Geotechnical Report

Metro South East Region

Geotechnical Study- Koo Wee Rup Corridor between Pakenham Bypass and South Gippsland Highway

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EXECUTIVE SUMMARY

This geotechnical report has been prepared to assist with the planning study for the duplication of Koo Wee Rup Road between the Pakenham Bypass and Manks Road and a bypass of Koo Wee Rup to the west of the Koo Wee Rup Township between Manks Road and the South Gippsland Highway.

A preliminary geotechnical investigation consisting of five (5) CPT tests was carried out at depths between 12.9m and 14.8m to give an indication of the ground conditions.

Due to the close vicinity of waterways and the presence of a high groundwater table in some CPT results, consideration should be given to undertake detailed groundwater and subsurface condition investigation to ensure their appropriate pavement design and pavement sub-grade condition can be ascertained. Due care must also be taken not to change the composition of the groundwater to below its existing beneficial use standards.

The proposed alignment traverses through low lying and poorly drained area, which may be subject to flooding. During construction the majority of the alignment would be constructed on fill with heights of up to 9m. The preliminary investigation results indicate that a very thick, soft to firm clay layer exists at depths approximately between 0.5m to 6.5m below the existing surface. Therefore, large subsurface settlement can be expected under the weight of the abutment fill. The use of geotextile/geogrid bore reinforcement may need to be considered to reduce settlements and construction time. The use of a suitable geotextile may need to be considered during wet periods, where clays may be exposed during construction.

Driven Reinforced Concrete (RC) and steel H pile foundations are both considered appropriate for bridge foundations.

This report provides preliminary geotechnical information for planning and more detailed geotechnical investigations will be required for this project.

TABLE OF CONTENTS

Appendices: A - G

1. INTRODUCTION

This report has been prepared by VicRoads Technical Consulting for Metropolitan South East Region to assist the Region with its planning study for the duplication of Koo Wee Rup Road between the Pakenham Bypass and Manks Road and a bypass of Koo Wee Rup to the west of the Koo Wee Rup township between Manks Road and the South Gippsland Highway.

The proposed bypass will cross the currently disused railway line south of Manks Road; Metropolitan South East Region is planning for a possible overpass over this railway line.

Both bypass options (1 and 2) will cross the disused railway line. Option 1 considerations include crossing the Bunyip River and the railway line to the adjacent drainage channels, while option 2 considerations include crossing the railway line and traversing along the west side of Bunyip River and the drains

A Locality Plan showing the area of the study and the bypass options considered are presented in Appendix A.

The preliminary geotechnical investigation consisted of five (5) Cone Penetration Tests (CPT's) carried out between the Pakenham Bypass and the South Gippsland Highway. Due to site access issues, the investigation did not cover the full length of the proposed alignment. The information contained in this report is intended to form the basis for proposals for more detailed geotechnical investigations to facilitate the selection of the alignment.

This report presents the results of the recent desk top study and preliminary geotechnical investigation carried out by VicRoads GeoPave in August 2007 and discusses the risks and construction issues.

2. SITE AND GEOLOGY

2.1 Site

The site is located between the Pakenham Bypass and the South Gippsland Highway in low lying and poorly drained areas consisting of alluvial and swamp deposits. The area of study is subject to flooding.

The study covered approximately 100m wide strip at both sides of the existing Koo Wee Rup Road and the area bounded by Bunyip River, South Gippsland Highway and Sybella Avenue. The study also covered a 600m wide strip along the north-west edge of Bunyip River.

The alignment corridor is traversed by drainage gullies which are likely to be filled with soft silts and clays. Springs and/or seepage zones are likely to be present in some areas. The near surface insitu clays are highly likely to be soft and of low bearing strength.

A long section is not available for the full length of the project. A preliminary long section provided by Metropolitan South East Region for the option of crossing the railway, Bunyip River and Drains (option 1) is presented in Appendix B.

Based on the topography, the formation of the proposed road would be likely to be constructed in fills.

2.2 Geology

Geological Survey of Victoria map – Cranbourne Sheet (No. 859 Zone 7), Australia 1:63,360 Series - shows that the area of study comprises of Recent Quaternary deposits of peaty clay, clay and silts and sands.

A geological map relevant to the bypass corridor is provided in Appendix C. The CPT locations are also shown on this map.

Cone Penetration Testing (CPT) confirmed the presence of Recent Quaternary deposits of clay, silts and sands. These materials may be highly moisture sensitive and contain shallow perched groundwater tables during the winter/spring period. As such, these materials can become untrafficable and unworkable in wet weather.

2.3 Geological Terminology Used

The soils in this document have been described using the methods and terminology presented in Australian Standard 1726 - 1993, Geotechnical Site Investigations. Some additional terminology used is defined on Summary Drawing Nos. 396223 and is presented in Appendix D.

3. PRELIMINARY GEOTECHNICAL INVESTIGATION

3.1 Cone Penetration Testing (CPT)

A total of five (5) CPT's were carried out to depths between 12.9m and 14.8m. The CPT testing was carried out using VicRoads Penetration Testing Vehicle in accordance with AS 1289 F511-1977.

The CPT Testing was carried out at the following locations:

- CPT C07-039 was carried out in the road reserve at the north side of Ballarto Road. The CPT was terminated at 14.8m below the ground surface level.
- CPT C07-040 was carried out at the north side of Ellett Road in the road reserve. The CPT was terminated at 13.1m below the ground surface level.
- CPT C07-041 was carried out at approximately 10m south east of Bunyip River (McDonalds Drain). The CPT was terminated at 12.9m below the ground surface level.
- CPT C07-042 was carried out at the north side of Railway Road in the road reserve. The CPT was terminated at 13.55m below the ground surface level.
- CPT C07-043 was carried out in the road reserve at the south east side of Rossiter Road. The CPT was terminated at 13.75m below the ground surface level.

The CPT locations are shown in the Geological Map provided in Appendix C. An indication of the bypass alignment options considered is also shown on this map.

The CPT plots along with the inferred soil types and properties are presented in Appendix E.

In all CPT test sites, groundwater measurements were attempted in the probe holes following testing. Where the groundwater level could be effectively measured, the water level is shown on the CPT plots.

4. GROUNDWATER

4.1 Measured Groundwater Levels

Groundwater levels, where encountered during the course of the investigation, have been recorded on the CPT plots.

The measured water level below the existing ground surface level on 21 August 2007 was 9.9m in CPTs C07-041 and C07-042 while the measured water level in CPT C07-043 was 1.75m.

The water level could not be measured in CPT's C07-039 and C07-040 due to caving in of the CPT holes at 2.0m and 0.5m below the ground surface level, respectively.

4.2 Groundwater Bores

A search of existing groundwater bores that fall within the proposed corridor was undertaken using the Department of Sustainability and Environment's (DSE) website (http://nremap-sc.nre.vic.gov.au).

A plan showing the groundwater bore locations is presented in Appendix F1. The boreholes which have relevant information to this investigation have been highlighted.

Due to the presence of groundwater and possibly perched water tables in the area care must be taken not to change the composition of these water sources, therefore the Electrical Conductivity (EC) levels need to be monitored to ensure that the waters are within the relevant guidelines. EC is also a measure of Total Dissolved Solids (TDS), multiplying EC values by a factor of 0.6 will result in its corresponding TDS value. TDS is used in the State Environmental Protection Policy – Groundwaters of Victoria to determine appropriate levels for various uses of groundwater.

Information regarding EC, pH and corresponding depths are provided in Appendix F2. The implication of these results will be discussed later in Section 4.3 of the report.

Standing Water Levels (SWL) vary between ground level (0 m) and 10.7m below ground level. The water level recorded at ground surface was in borehole 71794 located north of Boundary Drain Road on 12 January 1984. The Standing Water Levels (SWL) are presented in Appendix F3.

4.3 Groundwater Salinity

Based on the information from the Groundwater Bores the groundwater salinity, as measured by Electrical Conductivity (EC) varies between 440 to 7007 μS/cm and pH values vary between 4.6 and 8.5. The EC values of water samples from Bore 71184 vary between 420 and 567 μS/cm. The remaining EC values vary between 1648 and 7007. The pH and the EC values are from water samples obtained from 13.5m below the ground surface level.

EC values greater than 3500 µS/cm may have corrosive potential and water sampling and testing should be carried out for structure foundations. As there are no cut areas water salinity is unlikely to cause any discharging issues. However, water sampling and testing should be carried out at grade in sections of the road which are on shallow fill, if groundwater is encountered during test pit investigation. Standpipes should be installed at structure foundation locations for study of groundwater quality and water level.

5. RAINFALL DATA

A summary of rainfall data recorded from Koo Wee Rup between 1996 and 2007 is provided in Appendix G. This information should be given consideration with standpipe monitoring to assess the fluctuation of groundwater level and to assist with construction planning.

6. PRELIMENTARY INVESTIGATION RESULTS

CPT C07-039 carried out on the north side of Ballarto Road encountered clay varying from soft to very stiff from ground level (0m) to approximately 6.7m below ground level, and very stiff sandy clay/clay from 6.7- 14.8 m below ground level. The groundwater level could not be measured due to CPT C07-039 caving in at 2.0m.

CPT C07-040 carried out on the north side of Ellett Road encountered very loose silty sand from ground level (0m) to approximately 0.4m below ground level. Clays varying from soft to very stiff were found from approximately 0.4- 13.1m below ground level with an overlay of sandy material between 8.5-9.5m below ground level. The groundwater level could not be measured due to CPT C07-040 caving in at 0.5m.

CPT C07-043 was carried out in the road reserve at the south eastern side of Rossiter Road to a depth of 13.75m below the ground surface level and encountered the following material. From ground level (0m) to 0.3m loose silty sand/sand fill, from 0.3-5.4m below ground level firm to stiff clay from 5.4-7.4m below ground level loose to medium dense silty sand/sand, from 7.4-13.75m very stiff to hard clay with a section of loose sand at approximately 11.8m below ground level. The groundwater level was at 1.75m below the ground surface level.

CPT C07-041 carried out approximately 10m south east of Bunyip River (McDonalds Drain) to a depth of 12.9m, encountered the following material. From ground level (0m) to 4.5m below ground level, clays varying from firm to very stiff with loose silty sand sections at 0-0.9m and 1.4-1.9m. From 4.5-12.9m below ground level the material is firm to hard sandy clay to clay with a section of stiff to very stiff clay from 6.7-8.5m. The groundwater level was 9.5m below the ground surface level.

CPT C07-042 carried out at the north side of the Railway Road to a depth of 13.55m encountered the following material. From ground level (0m) to approximately 0.3m below ground level very loose sand fill, from 0.3-2.2m below ground level firm to very stiff clay, from 2.2-10.8m below ground level stiff to very stiff clay, from 10.8-12.1m loose to medium dense sand, from 12.1-13.55m below ground level stiff to very stiff sandy clay/clay. The groundwater level was 9.9m below the ground surface level.

6.1 Proposed areas of further Geotechnical Investigation

This preliminary investigation has highlighted the need for the following more extensive investigations.

- Approximately 20m deep boreholes with Standard Penetration Test (SPT) and undisturbed sampling in soft to firm clays for laboratory testing to determine strength parameters for bridge foundation design, including assessment of abutment fill stability and settlement as appropriate.
- Approximately 7.5m deep boreholes with Standard Penetration Test (SPT) and undisturbed sampling in soft to firm clays for laboratory testing to determine strength parameters for large culverts foundation design, including assessment of approach fill stability and settlement as appropriate. Alternatively Cone Penetration Testing (CPT) could be used.
- Boreholes/standpipes in high fill areas and structure foundation locations to assess groundwater levels and the effect on consolidation of foundation material.
- Shallow soil investigations consisting of backhoe test pits to a depth of approximately 2m with Dynamic Cone Penetration Testing (DCPT's) at 150 to 300m intervals to assess stripping depths beneath fill areas and at grade areas. Obtaining bulk soil samples for classification, grading and California Bearing Ratio (CBR), especially in at grade or low fill areas to determine subgrade conditions. Swell and shrinkage testing required to be carried out to assess the moisture sensitivity and swell characteristics of peat and organic clays.
- Water sampling and chemical analysis on groundwater sample

7. DISCUSSION

7.1 General

Preliminary investigation results and likely risks and construction issues are discussed below for the proposed road corridor between the Pakenham Bypass and the South Gippsland Highway.

7.2 Road Fill Embankment

7.2.1. General Description

The fill between the Pakenham Bypass and south of Manks Road (Ch. 1870m), south of Bunyip River (approx. chainage 2970m) and the South Gippsland Highway would be likely to vary up to approximately 2m. Due to the construction of the rail overpass, the embankment fill height rises to approximately 9m at the bridge abutment location

High groundwater or perched water tables could be present during wet periods in the year.

7.2.2. General Risk / Construction Issues of Fill

It is estimated that an immediate foundation settlement of 65mm and a total foundation settlement of 85mm may occur under a fill height of 2m. The estimation for immediate settlement under a fill height of 9m is 380mm and total settlement of 480mm.

Consideration should be given to the use of geotextile/geogrid base reinforcement with or without staged construction to reduce settlements and construction time and also to provide the required minimum batter slope for the embankment.

Bridge abutment fill settlements need to be monitored to confirm that anticipated settlements occur during construction for the particular construction method adopted and to ensure settlements do not exceed the limits specified in the Contract specification.

