C.F.A. Training College

FIELD SITE APPRAISAL AND SAMPLING
BALLAN, VIC

Report E3517/1-AD August 1996

Coffey Partners International Pty Ltd
A.C.N. 003 692 019

Consulting Engineers, Managers and Scientists
Environment • Geotechnics • Mining • Water Resources

COFFEY

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E3517/1-AD MKSP:MW
7 August 1996

C.F.A. Training College
RMB 300
BALLAN VIC 3342

Attention:

Dear Sir

RE: **FIELD SITE APPRAISAL AND SAMPLING**
BALLAN, VIC

We are pleased to submit our report on the above project. Three copies are provided for your records. Your attention is drawn to the enclosed sheet "Important Information about your Environmental Site Assessment".

As requested, a copy of 32 photographs taken during the field investigations have also been dispatched under separate cover (refer E3517/1-AF dated 8 August, 1996).

Should you have any queries regarding the report or its findings, please contact the undersigned.

For and on behalf of
COFFEY PARTNERS INTERNATIONAL PTY LTD

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TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

1.0 INTRODUCTION

1.1 Background

This report presents the findings of an environmental site investigation undertaken by Coffey Partners International Pty Ltd at the C.F.A. Training College, Ballan VIC (refer Figure 1). The investigation was commissioned by (Local Purchase Order LP-127960) following the submission of our proposal EP3591/1-AA dated 11 July, 1996.

The investigations were undertaken to provide C.F.A. Training College with assistance in the delineation of former buried sludge pits which were used for flammable liquids fire training.

1.2 Previous Investigations

Excerpts from an environmental investigation conducted by Diomedes & Associates Pty Ltd in June 1996 (Diomedes, 1996) indicated the subsurface conditions for the area under investigation (refer Figure 2) generally comprised 0.1m to 0.8m of surface fill overlying silty clay, silty and gravelly clays overlying basalt. No groundwater was encountered during the investigation and the test bores were all terminated at refusal on the underlying basalts.

Soil vapour investigations reported by Diomedes (1996) indicated the presence of volatile hydrocarbons particularly in the vicinity of borehole BH3 (refer Figure 3).

2.0 STUDY METHODOLOGY

2.1 Objectives

The objectives of this study were to:

- delineate former buried sludge pits which were reportedly present on the site;
- assess the contaminant distribution within the soil profile in the vicinity of the sludge pits.

2.2 Scope of Work

The scope of work undertaken during the course of this assessment included:

- test-pit excavation;
- visual and olefactory observations;
- in-situ soil vapour survey;

- soil sampling;
- a laboratory analytical program;
- data interpretation and reporting of results.

3.0 INVESTIGATION METHODS AND PROCEDURES

3.1 Sampling Strategy

Soil sampling locations were selected in the field following discussions with of the C.F.A. Training College. Anecdotal reports suggested the sludge from the former pits was scraped up and dumped in a more recent excavation between the sludge pits and the golf course. Test pits TP1, TP2, TP3 and TP4 (refer Figure 3) did not reveal any evidence of this disposal pit and in accordance with directions, attention was focussed in the former sludge pit area which was visually contaminated.

3.2 In-Situ Soil Vapour Survey

A portable MicroTIP photoionisation detector (PID) was used to screen the site for the presence of fuel vapours in the soil during excavation of each test pit. The PID gives a reading of the total concentration of ionisable volatile organic compounds (VOC) and was calibrated against a standard benzene reference gas. PID headspace measurements were also undertaken on duplicate soil samples. A summary of PID results are presented in Table 4-3.

3.3 Soil Sampling Procedures

Fieldwork was undertaken by a Coffey Environmental Scientist on 17 July, 1996. Twenty test pits (refer Figure 3) were excavated using a backhoe and soil samples were collected from 7 test pits; TP1, TP5, TP6, TP8, TP12, TP13 and TP14. Test pits were located on the basis of the inferred positions of the former sludge pits. The road between these pits was used as a major reference point.

Soil types were described in the field and logs of all test pits/excavations are provided in Appendix A together with explanatory sheets defining descriptive terms used on the logs.

Sample locations were chosen on the basis of visual observation of residual sludge and insitu PID readings. All samples were collected in duplicate in accordance with standard Coffey environmental protocols.

At the completion of the day's sampling activities, duplicate jar samples were subjected to PID headspace measurement as a further screen for volatile organic compounds. It should be noted that these headspace measurements provide depth specific screening data in contrast to the in-situ PID measurements which reflect cumulative changes in volatile organic concentrations over the full profile depth. A summary of the PID headspace results are presented in Table 4-3.

3.4 Decontamination Procedures

Decontamination of sampling equipment was completed in accordance with the Coffey Environmental Field Procedures and comprised:

- removal of encrusted material;
- wash with Decon 90 detergent cleaning solution;
- rinse with potable water;
- final rinse with deionised water.

3.5 Sample Collection and Transfer

Following collection, samples were transferred to glass jars (250ml) and immediately sealed. Samples for volatile analysis were collected in 20ml VOA vials, sealed with a teflon seal and crimped closed. All sample containers were labelled, placed in eskys with ice packs and then dispatched to the laboratory for analysis under chain-of-custody conditions.

3.6 Laboratory Testing

Of the 12 samples collected, 10 individual samples were dispatched for limited analyses comprising total petroleum hydrocarbons (TPH) and volatile aromatic hydrocarbons (benzene, toluene, ethyl benzene and xylenes (BTEX)), i.e. visually observed sludge samples collected from TP6, TP8 and TP12 at shallow depth were characterised whilst the remainder of the samples tested were collected from the natural soil profile. A summary of the samples selected for analysis is presented in Table 3-1.

Samples were analysed by NATA registered National Analytical Laboratories (NAL). Analytical methods were based on VICEPA and USEPA standard methods and are given in Table 3-2. Laboratory detection limits were set at or below background levels wherever possible in accordance with VicEPA protocols.

TABLE 3-1
SUMMARY OF SAMPLES SELECTED FOR ANALYSIS

Location	Sample No	Depth (m)	Soil Type *	Analysis (TPH, BTEX)
TP1	TP1-0.3-P	0.3	N (topsoil)	*
TP5	TP5-0.3-P	0.3	F (sludge)	
	TP5-0.8-P	0.8	N (clay)	*
TP6	TP6-0.3-P	0.3	F (sludge)	*
	TP6-0.8-P	0.8	N (clay)	*
TP8	TP8-0.6-P	0.6	F (sludge)	*
	TP8-1.0-P	1.0	N (clay)	*
TP12	TP12-0.7-P	0.7	F (sludge contaminated soil)	*
	TP12-1.1-P	1.1	N (clay)	*
TP13	TP13-0.3-P	0.3	F (sludge)	
	TP13-1.0-P	1.0	N (clay)	*
TP14	TP14-0.2-P	0.2	N (topsoil)	*

** F=Fill; N=Natural*

TABLE 3-2
LABORATORY ANALYTICAL METHODS

% Moisture	VICEPA Chemical Analysis Polluted Soils Nov. 1981 No. 4
BTEX	NAL E106 (GC:Headspace)
Total Petroleum Hydrocarbons (TPHs)	NAL E104.52, E104.12 (GC:PID)

3.7 Quality Assurance/Quality Control (QA/QC)

Work on this project was completed in accordance with standard Coffey QA/QC procedures which specify sampling protocols, number and type of sample containers per sampling location, sample preservation methods, approved holding times, sample identification codes, QC sample requirements and chain of custody documentation procedures.

All samples were collected in duplicate with the duplicates being held in Coffey cold storage for subsequent analysis should the need arise. One equipment wash blank from the final rinse water used during decontamination of sampling equipment was also collected. A trip blank, which consisted of "clean" deionised water and used to document whether the primary samples were exposed to ambient volatile contaminant concentrations during sample transport and/or in the

laboratory was also collected. Due to budget constraints, however, no field QC samples were submitted for analysis although all field QC samples have been retained in storage for analysis if required.

The analytical laboratory also completed an internal QC program comprising blanks, duplicates, and recoveries on 5% of samples tested and these results are presented in Appendix C. Results generally demonstrated an acceptable agreement between duplicate pairs and acceptable recoveries between spiked samples.

On the basis of these results, it is considered that the analytical methods adopted by the laboratory and the results on the field samples can be taken as quantitative.

4.0 RESULTS OF FIELD AND LABORATORY PROGRAM

4.1 Surface Conditions

The area under investigation (refer Figure 2) contains 2 sludge pits where flammable liquid fire training was undertaken. Anecdotal reports suggests that a black diesel sludge covered this whole area until about 1989. Review of aerial photos, held by CFA Ballan, revealed significant spillage at the eastern end of the pits toward the golf course (refer Figure 3).

In about 1990, the spillage area and sludge pits were covered with approximately 0.3m of scoria fill, which could be seen on the aerial photos as having been dumped on the former roadway located between the sludge pits. In some places a superficial covering of clay was also reportedly used to level lower lying areas so that mowing of grass could be undertaken with greater ease. The site is currently well grassed.

4.2 Subsurface Conditions

The Geological Survey of Victoria 1:63,360 Ballarat Sheet, maps the site as Quaternary Olivine Basalts. The current investigation confirmed the published geology. Generally 1 m to 2 m of residual clay overlies basalt rock, the maximum depth of residual clay being 2.2 m at TP6. A summary of soil profile conditions found at the site where scoria cover exists is presented in Table 4-1, below.

TABLE 4-1
GENERALISED SOIL PROFILE CONDITIONS

Soil Unit	Depth to Top of Layer (m)	Thickness (m)	Material Description
1	0	0.1 - 0.6	SCORIA FILL; SANDY GRAVEL: fine to coarse grained, red, fine to coarse grained sand with some medium plasticity red clay.
2	0.1 - 0.6	0.002 - 0.4	BLACK HYDROCARBON SLUDGE: appears as a thin layer (ranging from 2mm to 0.1m) on the surface of the underlying topsoil or mixed with soil over a specific interval (up to 0.4m).
3	0.102 - 1.0	0.1 - 0.2	TOPSOIL; SILTY CLAY: medium plasticity, brown. Black hydrocarbon sludge, where it occurs, usually associated with the surface of this unit.
4	0.2 - 1.2	0.1 - 0.2	SUBSOIL; SILTY CLAY: medium plasticity, grey to grey-brown, may comprise predominantly rounded buckshot gravel (2 to 5mm) with clay(CLAYEY SANDY GRAVEL)
5	0.3 - 1.4	Not penetrated	SILTY CLAY: high plasticity, yellow-grey to yellow-brown, mottled orange-yellow. Residual clay formed on basalt.

4.3 Soil Vapour Survey

Soil PID headspace results have been compared with standard investigation thresholds summarised in Table 4-2. PID in-situ and soil headspace results are tabulated in Table 4-3.

TABLE 4-2
ADOPTED SOIL VAPOUR CONCENTRATION CATEGORIES

Rating	Concentration Range (ppm)
Negligible	0 - 20
Low	21 - 60
Moderate	61- 300
Significant	>300

TABLE 4-3
SUMMARY OF PID IN-SITU SOIL AND HEADSPACE RESULTS

Location	Test Type*	Depth (m)	Duration (mins)	Background (ppm)	Last Reading (ppm)
TP1	BH	0.3	1-2	0.0	0.0
	HS	0.3	1-2	0.0	0.0
TP5	BH	0.3	1-2	0.0	0.0
	HS	0.3	1-2	0.0	0.0
	HS	0.8	1-2	0.0	0.0
TP6	BH	0.4	0.0	0.0	0.0
	HS	0.3	1-2	0.0	0.0
	HS	0.8	1-2	0.0	0.0
TP8	BH	0.6	1-2	0.0	2.6
	HS	0.6	1-2	0.0	23.4
	HS	1.0	1-2	0.0	1.4
TP9	BH	0.4	1-2	0.0	0.0
TP12	BH	0.4	1-2	0.0	3.5
	HS	0.7	1-2	0.0	25.8
	HS	1.1	1-2	0.0	1.2
TP13	BH	0.3	1-2	0.0	7.2
	HS	0.3	1-2	0.0	30.9
	HS	1.0	1-2	0.0	2.0
TP14	BH	0.3	1-2	0.0	2.3
	HS	0.2	1-2	0.0	0.0

** BH=in-situ soil vapour measurement; HS=headspace sample measurement*

PID in-situ and headspace results across the site were negligible except for headspace results for samples collected from TP8 at 0.6m depth, TP12 at 0.7m depth and TP13 at 0.3m depth where minor concentrations of total ionisable organic hydrocarbons were detected.

