



## 1.5 Waste Collection Information

A review of available waste collection information relating to the Site was undertaken and key information is summarised in Table 5. All correspondence was obtained from the Independent Fiskville Investigation.

**Table 5: Waste Collection Information**

Date	Description
4 March 2002	<b>Waste Collection Docket</b> This is a manifest for excavator hire, labour, labour supervision, paint and solvent. It details work of locating, excavating and removing drums from soil.
5 March 2002	<b>Invoice for Works Completed</b> This invoice details the works completed and the associated cost. It refers to drums and soil having been removed from various trenches, where removed drums were noted to mostly be damaged or crushed.
5 March 2002	<b>Waste Collection Docket</b> This is a manifest for skip hire. Soils contaminated with hydrocarbons are detailed as being disposed of in a lined skip.
6 March 2002	<b>Waste Collection Docket</b> This is a manifest for labour supervision, excavator hire, labour, paint and solvent. It details work of locating, excavating and removing drums from soil.
7 March 2002	<b>Waste Collection Docket</b> This is a manifest for labour supervision, excavator hire, labour, paint and solvent. It details work of locating, excavating and removing drums from soil.
14 March 2002	<b>Waste Collection Docket</b> This is a manifest for the disposal of contaminated soil. The contaminated soil disposed of is detailed as having low levels of contamination.



## **2.0 SUMMARY OF PREVIOUS REPORTS**

### **2.1 A.S James – Geotechnical Investigation (July 1988)**

A.S. James Pty Ltd (A.S James) were commissioned by CFA to conduct a geotechnical investigation in May 1988, the findings of which are provided in the following report, A.S. James Pty Ltd '*Geotechnical Investigation - Waste Disposal Site, Fiskville Training Centre*', dated 7 July 1988 (Reference No. 72024).

A copy of this report is provided in Appendix D.

A.S. James stated that the objective of the investigation was to determine the nature of industrial waste which was reported to have been buried in a small area near the airstrip at the Site and to recommend an appropriate long term approach to future utilisation of the area.

A.S. James reported from site observations that it appeared disposal had been in a series of three trenches, approximately 20 to 30 m in length and the (waste) drums were placed in these trenches. Typical drums were pierced and/or removed when damaged. A.S. James collected soil samples at nine locations within the trenches and one sample was collected from a test pit excavated approximately 3 to 4 m from the trenches.

The collected samples were submitted to East Melbourne Laboratory for qualitative volatile organic compounds (VOCs) analysis by infra red spectroscopy. The laboratory reported that aromatic organic compounds i.e. resins or solvents and may include benzene, toluene, xylene and phenol were detected in the nine trench samples; however no VOCs were detected in the test pit sample. The laboratory recommend that this type of materials biodegrade slowly and their presence would normally constitute an environmental problem.

An Atterberg Limit geotechnical test was conducted on the soil sample collected from test pit and the soil was confirmed to be clay with low permeability.

No groundwater was encountered during soil sampling at depths up to 2.5 m below ground level (bgl).

A.S James concluded that it appeared that little significant contamination of the adjacent soil had occurred. However if the chemicals remain in place, there will be long term break down of the containers. They recommended that an impermeable membrane with welded or glued joints could be placed over the drums to restrict drum degradation. However, they noted that this approach would not prevent leachate into groundwater and that this risk should be recognised. If the risk to groundwater is unacceptable, the materials should be removed from the Site and disposed of in a suitable manner. A.S. James recommended a waste disposal company, Cleanaway, who operate a disposal system near Tullamarine Airport.

A.S James stated that they understand that concern has been expressed as to the influence of the material on human contact and comment that this is not within their area of expertise and medical and or legal advice should be sought.

### **2.2 Minenco Environmental Services CFA Site Visit (May 1996)**

Minenco Environmental Services Pty Ltd (Minenco) previously called Bioremediation Services were engaged by CFA to conduct a site visit on 14 May 1996, the findings of which are provided in the report, Minenco Environmental Services Pty Ltd '*CRA Site Visit by Philip Peck, 14 May 1996*', dated 31 May 1996. (Reference No. CFA 599).

A copy of this report is provided in Appendix D.