Survey pegs driven to refusal into fill across each abutment position may be used to monitor settlements. The surveys will require a stable bench mark and may be carried out at monthly intervals.

Construction options such as pre-loading or staged construction may be used to improve the ground conditions. With these options a minimum batter slopes of 1H: 1V to 1.5H: 1V may be required for fill heights up to 2m. For fill heights up to 9m batter slopes of 2H: 1V to 3H: 1V may be required. Detailed batter design should be subject to the results of further geotechnical investigations outlined in Section 6.1 of this report. However, if the groundwater is at a shallow depth, these methods may be ineffective. Perched water may be present during the wet periods of the year.

If construction proceeds during or after a wet period the exposed upper clay may become wet. Considerable softening of the clay is likely to occur therefore resulting in its removal. Use of a needle punched non-woven geotextile may be required at the base of the excavation for fill placement.

The top soil and grass root zone may vary up to 300mm. Therefore, approximately 300mm of surface materials may require removal.

7.3 Bridge and Culvert Foundations

7.3.1. Bridge

The preliminary investigation results indicate that a pile foundation could be required for bridge structure. Driven foundations are considered suitable for the bridge foundations

The pile capacity would be developed by a combination of shaft resistance and end bearing. As maximum fill height is approximately 9m, jointed piles will be required. RC piles may need to be driven through prebored holes through the abutment fills to prevent the formation of tension cracks in the abutment fills. Steel H piles may be driven without preboring. Longer steel piles may be required compared to RC piles if steel piles are founded in non-cohesive soils (sands and gravels) because of its small net end bearing area.

The strength of the soils may vary both vertically and horizontally. Therefore, Pile Driving Analyser (PDA) should be used to confirm driven pile capacities during installation. Provision for use of the PDA to assess pile capacities should be included in the bridge construction specification.

The piles should be tested according to VicRoads Standard Specification to provide driving criteria for the remaining piles in the group. Any piles not achieving the required capacity should be retested after 24hours.

Detailed bridge foundation design should be subject to the results of further geotechnical investigations outlined in Section 6.1 of this report.

7.3.2. Culverts

Soft and loose materials require removal. Test pit and DCPT testing may be used for small culverts and pipes and CPT's or boreholes may be used for large culverts and culverts located under high fill to determine the subsurface conditions and the consistency of the materials.

A robust needle punched geotextile may be require at the base of excavations and compacted crushed rock or an open graded granular material may be required over the geotextile to the culvert invert level. The excavations may require dewatering.

During the construction of culverts the side batter slopes of 1.5H: 1V in soft to firm clays and 1H: 1V in stiff to very stiff clays may need to be adopted to a depth of 1.5m. Steeper batters require adequate support.

Detailed culvert foundation batter design should be subject to the results of further geotechnical investigations outlined in Section 6.1 of this report.

7.4 Subgrade Properties and Pavement Materials

7.4.1. Subgrade Properties

As mentioned in Section 1 of this report, the area of study is located in low lying and poorly drained areas consisting of alluvial and swamp deposits. The area is subject to flooding. The near surface in-situ clays are highly likely to be soft and of low bearing strength. In the low lying areas the soaked CBR is likely to vary between 1 and 3.

The majority of the alignment would be constructed on fill. A Design CBR (DCBR) of 3% may be obtainable, if the subgrade is improved through treatment or the placement of an overlying working platform to enable construction to proceed. The following measures may be adopted to facilitate construction on soft subgrade:

- Use of geotextiles.
- Draining and drying of the subgrade.
- Excavation and replacement of soft material with suitable material.
- Provision of a gravel or rock fill working platform covered by an impermeable layer.
- Stabilisation of the top layer of subgrade.
- Provision of a working platform of cement treated material.

Based on our knowledge of Pakenham Bypass test results on similar clay materials, insitu clays along the study corridor are most likely to be moderately expansive and therefore, a capping layer would not be required (if the percentage swell is less than 2.5%). However, laboratory testing as outlined in Section 6.1 should be undertaken to determine soaked CBR and swell values for confirmation.

7.4.2. Pavement Materials

A flexible pavement is likely to consist of:

- Base Course - Class 1 or Class 2 Crushed Rock with maximum nominal stone size of 20mm.
- Upper Subbase - Class 3 Crushed Rock with maximum nominal stone size of 20mm.
- Lower Subbase - Class 4 Crushed rock with maximum nominal stone size of 20 to 40mm.
- Type A Fill (CBR≥ 6%, Swell<1.5%) and may have a permeability requirement of 5×10^{-9} m/sec
- Layer thickness should equal or exceed the maximum nominal stone size by 2.5 times

Pavement design will be subject to the results of further geotechnical investigations outlined in Section 6.1 of this report.

7.5 Availability of fill and Pavement Materials

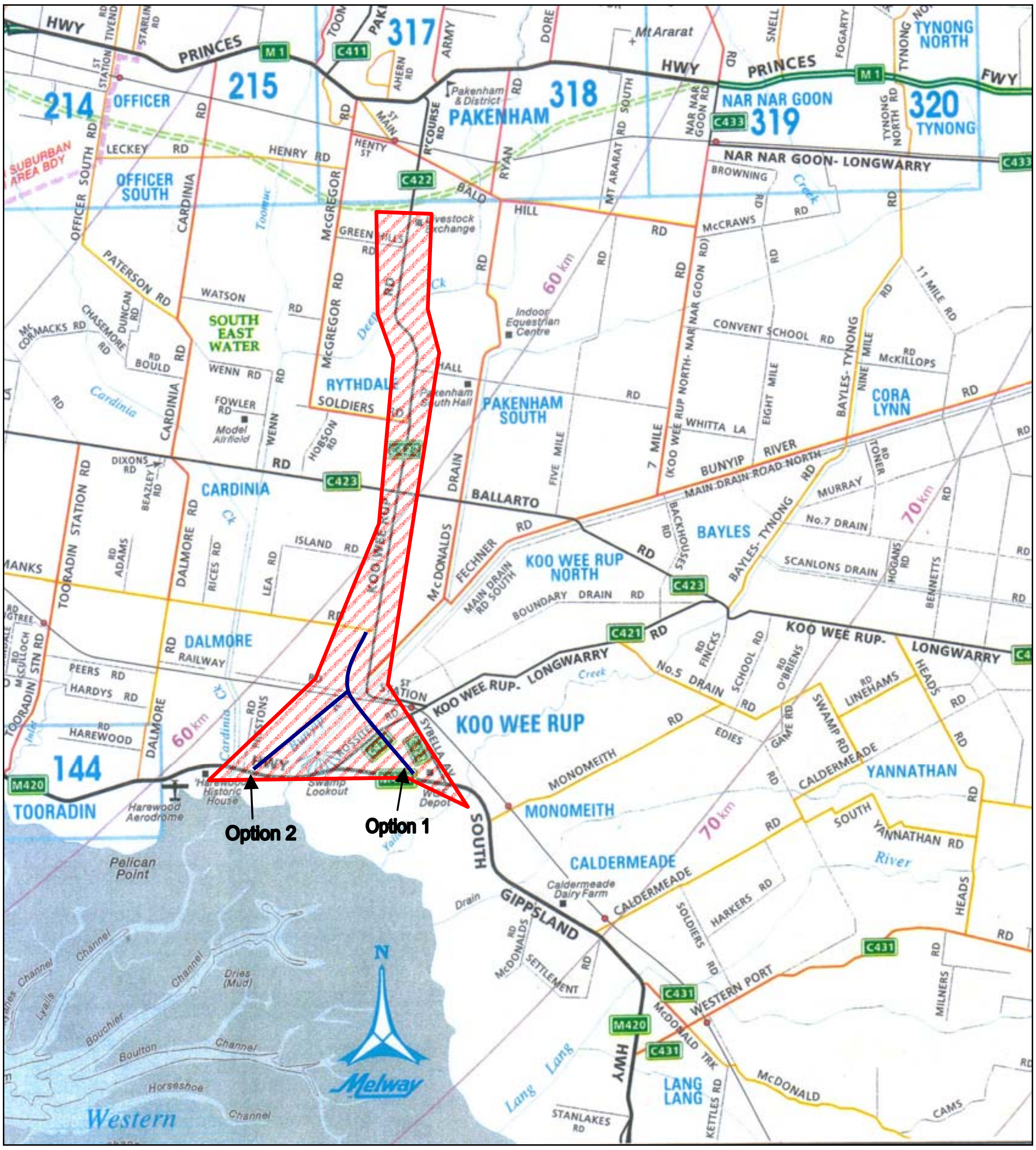
Five quarries north of Princess Hwy at Tynong and Pakenham Upper are likely able to supply Type A, Type B materials and crushed rock.

8. RECOMMENDATIONS

1. The risks and construction issues highlighted in section 7 of this report be considered in the selection of the alignment options
2. Consideration be given to undertake a detailed geotechnical investigation as outlined in section 6.1 once the final alignment has been determined.

Appendix A

Locality Plan

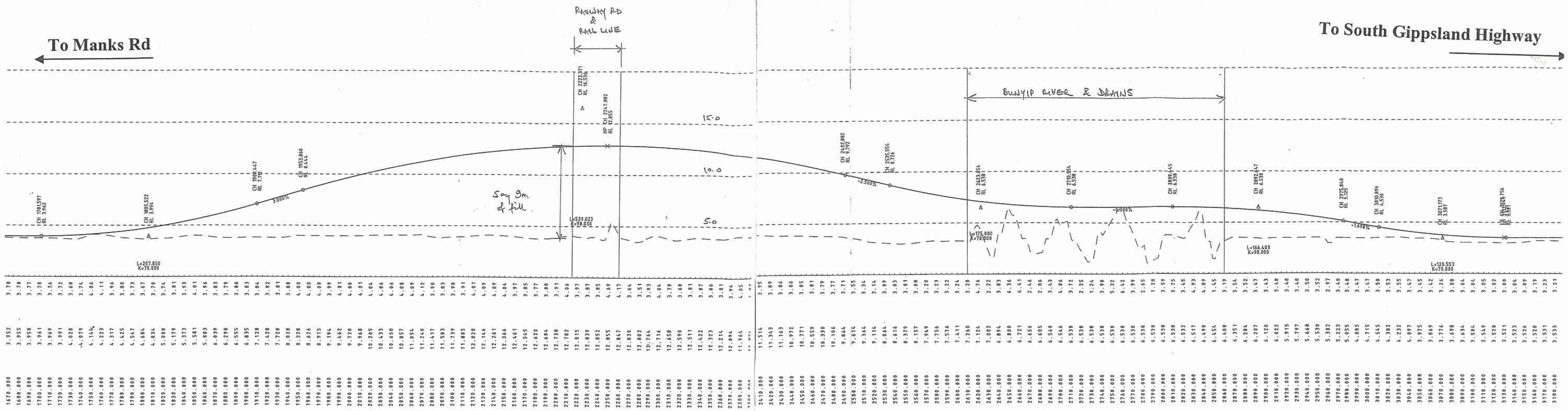


Locality Plan (Not to Scale)

Area of Study

Appendix B

Long Section (Option 1)



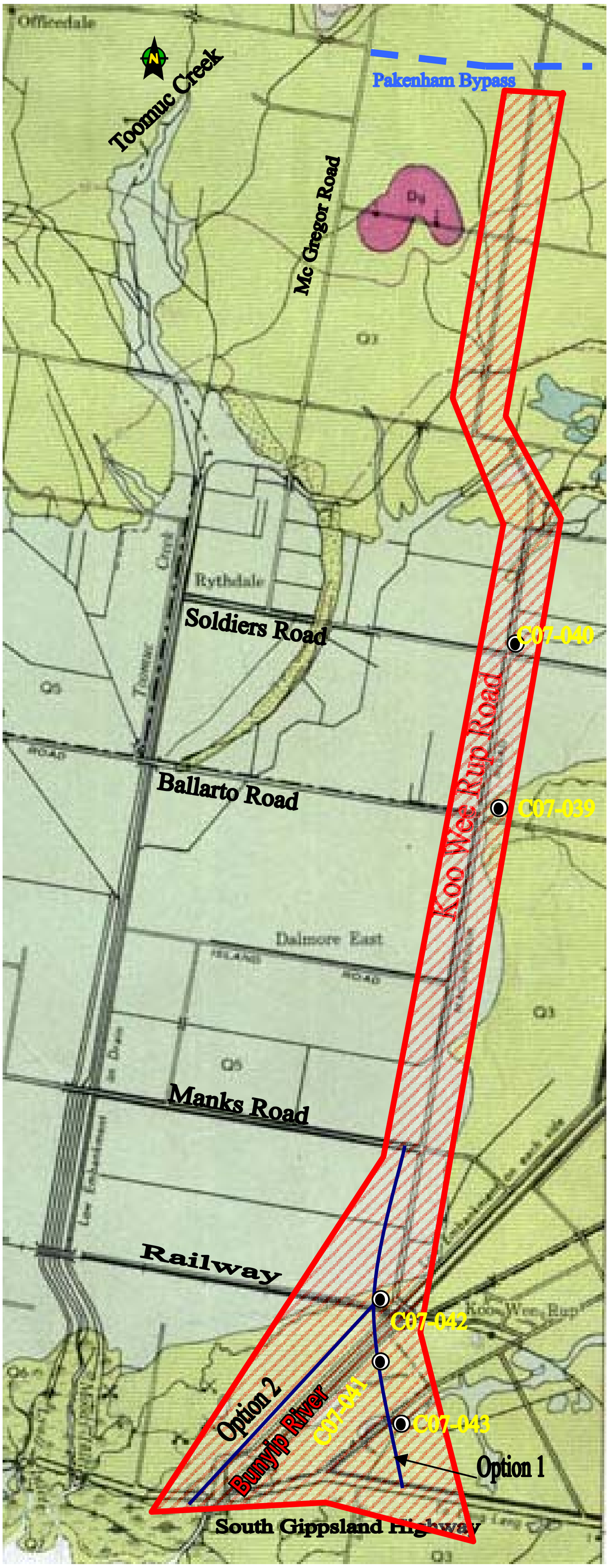
Koo Wee Rup Bypass
Option 1 Crossing Bunyip River

