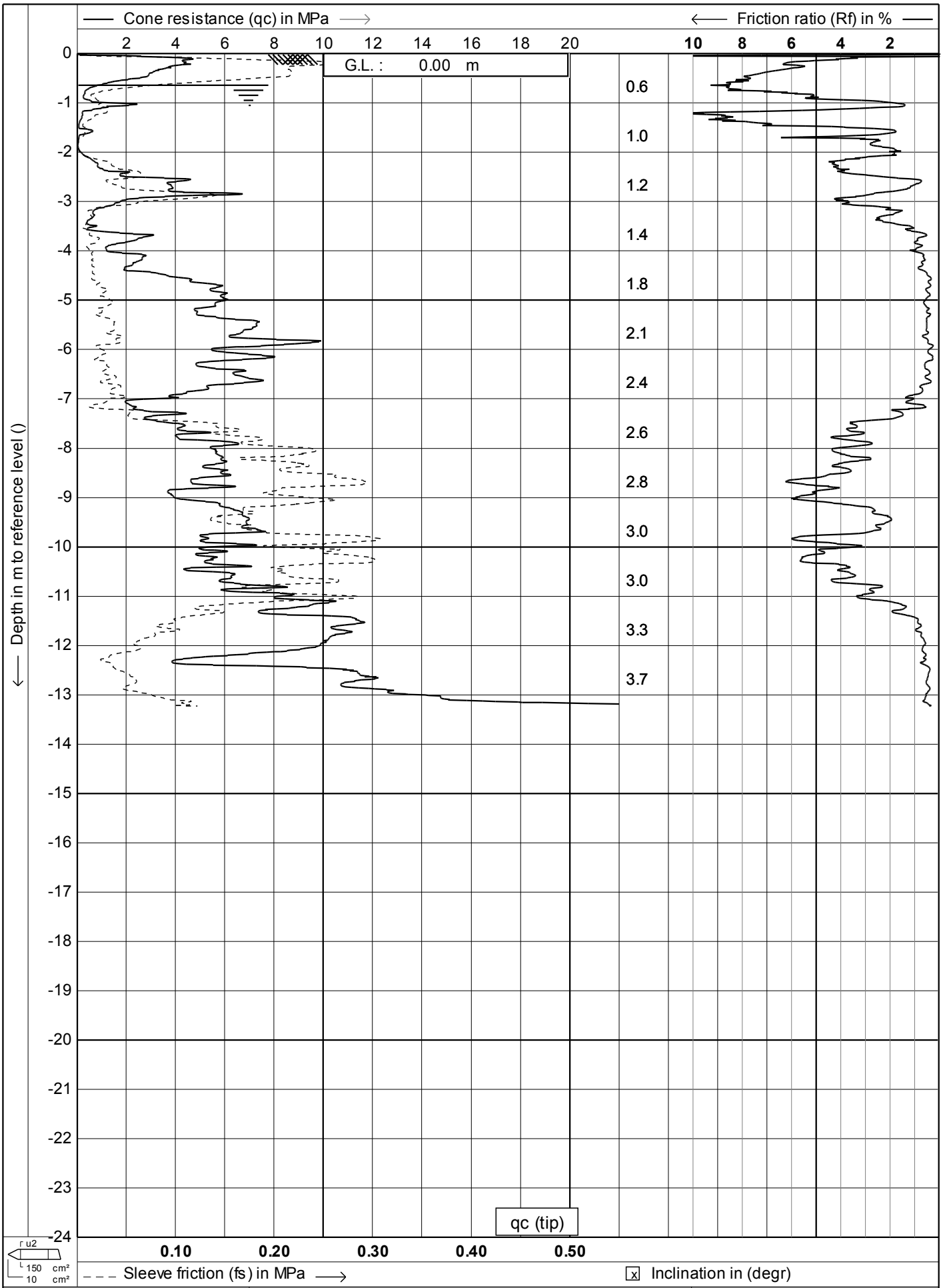
CPTask V1.14a



Test according A.S.T.M. Standard D 5778-95

Project : **Te Kauwhata Bypass**

Location: **Rimu Road - Te Kauwhata**

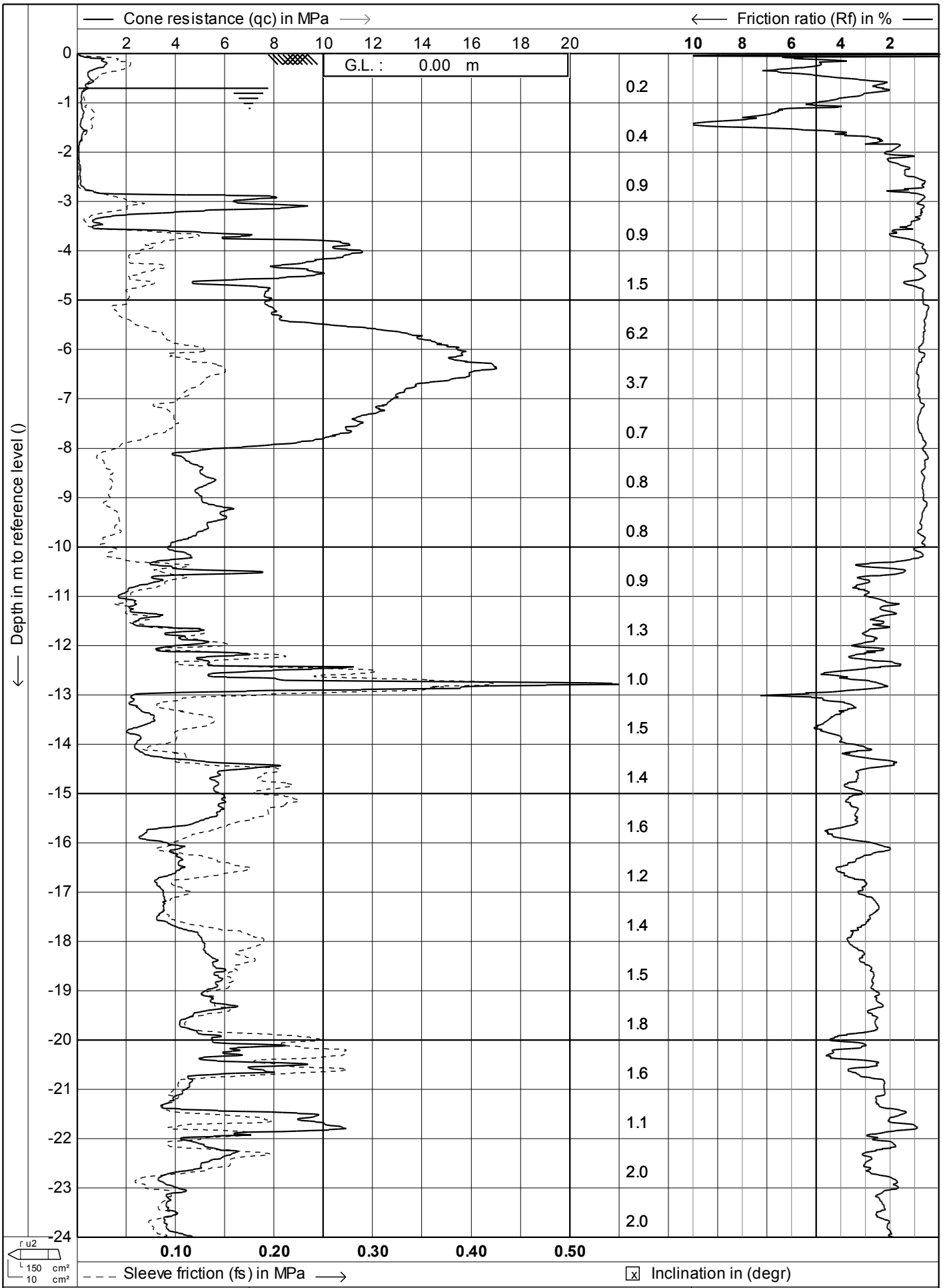
Date : **19-11-2009**

Cone no. : **C10CFIIP.F57**

Project no. : **02ET3**