The report includes the following:

- Summary of the observations of general nature and distribution of contamination at the Site;
- Briefly canvasses remediation options that may be applicable to the Site; and
- Makes recommendations for immediate actions required by the CFA to characterise the Site sufficiently for remediation planning to take place.



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Minenco concluded the FLP and FMA appear to represent the major areas of hydrocarbon contamination at the Site. Chronic releases of diesel and petrol mixture during fire training activities have occurred over a period of approximately 25 years. The current arrangements have been in place for approximately 15 years. Flammable liquid fuel usage over the past 12 month was reported to be in the range of 150,000 to 160,000L. It is estimated that as much as 25% of this product may have been lost to the ground during fire fighting activities (verbal communication, Dave Clancy CFA 16 May 1996). Minenco concluded that if the current fuel usage is representative of that over the operational life of the outdoor FTA, approximately 40,000L of fuel may have been lost to ground at the Site every year since the installation of the FLP.

### FLP & FMA

Contamination issues identified at the FLP and FMA include:

- Extensive areas of ground have been saturated with hydrocarbons;
- There are pools of free phase hydrocarbons;
- Free phase hydrocarbons have collected in sumps and drains in the FMA;
- The perimeter drains filled with water and fuels in the FLP;
- It is likely that soils at the Site are contaminated in the deeper subsurface;
- There is potential for migration of hydrocarbon contamination to the groundwater;
- Dam 1 received all surface run-off from the FLP and is heavily contaminated with hydrocarbons (contamination includes both free product and contaminated water). Accumulation of free hydrocarbons is a common occurrence. Dam 1 is reported to have been constructed to a rock base;
- There is no bunding of the FLP or FMA facilities with the exception of localised pits around various props; and
- Unsealed surfaces (in the FLP & FMA) provide a direct conduit to the subsurface.

Minenco concluded that the FLP and FMA areas in their current condition represent ongoing sources of soil and groundwater contamination.

Minenco recommended that the following upgrades to the FLP and FMA areas:

- Remove and ex-situ biotreatment of contaminated soils from the FLP and FMA areas;
- Engineer full bunding and drainage control, if fire fighting activities are to continue in the areas. All drainage needs to be directed to a suitable product/water separation facility;
- Seal all surfaces that are subject to inundation with fuel or fire fighting foams; and
- Engineer a product interception facility for the protection of environmental receptors downstream.

### Underground Storage Tanks (USTs)

The following USTS were identified:

- Diesel and petrol USTs at the ablution block (Amenities Building);
- Diesel UST at the ablution block, capacity ~2,000L, current status decommissioned, known to have leaked; and
- Diesel UST at the training centre, current status decommissioned.



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Minenco reported that there was potential soil and groundwater contamination associated with some or all of these USTs. The impacts of the USTs on the subsurface should be assessed subsequent to their removal.

#### Drum Burial Pits

Minenco reported that three drum burial pits are located north of Deep Creek Road, adjacent to the 'East – West' Airstrip. These pits were reported to have been excavated approximately 12 years ago (1984). Three parallel trenches were excavated to a depth of approximately 1 metre. Waste drums were then placed in the trenches. The drums contained residual solvent sludges, thinners and paint sludges. The original contents of the drums had been used in fire training exercises in burning pits adjacent to the FLP. Residual material in the drums reportedly ran into the bottom of the trenches. The trenches were then lit and allowed to burn. The pits locations remain evident due to reduced grass growth along the lines of the pit. Anecdotal evidence of excavation since the drum burial exercise suggests that the drums may have been rusted away completely since burial.

Minenco concluded that it is highly likely that there is residual soil contamination at the drum burial site. Contamination of the groundwater in the area may have occurred. It is also known that waste material from paint manufacture was dumped at the Site. Due to the unknown mixture of materials burnt in the pits, there is the potential for a wide range of potential contaminants, including Benzene, Toluene, Ethylbenzene and Xylene (BTEX) compounds, chlorinated solvents and heavy metals in the vicinity of the pits.

#### Decommissioned Fire Training Pits (FTP)

Minenco reported anecdotal evidence suggests that a wide range of petrochemicals were burnt in fire training pits that were located immediately to the east of the FLP. These pits were reportedly excavated and backfilled in the late 1980s. There was no visual evidence of their existence at the time of the Minenco site visit. Minenco report that the pits were unlined and that staining and visual evidence of contamination was present for less than 150mm into the clay soil surfaces in the pit. It is believed the pits were in use for nearly 20 years.