4.4 Laboratory Results

The soil test results have been compared with contamination reference criteria published by the Australian and New Zealand Environmental Conservation Council (ANZECC, 1992) and the relevant Dutch standards (ANZECC, 1990). These criteria provide a guide to acceptable levels of contamination in soils. Victorian EPA criteria for off-site disposal of contaminated soils as clean fill or low level contaminated fill have also been provided (VicEPA, 1995).

The Victorian EPA (VICEPA) consider ANZECC B and Dutch B levels as investigation threshold for environmental concern. ANZECC B criteria are mainly based on potential environmental effects and, in particular, possible phytotoxic effects on plants. Where concentrations exceed these criteria, VICEPA regard contaminant concentrations as being elevated and further investigation may

be required. Where concentrations exceed Dutch C criteria, contaminant concentrations are regarded as significant and some form of proactive site management or remediation may be required.

A summary of the soil analytical results are presented in Appendix B. The NATA certified laboratory results are included as Appendix C.

Test results indicate significant TPH concentrations, at levels exceeding Dutch C criteria, for samples collected from TP8 at depths of 0.6m in the sludge and from 1.0m in the natural soil profile. Elevated TPH concentrations were also detected for samples collected from TP6 at 0.3m depth and from TP14 at 0.2m depth at levels exceeding Dutch B criteria. TPH concentrations for samples collected from TP8, TP6 and TP14 are commensurate with VicEPA off-site disposal criteria for low level contaminated soil.

Consistent with the field soil vapour investigations, BTEX compounds were detected in visually observed sludge samples collected from TP8 and TP12 at depths of 0.6m and 0.7m respectively. However, concentrations were below Dutch B criteria. BTEX concentrations in all other samples tested were below laboratory detection limits.

5.0 DISCUSSION AND CONCLUSIONS

As discussed in Section 4.3, soil contamination has been gauged relative to ANZECC, Dutch and VicEPA criteria and the laboratory results for the limited samples tested indicate elevated TPH concentrations in the vicinity of locations TP8, TP6 and TP14 (refer Figure 3).

As observed during field investigations, the occurrence of sludge beneath the scoria cover is distributed across an area of approximately 1200 m^2. The sludge appears in the majority of cases as a relatively thin layer at the interface of the scoria cover and the underlying topsoil. The thickness of the sludge at this interface is generally 20 to 50 mm with maximum observed depth of 100 mm in the vicinity of TP8. At TP12 and TP13 the sludge was mixed with soil over an interval of up to 0.4m below the scoria cover. The laboratory results for a sample collected of the underlying natural soil from TP8 at 1m depth, however, also indicated that the sludge contamination has penetrated the underlying natural soil i.e. to a depth of approximately 0.4m below the scoria fill. The extent and depth of scoria cover and the thickness of visually observed black hydrocarbon sludge beneath the scoria cover is presented in Figure 4.

On the basis of the observed thickness of hydrocarbon sludge, the estimated volume of sludge in the investigation area is likely to be in the range of 20 to 60 m^3, based on a sludge thickness of between 0.02 and 0.05m. It must be noted that the scoria cover, as presented in Figure 4, varies considerably across the area of investigation.

For and on behalf of
COFFEY PARTNERS INTERNATIONAL PTY LTD

REFERENCES

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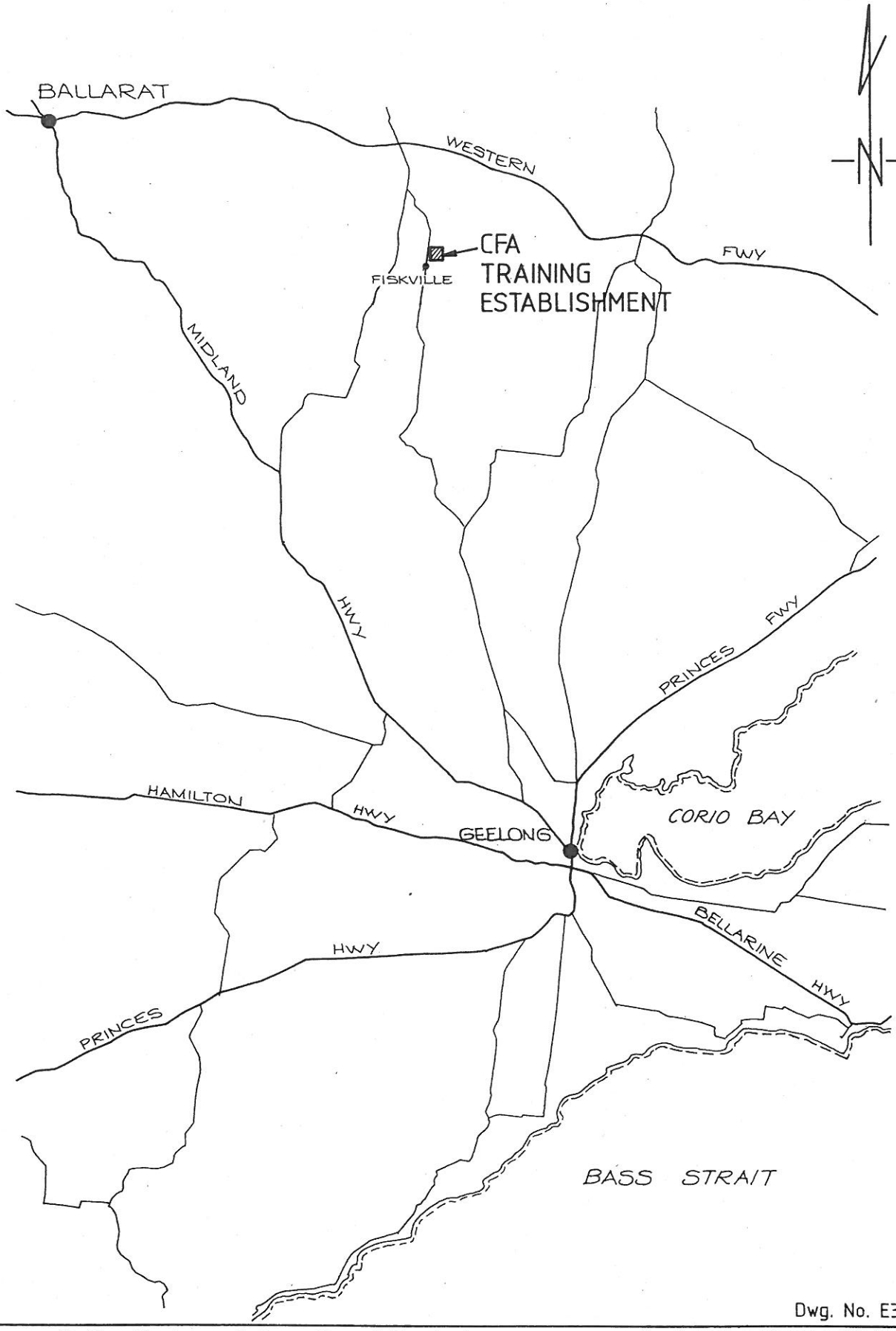
- ANZECC, (1992). *"Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites"*, publ Australian & New Zealand Environment and Conservation Council, National Health & Medical Research Council, January, 1992.

- Diomedes, (1996). "Excerpts from an Environmental Investigation of the C.F.A. Training College", Reference DA1108/SD3000, dated 27 June, 1996.

- VicEPA, (1995). *"Classification of Wastes"*, Publication 448, Environment Protection Authority of Victoria, May.



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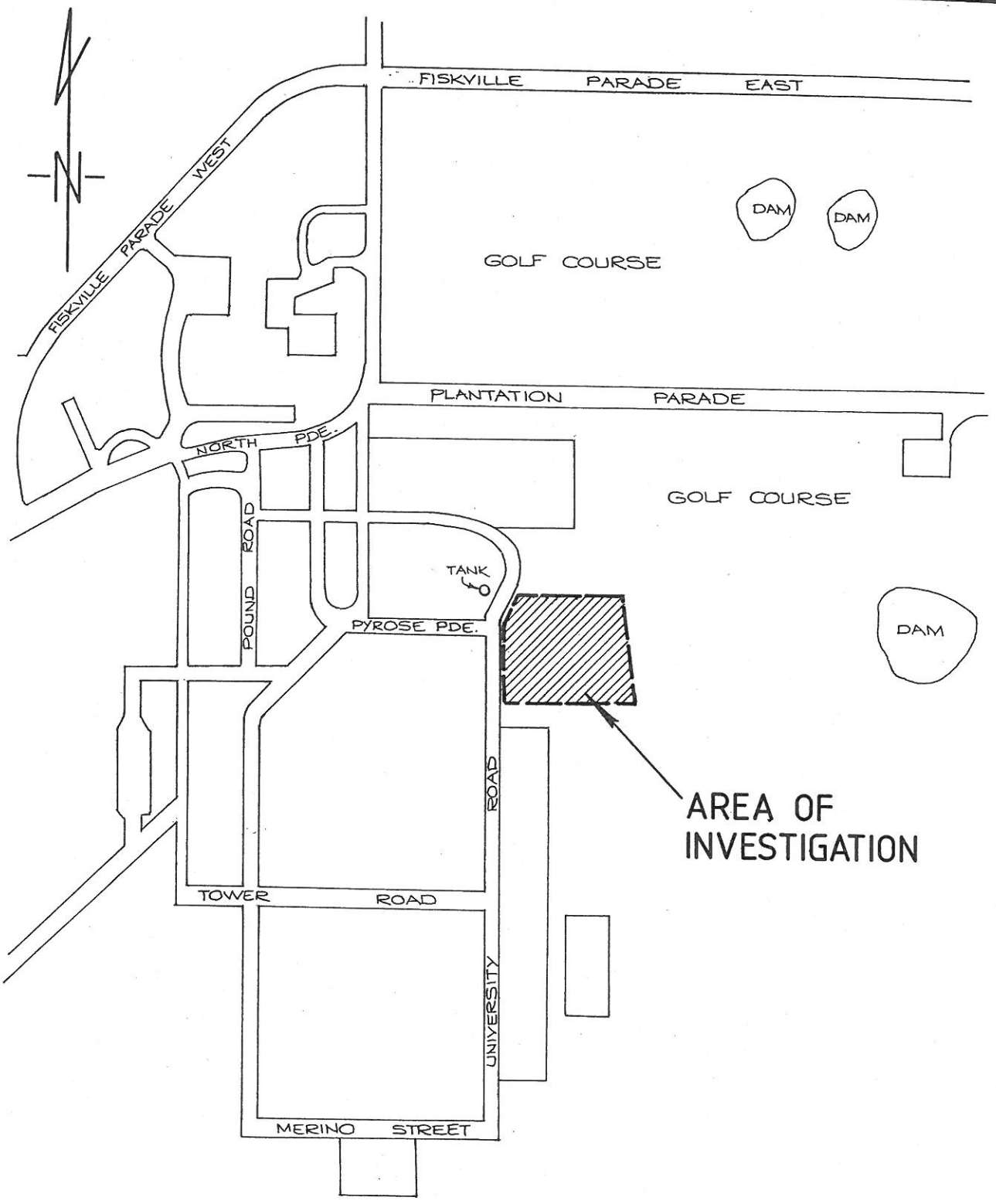
date	29/7/96
scale	1:500,000