CPT no. : **106a**

CPTask V1.14a



Test according A.S.T.M. Standard D 5778-95

Project : **Te Kauwhata Bypass**

Location: **Roto Road - Te Kauwhata**

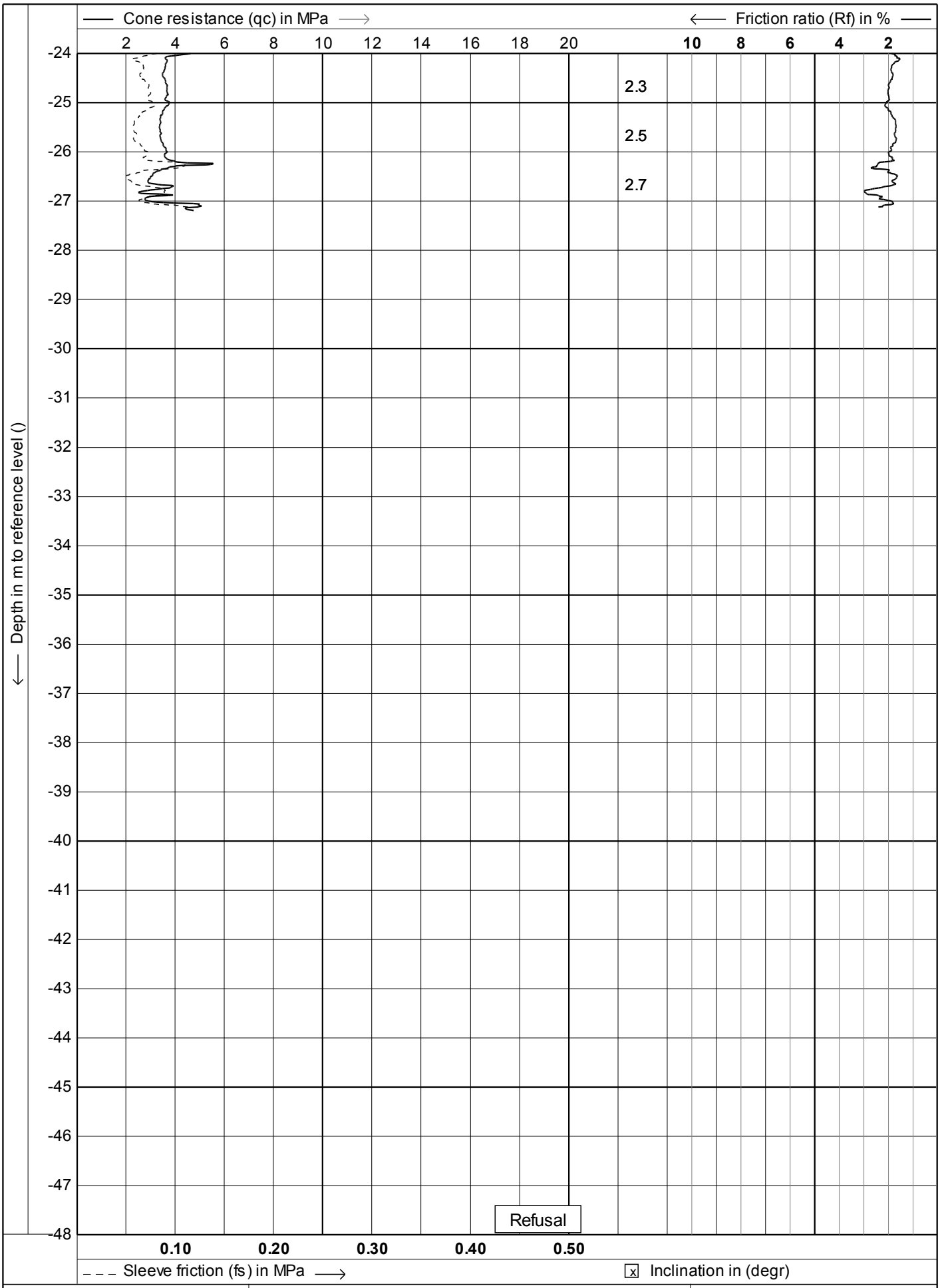
Date : **19-11-2009**

Cone no. : **C10CFIIP.F57**

Project no. : **02ET3**

CPT no. : **107**