SCALE: H 1:2000

Appendix C

Geological Map

Geological Map
1:63,360 Geological Map Series
Cranbourne Sheet No. 859 Zone 7
Geological Survey of Victoria

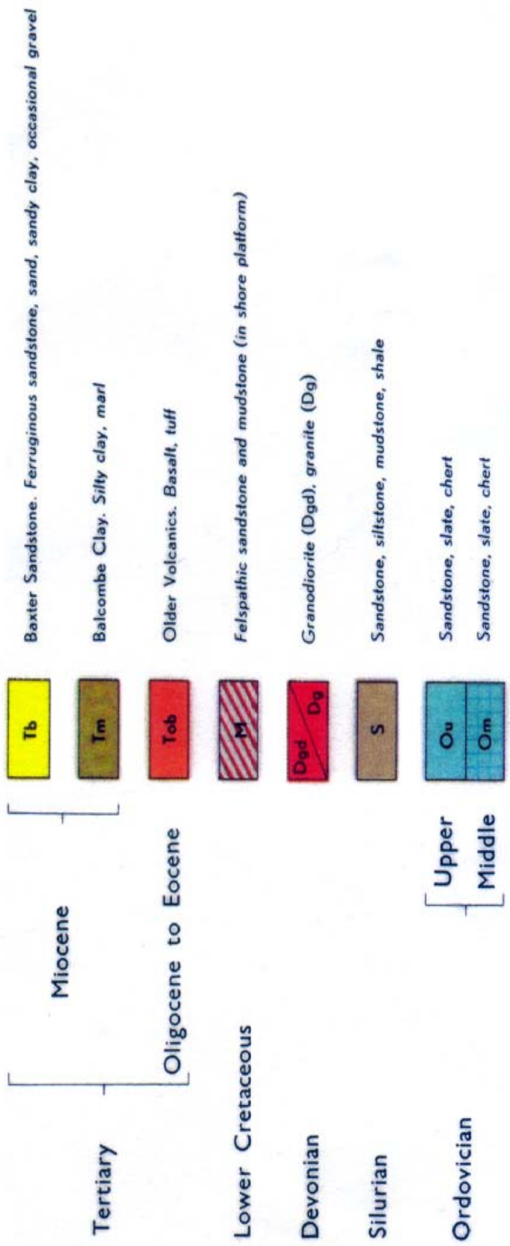


Area of Study

Peaty clay, clay (mainly swamp deposits

Silt, sand, clay and occasional gravel (including Cardinia Sand shown stipple)

Legend
◉ CPT



Appendix D

Geotechnical Summary Drawing

TEST SITE SYMBOLS

Auger hole	(HA) hand auger (PA) power auger
Rotary air percussion borehole (RP)	
Cored and/or washbored borehole (B)	
Borehole with standpipe (suffix 'S' after borehole number)	
Inclined borehole	
Friction cone penetration test (C) (suffix 'P' for piezo-friction cone penetration test)	
Dynamic cone penetration test (DCPT)	
Test pit (TP) Dozer pit (DP)	
Pavement Dipping (PD)	

FIELD TEST METHODS

Standard Penetration Test (SPT)

Refer AS 1289 6 3 1

The blow counts are recorded on the borehole log as one of

(i) 10,10,25	35 blows required for 300mm penetration after seating drive of 10 blows
(ii) 30/110*	30 blows undertaken for 110mm penetration in seating drive
(iii) 10, 30/110	30 blows undertaken for 110mm penetration after seating drive of 10 blows
(iv) 10, 20/10 (hammer bouncing)	20 blows undertaken for 10mm penetration before test ended due to hammer bounce after seating drive of 10 blows

The penetration resistance is recorded on the borehole log as one of

(i) N25	25 blows required for 300mm penetration after seating drive
(ii) N<1	Shoe penetrates 450mm under rod or rod and hammer weight
(iii) N>60	More than 60 blows required to penetrate 300mm after seating drive

Cone Penetration Test (CPT)

Refer AS 1289 6 5 1

Where soil descriptions are shown on the CPT plots have been inferred from the measured resistances and cannot be guaranteed Tenderers are advised to draw their own conclusions as to the character of the materials penetrated

Dynamic Cone Penetration Test (DCPT)

Refer AS 1289 6 3 2

SYMBOLS USED ON BOREHOLE LOGS

- Undisturbed Sample
- Continuous Sample
- Core
- Core loss
- 3-11-89 Water table level and date of observation
- Inflow of groundwater during drilling
- Water loss during drilling
- N25 Standard Penetration Test (SPT) and N value

GRAPHIC SYMBOLS FOR SOIL AND ROCK

Fill	Mudstone (siltstone & claystone)	Slate, phyllite or schist
Cobbles Boulders	Shale	Gneiss
Gravel	Sandstone	Hornfels
Sand	Conglomerate	Quartzite
Silt	Limestone	Breccia
Clay or undifferentiated soil	Tuff Scoria	Crushed or shear zone
Peat or organic soil	Granite, Granodiorite & other coarse grained igneous	
Coal	Basalt	
Cemented soil	Other fine-medium grained igneous	

SOIL DESCRIPTION

Basic Soil Types

Term	Size range	Term	Size range
BOULDERS	>200mm	Coarse SAND	0 6-2 36mm
COBBLES	63-200mm	Medium SAND	0 2-0 6mm
Coarse GRAVEL	20-63mm	Fine SAND	0 075-0 2mm
Medium GRAVEL	6-20mm	SILT & CLAY see A-Line chart	
Fine GRAVEL	2 36-6mm		

Organic soils include organic sands, organic silts, organic clays and peats Size range varies

Descriptive Terms for Material Proportion

Coarse grained soils	
% Fines	Modifier
≤ 5	Omit, or use 'trace'
> 5 ≤ 12	Described as with 'clay/silt' as applicable
>12	Prefix soil as 'silty/clayey' as applicable

Fine grained soils	
% Coarse	Modifier
≤ 15	Omit, or use 'trace'
>15 ≤ 30	Described as with 'sand/gravel' as applicable
>30	Prefix soil as 'sandy/gravelly' as applicable

Consistency - Non-Cohesive Soils

Term	SPT N Value	Relative Density (%)
Very loose	< 4	< 15
Loose	> 4 ≤ 10	> 15 ≤ 35
Medium dense	>10 ≤ 30	>35 ≤ 65
Dense	>30 ≤ 50	>65 ≤ 85
Very dense	> 50	> 85

Consistency - Cohesive Soils

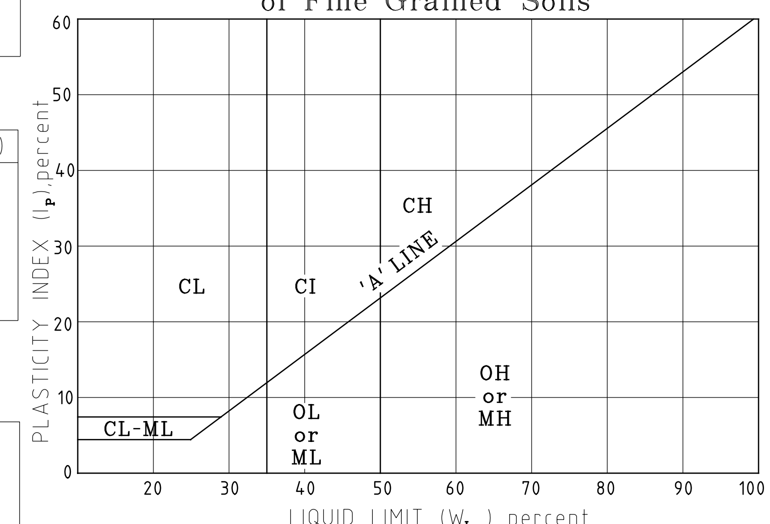
Term	Undrained shear strength (kPa)	Field Guide to Consistency
Very soft	≤ 12	Exudes between fingers when squeezed in hand
Soft	>12 ≤25	Can be moulded by light finger pressure
Firm	>25 ≤50	Can be moulded by strong finger pressure
Stiff	>50 ≤100	Cannot be moulded by fingers Can be indented by thumb
Very stiff	>100 ≤200	Can be indented by thumb nail
Hard	>200	Can be indented with difficulty by thumb nail

Classification Symbols

Where laboratory tests are not used to classify soils letter symbols are shown in brackets e g (CH) .

		Description name	Letter Symbol
Coarse Components	Main terms	GRAVEL	G
		SAND	S
	Qualifying terms	Well graded	W
		Poorly graded	P
Fine Components	Main terms	SILT	M
		CLAY	C
	Qualifying terms	Of low plasticity	L
		Of medium plasticity	I
		Of high plasticity	H
Organic Components	Main terms	PEAT	P_t
		ORGANICS	O

A-Line Chart for Classification of Fine Grained Soils



Soil Moisture

Term	Field Guide to Soil Moisture
Dry (D)	Cohesive soils, hard or friable or powdery, well dry of plastic limit Granular soil, cohesionless and free-running
Moist (M)	Soil feels cool, darkened in colour Cohesive soil can be moulded Granular soil tends to cehere
Wet (W)	Soil feels cool, darken in colour Cohesive soil usually weaken and free water forms on hands when handling Granular soil tends to cohere

LAST UPDATED MARCH 2007

PHOTOGRAPHIC REPRODUCTION
50 MILLIMETRES ON ORIGINAL DRAWING

FILE No. -
CHECKED J SLATER
APPROVED N FOK GROUP MANAGER
DRAWN VICROADS DESIGN EAST

GEOPAVE MATERIALS TECHNOLOGY

SUMMARY OF GEOTECHNICAL TERMS AND SYMBOLS
SHEET 1 of 2
(FOR DETAILED DESCRIPTION SEE AUSTRALIAN STANDARD AS 1726)

GEOTECHNICAL INVESTIGATION
Catalog : Materials Project : Geology File : 396223v8.dgn
CONTRACT NO. - SHEET 1 OF 2 DRAWING NO. 396223

ROCK DESCRIPTION

Rock Material

Strength

Letter Symbol	Term	Point Load Index (MPa) I_{s50}
EL	Extremely low	≤ 0 03
VL	Very low	>0 03 ≤ 0 1
L	Low	> 0 1 ≤ 0 3
M	Medium	> 0 3 ≤ 1 0
H	High	> 1 0 ≤ 3 0
VH	Very high	> 3 0 ≤ 10
EH	Extremely high	>10

Core Fractures

The fracture state is described by the Rock Quality Designation (RQD)

$$RQD\ (\%) = \frac{\text{Sum of core pieces} > 100\text{mm in length(mm)}}{\text{Length of core run (mm)}} \times 100$$

NOTES 1 Breaks produced by drilling or handling are ignored in the summation
2 Length of core run includes any core losses

Rock Weathering

Term	Symbol	Description
Residual Soil	RS	Soil developed on extremely weathered rock, the mass structure and substancwe 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, i e 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 be 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 Mass

Spacing of Planar Structures (e g bedding, laminations etc)

Term		Spacing
Very thick	All Rock Types	> 2m
Thick	All Rock Types	> 600mm ≤ 2m
Medium	All Rock Types	> 200mm ≤ 600mm
Thin	All Rock Types	> 60mm ≤ 200mm
Very Thin	All Rock Types	> 20mm ≤ 60mm
Thickly laminated (Sedimentary) / Narrow (Igneous & Metamorphic)		> 6mm ≤ 20mm
Thinly laminated (Sedimentary) / Very narrow (Igneous & Metamorphic		≤ 6mm

Discontinuity Spacing in One Dimension (e g joints, shear zones etc)

Letter Symbol	Term	Spacing
VW	Very widely spaced	> 2m
W	Widely spaced	> 600mm ≤ 2m
M	Medium spaced	> 200mm ≤ 600mm
C	Closely spaced	> 60mm ≤ 200mm
VC	Very closely spaced	> 20mm ≤ 60mm
EC	Extremely closely spaced	≤ 20mm

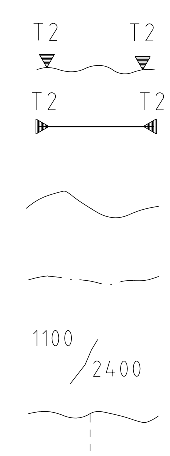
Planar Structures and Discontinuities

Symbol	Term
S_o	Bedding plane joint
S_v	Sub-vertical joint
S_H	Sub-horizontal joint
e g 30/145, 45/063	Angle of dip/dip direction relative to magnetic north (in degrees)