CFA TRAINING COLLEGE
BALLAN, VICTORIA
FIELD SITE APPRAISAL AND SAMPLING
LOCALITY PLAN

COFFEY

FIGURE 1

job no: E3517/1



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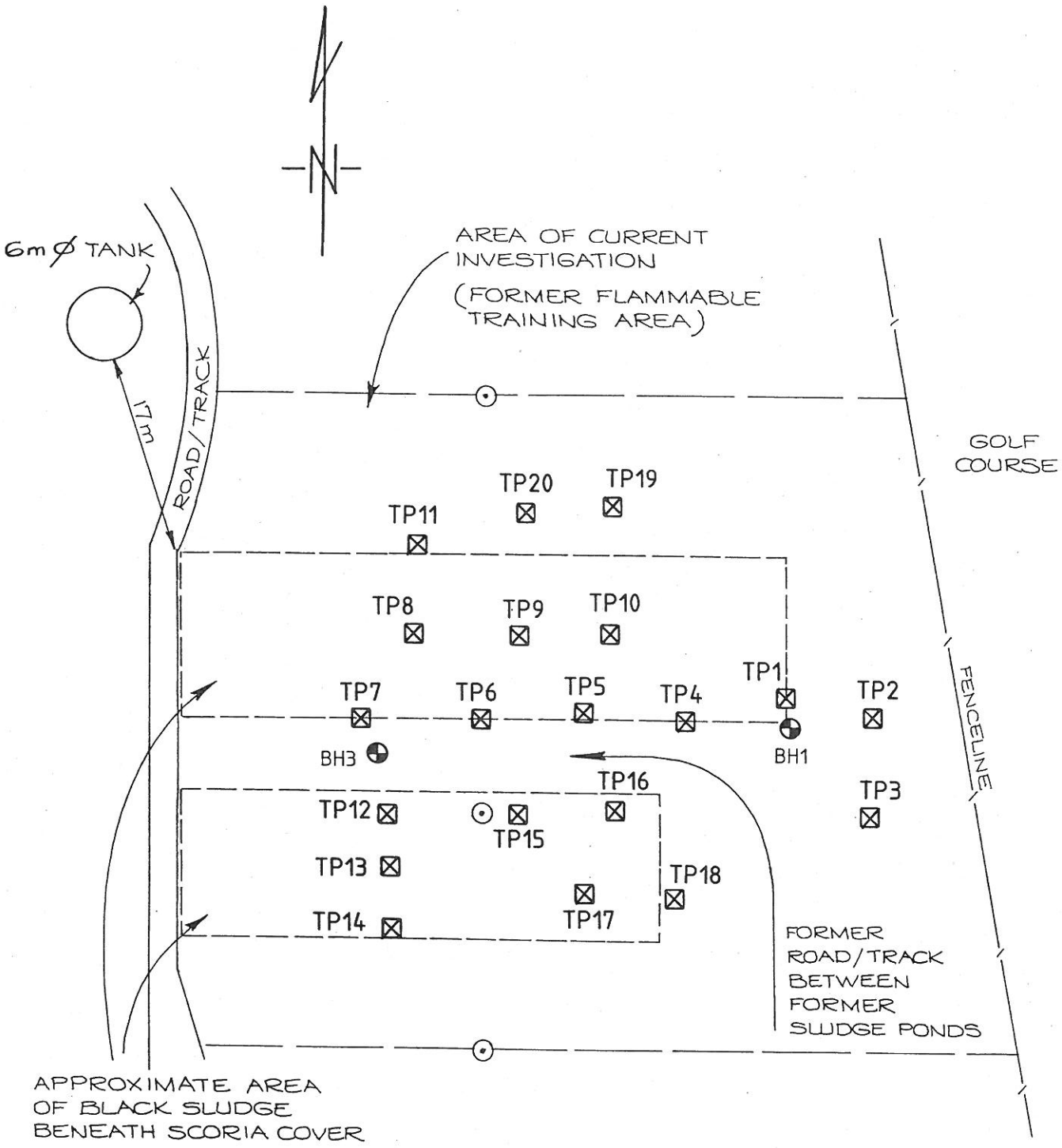
CFA TRAINING COLLEGE
BALLAN, VICTORIA
FIELD SITE APPRAISAL AND SAMPLING
SITE PLAN

COFFEY

FIGURE 2

job no: E3517/1



LEGEND

- ⊠ TP1 TEST PIT
- ◓ BH1 PREVIOUS INVESTIGATION BOREHOLE
- ⊙ POST (POWER POLE)

Dwg. No. E3517/1-3

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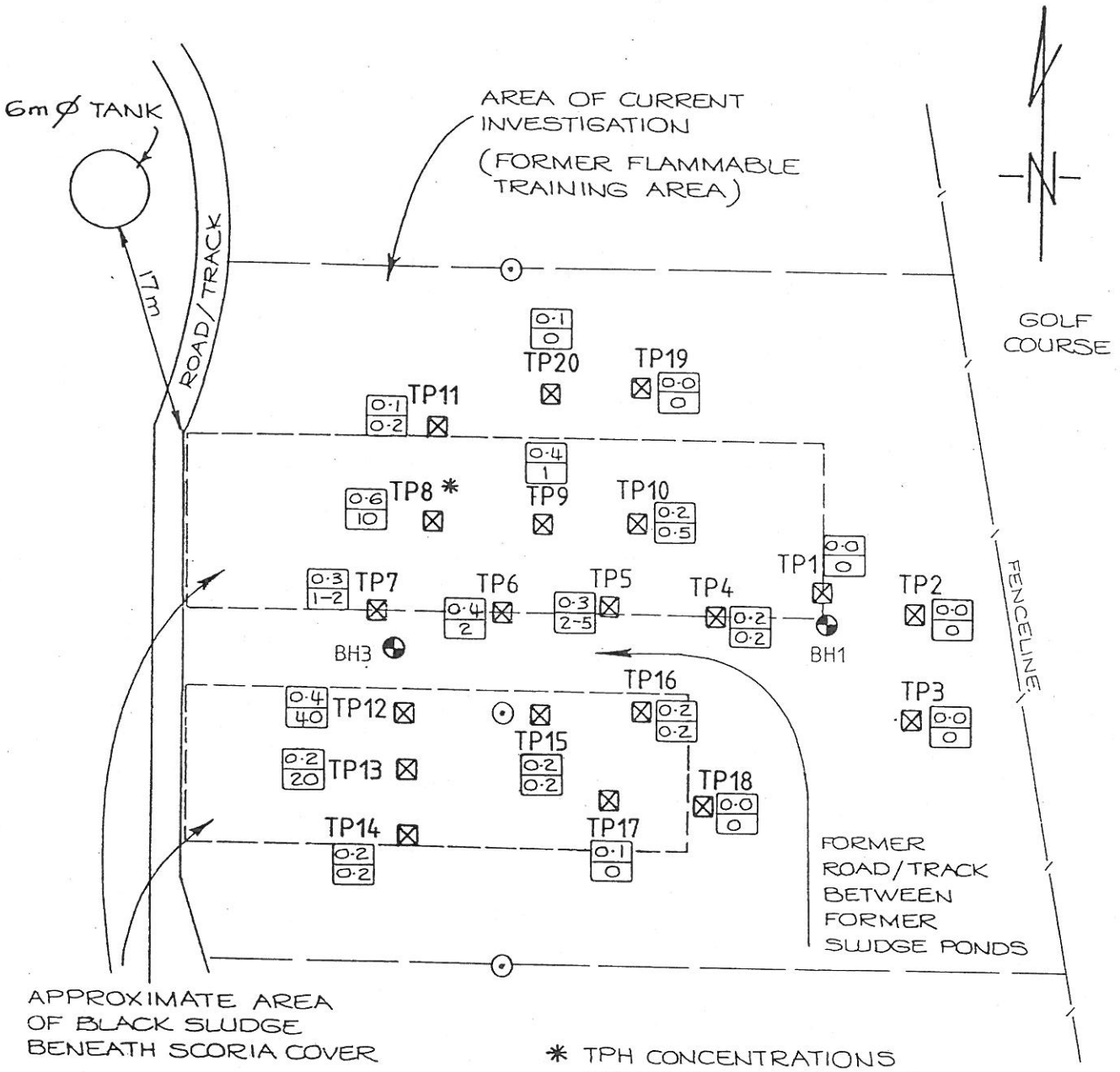
CFA TRAINING COLLEGE
BALLAN, VICTORIA
FIELD SITE APPRAISAL AND SAMPLING
TEST PIT SAMPLING LOCATIONS

COFFEY

FIGURE 3

job no: E3517/1



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scale	1:500

CFA TRAINING COLLEGE
BALLAN, VICTORIA
FIELD SITE APPRAISAL AND SAMPLING
EXTENT OF SLUDGE BENEATH SCORIA COVER

COFFEY

FIGURE 4

job no: E3517/1

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important information about your environmental site assessment

These notes have been prepared by Coffey Partners International Pty. Ltd. (CPI) using guidelines prepared by ASFE; The Association of Engineering Firms Practicing in the Geosciences. They are offered to help you in the interpretation of your Environmental Site Assessment (ESA) reports.

REASONS FOR CONDUCTING AN ESA

ESA's are typically, though not exclusively, carried out in the following circumstances:

- as pre-acquisition assessments, on behalf of either purchaser or vendor, when a property is to be sold;
- as pre-development assessments when a property or area of land is to be redeveloped or have its use changed — for example, from a factory to a residential subdivision;
- as pre-development assessments of greenfield sites, to establish "baseline" conditions and assess environmental, geological and hydrological constraints to the development of, for example, a landfill; and
- as audits of the environmental effects of an ongoing operation.

Each of these circumstances requires a specific approach to the assessment of soil and groundwater contamination. In all cases, however, the objective is to identify and if possible quantify the risks which unrecognised contamination poses to the proposed activity. Such risks may be both financial, for example, clean-up costs or limitations on site use, and physical, for example, health risks to site users or the public.

THE LIMITATIONS OF AN ESA

Although the information provided by an ESA can reduce exposure to such risks, no ESA, however diligently carried out, can eliminate them. Even a rigorous professional assessment may fail to detect all contamination on a site. Contaminants may be present in area that were not surveyed or sampled, or may migrate to areas which showed no signs of contamination when sampled.

AN ESA REPORT IS BASED ON A UNIQUE SET OF PROJECT SPECIFIC FACTORS

Your environmental report should not be used:

- When the nature of the proposed development is changed, for example, if a residential development is proposed instead of a commercial one;
- when the size or configuration of the proposed development is altered;
- when the location or orientation of the proposed structure is modified;
- when there is a change of ownership; or
- for application to an adjacent site.

To help avoid costly problems, refer to your consultant to determine how any factors which have changed subsequent to the date of the report may affect its recommendations.

ESA "FINDINGS" ARE PROFESSIONAL ESTIMATES

Site assessment identifies actual subsurface conditions only at those points where samples are taken, when they are taken. Data derived through sampling and subsequent laboratory testing are interpreted by geologists, engineers or scientists who then render an opinion about overall subsurface conditions, the nature and extent of contamination, its likely impact on the proposed development and appropriate remediation measures. Actual conditions may differ from those inferred to exist, because no professional, no matter how qualified, and no subsurface exploration program, no matter how comprehensive, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than a report indicates. Actual conditions in areas not sampled may differ from predictions. Nothing can be done to prevent the unanticipated, but steps can be taken to help minimise its impact. For this reason, owners should retain the services of their consultants through the development stage, to identify variances, conduct additional tests which may be needed, and to recommend solutions to problems encountered on site.

CB2153

SUBSURFACE CONDITIONS CAN CHANGE

Subsurface conditions are changed by natural processes and the activity of man. Because an ESA report is based on conditions which existed at the time of subsurface exploration, decisions should not be based on an ESA report whose adequacy may have been affected by time. Speak with the consultant to learn if additional tests are advisable.

ESA SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND PERSONS

Every study and ESA report is prepared in response to a specific Brief to meet the specific needs of specific individuals. A report prepared for a consulting civil engineer may not be adequate for a construction contractor, or even some other consulting civil engineer. A report should not be used by other persons for any purpose. No individual other than the client should apply a report even apparently for its intended purpose without first conferring with the consultant. No person should apply a report for any purpose other than that originally contemplated without first conferring with the consultant.

AN ESA REPORT IS SUBJECT TO MIS-INTERPRETATION

Costly problems can occur when design professionals develop their plans based on misinterpretations of an ESA. To help avoid these problems, the environmental consultant should be retained to work with appropriate design professionals to explain relevant findings and to review the adequacy of their plans and specifications relative to contamination issues.

LOGS SHOULD NOT BE SEPARATED FROM THE ENGINEERING REPORT

Final borehole or test pit logs are developed by environmental scientists, engineers or geologists based upon their interpretation of field logs (assembled by site personnel) and laboratory evaluation of field samples. Only final logs are customarily included in our reports. These logs should not under any circumstances be redrawn for inclusion in site remediation or other design drawings, because drafters may commit errors or omissions in the transfer process. Although photographic reproduction eliminates this problem, it does nothing to minimise the possibility of contractors misinterpreting the logs during bid preparation. When this occurs, delays, disputes and unanticipated costs are the all-too-frequent result.

To reduce the likelihood of boring log misinterpretation, the complete report must be available to persons or organisations involved in the project, such as contractors, for their use. Those who do not provide such access may proceed under the mistaken impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing all the available information to persons and organisations such as contractors helps prevent costly construction problems and the adversarial attitudes which may aggravate them to disproportionate scale.

READ RESPONSIBILITY CLAUSES CLOSELY

Because an ESA is based extensively on judgement and opinion, it is necessarily less exact than other disciplines. This situation has resulted in wholly unwarranted claims being lodged against consultants. To help prevent this problem, model clauses have been developed for use in written transmittals. These are not exculpatory clauses designed to foist liabilities onto some other party. Rather, they are definitive clauses which identify where your consultant's responsibilities begin and end. Their use helps all parties involved recognise their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your ESA report, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to your questions.