CPTask V1.14a



Test according A.S.T.M. Standard D 5778-95

Project : **Te Kauwhata Bypass**

Location: **Roto Road - Te Kauwhata**

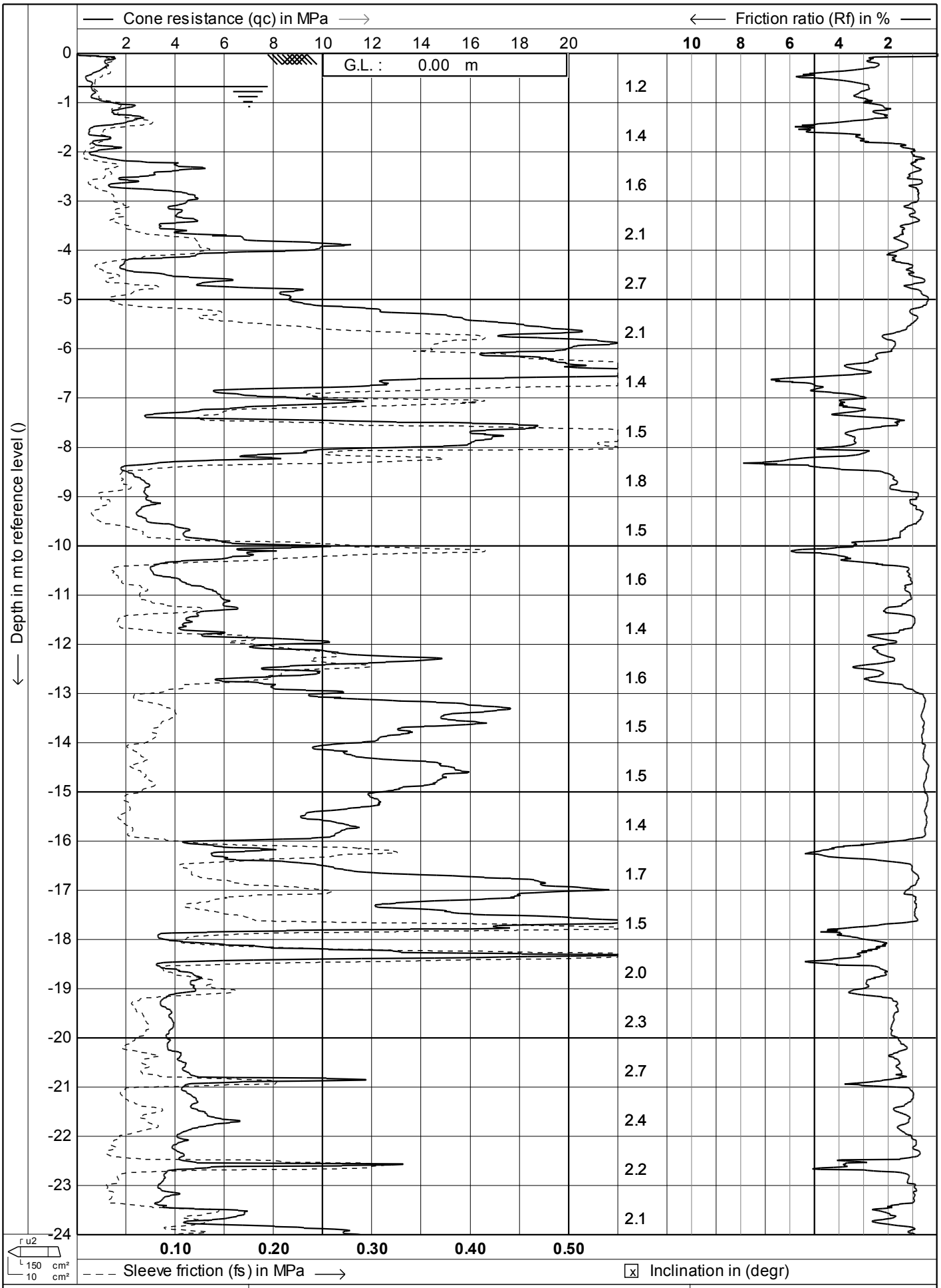
Date : **19-11-2009**

Cone no. : **C10CFIIP.F57**

Project no. : **02ET3**

CPT no. : **107**

CPTask V1.14a