Discontinuity Spacing in Three Dimensions (not applicable to rock core)

First term	Spacing
Very large	> 2m
Large	>600mm ≤ 2m
Medium	> 200mm ≤ 600mm
Small	> 60mm ≤ 200mm
Very small	≤ 60mm
Second Term	**Nature of Block**
Blocky	Equidimensional
Tabular	Thickness much less than length or width
Columnar	Height much greater than cross section

Seismic Refraction Testing Symbols



Seismic traverse location in section
Seismic traverse location in plan
Interface plotted from complete data coverage
Interface plotted from partial data coverage
Seismic velocity interface (Seismic velocity, m/sec)
Lateral velocity change

LAST UPDATED MARCH 2007

PHOTOGRAPHIC REPRODUCTION 0 10 20 30 40 50 — 50 MILLIMETRES ON ORIGINAL DRAWING

FILE No. - | CHECKED J SLATER | APPROVED N FOK GROUP MANAGER | DRAWN VICROADS DESIGN EAST

GEOPAVE MATERIALS TECHNOLOGY

SUMMARY OF GEOTECHNICAL TERMS AND SYMBOLS SHEET 2 of 2

(FOR DETAILED DESCRIPTION SEE AUSTRALIAN STANDARD AS 1726)

GEOTECHNICAL INVESTIGATION

Catalog : Materials | Project : Geology | File : 396224.dgn

CONTRACT NO. - | SHEET 2 of 2 | DRAWING NO. 396224

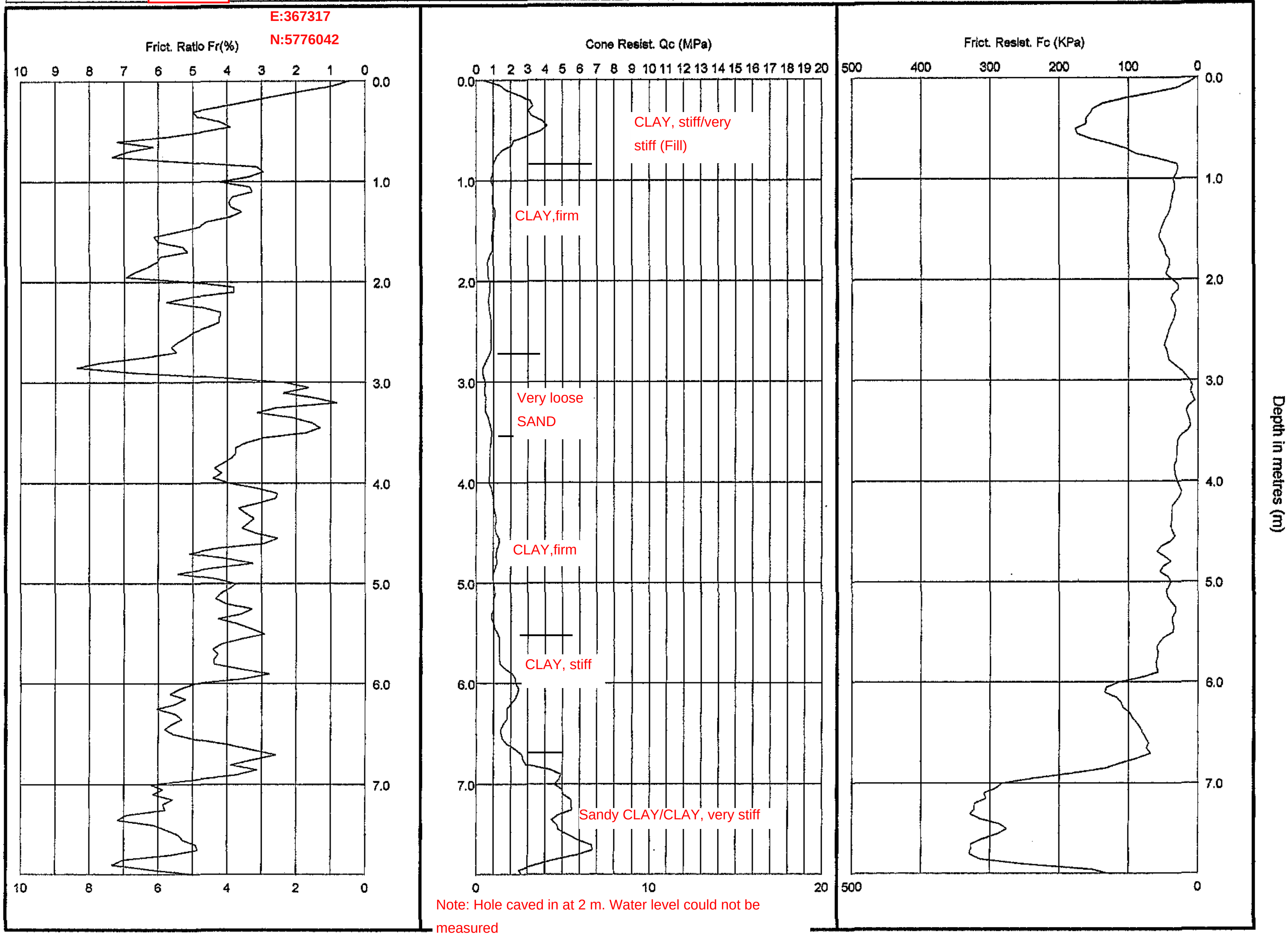
Appendix E

CPT plots

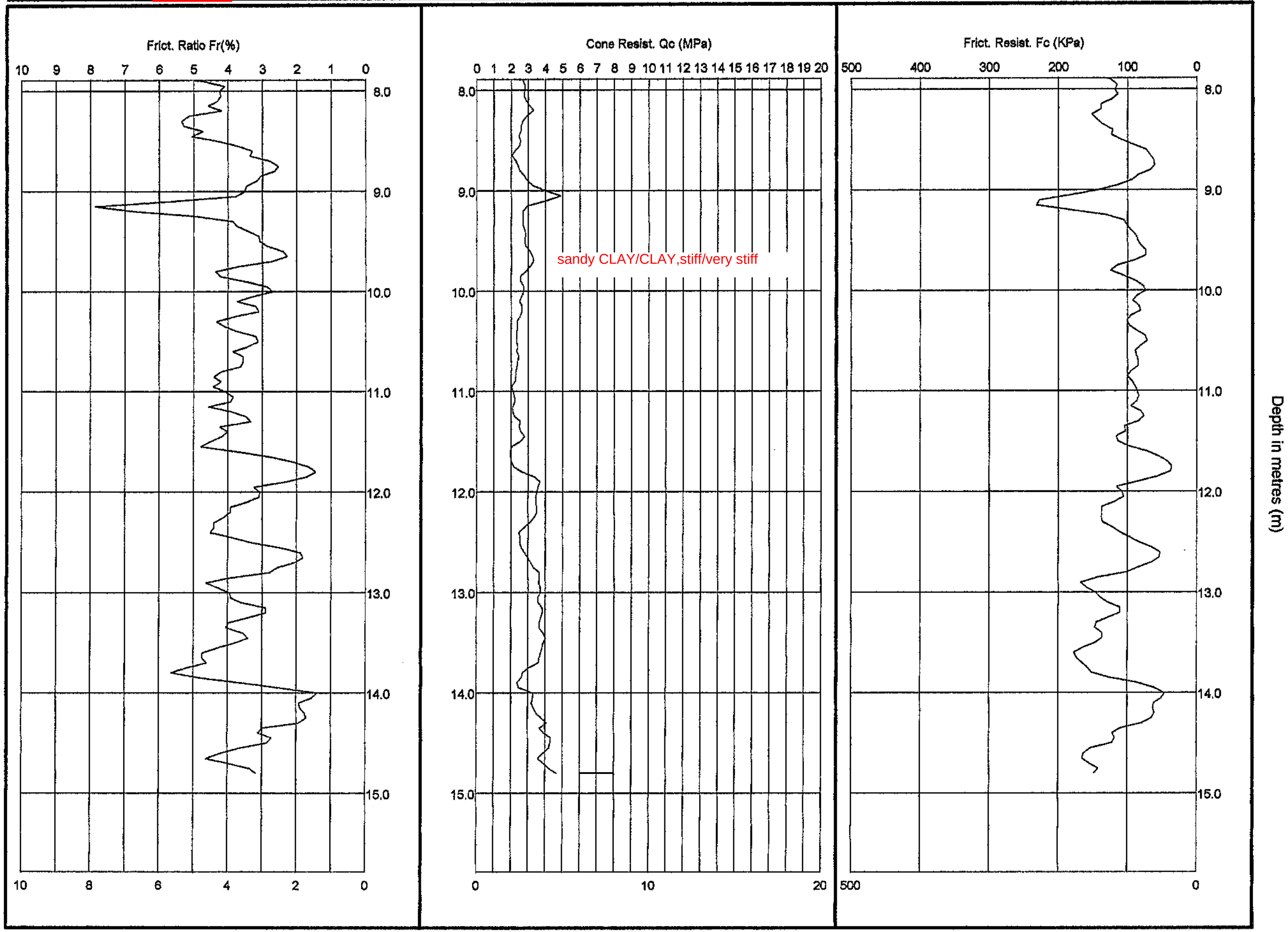
VICRoads Technical Consulting - Job : 52TW8154 - CPT result - Pakenham Koo Wee Rup Rd Ballarto Rd - Tue Aug 21 2007 11:16:00 - Site : C07-039 - Page 1 of 2