APPENDIX A

APPENDIX A

BOREHOLE LOGS

Coffey Partners International Pty Ltd
A.C.N. 003 692 019

COFFEY

explanation
sheet 1

descriptive terms soil and rock

SOIL DESCRIPTIONS

Classification of Material based on Unified Classification System (refer SAA Site Investigation Code AS1726-1975 Add. No. 1 Table D1).

Moisture Condition based on appearance of soil.

dry	Looks and feels dry; cohesive soils usually hard, powdery or friable, granular soils run freely through hands.
moist	Soil feels cool, darkened in colour; cohesive soils usually weakened by moisture, granular soils tend to cohere, but one gets no free water on hand on remoulding.
wet	Soil feels cool, darkened in colour; cohesive soils weakened, granular soils tend to cohere, free water collects on hands when remoulding.

Consistency based on unconfined compressive strength (Qu) (generally estimated or measured by hand penetrometer).

term	very soft	soft	firm	stif	very stiff	hard
Qu kPa	25	50	100	200	400	

If soil crumbles on test without meaningful result, it is described as **friable**.

Density Index (generally estimated or based on penetrometer result).

term	very loose	loose	medium dense	dense	very dense
density index ID %	15	35	65	85	

ROCK DESCRIPTIONS

Weathering based on visual assessment.

term	**criterion**
Fresh:	Rock substance unaffected by weathering.
Slightly Weathered:	Rock substance affected by weathering to the extent that partial staining or partial discolouration of the rock substance usually by limonite has taken place. The colour and texture of the fresh rock is recognisable; strength properties are essentially those of the fresh rock substance.
Moderately Weathered:	Rock substance affected by weathering to the extent that staining extends throughout whole of the rock substance and the original colour of the fresh rock is no longer recognisable.
Highly Weathered:	Rock substance affected by weathering to the extent that limonite staining or bleaching affects the whole of the rock substance and signs of chemical or physical decomposition of individual minerals are usually evident. Porosity and strength may be increased or decreased when compared to the fresh rock substance, usually as a result of the leaching or deposition of iron. The colour and strength of the original fresh rock substance is no longer recognisable.
Extremely Weathered:	Rock substance affected by weathering to the extent that the rock exhibits soil properties, i.e. it can be remoulded and can be classified according to the Unified Classification System, but the texture of the original rock is still evident.

Strength based on point load strength index, corrected to 50mm diameter - Is(50) (refer to I.S.R.M., Commission on Standardisation of Laboratory and Field Tests, Suggested Methods for Determining the Uniaxial Compressive Strength of Rock Materials and the Point Load Strength Index, Committee on Laboratory Tests Document No. 1) (Generally estimated: × indicates test result).

classification	extremely low	very low	low	medium	high	very high	extremely high
Is (50) MPa	0.03	0.1	0.3	1	3	10	

The unconfined compressive strength is typically about 20 × I_{S50} but the multiplier may range, for different rock types, from as low as 4 to as high as 30.

Defect Spacing

classification **spacing m**	extremely close	very close	close	medium	wide	very wide	extremely wide
	0.03	0.1	0.3	1	3	10	

Defect description uses terms contained on AS1726 table D2 to describe nature of defect (fault, joint, crushed zone, clay seam (etc.) and character (roughness, extent, coating etc.).

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A.C.N. 003 692 019

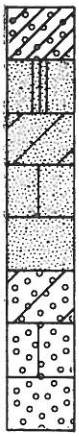
COFFEY

explanation
sheet 2

graphic symbols soil and rock

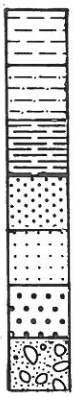
soil

- asphaltic concrete or hotmix
- concrete
- topsoil
- fill
- peat, organic clays and silts (Pt, OL, OH)
- clay (CL, CH)
- silt (ML, MH)
- sandy clay (CL, CH)
- silty clay (CL, CH)

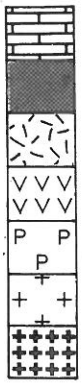


- gravelly clay (CL, CH)
- sandy silt (ML)
- clayey sand (SC)
- silty sand (SM)
- sand (SP, SW)
- clayey gravel (GC)
- silty gravel (GM)
- gravel (GP, GW)

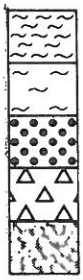
rock



- claystone (massive)
- siltstone (massive)
- shale (laminated)
- sandstone (undifferentiated)
- sandstone, fine grained
- sandstone, coarse grained
- conglomerate



- limestone
- coal
- dolerite, basalt
- tuff
- porphyry
- granite
- pegmatite



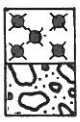
- schist
- gneiss
- quartzite
- talus
- alluvium

seams

- seam > 0.1m thick (on a sclae 1:50)
- seam 0.01m to 0.1m thick (on a scale of 1:50)

inclusions (special purposes only)

- rock fragments
- swamp



- ironstone, gravel, laterite
- shale breccia in sandstone

water level ▼

surfaces _____ known boundary

_ _ _ _ _ _ probable boundary

_____ ? _____ ? possible boundary

T84 - 147

SOIL CLASSIFICATION INCLUDING IDENTIFICATION AND DESCRIPTION

FIELD IDENTIFICATION PROCEDURES (Excluding particles larger than 60 mm and basing fractions on estimated mass)				GROUP SYMBOLS	TYPICAL NAMES
COARSE GRAINED SOILS — More than 50% of material less than 60 mm is larger than 0.06 mm (The 0.06 mm particle is about the smallest particle visible to the naked eye)	GRAVELS — More than half of coarse fraction is larger than 2.0 mm.	CLEAN GRAVELS (Little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes.	GW	Well graded gravels, gravel—sand mixtures, little or no fines.
			Predominantly one size or a range of sizes with some intermediate sizes missing.	GP	Poorly graded gravels, gravel—sand mixtures, little or no fines.
		GRAVELS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below).	GM	Silty gravels, poorly graded gravel—sand—silt mixtures.
			Plastic fines (for identification procedures see CL below).	GC	Clayey gravels, poorly graded gravel—sand—clay mixtures.
	SANDS — More than half of coarse fraction is smaller than 2.0 mm.	CLEAN SANDS (Little or no fines)	Wide range in grain sizes and substantial amounts of all intermediate particle sizes.	SW	Well graded sands, gravelly sands, little or no fines.
			Predominantly one size or a range of sizes with some intermediate sizes missing.	SP	Poorly graded sands, gravelly sands, little or no fines.
		SANDS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below).	SM	Silty sands, poorly graded sand—silt mixtures.
			Plastic fines (for identification procedures see CL below).	SC	Clayey sands, poorly graded sand—clay mixtures.
FINE GRAINED SOILS — More than 50% of material less than 60 mm is smaller than 0.06 mm	IDENTIFICATION PROCEDURES ON FRACTIONS < 0.2 mm				
	SILTS AND CLAYS — Liquid limit less than 50	DRY STRENGTH †	DILATANCY †	TOUGHNESS †	
		None to Low	Quick to slow	None	ML — Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with low plasticity. Silts of low to medium Liquid Limit. *
		Medium to high	None to very slow	Medium	CL — Inorganic clays of low to medium plasticity, * gravelly clays, sandy clays, silty clays.
		Low to medium	Slow	Low	OL — Organic silts and organic silt – clays of low to medium plasticity. *
	SILTS AND CLAYS — Liquid limit greater than 50	Low to medium	Slow to none	Low to medium	MH — Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, silts of high Liquid Limit.
		High to very high	None	High	CH — Inorganic clays of high plasticity. *
		Medium to high	None to very slow	Low to medium	OH — Organic clays of high plasticity. *
HIGHLY ORGANIC SOILS	Readily identified by colour, odour, spongy feel and frequently by fibrous texture.			Pt	Peat and other highly organic soils.

INFORMATION REQUIRED FOR DESCRIBING SOILS

SYMBOL Give typical name, indicate approximate percentages of sand and gravel, max. size, angularity, surface condition, and strength of the coarse grains: colour, amount, plasticity of fine component.

For undisturbed soils add information on moisture condition, degree of compactness, stratification, cementation, odour.

Give local or geologic name and/or other pertinent descriptive information.
Example:
SM_1-Gravelly Silty SAND coarse to fine, pale brown, about 20% strong, angular gravel particles – 10 mm maximum size, rounded and sub-angular sand, about 15% non-plastic fines, moist, dense, alluvial sand.

SYMBOL Give typical name, indicate degree and character of plasticity, colour, amount and size of coarse grains.

For undisturbed soils add information on moisture condition, consistency, structure, stratification, odour.

Give local or geologic name, and other pertinent descriptive information.

Example:
CL—Sandy CLAY of low plasticity, pale grey and brown; Sand fine to medium, trace of fine gravel, dry, firm, numerous vertical root holes; (FILL).

LABORATORY CLASSIFICATION CRITERIA

USE GRAIN SIZE CURVE IN IDENTIFYING THE FRACTIONS AS GIVEN UNDER FIELD IDENTIFICATION

Determine percentages of gravel and sand from grain size curve. Depending on percentage smaller than 0.06 mm size coarse grained soils are classified as follows:—

GW, GP, SW, SP, GM, GC, SM, SC: Borderline cases requiring use of dual symbols.

Less than 5%

More than 12%

5% to 12%

$C_u = \frac{D_{60}}{D_{10}}$ Greater than 4 $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 & 3

Not meeting all gradation requirements for GW.

Atterberg limits below "A" line or I_p less than 4.

Above "A" line with Pi between 4 and 7 are borderline cases requiring use of dual symbols.

Atterberg limits above "A" line with I_p greater than 7.

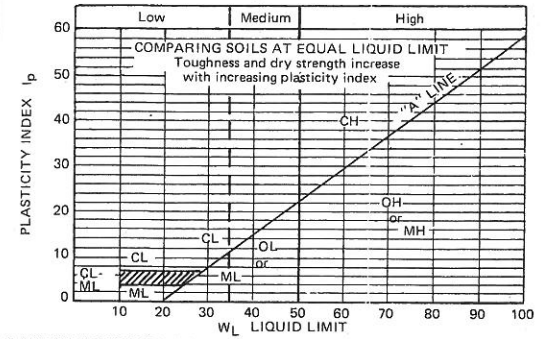
$C_u = \frac{D_{60}}{D_{10}}$ Greater than 6 $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 & 3

Not meeting all gradation requirements for SW.

Atterberg limits below "A" line or I_p less than 4.

Above "A" line with I_p between 4 and 7 are borderline cases requiring use of dual symbols.

Atterberg limits above "A" line with I_p greater than 7.



PLASTICITY CHART (For laboratory classification of fine grained soils)

1. Boundary classifications – Soils possessing characteristics of two groups are designated by combinations of group symbols. For example GW—GC, well graded gravel-sand mixture with clay binder.

* Low plasticity – Liquid Limit W_L less than 35%. Medium plasticity – W_L between 35% and 50%.

Adapted from A.S. 1726-1981 (App.D)

FIELD IDENTIFICATION PROCEDURES FOR FINE GRAINED SOILS OR FRACTIONS

These procedures are to be performed on the minus 0.2 mm size particles. For field classification purposes, screening is not intended, simply remove by hand the coarse particles that interfere with the tests.

† TOUGHNESS (Consistency near plastic limit)

After removing particles larger than 0.2 mm size, a specimen of soil about 10cm³ in size is moulded to the consistency of putty. If too dry, water must be added and if sticky, the specimen should be spread out in a thin layer and allowed to lose some moisture by evaporation. Then the specimen is rolled out by hand on a smooth surface or between the palms into a thread about 3 mm in diameter. The thread is then folded and rerolled repeatedly. During this manipulation the moisture content is gradually reduced and the specimen stiffens, finally loses its plasticity, and crumbles when the plastic limit is reached.
After the thread crumbles, the pieces should be lumped together and a slight kneading action continued until the lump crumbles.
The tougher the thread near the plastic limit and the stiffer the lump when it finally crumbles, the more potent is the colloidal clay fraction in the soil.
Weakness of the thread at the plastic limit and quick loss of coherence of the lump below the plastic limit indicate either inorganic clay of low plasticity, or materials such as kaolin-type clays and organic clays which occur below the A-line.
Highly organic clays have a very weak and spongy feel at the plastic limit.

† DILATANCY (Reaction to shaking)

After removing particles larger than 0.2 mm size, prepare a pat of moist soil with a volume of 10 cm³. Add enough water if necessary to make the soil soft but not sticky.
Place the pat in the open palm of one hand and shake horizontally, striking vigorously against the other hand several times. A positive reaction consists of the appearance of water on the surface of the pat which changes to a livery consistency and becomes glossy. When the sample is squeezed between the fingers, the water and gloss disappear from the surface, the pat stiffens, and finally it cracks or crumbles.
The rapidity of appearance of water during shaking and of its disappearance during squeezing assist in identifying the character of the fines in a soil.
Very fine clean sands give the quickest and most distinct reaction whereas a plastic clay has no reaction. Inorganic silts, such as a typical rock flour, show a moderately quick reaction.