Minenco concluded that the unlined FTP were likely to have been serious contamination sources during their operational phase. Despite the visual evidence to the contrary it was highly probable that they have contributed to soil and potential groundwater contamination. The pits were excavated when decommissioned. Due to the unknown mixture of materials burnt in the pits, there is the potential for a wide range of potential contaminants in vicinity of the pits.

#### Sludge Burial Pit

Minenco reported that material excavated from the FTP was buried in a deep hole excavated approximately 40 meters to the east of the pits. The exact location of the Sludge Burial Pit is unknown. The hole was reportedly the full extent of a KATO excavator arm which suggests the hole was approximately 6 m deep.

Minenco concluded that the Sludge Burial Pit represents a significant potential source for groundwater contamination and the contents buried in the pit may contain mobile contaminants.

#### Fuel Storage Facility

Minenco reported that no contamination had been reported in this area. However the tanks and lines should be pressure tested and fuel metering system should be installed on all fuel transfer lines.

#### Sewage Treatment Plant

It was noted the tank at the sewage treatment plant had subsided and cracked. Sewage had leaked into the ground and into open drain. It was reported that blue-green algae have been observed in water bodies receiving drainage from this area. Minenco recommended that the sewage treatment plant should be addressed to minimise risks of downstream impacts from sewage effluent

#### OH&S Considerations

Minenco reported that some Occupation Health and Safety issues were raised during site visit which included:





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- The volumes of fuel lying around represented a hazard;
- Water in Dam 1 which was used for fire training could pose a potential health risk as it contained hydrocarbons; and
- Improved housekeeping would minimise environmental impacts of fuels and chemicals stored and used on site.

Minenco recommended the following actions for the Site:

- An initial investigation (*Stage I Investigation*) is urgently required to identify key site characteristics and focus more detailed investigations of site contamination and its associated risks;
- A secondary investigation (*Stage II Investigation*) after the initial investigation to fully determine the extent of all contamination. A secondary investigation targeted at key parameters of concern would provide the information essential to a structured risk management and remediation plan; and
- Hydrocarbon contamination of soil and water can be remediated by a range of technologies, including both *in situ* and *ex situ* technologies.

Minenco concluded that urgent action was required to commence investigation of contamination at the Site.

### 2.3 Diomides – Environmental Site Assessment (June 1996)

Diomides & Associates (Diomides) was commissioned to conduct an Environmental Site Assessment (ESA) in 1996, the findings of which are provided in the report, Diomides & Associates Pty Ltd '*Environmental Site Assessment*', dated 27 June 1996 (Reference DA11087/SD3000).

A copy of this report was not obtained during this ESA however the findings of the report are summarised in the CRA report '*Review of Site Investigations at Fiskville, Vic*, (Reference CRA5991rpt1). The summary below has been compiled from this CRA report.

Diomides reported that their scope of work included the inspection of the following areas; areas of buried drums containing solvents and other flammable liquids, decommissioned fire training pits, sludge burial pits, areas of ground saturated with petroleum hydrocarbons, contaminated sediment in a dam near the FLP.

The scope of work consisted of soil sampling, sediment sampling and surface water sampling.

#### Soil Samples

Soil samples were collected at the following locations:

- Nine soil boreholes were drilled to a maximum depth of 2.6m bgl in the FLP area;
- Three soil boreholes drilled to a maximum depth of 1.0m bgl in the drum burial pits near the Airstrip; and
- Four boreholes to a maximum of 2.8m bgl near the underground storage tanks (USTs) near the Training Centre and Administration Building.

Soil samples were collected at each borehole at depths of 0.5, 1.0 and 2.5 m bgl. In total, 46 discrete soil samples and 12 composite soil samples were analysed for the following compounds:

- Total Petroleum Hydrocarbons (TPH);
- Benzene, Toluene, Ethylbenzene and Xylene (BTEX);
- Polynuclear Aromatic Hydrocarbons (PAH);
- Phenols;



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- Organochlorine Pesticides (OCPs);
- Polychlorinated biphenyls (PCBs); and
- Selected Metals.

#### Sediment Samples

- Three sediment samples were collected from Dam 1 and were analysed for TPH, BTEX, PAH and selected metals.