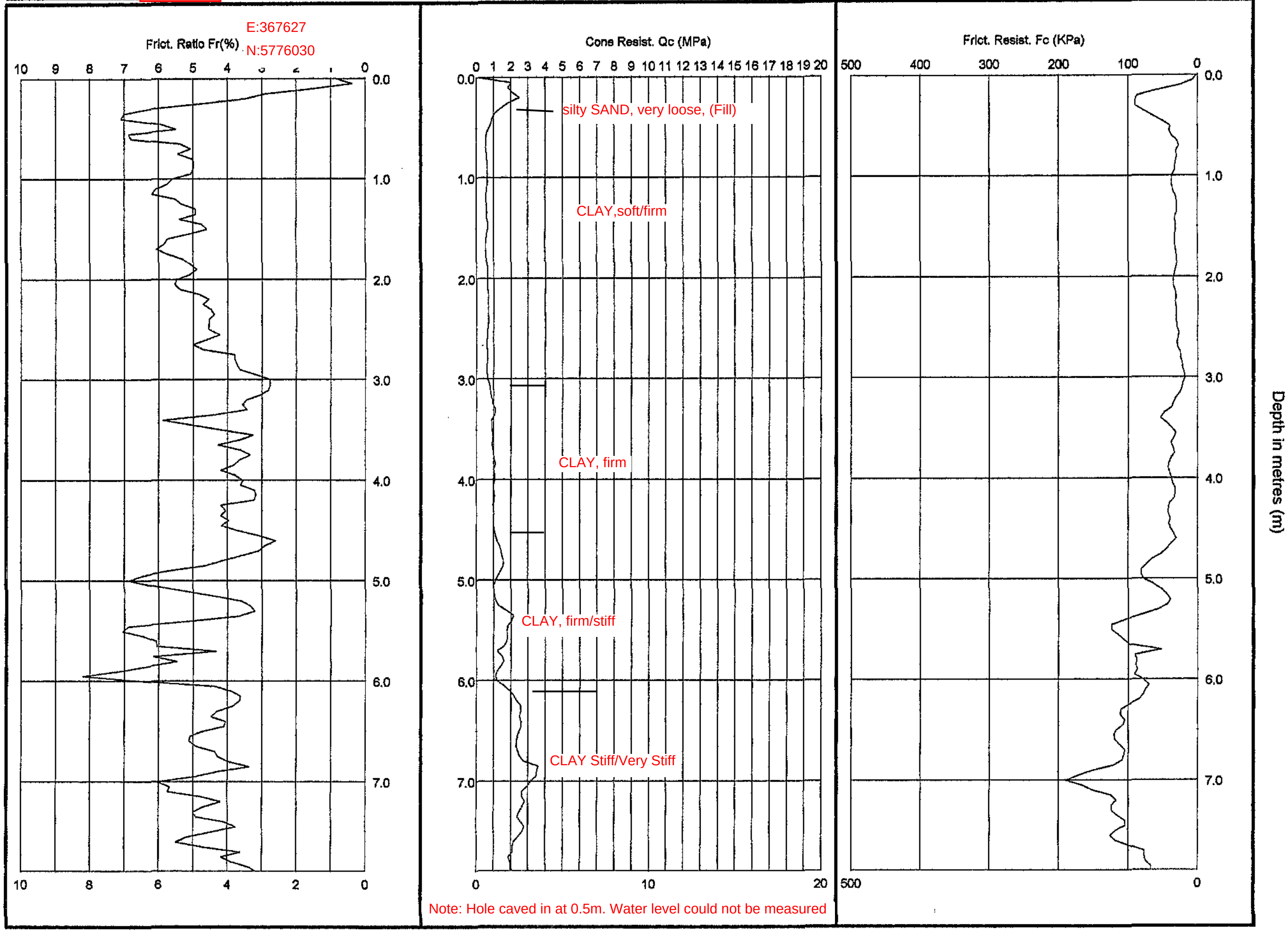
E:367317

N:5776042

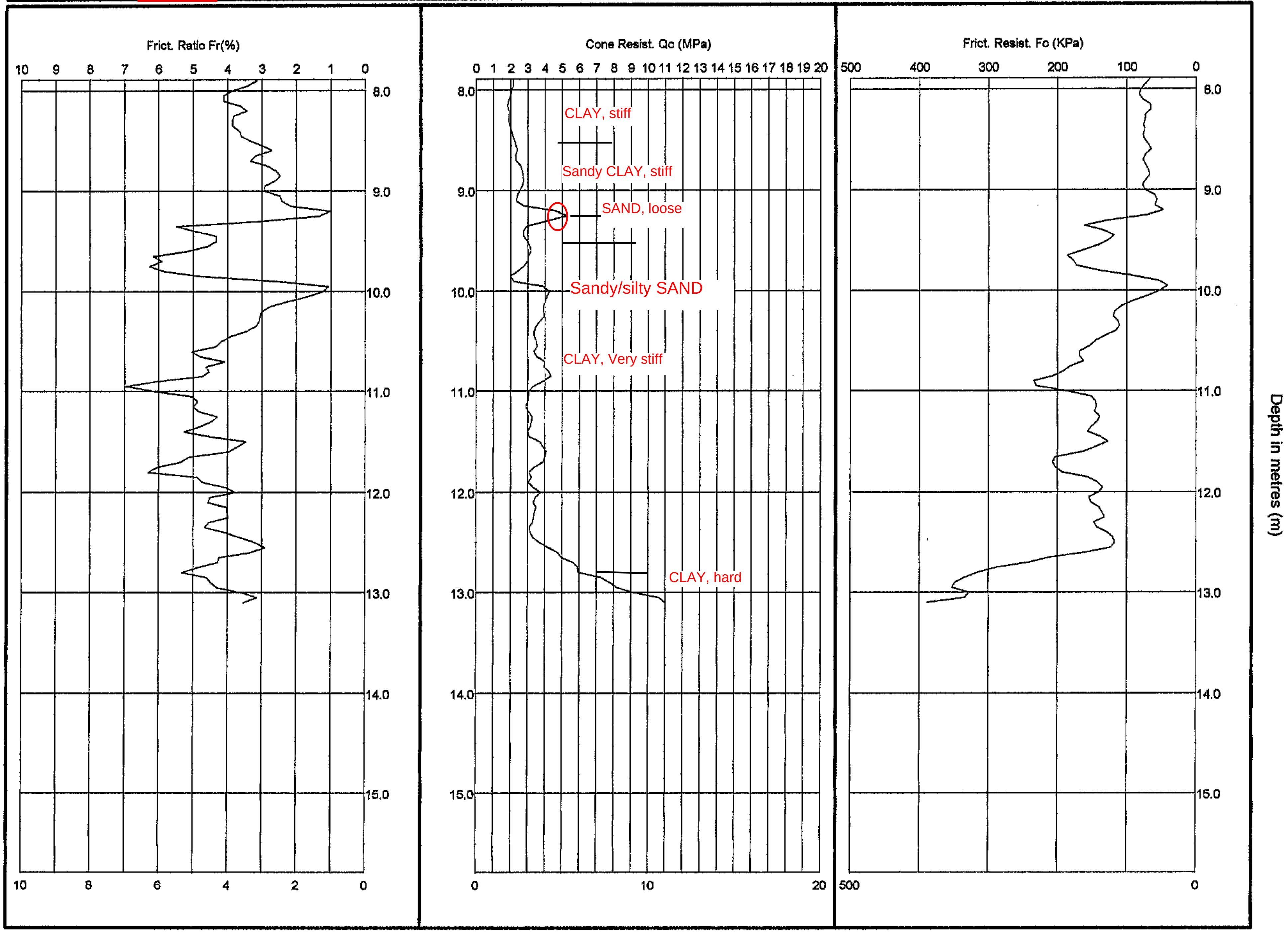


Note: Hole caved in at 2 m. Water level could not be measured

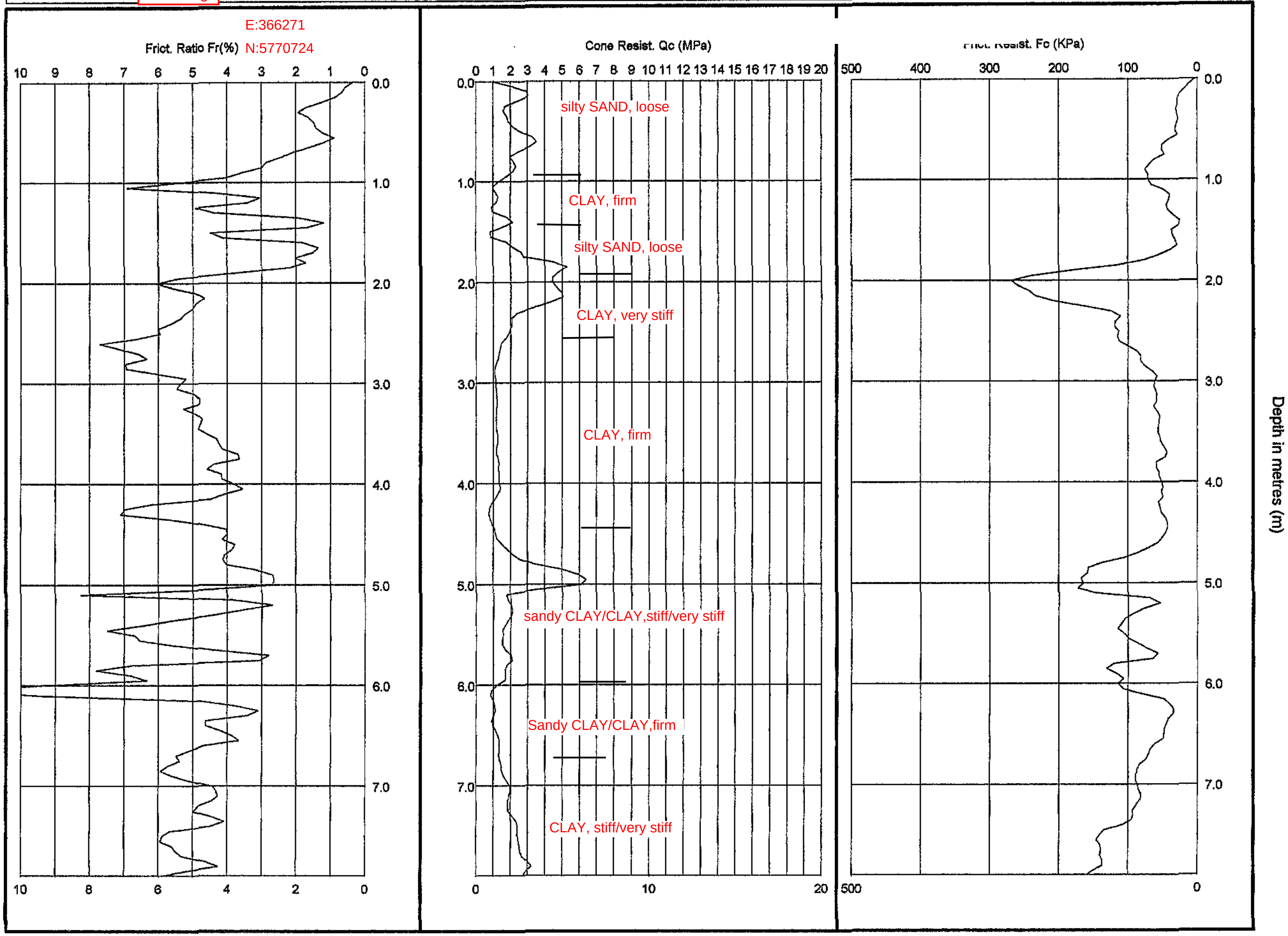

Frict. Ratio Fr(%)
Cone Resist. Qc (MPa)
Frict. Resist. Fc (KPa)
sandy CLAY/CLAY,stiff/very stiff
Depth in metres (m)
8.0
9.0
10.0
11.0
12.0
13.0
14.0
15.0