† DRY STRENGTH (Crushing characteristics)

After removing particles larger than 0.2 mm size, mould a pat of soil to the consistency of putty, adding water if necessary. Allow the pat to dry completely by oven, sun, or air drying, and then test its strength by breaking and crumbling between the fingers. This strength is a measure of the character and quantity of the colloidal fraction contained in the soil. The dry strength increases with increasing plasticity.
High dry strength is characteristic for clays of the CH group.
A typical inorganic silt possesses only very slight dry strength.
Silty fine sands and silts have about the same slight dry strength, but can be distinguished by the feel when powdering the dried specimen. Fine sand feels gritty whereas a typical silt has the smooth feel of flour.

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Coffey Partners International

Consulting Engineers in the geotechnical sciences

SOIL CLASSIFICATION CHART

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engineering log - excavation

COFFEY

pit no TP1

sheet 1 of 1

client:	C.F.A. TRAINING COLLEGE	office job no:	E3517/1
principal:	-	pit commenced:	17/7/96
project:	FIELD SITE APPRAISAL & SAMPLING, BALLAN	pit completed:	17/7/96
pit location:	REFER TO DRAWING NO. E3517/1-3	logged by:	GWE
		checked by:	PCA
equipment type and model:	CASE 480D BACKHOE		
excavation dimensions:	2 m long 0.8 m wide	orientation:	R.L.Surface: NOT MEASURED
			datum:

method	penetration 1 2 3 4	support	water	samples, tests, etc	R.L. / depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency/ density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
BH		NIL	D				CH	FILL: SILTY CLAY, high plasticity, yellow, mottled grey, some red-orange,	M	St		FILL
				Bs			CL	SILTY CLAY: medium plasticity, brown,		Fb		TOPSOIL
							CL	SILTY CLAY: medium plasticity, grey,		St		SUBSOIL
					1		CH	SILTY CLAY: high plasticity, yellow-brown, mottled orange-yellow,		VSt		RESIDUAL
					2		CL	SILTY CLAY: medium plasticity, yellow,		St		
								BASALT: brown, moderately to highly weathered				TERTIARY BASALT
					3			Pit TP1 Terminated at 2.40 m				
					4							

METHOD
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R bulldozer ripper
- E excavator
- HA hand auger
- HT hand tools

SUPPORT
- SH shoring SC shotcrete
- Nil no support
- RB rockbolts

PENETRATION

1 2 3 4 — little resistance ranging to very slow progress

WATER
- D none observed
- ¥ not measured
- water level
- water outflow
- water inflow

SAMPLES, TESTS, ETC
- U undisturbed sample (mm)
- D disturbed sample
- Bs bulk sample
- E environmental sample
- VS vane shear
- DP dynamic penetrometer
- FD field density
- WS water sample

CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION

based on unified classification system

MOISTURE
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

CONSISTENCY/DENSITY INDEX
- VS very soft
- S soft
- F firm
- St stiff
- VSt very stiff
- H hard
- Fb friable
- VL very loose
- L loose
- MD medium dense
- D dense
- VD very dense

T88-239

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engineering log - excavation

COFFEY

pit no TP2
sheet 1 of 1

client: C.F.A. TRAINING COLLEGE
principal: -
project: FIELD SITE APPRAISAL & SAMPLING, BALLAN
pit location: REFER TO DRAWING NO. E3517/1-3

office job no: E3517/1
pit commenced: 17/7/96
pit completed: 17/7/96
logged by: GWE
checked by: PCA

equipment type and model: CASE 480D BACKHOE
excavation dimensions: 2 m long 0.8 m wide orientation:
R.L.Surface: NOT MEASURED
datum:

method	penetration 1 2 3 4	support	water	samples, tests, etc	R.L. / depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency/ density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
BH		NIL	D				CL	SILTY CLAY: medium plasticity, dark brown,	M	Fb		TOPSOIL
							CL	SILTY CLAY: medium plasticity, grey-brown,		St		SUBSOIL
					1		CH	SILTY CLAY: high plasticity, yellow and grey, mottled orange,		VSt		RESIDUAL
					2		CL	SILTY CLAY: medium plasticity, yellow,		St		Basalt floaters, approx. 200-300mm in the clay
								BASALT: brown, moderately to highly weathered				TERTIARY BASALT
					3			Pit TP2 Terminated at 2.40 m				
					4							

METHOD
N natural exposure
X existing excavation
BH backhoe bucket
B bulldozer blade
R bulldozer ripper
E excavator
HA hand auger
HT hand tools

SUPPORT
SH shoring SC shotcrete
Nil no support
RB rockbolts

PENETRATION
1 2 3 4 — little resistance ranging to very slow progress

WATER
D none observed
✱ not measured
water level
water outflow
water inflow

SAMPLES, TESTS, ETC
U undisturbed sample (mm)
D disturbed sample
Bs bulk sample
E environmental sample
VS vane shear
DP dynamic penetrometer
FD field density
WS water sample

CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION
based on unified classification system

MOISTURE
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

CONSISTENCY/DENSITY INDEX
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

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engineering log - excavation

COFFEY

pit no TP3

sheet 1 of 1

client:	C.F.A. TRAINING COLLEGE	office job no:	E3517/1
principal:	-	pit commenced:	17/7/96
project:	FIELD SITE APPRAISAL & SAMPLING, BALLAN	pit completed:	17/7/96
pit location:	REFER TO DRAWING NO. E3517/1-3	logged by:	GWE
		checked by:	PCA
equipment type and model:	CASE 480D BACKHOE		
excavation dimensions:	2 m long 0.8 m wide	orientation:	R.L.Surface: NOT MEASURED
			datum:

method	penetration 1 2 3 4	support	water	samples, tests, etc	R.L. / depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency / density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
BH		NIL	D		1		CL	SILTY CLAY: medium plasticity, brown,	M	Fb		TOPSOIL
							CL	SILTY CLAY: medium plasticity, grey,		St		SUBSOIL
							CH	SILTY CLAY: high plasticity, yellow-grey, mottled orange-yellow,		VSt		RESIDUAL
								Pit bottomed on basalt				
					2			Pit TP3 Terminated at 1.90 m				
					3							
					4							

METHOD
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R bulldozer ripper
- E excavator
- HA hand auger
- HT hand tools

SUPPORT
SH shoring SC shotcrete
Nil no support
RB rockbolts

PENETRATION
1 2 3 4 — little resistance ranging to very slow progress

WATER
- D none observed
- ✱ not measured
- water level
- water outflow
- water inflow

SAMPLES, TESTS, ETC
- U undisturbed sample (mm)
- D disturbed sample
- Bs bulk sample
- E environmental sample
- VS vane shear
- DP dynamic penetrometer
- FD field density
- WS water sample

CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION
based on unified classification system

MOISTURE
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

CONSISTENCY/DENSITY INDEX
- VS very soft
- S soft
- F firm
- St stiff
- VSt very stiff
- H hard
- Fb friable
- VL very loose
- L loose
- MD medium dense
- D dense
- VD very dense

T88-239

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engineering log - excavation

COFFEY

pit no TP4

sheet 1 of 1

client:	C.F.A. TRAINING COLLEGE	office job no:	E3517/1
principal:	-	pit commenced:	17/7/96
project:	FIELD SITE APPRAISAL & SAMPLING, BALLAN	pit completed:	17/7/96
pit location:	REFER TO DRAWING NO. E3517/1-3	logged by:	GWE
		checked by:	PCA
equipment type and model:	CASE 480D BACKHOE		
excavation dimensions:	2 m long 0.8 m wide	orientation:	R.L.Surface: NOT MEASURED
			datum:

method	penetration 1 2 3 4	support	water	samples, tests, etc	R.L. depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency/ density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
BH		NIL	D				CL	FILL: GRAVELLY CLAY, medium plasticity, red, gravel fine to coarse grained,	M	St		SCORIA FILL
							CL	SILTY CLAY: medium plasticity, brown, with a trace (approx. 2mm thick) of black, hydrocarbon sludge at the surface		Fb		TOPSOIL
							CL			St		SUBSOIL
							CH	SILTY CLAY: medium plasticity, grey,		VSt		
					1			SILTY CLAY: high plasticity, yellow-grey, mottled orange-yellow,				RESIDUAL
					2			Pit bottomed on basalt				
								Pit TP4 Terminated at 2.00 m				
					3							
					4							

METHOD
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R bulldozer ripper
- E excavator
- HA hand auger
- HT hand tools

SUPPORT
SH shoring SC shotcrete
Nil no support
RB rockbolts

PENETRATION
1 2 3 4 — little resistance ranging to very slow progress

WATER
- D none observed
- * not measured
- water level
- water outflow
- water inflow

SAMPLES, TESTS, ETC
- U undisturbed sample (mm)
- D disturbed sample
- Bs bulk sample
- E environmental sample
- VS vane shear
- DP dynamic penetrometer
- FD field density
- WS water sample

CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION
based on unified classification system

MOISTURE
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

CONSISTENCY/DENSITY INDEX
- VS very soft
- S soft
- F firm
- St stiff
- VSt very stiff
- H hard
- Fb friable
- VL very loose
- L loose
- MD medium dense
- D dense
- VD very dense

T88-239

Coffey Partners International Pty. Ltd.
ACN 003 692 019

engineering log - excavation

COFFEY

pit no TP5

sheet 1 of 1

client:	C.F.A. TRAINING COLLEGE	office job no:	E3517/1
principal:	-	pit commenced:	17/7/96
project:	FIELD SITE APPRAISAL & SAMPLING, BALLAN	pit completed:	17/7/96
pit location:	REFER TO DRAWING NO. E3517/1-3	logged by:	GWE
equipment type and model:	CASE 480D BACKHOE	checked by:	PCA
excavation dimensions:	2 m long 0.8 m wide	orientation:	
		R.L.Surface:	NOT MEASURED
		datum:	

method	penetration 1 2 3 4	support	water	samples, tests, etc	R.L. / depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency/ density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
BH		NIL	▽				GW	FILL: SANDY GRAVEL, fine to coarse grained, red, sand, fine to coarse grained, with some clay, medium plasticity.	M	MD		SCORIA FILL
				E			CL	SILTY CLAY: medium plasticity, brown, with 20mm to 50mm of black, hydrocarbon sludge incorporated into the surface		Fb		TOPSOIL
							CL	SILTY CLAY: medium plasticity, grey,		St		SUBSOIL
				E			CH	SILTY CLAY: high plasticity, brown-yellow, mottled orange-yellow,		VSt		RESIDUAL
					1							
					2			Pit bottomed on basalt				
								Pit TP5 Terminated at 2.50 m				
					3							
					4							

METHOD
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R bulldozer ripper
- E excavator
- HA hand auger
- HT hand tools

SUPPORT
- SH shoring SC shotcrete
- Nil no support
- RB rockbolts

PENETRATION
1 2 3 4 — little resistance ranging to very slow progress

WATER
- D none observed
- ✱ not measured
- ▽ water level
- ▽ water outflow
- ▽ water inflow

SAMPLES, TESTS, ETC
- U undisturbed sample (mm)
- D disturbed sample
- Bs bulk sample
- E environmental sample
- VS vane shear
- DP dynamic penetrometer
- FD field density
- WS water sample

CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION
based on unified classification system

MOISTURE
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

CONSISTENCY/DENSITY INDEX
- VS very soft
- S soft
- F firm
- St stiff
- VSt very stiff
- H hard
- Fb friable
- VL very loose
- L loose
- MD medium dense
- D dense
- VD very dense

T88-239

Coffey Partners International Pty. Ltd.
ACN 003 692 019

engineering log - excavation

COFFEY

pit no TP6

sheet 1 of 1

office job no: E3517/1

client: C.F.A. TRAINING COLLEGE
principal: -
project: FIELD SITE APPRAISAL & SAMPLING, BALLAN
pit location: REFER TO DRAWING NO. E3517/1-3

pit commenced: 17/7/96
pit completed: 17/7/96
logged by: GWE
checked by: PCA

equipment type and model: CASE 480D BACKHOE
excavation dimensions: 2 m long 0.8 m wide orientation:

R.L.Surface: NOT MEASURED
datum:

method	penetration 1 2 3 4	support	water	samples, tests, etc	R.L. / depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency/ density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
BH		NIL	D				GW	FILL: SANDY GRAVEL, fine to coarse grained, red, sand, fine to coarse grained, with some clay, medium plasticity,	M	MD		SCORIA FILL
				Bs			CL	SILTY CLAY: medium plasticity, brown, with black hydrocarbon contamination of upper 20mm		Fb		TOPSOIL
							GW			MD		
							CH	CLAYEY SANDY GRAVEL: fine to medium grained, brown-grey, sand, fine to coarse grained, clay medium plasticity, with buckshot gravel 2-5mm		VSt		SUBSOIL
				Bs				SILTY CLAY: high plasticity, yellow-grey, mottled orange-yellow,				RESIDUAL
					1							
					2			Pit bottomed on basalt				
					3			Pit TP6 - Terminated at 2.80 m				
					4							

METHOD
N natural exposure
X existing excavation
BH backhoe bucket
B bulldozer blade
R bulldozer ripper
E excavator
HA hand auger
HT hand tools

SUPPORT
SH shoring SC shotcrete
Nil no support
RB rockbolts

PENETRATION
1 2 3 4 — little resistance ranging to very slow progress

WATER
D none observed
X not measured
water level
water outflow
water inflow

SAMPLES, TESTS, ETC
U undisturbed sample (mm)
D disturbed sample
Bs bulk sample
E environmental sample
VS vane shear
DP dynamic penetrometer
FD field density
WS water sample

CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION
based on unified classification system

MOISTURE
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

CONSISTENCY/DENSITY INDEX
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

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ACN 003 692 019

COFFEY

pit no TP7

sheet 1 of 1

engineering log - excavation

client:	C.F.A. TRAINING COLLEGE	office job no:	E3517/1
principal:	-	pit commenced:	17/7/96
project:	FIELD SITE APPRAISAL & SAMPLING, BALLAN	pit completed:	17/7/96
pit location:	REFER TO DRAWING NO. E3517/1-3	logged by:	GWE
		checked by:	PC
equipment type and model:	CASE 480D BACKHOE	R.L.Surface:	NOT MEASURED
excavation dimensions:	2 m long 0.8 m wide	orientation:	datum:

method	penetration 1 2 3 4	support	water	samples, tests, etc	R.L. depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics colour, secondary and minor components	moisture condition	consistency/ density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
BH		NIL	▽				GW	FILL: SANDY GRAVEL, fine to coarse grained, red-brown, sand, fine to coarse grained, with some medium plasticity, clay, yellow-brown	M	MD		SCORIA and SOIL FILL
							CL	SILTY CLAY: medium plasticity, brown, with black, hydrocarbon sludge, approximately 10-20mm incorporated into surface		Fb / St		TOPSOIL/MIXED SOIL
							CL					SUBSOIL
							CH	SILTY CLAY: medium plasticity, grey,		VSt		
					1			SILTY CLAY: high plasticity, yellow-grey, mottled orange-yellow,				RESIDUAL
					2			Bottomed on basalt				
								Pit TP7 Terminated at 2.60 m				
					3							
					4							

METHOD
N natural exposure
X existing excavation
BH backhoe bucket
B bulldozer blade
R bulldozer ripper
E excavator
HA hand auger
HT hand tools

SUPPORT
SH shoring SC shotcrete
Nil no support
RB rockbolts

PENETRATION
1 2 3 4 — little resistance ranging to very slow progress

WATER
D none observed
¥ not measured
▽ water level
water outflow
water inflow

SAMPLES, TESTS, ETC
U undisturbed sample (mm)
D disturbed sample
Bs bulk sample
E environmental sample
VS vane shear
DP dynamic penetrometer
FD field density
WS water sample

CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION
based on unified classification system

MOISTURE
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

CONSISTENCY/DENSITY INDEX
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

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engineering log - excavation

COFFEY

pit no TP8

sheet 1 of 1

client:	C.F.A. TRAINING COLLEGE	office job no:	E3517/1
principal:	-	pit commenced:	17/7/96
project:	FIELD SITE APPRAISAL & SAMPLING, BALLAN	pit completed:	17/7/96
pit location:	REFER TO DRAWING NO. E3517/1-3	logged by:	GWE
		checked by:	PCA
equipment type and model:	CASE 480D BACKHOE		
excavation dimensions:	2 m long 0.8 m wide	orientation:	R.L.Surface: NOT MEASURED
			datum:

method	penetration (1 2 3 4)	support	water	samples, tests, etc	R.L. / depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency/ density index	hand penetrometer kPa (100 200 300 400)	structure and additional observations
BH		Nil	▽		0		GC	FILL: CLAYEY SANDY GRAVEL, fine to coarse grained, red, sand, fine to coarse grained, clay medium plasticity, red	M	MD		SCORIA FILL
				Bs			CL	SILTY CLAY: medium plasticity, brown, with black, hydrocarbon sludge possibly diesel sludge incorporated between 0.6m and 0.7m		Fb		TOPSOIL
							CH	SILTY CLAY: high plasticity, yellow-grey, mottled-orange-yellow		VSt		RESIDUAL
				Bs	1							
					2			Bottomed on basalt				
					3			Pit TP8 Terminated at 2.50 m				
					4							

METHOD
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R bulldozer ripper
- E excavator
- HA hand auger
- HT hand tools

SUPPORT
- SH shoring SC shotcrete
- Nil no support
- RB rockbolts

PENETRATION

1 2 3 4 — little resistance ranging to very slow progress

WATER
- 0 none observed
- ✱ not measured
- ▽ water level
- ▽ water outflow
- ▽ water inflow

SAMPLES, TESTS, ETC
- U undisturbed sample (mm)
- D disturbed sample
- Bs bulk sample
- E environmental sample
- VS vane shear
- DP dynamic penetrometer
- FD field density
- WS water sample

CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION

based on unified classification system

MOISTURE
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

CONSISTENCY/DENSITY INDEX
- VS very soft
- S soft
- F firm
- St stiff
- VSt very stiff
- H hard
- Fb friable
- VL very loose
- L loose
- MD medium dense
- D dense
- VD very dense

T88-239

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ACN 003 692 019

engineering log - excavation

COFFEY

pit no TP9

sheet 1 of 1

client:	C.F.A. TRAINING COLLEGE	office job no:	E3517/1
principal:	-	pit commenced:	17/7/96
project:	FIELD SITE APPRAISAL & SAMPLING, BALLAN	pit completed:	17/7/96
pit location:	REFER TO DRAWING NO. E3517/1-3	logged by:	GWE
		checked by:	PCA
equipment type and model:	CASE 480D BACKHOE		
excavation dimensions:	2 m long 0.8 m wide	orientation:	R.L.Surface: NOT MEASURED
			datum:

method	penetration 1 2 3 4	support	water	samples, tests, etc	R.L. / depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency/ density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
BH		NIL	▽		0		GC	FILL: CLAYEY SANDY GRAVEL, fine to coarse grained, red, sand, fine to coarse grained, clay medium plasticity, red	M	MD		SCORIA FILL
							CL	SILTY CLAY: medium plasticity, brown, with black, hydrocarbon sludge, approximately 10mm thick		Fb		TOPSOIL
							GC			MD		SUBSOIL/Buckshot gravel layer
							CH	CLAYEY SANDY GRAVEL: fine to coarse grained, brown-grey, sand, fine to coarse grained, clay medium plasticity,		VSt		
					1			SILTY CLAY: high plasticity, yellow-grey, mottled orange-yellow,				RESIDUAL
					2			Pit bottomed on basalt				
								Pit TP9 Terminated at 2.30 m				
					3							
					4							

METHOD
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R bulldozer ripper
- E excavator
- HA hand auger
- HT hand tools

SUPPORT
- SH shoring SC shotcrete
- Nil no support
- RB rockbolts

PENETRATION

1 2 3 4 — little resistance ranging to very slow progress

WATER
- 0 none observed
- ✕ not measured
- ▽ water level
- ▽ water outflow
- ▽ water inflow

SAMPLES, TESTS, ETC
- U undisturbed sample (mm)
- D disturbed sample
- Bs bulk sample
- E environmental sample
- VS vane shear
- DP dynamic penetrometer
- FD field density
- WS water sample

CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION

based on unified classification system

MOISTURE
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

CONSISTENCY/DENSITY INDEX
- VS very soft
- S soft
- F firm
- St stiff
- VSt very stiff
- H hard
- Fb friable
- VL very loose
- L loose
- MD medium dense
- D dense
- VD very dense

T88-239

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engineering log - excavation

COFFEY

pit no: TP10
sheet 1 of 1

client:	C.F.A. TRAINING COLLEGE	office job no:	E3517/1
principal:	-	pit commenced:	17/7/96
project:	FIELD SITE APPRAISAL & SAMPLING, BALLAN	pit completed:	17/7/96
pit location:	REFER TO DRAWING NO. E3517/1-3	logged by:	GWE
		checked by:	PCD
equipment type and model:	CASE 480D BACKHOE		
excavation dimensions:	2 m long 0.8 m wide	orientation:	R.L.Surface: NOT MEASURED
			datum:

method	penetration 1 2 3 4	support	water	samples, tests, etc	R.L. / depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency/ density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
BH		NIL	D		0		GC	FILL: CLAYEY SANDY GRAVEL, fine to coarse grained, red, sand, fine to coarse grained, clay medium plasticity, red	M	MD		SCORIA FILL
							CL	SILTY CLAY: medium plasticity, brown, with black, hydrocarbon (diesel) sludge approximately 5mm thick		Fb		TOPSOIL
							CL	SILTY CLAY: medium plasticity, brown-grey,		St		SUBSOIL
					1		CH	SILTY CLAY: high plasticity, yellow-grey, mottled orange-yellow,		VSt		RESIDUAL
					2			Pit bottomed on basalt				
								Pit TP10 Terminated at 2.00 m				
					3							
					4							

METHOD
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R bulldozer ripper
- E excavator
- HA hand auger
- HT hand tools

SUPPORT
- SH shoring SC shotcrete
- Nil no support
- RB rockbolts

PENETRATION
1 2 3 4 — little resistance ranging to very slow progress

WATER
- D none observed
- X not measured
- water level
- water outflow
- water inflow

SAMPLES, TESTS, ETC
- U undisturbed sample (mm)
- D disturbed sample
- Bs bulk sample
- E environmental sample
- VS vane shear
- DP dynamic penetrometer
- FD field density
- WS water sample

CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION
based on unified classification system

MOISTURE
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

CONSISTENCY/DENSITY INDEX

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

T88-239

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ACN 003 692 019

engineering log - excavation

COFFEY

pit no: TP11
sheet 1 of 1

client:	C.F.A. TRAINING COLLEGE	office job no:	E3517/1
principal:	-	pit commenced:	17/7/96
project:	FIELD SITE APPRAISAL & SAMPLING, BALLAN	pit completed:	17/7/96
pit location:	REFER TO DRAWING NO. E3517/1-3	logged by:	GWE
		checked by:	PCL
equipment type and model:	CASE 480D BACKHOE	R.L. Surface:	NOT MEASURED
excavation dimensions:	2 m long 0.8 m wide	orientation:	datum:

method	penetration 1 2 3 4	support	water	samples, tests, etc	R.L. / depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency/ density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
BH		NIL	D				GC	FILL: CLAYEY GRAVEL, fine to coarse grained, red, clay high plasticity,	M	MD		SCORIA FILL
							CL			Fb		
							CL	SILTY CLAY: medium plasticity, brown, with trace (approx. 2mm) of black, hydrocarbon sludge at surface		St		TOPSOIL
												SUBSOIL
							CH	SILTY CLAY: medium plasticity, grey,		VSt		
					1			SILTY CLAY: high plasticity, yellow-grey, mottled orange-yellow,				RESIDUAL
								Pit bottomed on basalt				
								Pit TP11 Terminated at 1.60 m				
					2							
					3							
					4							

METHOD
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R bulldozer ripper
- E excavator
- HA hand auger
- HT hand tools

SUPPORT
SH shoring SC shotcrete
Nil no support
RB rockbolts

PENETRATION
1 2 3 4 — little resistance ranging to very slow progress

WATER
- D none observed
- ✱ not measured
- water level
- water outflow
- water inflow

SAMPLES, TESTS, ETC
- U undisturbed sample (mm)
- D disturbed sample
- Bs bulk sample
- E environmental sample
- VS vane shear
- DP dynamic penetrometer
- FD field density
- WS water sample

CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION
based on unified classification system

MOISTURE
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

CONSISTENCY/DENSITY INDEX
- VS very soft
- S soft
- F firm
- St stiff
- VSt very stiff
- H hard
- Fb friable
- VL very loose
- L loose
- MD medium dense
- D dense
- VD very dense