Test according A.S.T.M. Standard D 5778-95

Project : **Te Kauwhata Bypass**

Location: **Roto Road - Te Kauwhata**

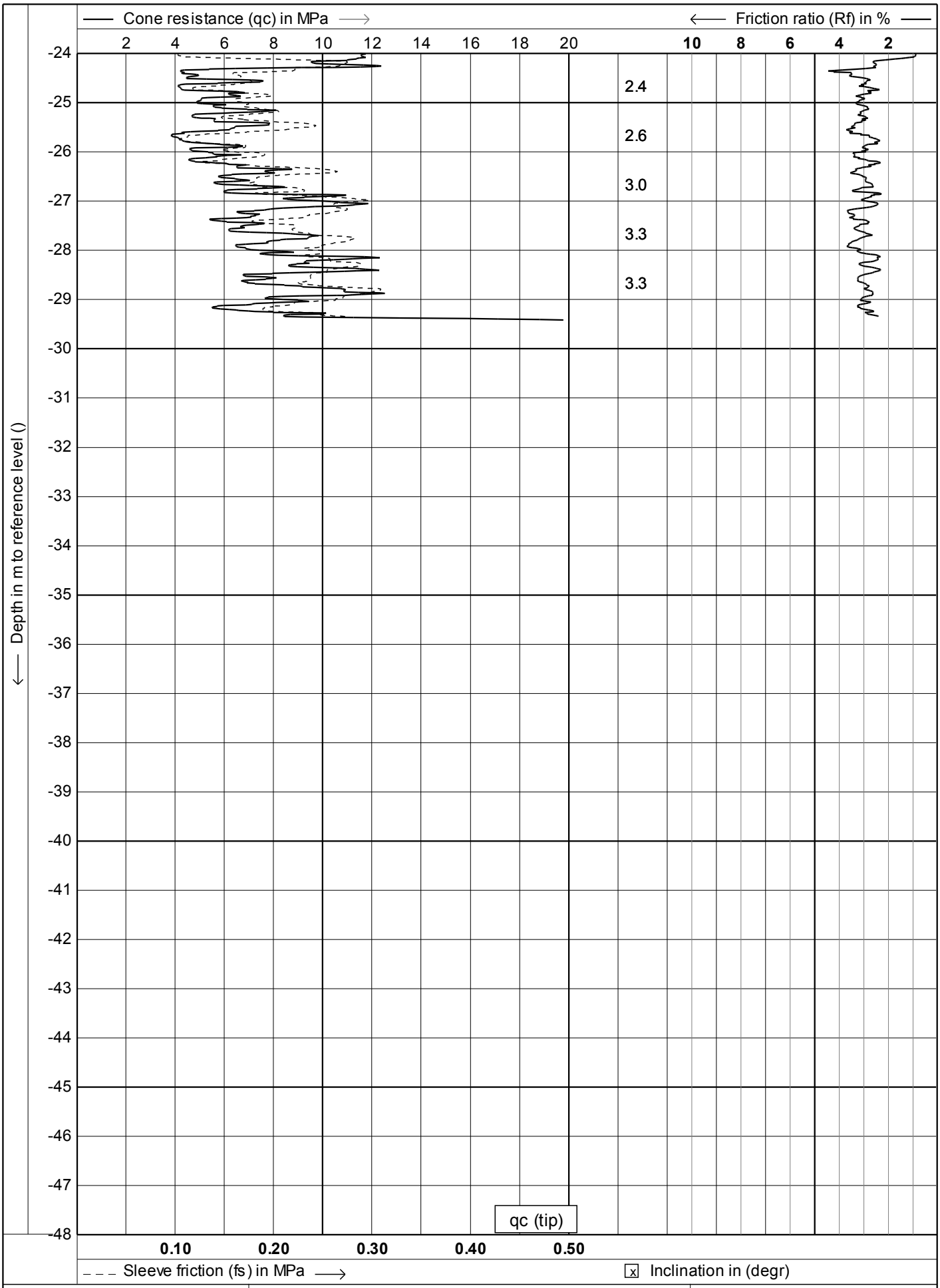
Date : **19-11-2009**

Cone no. : **C10CFIIP.F57**

Project no. : **02ET3**

CPT no. : **108**

CPTask V1.14a



Test according A.S.T.M. Standard D 5778-95