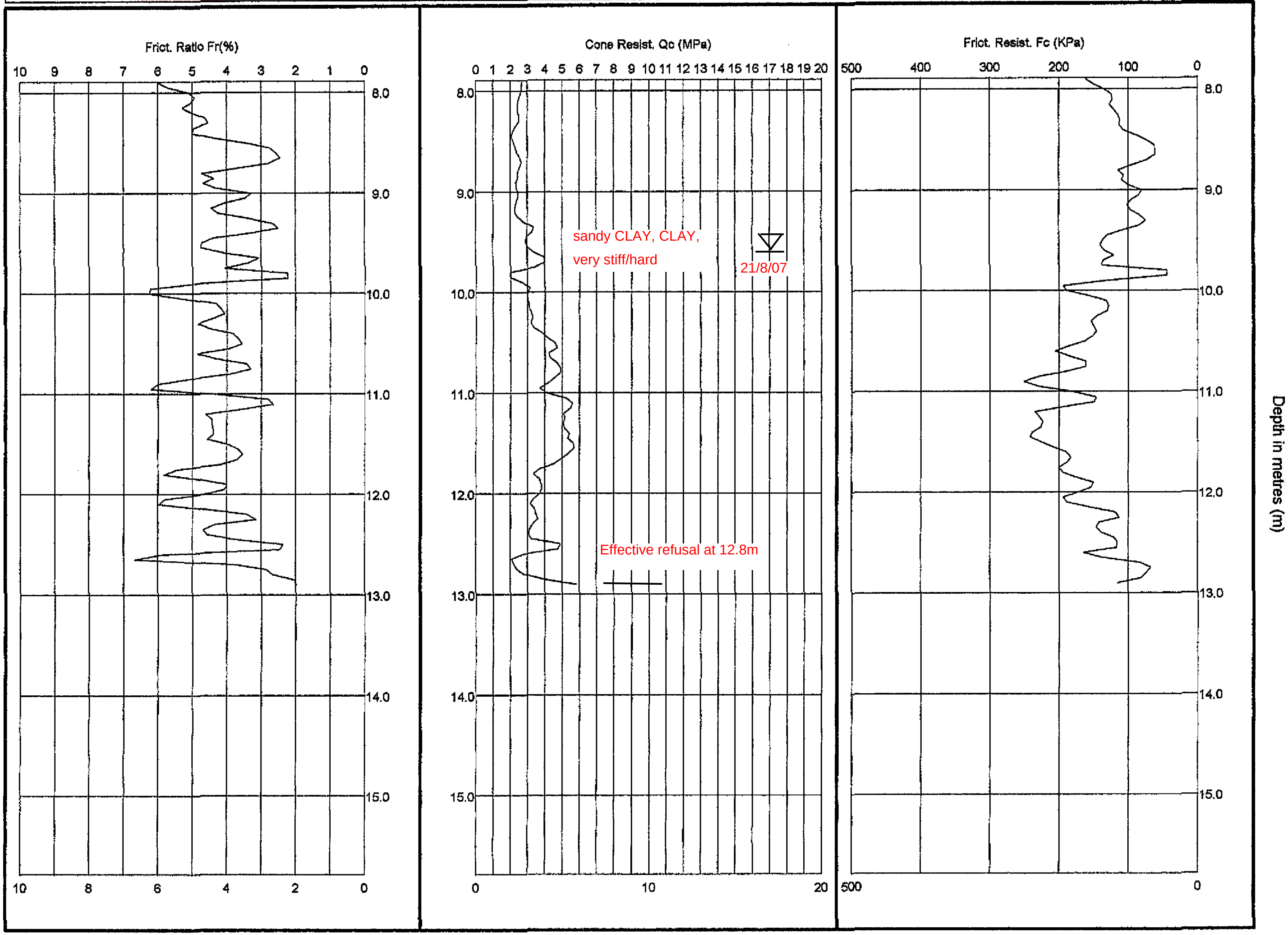


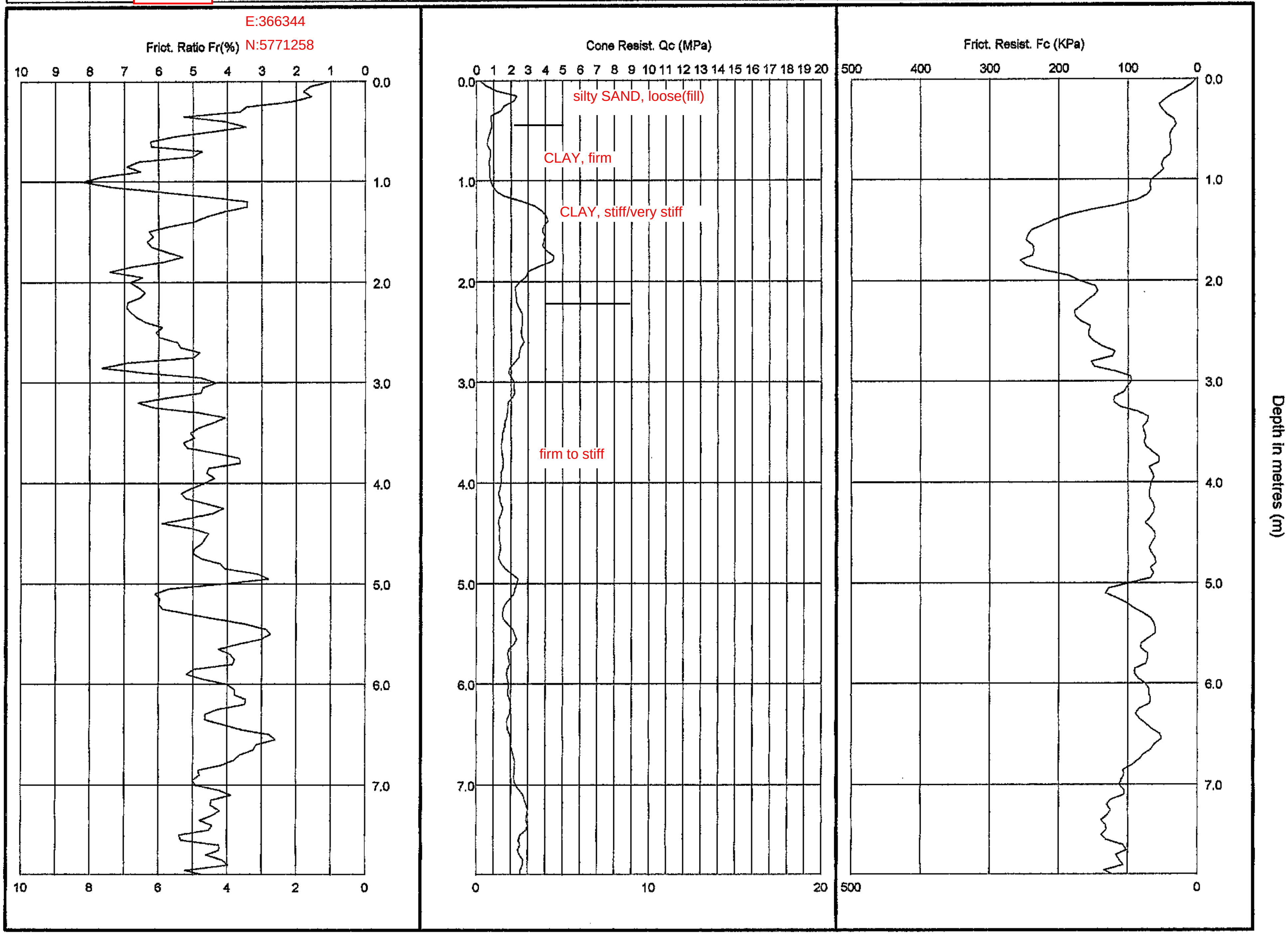
Note: Hole caved in at 0.5m. Water level could not be measured

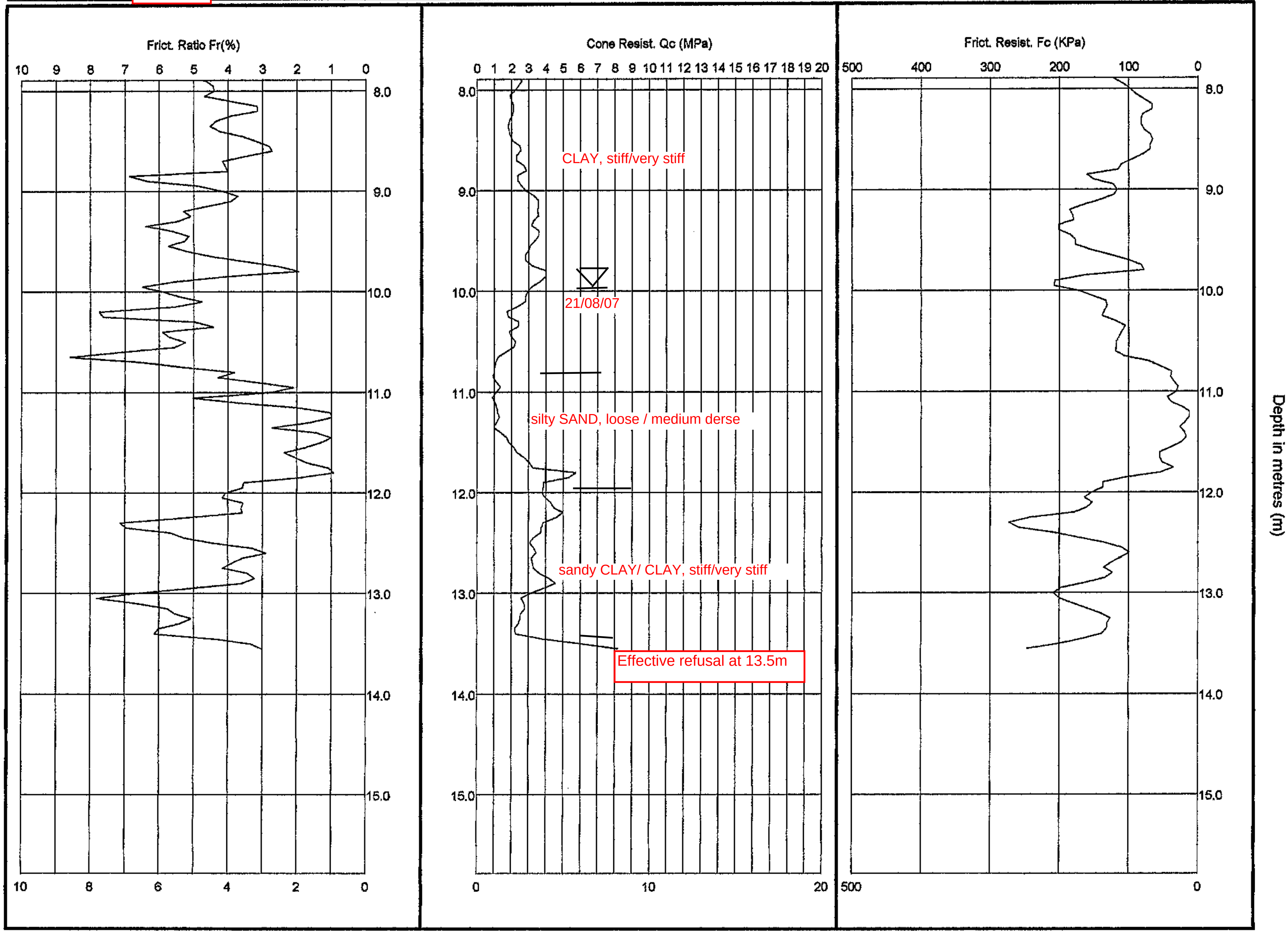

Frict. Ratio Fr(%)
Cone Resist. Qc (MPa)
Frict. Resist. Fc (KPa)
CLAY, stiff
Sandy CLAY, stiff
SAND, loose
Sandy/silty SAND
CLAY, Very stiff
CLAY, hard
Depth in metres (m)

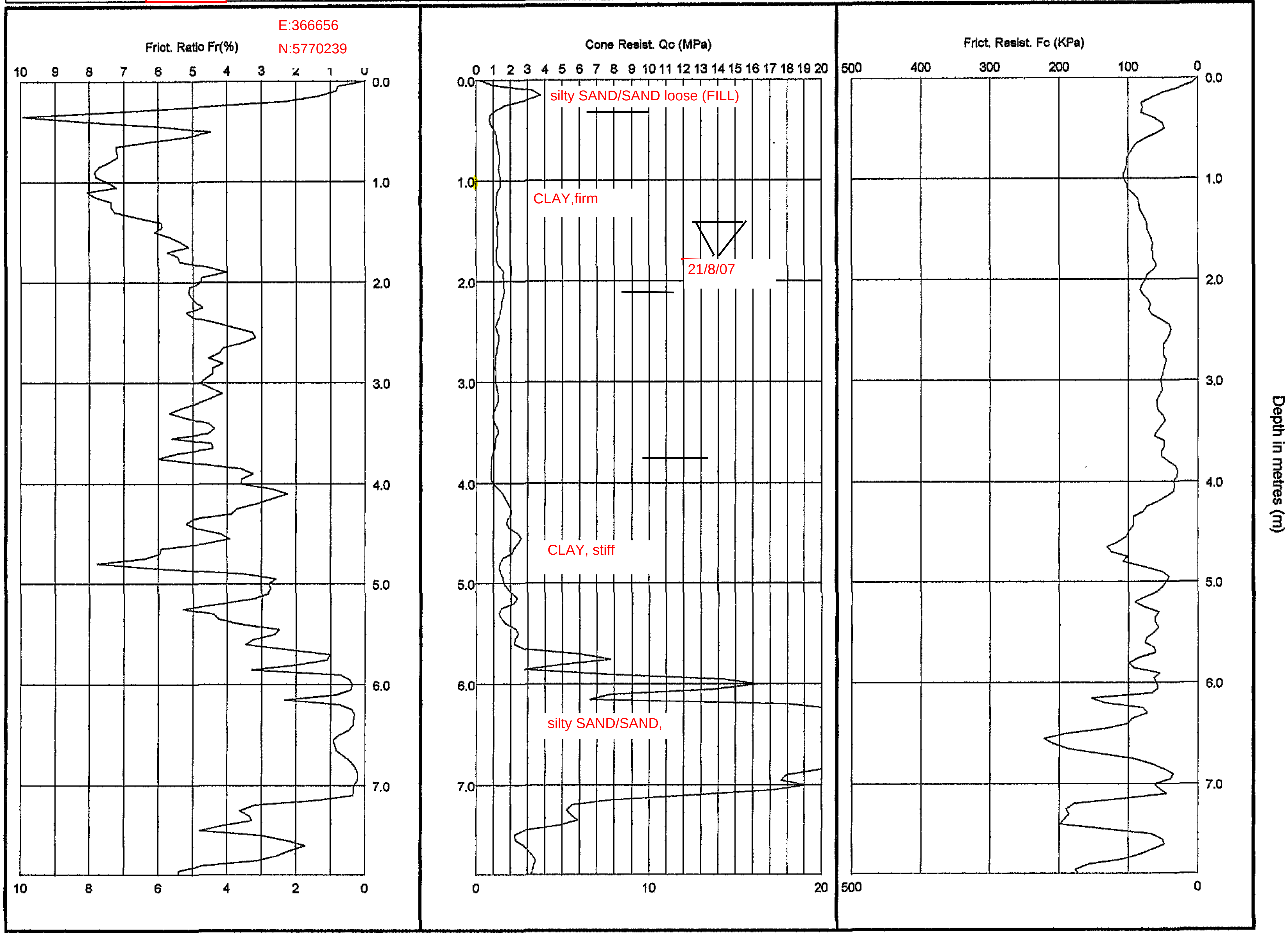
VICRoads Technical Consulting Job : 52TW8154 - CPT result - Pakenham Koo Wee Rup Rd near Drainage Channel - Tue Aug 21 2007 15:49:00 - Site : C07-041 - Page 1 of 2

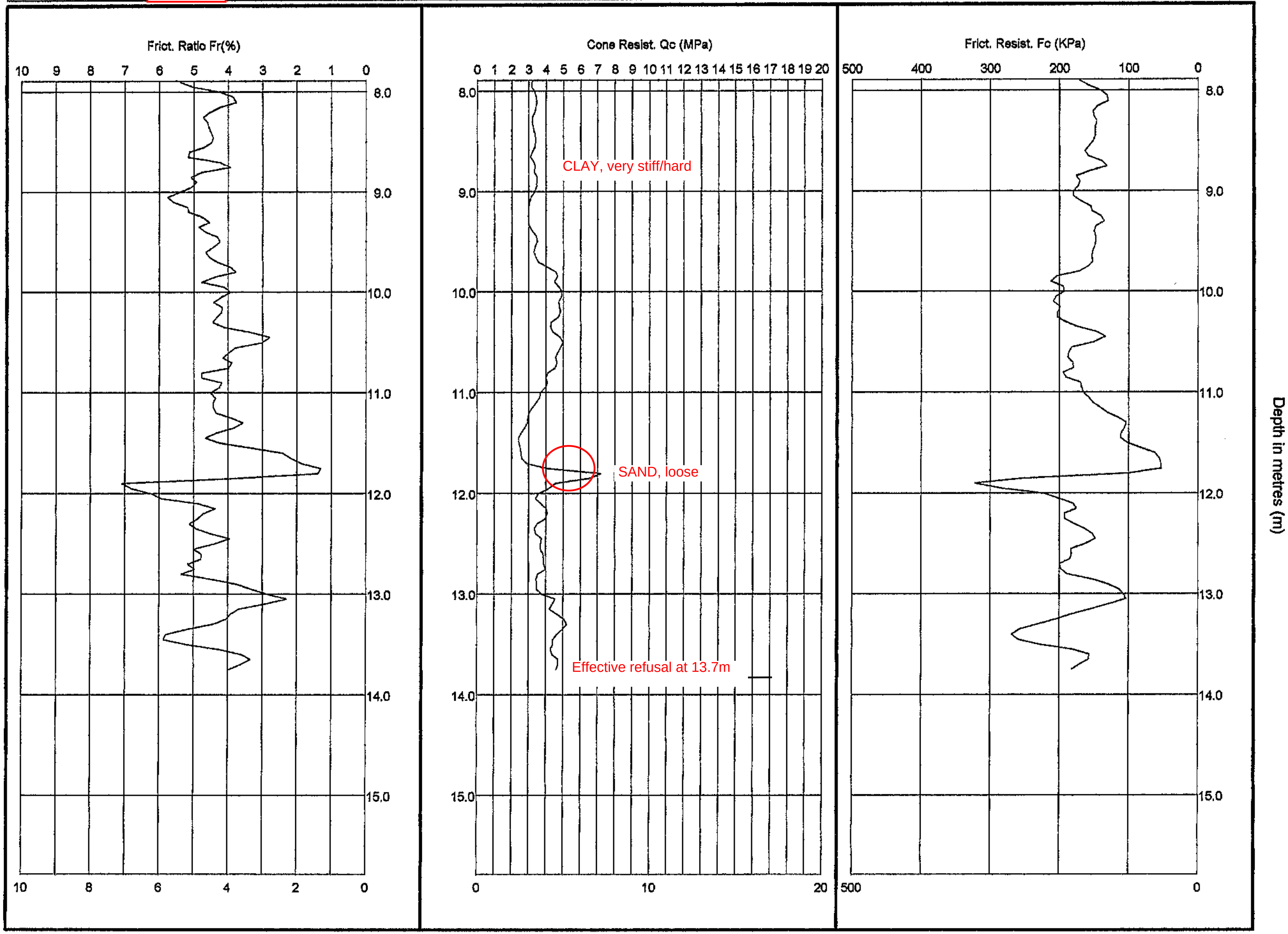



Frict. Ratio Fr(%)
10 9 8 7 6 5 4 3 2 1 0
Cone Resist. Qc (MPa)
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Frict. Resist. Fc (KPa)
500 400 300 200 100 0
8.0
9.0
10.0
11.0
12.0
13.0
14.0
15.0
sandy CLAY, CLAY,
very stiff/hard
21/8/07
Effective refusal at 12.8m
10 8 6 4 2 0
0 10 20
500 0
Depth in metres (m)