T88-239

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ACN 003 692 019

engineering log - excavation

COFFEY

pit no TP12

sheet 1 of 1

client:	C.F.A. TRAINING COLLEGE	office job no:	E3517/1
principal:	-	pit commenced:	17/7/96
project:	FIELD SITE APPRAISAL & SAMPLING, BALLAN	pit completed:	17/7/96
pit location:	REFER TO DRAWING NO. E3517/1-3	logged by:	GWE
		checked by:	PCA
equipment type and model:	CASE 480D BACKHOE		
excavation dimensions:	2 m long 0.8 m wide	orientation:	R.L.Surface: NOT MEASURED
			datum:

method	penetration 1 2 3 4	support	water	samples, tests, etc	R.L. depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics colour, secondary and minor components	moisture condition	consistency/ density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
BH		NIL	▽				GC	FILL: CLAYEY SANDY GRAVEL, fine to coarse grained, red, sand, fine to coarse grained, clay medium plasticity, red	M	MD		SCORIA and SOIL FILL
				Bs			CL-CH	FILL: SILTY CLAY, medium to high plasticity, brown-yellow, mottled orange-yellow, containing black, hydrocarbon (diesel) sludge) mixed with soil from 0.4m to 0.8m		F / St		
				Bs	1			200mm cement pipe at approx. 1m				
								Pit bottomed on basalt				
					2			Pit TP12 Terminated at 1.40 m				
					3							
					4							

METHOD
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R bulldozer ripper
- E excavator
- HA hand auger
- HT hand tools

SUPPORT
- SH shoring SC shotcrete
- Nil no support
- RB rockbolts

PENETRATION
1 2 3 4 — little resistance ranging to very slow progress

WATER
- D none observed
- ✱ not measured
- ▽ water level
- ▽| water outflow
- |▽ water inflow

SAMPLES, TESTS, ETC
- U undisturbed sample (mm)
- D disturbed sample
- Bs bulk sample
- E environmental sample
- VS vane shear
- DP dynamic penetrometer
- FD field density
- WS water sample

CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION
based on unified classification system

MOISTURE
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

CONSISTENCY/DENSITY INDEX

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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ACN 003 692 019

engineering log - excavation

COFFEY

pit no TP13
sheet 1 of 1

client:	C.F.A. TRAINING COLLEGE	office job no:	E3517/1
principal:	-	pit commenced:	17/7/96
project:	FIELD SITE APPRAISAL & SAMPLING, BALLAN	pit completed:	17/7/96
pit location:	REFER TO DRAWING NO. E3517/1-3	logged by:	GWE
		checked by:	PC
equipment type and model:	CASE 480D BACKHOE		
excavation dimensions:	2 m long 0.8 m wide	orientation:	R.L.Surface: NOT MEASURED
			datum:

method	penetration 1 2 3 4	support	water	samples, tests, etc	R.L. / depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency/ density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
BH		NIL	▽	Bs	0		GC	FILL: CLAYEY GRAVEL, fine to coarse grained, red, clay, medium plasticity,	M	MD		SCORIA FILL
							CL	SILTY CLAY: medium plasticity, brown, containing black, hydrocarbon sludge with strong odour, 0.2 to 0.4m		Fb		TOPSOIL
							GC	CLAYEY GRAVEL: fine to coarse grained, brown-grey, clay, medium plasticity,		MD		SUBSOIL with buckshot gravel
				Bs	1		CH	SILTY CLAY: high plasticity, brown-yellow, brown-grey, mottled orange-yellow,		VSt		RESIDUAL
								Pit bottomed on basalt				
					2			Pit TP13 Terminated at 1.30 m				
					3							
					4							

METHOD
N natural exposure
X existing excavation
BH backhoe bucket
B bulldozer blade
R bulldozer ripper
E excavator
HA hand auger
HT hand tools
SUPPORT
SH shoring SC shotcrete
Nil no support
RB rockbolts

PENETRATION
1 2 3 4 — little resistance ranging to very slow progress

WATER
D none observed
✱ not measured
▽ water level
▽ water outflow
▽ water inflow

SAMPLES, TESTS, ETC
U undisturbed sample (mm)
D disturbed sample
Bs bulk sample
E environmental sample
VS vane shear
DP dynamic penetrometer
FD field density
WS water sample

CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION
based on unified classification system

MOISTURE
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

CONSISTENCY/DENSITY INDEX

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

T88-239

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engineering log - excavation

COFFEY

pit no TP14

sheet 1 of 1

client: C.F.A. TRAINING COLLEGE
principal: -
project: FIELD SITE APPRAISAL & SAMPLING, BALLAN
pit location: REFER TO DRAWING NO. E3517/1-3

office job no: E3517/1
pit commenced: 17/7/96
pit completed: 17/7/96
logged by: GWE
checked by: PCA

equipment type and model: CASE 480D BACKHOE
excavation dimensions: 2 m long 0.8 m wide orientation:
R.L. Surface: NOT MEASURED datum:

method	penetration 1 2 3 4	support	water	samples, tests, etc	R.L. / depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency/ density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
BH		Nil	D				GC	FILL: CLAYEY GRAVEL, fine to coarse grained, red, clay high plasticity,	M	MD		SCORIA FILL
				Bs			CL	SILTY CLAY: medium plasticity, brown, containing traces of black, hydrocarbon staining (approx. 2mm)		St		TOPSOIL
					1		CH	SILTY CLAY: high plasticity, yellow-brown, mottled orange-yellow,				RESIDUAL
								Pit TP14 Terminated at 1.00 m				
					2							
					3							
					4							

METHOD
N natural exposure
X existing excavation
BH backhoe bucket
B bulldozer blade
R bulldozer ripper
E excavator
HA hand auger
HT hand tools

SUPPORT
SH shoring SC shotcrete
Nil no support
RB rockbolts

PENETRATION
1 2 3 4 little resistance ranging to very slow progress

WATER
D none observed
* not measured
water level
water outflow
water inflow

SAMPLES, TESTS, ETC
U undisturbed sample (mm)
D disturbed sample
Bs bulk sample
E environmental sample
VS vane shear
DP dynamic penetrometer
FD field density
WS water sample

CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION
based on unified classification system

MOISTURE
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

CONSISTENCY/DENSITY INDEX
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

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ACN 003 692 019

engineering log - excavation

COFFEY

pit no TP15

sheet 1 of 1

client:	C.F.A. TRAINING COLLEGE	office job no:	E3517/1
principal:	-	pit commenced:	17/7/96
project:	FIELD SITE APPRAISAL & SAMPLING, BALLAN	pit completed:	17/7/96
pit location:	REFER TO DRAWING NO. E3517/1-3	logged by:	GWE
		checked by:	PCA
equipment type and model:	CASE 480D BACKHOE		
excavation dimensions:	2 m long 0.8 m wide	orientation:	R.L.Surface: NOT MEASURED
			datum:

method	penetration 1 2 3 4	support	water	samples, tests, etc	R.L. depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency/ density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
BH		Nil	D				GC	FILL: CLAYEY GRAVEL, fine to coarse grained, red, clay high plasticity,	M	MD		SCORIA FILL
							CL	SILTY CLAY: medium plasticity, brown, with a trace (approx. 2mm) of black, hydrocarbon sludge		Fb		TOPSOIL
							CL	SILTY CLAY: medium plasticity, brown-grey,		St		SUBSOIL
							CH	SILTY CLAY: high plasticity, yellow-brown, mottled orange-yellow,		VSt		RESIDUAL
					1			Pit TP15 Terminated at 0.80 m				
					2							
					3							
					4							

METHOD
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R bulldozer ripper
- E excavator
- HA hand auger
- HT hand tools

SUPPORT
- SH shoring SC shotcrete
- Nil no support
- RB rockbolts

PENETRATION

1 2 3 4 — little resistance ranging to very slow progress

WATER
- D none observed
- * not measured
- water level
- water outflow
- water inflow

SAMPLES, TESTS, ETC
- U undisturbed sample (mm)
- D disturbed sample
- Bs bulk sample
- E environmental sample
- VS vane shear
- DP dynamic penetrometer
- FD field density
- WS water sample

CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION

based on unified classification system

MOISTURE
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

CONSISTENCY/DENSITY INDEX
- VS very soft
- S soft
- F firm
- St stiff
- VSt very stiff
- H hard
- Fb friable
- VL very loose
- L loose
- MD medium dense
- D dense
- VD very dense

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ACN 003 692 019

engineering log - excavation

COFFEY

pit no TP16

sheet 1 of 1

office job no: E3517/1

client: C.F.A. TRAINING COLLEGE
principal: -
project: FIELD SITE APPRAISAL & SAMPLING, BALLAN
pit location: REFER TO DRAWING NO. E3517/1-3

pit commenced: 17/7/96
pit completed: 17/7/96
logged by: GWE
checked by: PCA

equipment type and model: CASE 480D BACKHOE
excavation dimensions: 2 m long 0.8 m wide orientation:

R.L.Surface: NOT MEASURED
datum:

method	penetration 1 2 3 4	support	water	samples, tests, etc	R.L. / depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency/ density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
BH		Nil	D				GC	FILL: CLAYEY GRAVEL, fine to coarse grained, red, clay high plasticity,	M	MD		SCORIA FILL
							CL	SILTY CLAY: medium plasticity, brown, with a trace (approx. 2mm) of black, hydrocarbon contamination		Fb		TOPSOIL
							CL	SILTY CLAY: medium plasticity, grey,		St		SUBSOIL
							CH	SILTY CLAY: high plasticity, yellow-brown, mottled orange-yellow,		VSt		RESIDUAL
								Pit TP16 Terminated at 0.60 m				

1
2
3
4

METHOD
N natural exposure
X existing excavation
BH backhoe bucket
B bulldozer blade
R bulldozer ripper
E excavator
HA hand auger
HT hand tools
SUPPORT
SH shoring SC shotcrete
Nil no support
RB rockbolts

PENETRATION
1 2 3 4
little resistance ranging to very slow progress

WATER
D none observed
✱ not measured
water level
water outflow
water inflow

SAMPLES, TESTS, ETC
U undisturbed sample (mm)
D disturbed sample
Bs bulk sample
E environmental sample
VS vane shear
DP dynamic penetrometer
FD field density
WS water sample

CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION
based on unified classification system

MOISTURE
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

CONSISTENCY/DENSITY INDEX
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

Coffey Partners International Pty. Ltd.
ACN 003 692 019

engineering log - excavation

COFFEY

pit no TP17
sheet 1 of 1

client:	C.F.A. TRAINING COLLEGE	office job no:	E3517/1
principal:	-	pit commenced:	17/7/96
project:	FIELD SITE APPRAISAL & SAMPLING, BALLAN	pit completed:	17/7/96
pit location:	REFER TO DRAWING NO. E3517/1-3	logged by:	GWE
		checked by:	PCA
equipment type and model:	CASE 480D BACKHOE	R.L.Surface:	NOT MEASURED
excavation dimensions:	2 m long 0.8 m wide	orientation:	datum:

method	penetration 1 2 3 4	support	water	samples, tests, etc	R.L. / depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency/ density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
BH		NIL	D				GC	FILL: CLAYEY GRAVEL, fine to coarse grained, red, clay high plasticity.	M	MD		SCORIA FILL
							CL	SILTY CLAY: medium plasticity, brown.		Fb		TOPSOIL
							CL	SILTY CLAY: medium plasticity, brown-grey.		St		SUBSOIL
							CH	SILTY CLAY: high plasticity, grey.		VSt		RESIDUAL
					1			Pit TP17 Terminated at 0.60 m				
					2							
					3							
					4							

METHOD
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R bulldozer ripper
- E excavator
- HA hand auger
- HT hand tools

SUPPORT
- SH shoring SC shotcrete
- Nil no support
- RB rockbolts

PENETRATION
1 2 3 4 — little resistance ranging to very slow progress

WATER
- D none observed
- ¥ not measured
- water level
- water outflow
- water inflow

SAMPLES, TESTS, ETC
- U undisturbed sample (mm)
- D disturbed sample
- Bs bulk sample
- E environmental sample
- VS vane shear
- DP dynamic penetrometer
- FD field density
- WS water sample

CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION
based on unified classification system

MOISTURE
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

CONSISTENCY/DENSITY INDEX
- VS very soft
- S soft
- F firm
- St stiff
- VSt very stiff
- H hard
- Fb friable
- VL very loose
- L loose
- MD medium dense
- D dense
- VD very dense