#### Surface Water Samples

- Surface water samples were collected from Dam 1 and Dam 2 and were analysed for TPH, BTEX, PAH, phenols, OCPs, PCBs and selected metals.

#### Assessment Criteria

##### Soil & Sediment

Reported soil and sediment analytical results were compared against the guidelines values published by the Australian and New Zealand Environmental Conservation Council (*ANZECC, 1992*), which are recognised by the Victorian EPA. In the absence of guidelines values for specific contaminants ANZECC recommended Dutch B levels. However, since the ANZECC guidelines were published 1992 the Dutch guidelines were revised and the original Dutch B was replaced with the following two sets of guideline values:

- A 'target value', above which there is considered to be pollution (sometimes referred to as Dutch B); and
- An 'intervention value', above which requires management and/or remediation (sometimes referred to as Dutch C).

##### Surface Water

Reported surface water analytical results were compared against the ANZECC and ARMCANZ (2000) WQG, for the protection of aquatic ecosystems and drinking water (*ANZECC 1992a aquatic, drink*) and the Victorian EPA SEPP (WoV, GoV, 2003). In the absence of guidelines values for specific contaminants the Victorian EPA has used Dutch levels. The Dutch guideline values for water were as follows:

- Dutch B = value for potable water above which further investigation is warranted;
- Dutch C = value for potable water above which the Victoria EPA requires notification.

#### Results

##### Soil Samples

It was reported that the following analytes were detected at concentrations exceeding the assessment criteria:

- TPH and lead concentrations in one (1) sample from Fire Training Pits exceeded the Dutch C Value;
- TPH concentrations in two (2) samples from FLP exceeded the Dutch B Value;
- TPH concentrations in two (2) samples from the Drum Burial Area (south of the Airstrip) exceeded the Dutch B Value;
- TPH and BTEX concentrations in one (1) sample from Drum Burial Area (south of the Airstrip) exceeded the Dutch C Value;
- Chromium concentrations in nine (9) of the 11 composite samples exceeded the ANZECC Guideline Value; and



- Phenol concentrations in the two (2) composite samples from the Drum Burial Area (south of the Airstrip) exceeded the Dutch B Value.

The reported concentrations of all other analytes were below the assessment criteria.

### **Sediment Samples**

It was reported that the TPH concentrations in all three sediment samples collected from Dam 1 exceeded the Dutch C Value.

The reported concentrations of all other analytes were below the assessment criteria.

### **Surface Water Samples**

It was reported that the TPH and Zinc concentrations in the surface water samples collected from Dam 1 exceeded the Dutch B Value.

The reported concentrations of all other analytes were below the assessment criteria.

## **2.4 Coffey – Field Site Appraisal and Sampling (August 1996)**

Coffey were commissioned by CFA to conduct an ESA in July 1996, the findings of which are provided in the report, Coffey Partners International Pty Ltd 'Field Site Appraisal and Sampling, Ballan, VIC', dated 7 August 1996 (Reference E3517/1-AD).

A copy of this report is provided in Appendix D.

Coffey stated that the objectives of the ESA were:

- To delineate former buried sludge pits (previously referred to as the Fire Training Pits by Minenco) which were reportedly present on the Site; and
- Assess the contaminant distribution within the soil profile in the vicinity of the Fire Training Pits.

Coffey reported that the area under investigation contains two Fire Training Pits where flammable liquid fire training was undertaken. They reported that anecdotal reports suggested that a black diesel sludge covered this area until approximately 1989. They reported that a review of aerial photos which were held by the CFA, revealed a significant spillage at the eastern end of the pits toward the golf course. In approximately 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 Fire Training 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.

Coffey reported that soil sampling locations were selected in the field following discussions with Mr. David Clancy of the CFA Training College. Anecdotal reports suggested the sludge from the former Fire Training Pits was scraped and dumped in a more recent excavation between the sludge pits and the golf course. However test pit excavations did not reveal any evidence of this disposal pit and in accordance with Mr. Clancy's directions, attention was focussed in the former Fire Training Pits area which was visually contaminated.