E:366344
N:5771258
Frict. Ratio Fr(%)
Cone Resist. Qc (MPa)
Frict. Resist. Fc (KPa)
silty SAND, loose(fill)
CLAY, firm
CLAY, stiff/very stiff
firm to stiff
Depth in metres (m)

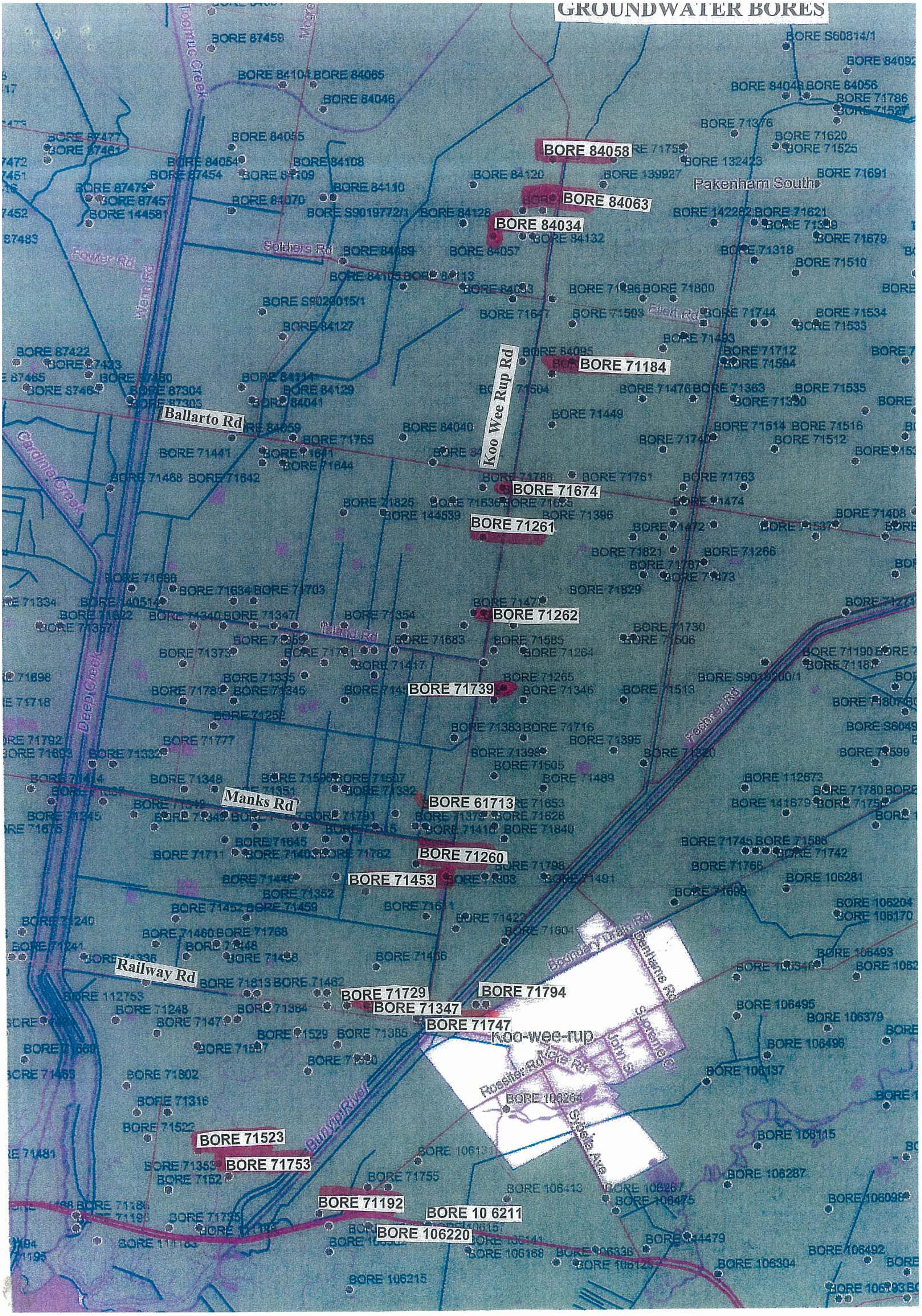

Frict. Ratio Fr(%)
Cone Resist. Qc (MPa)
Frict. Resist. Fc (KPa)
CLAY, stiff/very stiff
21/08/07
silty SAND, loose / medium derse
sandy CLAY/ CLAY, stiff/very stiff
Effective refusal at 13.5m
Depth in metres (m)
8.0
9.0
10.0
11.0
12.0
13.0
14.0
15.0


E:366656
N:5770239
Frict. Ratio Fr(%)
Cone Resist. Qc (MPa)
Frict. Resist. Fc (KPa)
silty SAND/SAND loose (FILL)
CLAY,firm
21/8/07
CLAY, stiff
silty SAND/SAND,
Depth in metres (m)
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0


Frict. Ratio Fr(%)
10 9 8 7 6 5 4 3 2 1 0
10 8 6 4 2 0
Cone Resist. Qc (MPa)
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
0 10 20
CLAY, very stiff/hard
SAND, loose
Effective refusal at 13.7m
Frict. Resist. Fc (KPa)
500 400 300 200 100 0
500 0
8.0
9.0
10.0
11.0
12.0
13.0
14.0
15.0
Depth in metres (m)

Appendix F1

Plan Showing Groundwater Bores


GROUNDWATER BORES
BORE 84058
BORE 84063
BORE 84034
BORE 71184
Koo Wee Rup Rd
Ballarto Rd
BORE 71674
BORE 71261
BORE 71262
BORE 71739
Manks Rd
BORE 61713
BORE 71260
BORE 71453
Railway Rd
BORE 71729
BORE 71794
BORE 71347
BORE 71747
Koo-wee-rup
BORE 71523
BORE 71753
BORE 71192
BORE 10 6211
BORE 106220
Pakenham South
Toomuc Creek
Cardinia Creek
Deep Creek
Soldiers Rd
Bunyip River

Appendix F2

Electrical Conductivity (EC) & pH

SITE NO	DITR NO	PARISH NO	SAMPLE NO	SAMPLE DATE	METHOD	SAMPLE FROM (m)	SAMPLE TO (m)	PH	EC uS/cm
71184		2920	9476	13/06/1967	BAL	21.33	46.9	8.1	
71184	3292000009	2920	9477	14/06/1967	BAL	21.33	46.9	8.1	
71184	3292000009	2920	9475	22/05/1967	FLO	22.25	24.1	7.8	
71184	3292000009	2920	9478	12/01/1971	AIR			8.5	1648
71184	3292000009	2920	9479	31/08/1977	FLO	20.72	36.6	8	560
71184	3292000009	2920	9480	3/05/1978	FLO			8.09	567
71184	3292000009	2920	9481	11/12/1978	BAL			8.12	900
71184	3292000009	2920	9482	30/01/1979	AIR			7.35	2850
71184	3292000009	2920	9483	22/05/1979	BAL			8.2	3000
71184	3292000009	2920	31172	17/08/1983	NKN			7.5	570
71184	3292000009	2920	33111	13/12/1984	NKN			7.4	520
71184	3292000009	2920	43114	10/04/1985	BAL			8.1	500
71184	3292000009	2920	43133	11/09/1985	BAL			7.6	520
71184	3292000009	2920	43157	22/01/1986	BAL			7.8	440
71192		2920	9607	22/05/1975	BAL			7.64	2120
71192	3292000018	2920	9608	14/07/1975	BAL			7.7	2240
71192	3292000018	2920	9609	18/08/1975	BAL			8.44	1930
71192	3292000018	2920	9610	17/09/1975	BAL			7.59	2040
71192	3292000018	2920	9611	15/01/1976	BAL			7.88	2110
71192	3292000018	2920	9612	11/02/1976	BAL			7.81	2010
71192	3292000018	2920	9613	30/03/1976	BAL			7.81	2150
71192	3292000018	2920	9614	30/08/1977	FLO	42.67	123.4	8.24	1870
71192	3292000018	2920	9615	29/11/1977	FLO	42.67	123.4	8	1990
71192	3292000018	2920	9616	9/02/1978	FLO	42.67	123.4	7.92	2050
71192	3292000018	2920	9617	4/04/1978	FLO			7.5	2350
71192	3292000018	2920	9618	2/05/1978	FLO			8.13	2130
71192	3292000018	2920	9619	6/07/1978	FLO	42.67	123.4	8	2155
71192	3292000018	2920	9620	12/09/1978	FLO			8.2	2090
71192	3292000018	2920	51642	24/02/1982	FLO			7.65	2900
71192	3292000018	2920	30760	20/06/1983	NKN			7.8	2100
71192	3292000018	2920	31041	9/08/1983	NKN			7.5	2100
71192	3292000018	2920	31059	9/08/1983	NKN			7.5	2100
71192	3292000018	2920	39370	11/11/1987	BAL	42.7	123.5	8	2200
71192	3292000018	2920	53115	28/04/1988	NKN			8	1400
71192	3292000018	2920	41344	22/11/1988	NKN	42.7	123.4	7.3	2000

71192	3292000018	2920	0	23/11/1989	MON				
71192	3292000018	2920	42739	23/11/1989	NKN	42.7	123.4	7.2	2000
71192	3292000018	2920	71431	23/11/1989	NKN				2010
71192	3292000018	2920	44315	12/12/1990	PUM			7.6	2000
71192	3292000018	2920	45591	4/12/1991	NKN			7.4	2100
71192	3292000018	2920	48183	15/12/1992	PUM			7.2	2000
71192	3292000018	2920	54102	17/11/1993	PUM			7.3	2000
71192	3292000018	2920	0	17/11/1993	MON				
71192	3292000018	2920	63482	14/11/1994	PUM	42	123	7.2	2000
71192	3292000018	2920	0	15/11/1994	MON				
71192	3292000018	2920	63264	15/11/1994	NKN				1996
71192	3292000018	2920	81429	6/12/1995	PUM			7.3	2200
71192	3292000018	2920		15/12/2002	MON				
71192	3292000018	2920	1	15/12/2002	PUM			7.29	1740
71193		2920							
71246		2920	9637	4/10/1968	AIR	56.69	67.4	7.6	1550
71246	3292008024	2920	9638	24/01/1979	BAL			7.95	1950
71246	3292008024	2920	9639	8/06/1979	AIR			7.92	1925
71252		2920	9643	24/01/1979	BAL			7.9	1900
71256		2920							
71260		2920	9651	9/01/1969	BAL			8.4	2140
71260	3292008038	2920	9650	12/07/1967	PUM			8	
71261		2920	9652	12/07/1967	BAL	24.38	25.6	8.2	
71262		2920	9653	6/06/1962	FLO	9.14	12.2	7.5	
71263		2920	9654	11/07/1967	BAL	60.96	73.2	8.4	
71327		2920	9701	23/01/1979	BAL			7.95	1990
71327	3292008106	2920	9702	20/06/1979	AIR			7.92	2000
71330		2920	9705	24/01/1979	BAL			8.3	2040
71354		2920	9707	23/01/1979	BAL			8.45	2040
71355		2920	9708	20/02/1980	BAL			7.2	1850
71379		2920	9712	25/01/1979	BAL			7.7	1760
71379	3292008165	2920	9713	20/06/1979	BAL			6.9	1900
71611		2920	9722	3/11/1960	FLO			6.6	
71611	3292008398	2920	9721	1/06/1960	FLO			6.4	
71674		2920	9745	21/01/1971	FLO	0	32	7.7	1202
71681		2920	9757	4/02/1972	AIR	48.76	0	6.96	1483