Project : **Te Kauwhata Bypass**

Location: **Roto Road - Te Kauwhata**

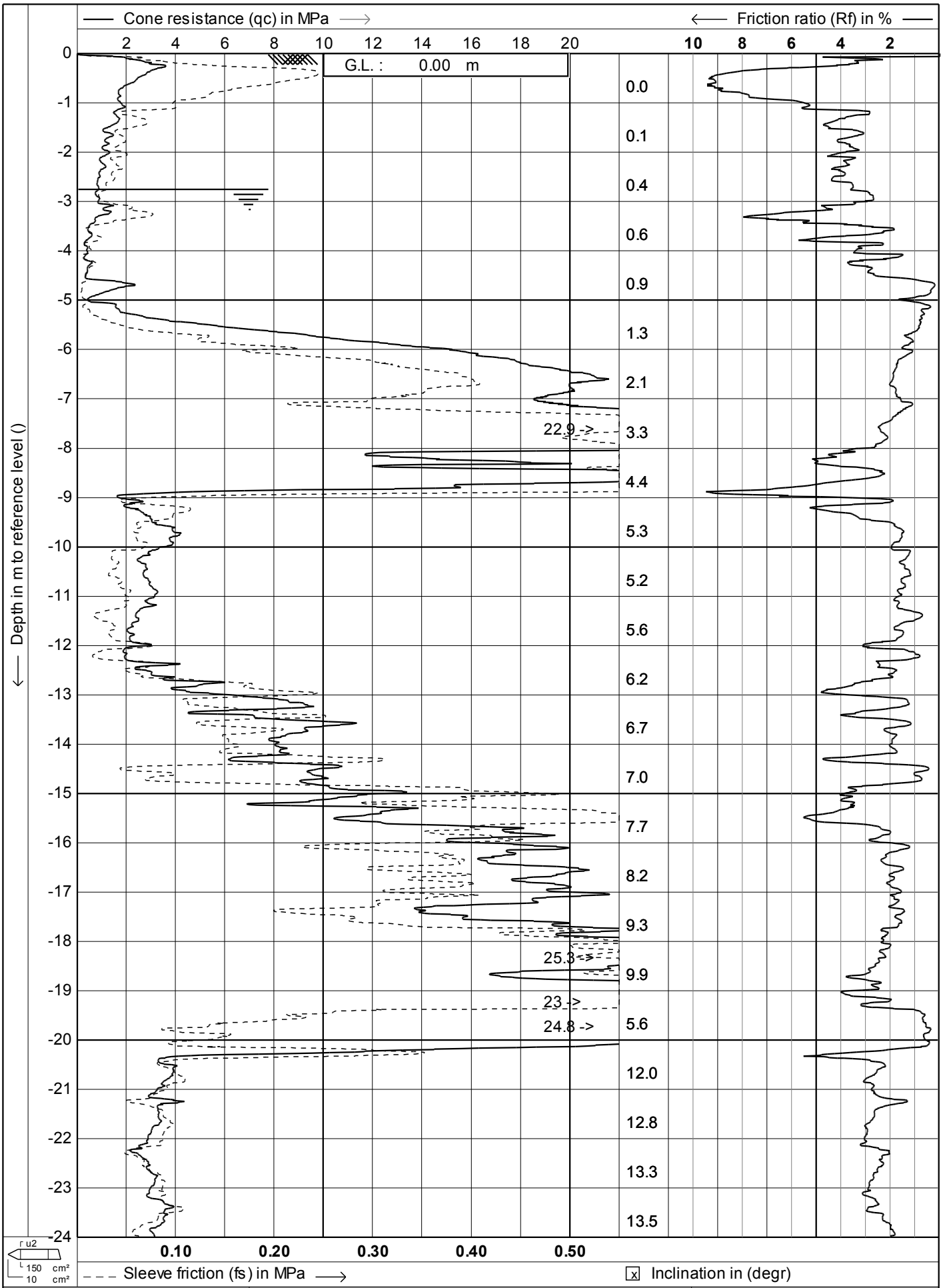
Date : **19-11-2009**

Cone no. : **C10CFIIP.F57**

Project no. : **02ET3**

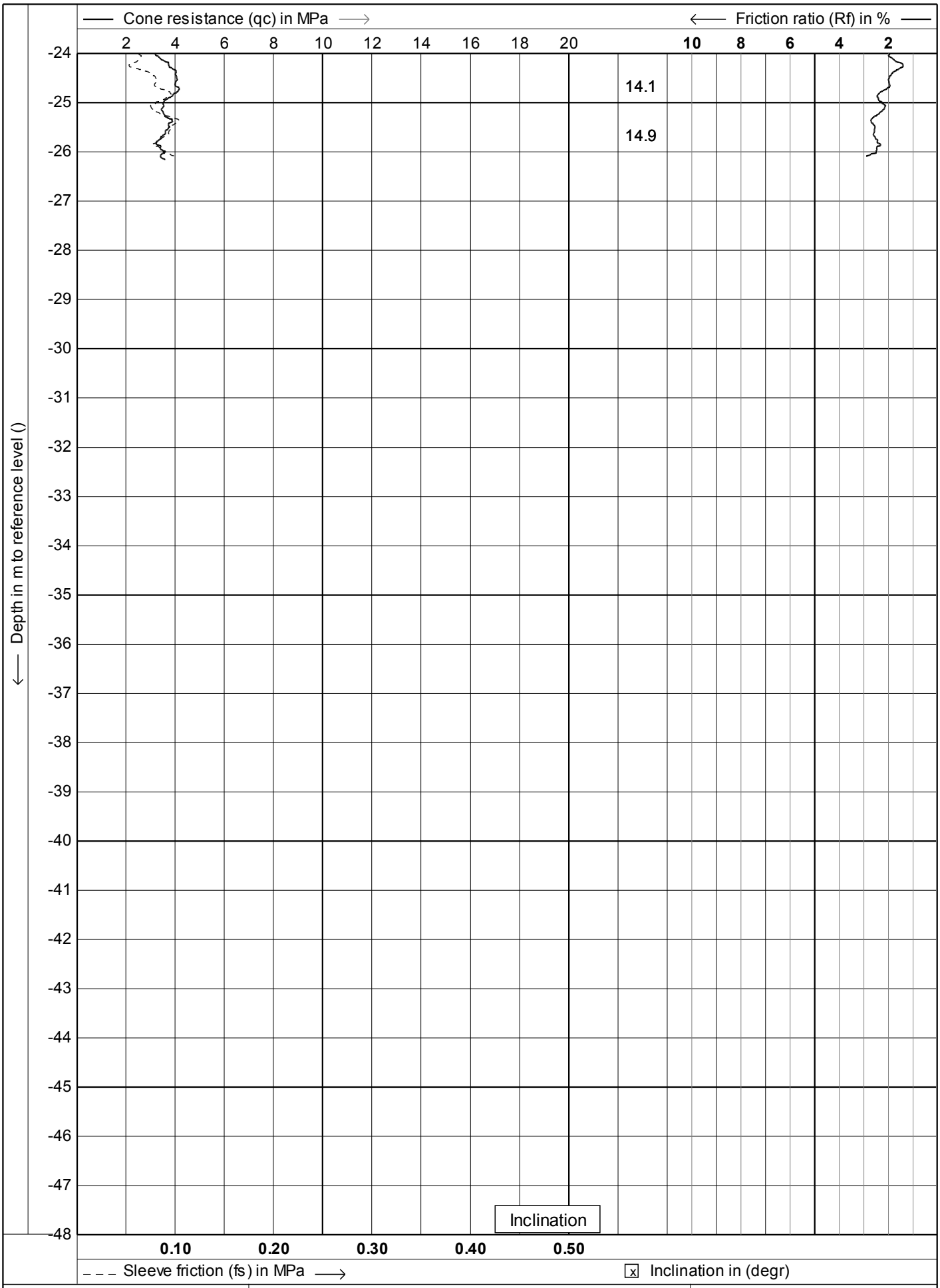
CPT no. : **108**

CPTask V1.14a



Penny DRILLING GEOPROBE Ground Drilling and Environmental Specialists	Test according A.S.T.M. Standard D 5778-95	Date : **19-11-2009**	
		Cone no. : **C10CFIIP.F57**	
	Project : **Te Kauwhata Bypass**	Project no. : **02ET3**	
	Location: **Roto Road - Te Kauwhata**	CPT no. : **109**	**1/28**

CPTask V1.14a



Test according A.S.T.M. Standard D 5778-95

Project : **Te Kauwhata Bypass**

Location: **Roto Road - Te Kauwhata**

Date : **19-11-2009**

Cone no. : **C10CFIIP.F57**

Project no. : **02ET3**

CPT no. : **109**

Penny Drilling GeoProbe — Ground Drilling and Environmental Specialists

CPTask V1.14a