The site works included the excavation of 20 test pits in the former Fire Training Pits areas and also in the area of the suspected sludge disposal pit (test pits TP1-TP4). The test pits were excavated to a minimum depth of 0.5 m bgl and a maximum depth of 2.8 m bgl (where they terminated on basalt rock). A total of 12 soil samples were collected from seven test pits and analysed for TPH, BTEX at NATA accredited National Analytical Laboratories.

### **Assessment Criteria**

Reported soil analytical results were compared against the ANZECC 1992 guidelines values and the Dutch (B&C) guidelines values and the Victorian EPA criteria (VicEPA, 1995) for off-site disposal of contaminated soils as clean fill or low level contaminated fill.



## Results

It was reported that the following analytes were detected at concentrations exceeding the assessment criteria:

- TPH concentrations in one (1) sample from test pit TP8 exceeded the Dutch C Value;
- TPH concentrations in two (2) samples from test pits TP6 and TP14 exceeded the Dutch B Value;
- TPH concentrations for samples collected from TP8, TP6 and TP14 were commensurate with VicEPA off-site disposal low level contaminated soil.

BTEX concentrations were detected above the limit of reporting (LOR) in test pits (TP6, TP8 and TP14) but were below the Dutch B criteria.

Coffey concluded that the sludge was found in an area of approximately 1200 m<sup>2</sup> as a relatively thin layer at the interface between the scoria cover and underlying topsoil. The thickness was generally 20 to 50mm to a maximum of 100mm observed in the vicinity of TP8. Coffey concluded that based on 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<sup>3</sup>.

## 2.5 EPA – CFA Fiskville – Site Contamination (August 1996)

The EPA (South West Region) conducted a site inspection on 23 July 1996 at the Site, the findings of which are provided in the report, EPA South West Region 'CFA Training College, Fiskville – Site Contamination', dated 21 August 1996 (Reference 25151).

A copy of this report is provided in Appendix D.

The letter report includes a copy of the *Site Inspection Report*.

The report stated that the inspections focused on several areas of the Site and covered a number of issues relating to recent and past activities at the Site. They noted that fire fighting exercises at the Site have given rise to a number of issues but that the disposal of waste associated with these exercises and the general running of the Site have contributed significantly to these issues.

### Waste Treatment and Disposal

Under the heading Waste Treatment and Disposal, the EPA discusses the following 3 areas of the Site:

#### ■ Drum Burial Pits

The EPA noted that three drum burial pits were identified in an area lying to the north of the training area (approximately 500m), adjacent to the Airstrip. They noted the burial pits were located approximately 100m east of a small water course which drained southward into a lake (Lake Fiskville). The areas were discernible by the lack of longer grass growing on the surface covering the drums. The EPA noted that was explained that the drums could contain a variety of compounds (understood to be solvent sludges, thinner and paint sludges, including waste from paint manufacture). They noted that flammable liquid wastes from a number of sources (known and unknown) had been used in the past for fire fighting exercises but the practice was now ceased.

#### ■ Landfill

The EPA reported that at the far west of the Site, a landfill had been established for the burial of burnt and partially burnt plastics, furniture and other debris used in fire fighting exercises, along with some scrapings of contaminated soil from the bottom of the fire pits (used for holding flammable liquids which are ignited). The landfill consists of holes dug to a depth of approximately 1.5-2m for placement of waste. It was estimated that waste is deposited five (5) times per year in volumes of 4-5 m<sup>3</sup>.



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They noted the landfill is situated close to another landfill which had been used for the burial of various unknown materials by a previous occupier of the Site. The EPA noted the area is situated immediately adjacent to a small watercourse which is the outlet of the Lake Fiskville.

#### ■ Sewage Treatment System

The EPA noted that sewage from residential houses, temporary accommodation and Canteen and administrative blocks was conveyed to an onsite sewage treatment plant. The residential units were serviced by a holding tank for settling solids. The liquid effluent from the tank was pumped to the sewage treatment plant and the solids are cleaned out annually. The EPA noted the treatment tank was not been maintained particularly well and it needed attention. The EPA noted that the CFA were in the process of repairing the tank so that it can be restored to meet the needs of the Site.

The EPA note that discharge from the treatment plant is to the land. The effluent is discharged via a pipe at a point about 100m from watercourse which drains into Lake Fiskville. The EPA concluded that the sewer line from the houses run under the Lake Fiskville or watercourse draining into Lake Fiskville and they question the integrity of the line. They also noted that an algae bloom occurred in the lake in early 1995 but there was none since.