Coffey Partners International Pty. Ltd.
ACN 003 692 019

engineering log - excavation

COFFEY

pit no TP18

sheet 1 of 1

client:	C.F.A. TRAINING COLLEGE	office job no:	E3517/1
principal:	-	pit commenced:	17/7/96
project:	FIELD SITE APPRAISAL & SAMPLING, BALLAN	pit completed:	17/7/96
pit location:	REFER TO DRAWING NO. E3517/1-3	logged by:	GWE
		checked by:	PCA
equipment type and model:	CASE 480D BACKHOE	R.L.Surface:	NOT MEASURED
excavation dimensions:	2 m long 0.8 m wide	orientation:	datum:

method	penetration 1 2 3 4	support	water	samples, tests, etc	R.L.	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics colour, secondary and minor components	moisture condition	consistency/ density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
BH	.	NIL	D					CL	SILTY CLAY: medium plasticity, brown, contains some scoria gravel pieces in surface	M	Fb		TOPSOIL
								CL	SILTY CLAY: medium plasticity, brown-grey,		St		SUBSOIL
								CH	SILTY CLAY: high plasticity, yellow-brown, mottled orange-yellow,		VSt		RESIDUAL
						1			Pit TP18 Terminated at 0.60 m				
						2							
						3							
						4							

METHOD
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R bulldozer ripper
- E excavator
- HA hand auger
- HT hand tools

SUPPORT
- SH shoring SC shotcrete
- Nil no support
- RB rockbolts

PENETRATION
1 2 3 4 — little resistance ranging to very slow progress

WATER
- D none observed
- ✱ not measured
- water level
- water outflow
- water inflow

SAMPLES, TESTS, ETC
- U undisturbed sample (mm)
- D disturbed sample
- Bs bulk sample
- E environmental sample
- VS vane shear
- DP dynamic penetrometer
- FD field density
- WS water sample

CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION
based on unified classification system

MOISTURE
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

CONSISTENCY/DENSITY INDEX

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

T88-239

Coffey Partners International Pty. Ltd.
ACN 003 692 019

engineering log - excavation

COFFEY

pit no TP19
sheet 1 of 1

client:	C.F.A. TRAINING COLLEGE	office job no:	E3517/1
principal:	-	pit commenced:	17/7/96
project:	FIELD SITE APPRAISAL & SAMPLING, BALLAN	pit completed:	17/7/96
pit location:	REFER TO DRAWING NO. E3517/1-3	logged by:	GWE
		checked by:	PCA
equipment type and model:	CASE 480D BACKHOE		
excavation dimensions:	2 m long 0.8 m wide	orientation:	R.L.Surface: NOT MEASURED
			datum:

method	penetration 1 2 3 4	support	water	samples, tests, etc	R.L. / depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency/ density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
BH		Nil	D				CL	SILTY CLAY: medium plasticity, brown, containing some red scoria gravel in surface	M	Fb		TOPSOIL
							CL	SILTY CLAY: medium plasticity, brown-grey,		St		SUBSOIL
							CH	SILTY CLAY: high plasticity, grey,		VSt		RESIDUAL
					1			Pit TP19 Terminated at 0.60 m				
					2							
					3							
					4							

METHOD
N natural exposure
X existing excavation
BH backhoe bucket
B bulldozer blade
R bulldozer ripper
E excavator
HA hand auger
HT hand tools

SUPPORT
SH shoring SC shotcrete
Nil no support
RB rockbolts

PENETRATION
1 2 3 4 little resistance ranging to very slow progress

WATER
D none observed
✱ not measured
water level
water outflow
water inflow

SAMPLES, TESTS, ETC
U undisturbed sample (mm)
D disturbed sample
Bs bulk sample
E environmental sample
VS vane shear
DP dynamic penetrometer
FD field density
WS water sample

CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION
based on unified classification system

MOISTURE
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

CONSISTENCY/DENSITY INDEX
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

Coffey Partners International Pty. Ltd.
ACN 003 692 019

engineering log - excavation

COFFEY

pit no TP20

sheet 1 of 1

client: C.F.A. TRAINING COLLEGE
principal: -
project: FIELD SITE APPRAISAL & SAMPLING, BALLAN
pit location: REFER TO DRAWING NO. E3517/1-3

office job no: E3517/1
pit commenced: 17/7/96
pit completed: 17/7/96
logged by: GWE
checked by: PCA

equipment type and model: CASE 480D BACKHOE
excavation dimensions: 2 m long 0.8 m wide orientation:
R.L.Surface: NOT MEASURED
datum:

method	penetration 1 2 3 4	support	water	samples, tests, etc	R.L. / depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency/density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
BH		NIL	D				GC	FILL: CLAYEY GRAVEL, fine to coarse grained, red, clay high plasticity,	M	MD		SCORIA FILL
							CL	SILTY CLAY: medium plasticity, brown,		Fb		TOPSOIL
							CL	SILTY CLAY: medium plasticity, brown-grey,		St		SUBSOIL
					1			Pit TP20 Terminated at 0.50 m				
					2							
					3							
					4							

METHOD
N natural exposure
X existing excavation
BH backhoe bucket
B bulldozer blade
R bulldozer ripper
E excavator
HA hand auger
HT hand tools
SUPPORT
SH shoring SC shotcrete
Nil no support
RB rockbolts

PENETRATION
1 2 3 4 little resistance ranging to very slow progress
WATER
D none observed
* not measured
water level
water outflow
water inflow

SAMPLES, TESTS, ETC
U undisturbed sample (mm)
D disturbed sample
Bs bulk sample
E environmental sample
VS vane shear
DP dynamic penetrometer
FD field density
WS water sample

CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION
based on unified classification system
MOISTURE
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

CONSISTENCY/DENSITY INDEX
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

APPENDIX B

APPENDIX B

SUMMARY OF SOIL PETROLEUM HYDROCARBON RESULTS

SUMMARY OF SOIL PETROLEUM HYDROCARBONS RESULTS

Location: CFA Training College, Ballan VIC
Job Reference : E3517/1
Results expressed in mg/kg dry weight

Test Pit Location	Sample No	Depth (m)	BENZENE	TOLUENE	ETHYL BENZENE	XYLENES	TPH C6-C9	TPH C10-C14	TPH C15-C28	TPH C29-C36
		Lab Detection Limits:	*0.02*	*0.02*	*0.02*	*0.02*	20	20	20	20
		ANZECC B	*1*							
		Dutch B	*1*	*3*	*5*	*5*	*100*	*{ ------ ---- 1000 --- ---------- }*		
		Dutch C	*5*	*30*	*50*	*50*	*800*	*{ ------ ---- 5000 --- ---------- }*		
		VicEPA (Clean Fill)	*{ --- ---------- ------ 7 ----- ---------- }*				*100*	*{ ------ ---- 1000 --- ---------- }*		
		VicEPA (Low Level Fill)	*{ --- ---------- ----- 70 ------ ---------- }*				*1000*	*{ ------ ---- 10000 --- ---------- }*		
TP8	TP8-0.6-P	0.6	0.08	0.42	0.17	0.59	<20	610	42000	43000
TP8	TP8-1.0-P	1.0	<0.02	<0.02	<0.02	<0.02	<20	910	46000	41000
TP12	TP12-0.7-P	0.7	0.32	0.69	0.36	1.80	<20	<20	160	100
TP12	TP12-1.1-P	1.1	<0.02	<0.02	<0.02	<0.02	<20	<20	<20	<20
TP13	TP13-1.0-P	1.0	<0.02	<0.02	<0.02	<0.02	<20	<20	<20	<20
TP6	TP6-0.3-P	0.3	<0.02	<0.02	<0.02	<0.02	<20	<20	2100	790
TP6	TP6-0.8-P	0.8	<0.02	<0.02	<0.02	<0.02	<20	<20	<20	<20
TP5	TP5-0.8-P	0.8	<0.02	<0.02	<0.02	<0.02	<20	<20	<20	<20
TP1	TP1-0.3-P	0.3	<0.02	<0.02	<0.02	<0.02	<20	<20	170	300
TP14	TP14-0.2-P	0.2	<0.02	<0.02	<0.02	<0.02	<20	34	1000	1900

APPENDIX C

E3517/1-AD
7 August 1996

APPENDIX C

NATA CERTIFIED LABORATORY RESULTS

NATIONAL ANALYTICAL LABORATORIES PTY LTD
A.C.N. 006 716 963
585 BLACKBURN ROAD NOTTING HILL VICTORIA AUSTRALIA 3168
TELEPHONE 03 9562 5899
FACSIMILE 03 9562 0336

CERTIFICATE OF ANALYSIS

DATE 29 July 1996

LABORATORY NUMBER JULR8265

CLIENT Coffey Partners International Pty Ltd

SAMPLE Sample/s received 19/7/96 - Job Ref: 3517/1

METHODS

Benzene, Toluene, Ethyl Benzene, Xylene	NAL E106.01
Total Petroleum Hydrocarbons	NAL E104.52

RESULTS

Please refer to attached page/s for results

Approved By _ _ Authorised By

CHIEF CHEMIST MANAGING DIRECTOR

DATE :29/07/96 Client : COFFEY PARTNERS INTERNATIONAL PTY. LTD. Job Reference : E3517/1

Results expressed in mg/kg dry weight.

LABID	Received	Sample	TPH C6-C9	TPH C10-C14	TPH C15-C28	TPH C29-C36	BENZENE	TOLUENE	ETHYL BENZENE	XYLENES
JULE8265	19/07/96	TP8 0.6-P	< 20	610	42000	43000	0.08	0.42	0.17	0.59
JULE8266	19/07/96	TP8 1.0-P	< 20	910	46000	41000	< 0.02	< 0.02	< 0.02	< 0.02
JULE8267	19/07/96	TP12 0.7-P	< 20	< 20	160	100	0.32	0.69	0.36	1.8
JULE8268	19/07/96	TP12 1.1-P	< 20	< 20	< 20	< 20	< 0.02	< 0.02	< 0.02	< 0.02
JULE8269	19/07/96	TP13 1.0-P	< 20	< 20	< 20	< 20	< 0.02	< 0.02	< 0.02	< 0.02
JULE8270	19/07/96	TP6 0.3-P	< 20	< 20	2100	790	< 0.02	< 0.02	< 0.02	< 0.02
JULE8271	19/07/96	TP6 0.8-P	< 20	< 20	< 20	< 20	< 0.02	< 0.02	< 0.02	< 0.02
JULE8272	19/07/96	TP5 0.8-P	< 20	< 20	< 20	< 20	< 0.02	< 0.02	< 0.02	< 0.02
JULE8273	19/07/96	TP1 0.3-P	< 20	< 20	170	300	< 0.02	< 0.02	< 0.02	< 0.02
JULE8274	19/07/96	TP14 0.2-P	< 20	34	1000	1900	< 0.02	< 0.02	< 0.02	< 0.02

A blank space indicates no test performed.

QUALITY ASSURANCE REPORT

DATE :29/07/96 Client : COFFEY PARTNERS INTERNATIONAL PTY. LTD. Job Reference : E3517/1

Results expressed in mg/kg dry weight.

LABID	Received	Sample	TPH C6-C9	TPH C10-C14	TPH C15-C28	TPH C29-C36	BENZENE	TOLUENE	ETHYL BENZENE	XYLENES	
JULE8605	19/07/96	BLANK					< 0.02	< 0.02	< 0.02	< 0.02	
JULE8606	19/07/96	QA/QC SPIKE					0.88	0.84	0.78	1.6	spike/JULE8605
JULE8606	19/07/96	QA/QC SPIKE					1.1	1.0	0.95	2.0	Expected Result
JULE8606	19/07/96	BLANK					80.0	84.0	82.1	80.0	% Recovery
JULE8605	19/07/96	BLANK					< 0.02	< 0.02	< 0.02	< 0.02	
JULE8671	19/07/96	BLANK	< 20	< 20	< 20	< 20					
JULE8672	19/07/96	TP1 0.3-P	< 20	< 20	140	260					duplt/JULE8273
JULE8273	19/07/96	TP1 0.3-P	< 20	< 20	170	300					
JULE8672	19/07/96	TP1 0.3-P	0	0	19.4	14.3					Rel % Difference
JULE8673	19/07/96	TP1 0.3-P	730	< 20	110	220					spike/JULE8273
JULE8673	19/07/96	TP1 0.3-P	740	< 20	110	220					Expected Result
JULE8673	19/07/96	TP1 0.3-P	98.6	100	0	0					% Recovery
JULE8273	19/07/96	TP1 0.3-P	< 20	< 20	170	300					
JULE8674	19/07/96	TP1 0.3-P	730	< 20	170	310					spike/JULE8273
JULE8674	19/07/96	TP1 0.3-P	740	< 20	170	310					Expected Result
JULE8674	19/07/96	TP1 0.3-P	98.6	100	0	100					% Recovery
JULE8273	19/07/96	TP1 0.3-P	< 20	< 20	170	300					

A blank space indicates no test performed.