71681	3292010011	2920	30999	6/07/1983	NKN			7.9	2000
71683		2920	9761	5/05/1972	FLO	37.49	43.6	5.84	1862
71686		2920	36788	18/07/1986	NKN			8.4	1800
71686	3292010016	2920	45510	8/11/1991	PUM			7.3	2000
71688		2920	9767	4/03/1973	BAL	57.91	62.8	7.6	1840
71690		2920	9769	29/06/1973	FLO			8.25	1820
71700		2920	9782	15/03/1974	AIR	42.67	48.2	7.39	1570
71702		2920	9784	2/08/1974	FLO	24.68	27.4	7.94	1615
71702	3292010032	2920	9785	2/08/1974	AIR	54.25	55.8	7.24	1620
71702	3292010032	2920	9786	2/08/1974	FLO	7.61	12.8	7.58	1640
71702	3292010032	2920	9787	2/08/1974	FLO	56.69	64.9	8.13	1970
71703		2920							
71710		2920	9790	25/01/1973	FLO	35.96	40.8	7.38	2080
71710	3292010040	2920	9791	31/01/1973	FLO	55.47	61.3	8.32	1930
71711		2920	9792	30/03/1973	FLO	46.93	51.8	6.71	1991
71713		2920							
71714		2920	9794	30/05/1975	AIR	29.26	31.7	8.2	2170
71716		2920	9796	25/01/1979	BAL			8	1810
71716	3292010046	2920	9797	19/06/1979	BAL			7.6	1860
71721		2920	9803	8/11/1976	FLO	35.35	37.2	7.11	2400
71722		2920	9804	7/02/1977	FLO	20.72	22.9	4.15	2740
71722	3292010054	2920	9805	7/02/1977	FLO	56.38	65.2	7.53	3740
71722	3292010054	2920	9806	7/02/1977	FLO	65.22	70.1	8.28	2120
71729		2920	9814	9/02/1978	AIR	49	53.7	6.79	1860
71733		2920	9817	5/10/1976	AIR	65.5	71.5	7.62	2140
71735		2920							
71737		2920	9819	6/10/1978	FLO	44	47	7.71	720
71739		2920	9821	17/07/1978	AIR	0	44.8	7.82	1850
71743		2920	9826	4/05/1979	AIR	27	28.3	8.5	1850
71747		2920	9830	4/05/1979	AIR	13.5	14.4	6.4	3080
71751		2920							
71753		2920	9835	3/03/1980	AIR	53	56.4	6.1	1500
71755		2920	9837	3/03/1980	AIR	28.5	30.5	6.95	1080
71765		2920	51655	26/03/1982	AIR	41	45.2	8.3	1740
71768		2920	9850	28/05/1981	AIR	54	56.4	8	1850
71776		2920	51659	28/05/1982	AIR	46.5	51	8.3	1900

71777		2920	51660	24/09/1982	AIR	46.94	50	8.3	1900
71798		2920	36000	7/05/1986	PUM	66.1	72.2	7.2	1800
71798	3292010132	2920	38112	8/04/1987	PUM	66.1	72.2	7.2	1800
71798	3292010132	2920	39391	24/11/1987	PUM	66.1	72.2	7.1	1800
71798	3292010132	2920	40526	12/05/1988	PUM	66.1	72.2	6.9	1800
71798	3292010132	2920	41320	16/11/1988	PUM	66.1	72.2	6.7	1800
71798	3292010132	2920	41926	10/04/1989	PUM	66.1	72.2	7.8	1800
71798	3292010132	2920	42784	4/12/1989	PUM	66.1	72.2	7.5	2100
71798	3292010132	2920	43418	11/04/1990	PUM	66.1	72.2	6.8	1900
71798	3292010132	2920	44156	14/11/1990	PUM	66.1	72.2	6.8	1900
71798	3292010132	2920	44890	10/04/1991	PUM			6.5	2300
71798	3292010132	2920	45511	1/11/1991	PUM	66.1	72.2	6.6	2100
71798	3292010132	2920	46071	11/02/1992	PUM	66.1	72.2	6.8	1900
71798	3292010132	2920	48419	14/12/1992	PUM	66.1	72.2	7.1	2000
71798	3292010132	2920	50065	1/04/1993	PUM	66.1	72.2	6.7	2000
71798	3292010132	2920	54176	9/12/1993	PUM	66.1	72.2	6.8	1800
71798	3292010132	2920	68313	18/11/1994	PUM	66.1	72.2	6.7	1800
71798	3292010132	2920	68363	3/04/1995	PUM	66.1	72.2	6.7	1900
71798	3292010132	2920	81409	13/12/1995	PUM			6.7	2000
71798	3292010132	2920	76457	29/03/1996	PUM			6.6	1800
71803		2920	33851	9/02/1985	BAL	39	42.6	7.4	2700
71811		2920	35166	22/11/1985	BAL	41	44.8	7.5	2000
71813		2920	35889	25/02/1986	NKN			8.2	1900
71817		2920	37558	4/12/1986	NKN			8.2	2600
71820		2920	38556	14/05/1987	NKN			8.2	2100
71825		2920	41025	8/07/1988	NKN			8	1800
71840		2920	44603	14/02/1991	BAL	39	42.5	7.7	2300
84031		3272	14078	12/03/1980	AIR	7.6	12	7.4	2880
84031	3327200008	3272	14079	12/03/1980	AIR	19	20	7.5	7010
84031	3327200008	3272	14080	12/03/1980	AIR	38	43	7.2	7550
84031	3327200008	3272	31042	9/08/1983	NKN			7.2	7500
84031	3327200008	3272	31060	9/08/1983	NKN			7.2	7500
84034		3272	14087	10/01/1969	BAL	20.72	22.9	7.4	3950
84034	3327208002	3272	14088	18/08/1971	AIR			8.25	3485
84055		3272	14094	12/01/1971	FLO			7.6	9287
84055	3327210002	3272	14095	8/04/1971	FLO	19.8	21	6.91	10286

84057		3272	14098	1/04/1972	BAL	44.19	46	8.08	3483
84058		3272	14099	20/03/1972	FLO	8.53	10.4	6.74	3215
84058	3327210006	3272	14100	20/03/1972	FLO	31.39	34.4	7.36	4447
84059		3272	14101	4/10/1972	AIR	24.99	28.6	8.67	2035
84060		3272	14102	12/12/1972	FLO	9.14	12.2	7.18	7932
84063		3272	14105	1/02/1974	AIR	22.55	25.6	7.55	3800
84063	3327210011	3272	14106	1/02/1974	AIR	34.13	46.6	7.28	3120
84076		3272	14116	4/05/1979	AIR	31	34.5	8.38	2450
84084		3272	14119	4/12/1981	AIR	20	24.5	8.4	2950
84091		3272	52112	25/01/1982	FLO	42.67	49.1	6.9	4800
84104		3272	23466	9/01/1976	FLO	15.84	18.6	2.46	8700
84105		3272	41456	11/10/1988	BAL	25	29.2	7.6	2600
84107		3272	44046	16/10/1990	BAL	21.8	25.1	7.5	1900
87454		3363	34161	17/03/1985	BAL	290	330	7.6	8400
87454	3336310044	3363	34161	17/03/1985	BAL	290	330	7.6	8400
87459		3363	38341	21/02/1987	NKN			7.8	7000
106191		3935	22281	23/02/1973	FLO	0	59.4	6.11	1238
106192		3935	22282	23/02/1973	AIR			6	2160
106211		3935	22306	13/07/1973	AIR	47.85	53.9	4.46	7007
106220		3935	22311	2/02/1974	BAL	61	71	6.32	1400
106223		3935	22312	7/03/1975	AIR	47.55	77.7	7.7	1920
106264		3935	22349	3/03/1980	AIR	64	66.3	7.7	1700
112753		2920	45885	6/02/1992	NKN			7.5	2000
112881		2920	45930	16/02/1992	NKN			7.5	1900

Appendix F3

Standing Water Level (SWL)

SITE NO	WATER SCREEN	FROM (m)	TO (m)	LITHO LOGY	CASING DEPTH (m)	DIA (mm)	SWL (m)	PUMP DEPTH (m)	PUMP RATE (1/sec)	PUMP TIME (H:M)	DRAW DOWN (m)	EC	TEST TYPE	TEST DATE
71192	SCREEN	43	123											2/06/1972
71713	SCREEN	48.8	53.6	SAND			5.8				1.2		BAL	4/11/1974
71713	WATER	48.8	53.6	SAND	48.8	114	5.8	53.6	0.4		1.2	0		4/11/1974
71729	SCREEN	49	53.7	NOT		102	14			0:30	5		BAL	9/02/1978
71729	WATER	49	53.7	SAND	53.7	114	14	0	0.4		5	0		9/02/1978
71739	SCREEN	44	44.8	NOT			9.1			2:00	5.2		BAL	30/06/1978
71739	WATER	44	44.8	SAND	44.8	114	9.1	44.8	0.7		5.2	0		30/06/1978
71743	SCREEN	27	28.3	SAND		102	2.5			0:15	4		BAL	21/03/1979
71743	WATER	27	28.3	SAND	27	114	2.5	28.3	1		4	0		21/03/1979
71747	SCREEN	13.5	14.4	SAND		102	2.5			0:30	4		BAL	10/03/1979
71747	WATER	13.5	14.4	SAND	13.5	114	2.5	14.4	0.5		4	0		10/03/1979
71753	SCREEN	53	56.4	SAND		102	6			0:30	4		BAL	22/01/1980
71753	WATER	53	56.4	SAND	53	114	6	46.4	0.5		4	0		22/01/1980
71755	SCREEN	28.5	30.5	SAND		102	6.5			0:15	1		BAL	20/01/1980
71755	WATER	28.5	30.5	SAND	28.5	114	6.5	30.5	1		1	0		20/01/1980
71794	SCREEN	65	70	SAND		101	7			0:30	5		BAL	12/01/1984
71794	SCREEN	56	60	SAND		101								12/01/1984
71794	WATER	65	70	SAND	65	114	0	0	0		0	0		12/01/1984
71794	WATER	56	65	SAND	65	114	7	70	1.3		5	0		12/01/1984
84058	SCREEN	31.4	34.7	NOT			4.3				16.4		NKN	20/03/1972
84058	WATER	31.4	34.7	SAND	35	114	4.3	0	0.5		16.4	0		20/03/1972
84063	SCREEN	0	47.5	NOT						0:30			BAL	21/11/1973
84063	WATER	34.1	46.6	BASA	29.3	127	4	0	0.6		15.2	0		21/11/1973
84063	WATER	22.6	25.9	SAND	29.3	127	10.7	0	0.5		23.2	0		21/11/1973

Appendix G

Rainfall Data

Stn_Num	Year	NameAndL	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
86314	1996	Total Montl	58.8	98.2	58	83.6	25.8	83.2	115	99	104.4	69.8	46.2	30.4	872.4
86314	1997	Total Montl	23.4	1.8	23.8	20.4	71.4	52	42	49	63.8	42.2	80.2	7.4	477.4
86314	1998	Total Montl	58	69.6	24.4	53.2	59	67.6	65.8	16.2	66.6	128.4	65	87.8	761.6
86314	1999	Total Montl	47.8	51.8	58.2	48.2	60	49.2	30.6	71.4	53	62.6	33.4	90	656.2
86314	2000	Total Montl	51.8	61	14.6	51	142.3	48.4	55.9	62.4	100.8	102.8	47.4	67.5	805.9
86314	2001	Total Montl	22	67.2	57.5	142.3	26.8	67.1	21.2	96.7	30.7	111.1	75.6	52.2	770.4
86314	2002	Total Montl	53.1	76.6	13.4	53.8	66.2	45.3	46.2	45.2	73.2	57.2	34.8	34.1	599.1
86314	2003	Total Montl	31.6	8	39.5	64.8	26.5	28.6	105.5	81.9	67.4	98	37	39.4	628.2
86314	2004	Total Montl	60.6	33.7	24.8	66.5	56.6	99.7	54.6	75.2	108.7	57.7	116.9	54.2	809.2
86314	2005	Total Montl	33.8	134	14.6	28.5	20.3	42.1	58.7	103.4	82.2	56.6	87.8	77.3	739.3
86314	2006	Total Montl	54.8	46.2	25.4	82.7	78.2	15.8	35	42	41.8	19.2	44.5	31.7	517.3
86314	2007	Total Montl	29.2	40	41.9	23	66	63.5	100.4	53	—	—	—	—	—
86314	Number of	Total Montl	50	50	50	50	50	49	50	50	50	50	50	50	48
86314	Mean	Total Montl	48	45	47.6	63.3	73.6	63	70.9	78.2	82.5	78.6	65.8	60.9	781.7
86314	Median	Total Montl	46.9	41.7	44.1	56.7	72	62	66.7	79.9	82.3	72.9	65.3	51.5	800.6
86314	Lowest	Total Montl	2	1	9.9	12.3	20.3	15.8	21.2	16.2	19.2	19.2	14.4	7.4	477.4
86314	Highest	Total Montl	146.6	172.9	193.9	142.3	165.2	136.8	122	127.8	158.3	146.6	136.8	155.7	1035.6

Koo Wee Rup Rainfall Data