#### Training Areas and Activities

The EPA reported that the FLP was used for fire fighting exercises using props which have been ignited using flammable liquids. They noted some of the FLP was sealed but the surface was extensively cracked and broken. They also noted that fuel and burnt residue from the FLP had been allowed escape to the soil surrounding and beneath the FLP, as clearly evident by gross black oily contamination of these areas. They noted the FLP is serviced by a relatively small interceptor sump which drains into Dam 1. The sump is clearly overwhelmed by hydrocarbon loading and does not prevent discharge of contaminants to the Dam 1. The liquid within the interceptor was thick and black being heavily contaminated with fuel and oil. The EPA noted that soil around the interceptor was highly contaminated suggesting the system had overflowed. They also noted that there were signs of direct run-off from the pad to the pond.

The EPA noted that training in this area had now ceased due to concern for the contamination of surrounding soils, water and sediments.

The EPA noted that Dam 2 is a relatively new area of the FLP and that training is controlled in this area so that no flammable liquids are used. Vehicles used in training exercises are drained of all oil and fuels prior to use and LPG is used for fuelling fires.

The EPA also noted that some concern was expressed regarding the contamination of the waterbodies by fire fighting foams as they are not biodegradable.

The EPA noted that adjacent to the FLP is a grassed area which had been used in the past as Fire Training Pits. Liquids fuels were poured into this pits and ignited for fire training excises. When these pits were not longer required they were covered in without the removal of any residues.

#### Cover Letter Conclusions

The EPA reported that site is likely to be contaminated due to poor practices in the past. This is supported by the results of the initial site investigation commissioned by the CFA.

The EPA noted they were encouraged by CFA's proactive approach to determining the extent of contamination of the Fiskville site.

The EPA recommended that further site investigations should be carried out in-line with that suggested by in the consultant's report and that this should cover groundwater, surface water quality and further soil testing. They also recommend that measures should be considered at this point for ensuring that activities do not cause similar problems in the future (e.g. construction of a bunded FLP with satisfactory treatment of run-off before discharge).





The EPA stated that if no further action is taken on the contamination issues already identified, the EPA may require further investigation and clean up to be undertaken through the issue of a pollution abatement notice and/or clean up notice.

Also the EPA stated the discharge of effluent from the sewage treatment plant and landfilling activities needed to be addressed as this activities are listed as scheduled premises under *Table A – Schedule Premises, Sections 1 (d) and 1 (e)*, of the *Environmental Protection (Schedule Premises and Exemptions) Regulations 1996*. Therefore these activities needed to be licensed if the CFA intends continuing their use. They noted that current practices associated with these activities may not meet with licensing requirements.

## **2.6 Coffey – Sediment and Surface Water Sampling (October 1996)**

Coffey were commissioned by CFA to conduct sediment and surface water sampling in September 1996, the findings of which are provided in the report, Coffey Partners International Pty Ltd ‘*Sediment and Surface Water Sampling, Ballan Vic*, dated 15 October 1996 (Reference E3523/2-AD)

A copy of this report is provided in Appendix D.

As stated by Coffey the primary objective of the sampling was to undertake a preliminary assessment of water and sediment contamination status in the drainage system of the Site.

The scope of work consisted of sampling surface water at seven (7) locations across the Site and sediment sampling at three (3) locations.

### **Surface Water Samples**

Surface water samples were collected from the following locations:

- Dam 1 – inlet;
- Dam 2 – inlet and outlet;
- Lake Fiskville – 2 inlets and 1 outlet; and
- Beremboke Creek - down gradient of Lake Fiskville and landfill.

The collected surface water samples were analysed for TPH, Metals (As, Cd, Cu, Cr, Ni, Pb, Zn, Hg and total P), pH, total dissolved solids (TDS), total suspended solids (TSS), nitrate (NO<sub>3</sub>-N), total nitrogen and ammonia (NH<sub>3</sub>), total phenols and biological oxygen demand (BOD).

The reported analytical results were compared against the Victorian EPA SEPP (WoV, GoV, 2003) and the ANZECC (1992a aquatic, drinking water). The Dutch Criteria (B and C) were used where no Australian criteria were available.

In surface water samples collected from Dam 1 and Dam 2, the following analytes were detected at concentrations exceeding the assessment criteria:

- Suspended Solids in samples Dam 1–inlet, Dam 2–outlet and Lake Fiskville-inlet (from Dam 2) exceeded the SEPP (GoV, 2003) criteria;
- BOD concentrations in sample Dam 1-inlet exceeded the SEPP (GoV, 2003) criteria;
- TPH concentrations in sample Dam 1-inlet exceeded the Dutch C criteria, while TPH concentrations in Dam 2–inlet and Dam 2–outlet exceeded the Dutch B criteria; and
- Copper concentrations in all surface water samples and nickel, lead and zinc concentrations in samples from Dam 1, Dam 2 and Lake Fiskville exceeded the ANZECC (1992a aquatic) criteria.

The reported concentrations of all other analytes were below the assessment criteria.





## Sediment Samples

Sediment samples were collected from three (3) locations adjacent to the edge of Dam 2.

The collected sediment samples were analysed for Total Petroleum Hydrocarbons and Metals and total phenols. Results of analytical testing were compared to ANZECC (1992b) and Dutch Criteria (B and C) soil assessment criteria.

In sediment samples collected from Dam 2, the following analytes were detected at concentrations exceeding the assessment criteria:

- Chromium concentrations in all three (3) samples exceeded the ANZECC (1992b) criteria; and
- TPH concentrations in sample Dam 2 A-P collected adjacent to the inlet to Dam 2 exceeded the Dutch B criteria.

The reported concentrations of all other analytes were below the assessment criteria.

Overall, the Coffey report concluded that:

- Hydrocarbon contamination was impacting on the water quality in Dam 1 and Dam 2;
- The spatial distribution of measured heavy metals concentrations detected in surface water samples was not indicative of any specific source. The measured values were commensurate with concentrations in limited groundwater samples. Therefore, heavy metal concentrations were likely to be typical of normal “background” conditions in the area rather than as a result of onsite activities; and
- The presence of significant volumes of hydrocarbon contaminants Dam 2 sediments may be providing a source of secondary contaminant source.

## 2.7 Coffey – Groundwater Monitoring Network (1996)

Coffey were commissioned by CFA to install a groundwater monitoring network at the Site in August 1996, the findings of which are provided in the report, Coffey Partners International Pty Ltd ‘*Groundwater Monitoring Network Installation, Ballan Vic*, dated 15 October 1996 (Reference E3523/1-AK).

A copy of this report is provided in Appendix D.

As stated by Coffey the objectives of the Site investigation were to:

- Provide a network of groundwater sampling points on the Site that would be adequate in terms of establishing overall groundwater quality and flow characteristics; assess localised contaminant occurrence around nominated Areas of Environmental Concern (AEC); and provide an assessment of gross water quality changes associated with the Site; and
- Allow for on-going monitoring over the projected life of the Site.

The scope of works included the drilling and installation of eight (8) groundwater monitoring bores at the AEC, soil core and groundwater sampling and analysis. The eight AEC were identified as follows:

- Fuel mix areas (FMA);
- Flammable liquid pad (FLP);
- Dam 1;
- Underground storage tank (UST) facilities;
- Drum burial pits;
- Sludge burial pit; and



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- Landfill.

A summary of the well construction details is summarised in below:

**Table 2: Summary of Borehole Construction**

Borehole No	AEC Targeted	Drilled Depth (m)	Surface Water Level (mpvc)	Surface Water Level (RL m AHD)*
BH1	UST	25	dry	-
BH2	flammable liquid pad	17	14.8	426.18
BH3	Landfill	21	dry	-
BH4	drum burial pits	20	dry	-
BH5	drum burial pits	1.8	0.3	442.18
BH6	flammable liquid pad	2.0	dry	-
BH7	sludge burial pit	2.8	dry	-
BH8	fuel mix areas	2.3	dry	-

\* MPVC = metres below polyvinyl chloride pipe, RL = Relative Level, AHD = Australian Height Datum

### Soil Samples

Soil samples were collected from each borehole at selected intervals and analysed for TPH, BTEX and metals.

Reported analytical results for soil were compared to ANZECC (1992b) and Dutch (B and C) Criteria soil assessment criteria. Concentrations of chromium in soil samples collected from BH1 and BH4 exceeded the ANZECC criteria.

The reported concentrations of all other analytes were below the assessment criteria.

### Groundwater Samples

Groundwater samples were collected from BH2 (basalt aquifer) and BH5 (residual clay aquifer). All other boreholes were found to be dry.

The reported analytical results were compared against the Victorian EPA SEPP (WoV, GoV, 2003) and the ANZECC (1992a aquatic, drink) guideline values. The Dutch Criteria (B and C) were used where no Australian criteria was available.

In groundwater samples collected, the following analytes were detected at concentrations exceeding the assessment criteria:

- Copper and zinc concentrations in samples from BH2 and BH5 exceeded the ANZECC (1992a aquatic) criteria and nickel concentrations in BH2 also exceeded the ANZECC (1992a aquatic) criteria; and
- TPH concentration in BH5 exceeded the Dutch B criteria.



The reported concentrations of all other analytes were below the assessment criteria and LOR.

Overall, the Coffey report concluded that:

- The drilling and bore installation programme indicated a general absence of significant groundwater resources on the Site;
- Where groundwater was encountered it appeared to be of limited extent and the water bearing zones were of low permeability;
- The investigations indicated a low potential for contaminant migration either on or off-site via subsurface groundwater systems;
- The single deep bore (BH2) which intersected groundwater showed no indication of hydrocarbon contamination and detected heavy metals were considered to commensurate with likely 'background' conditions;
- Shallow groundwater intersected in BH5 which was located immediately adjacent to the backfilled drum burial trenches. Water intersected in this borehole was probably a consequence of locally enhanced recharge occurring in the trench backfill materials. Reported TPH contamination in this borehole was commensurate with this recharge scenario;
- The hydrocarbon contamination found in groundwater sample BH5 was likely to represent a localised effect;
- Given the nature of residual clays at BH5, significant contaminant migration from such localised contaminant sources was unlikely unless local permeability conditions are enhanced by clay fissuring or man-made features such as service trench backfill. Management of such localised effects would be best achieved by removing the contaminants at source; and
- Primary site cleanup goals should be the identification and clean up of localised area of upper soil profile contamination such as has already been identified in the former buried sludge pits.

## 2.8 CRA ATD - Review of Site Investigations at Fiskville (November 1996)

CRA ATD Pty Ltd (CRA) were commissioned by CFA to review the environmental status of the Site and evaluate remediation options in April 1996, the findings of which are provided in the report, CRA ATD Pty Ltd 'Review of Site Investigations at Fiskville, Vic, dated 19 November 1996 (Reference CRA5991rpt1).

A copy of this report is provided in Appendix D.

This report reviewed and summarised the investigations undertaken by Diomedes and Coffey in 1996, and which are discussed in Section 2.3 to Section 2.7 above. A figure showing Coffey's sample locations from 1996 is presented as Figure 6 – 1990's Sample Location Plan in Appendix C.

CRA concluded that the investigations revealed localised soil, sediment and surface water contamination at the Site, which was principally the result of storage and handling of fuels, fire training activities and disposal of fuel residues.

CRA reported that levels of soil contamination at the Site exceeded soil investigation guidelines for TPH at several locations, including the FLP, the Fire Training Pits and the Drum Burial Pits. Significant hydrocarbon was also evident in sediments in Dam 1 and near the inlet in Dam 2. No significant groundwater contamination was identified. Some low levels soil contamination of phenols, BTEX and lead were also encountered, but only where TPH concentrations were also above investigation. Slightly elevated levels of chromium detected in most soils, were considered to represent site background.



CRA concluded that onsite bioremediation should achieve soil remediation objectives at low cost for hydrocarbon impacted soil from the FLP, FMA and Fire Training Pits.

CRA also concluded that soil from the Drum Burial Pits may contain drums and other containers, so onsite treatment would be difficult. Thus offsite disposal is likely to be the most appropriate remedial action for this area.

The total estimated volume of contaminated soil requiring treatment appeared to be in excess of 2000m<sup>3</sup>.

CRA recommended that:

- The FLP/FMA area be reviewed and improvements to prop design, firewater collection, draining and water treatment be implemented as soon as practical to prevent further contamination of soil and dam sediment;
- Contaminated soils from the FLP/FMA and fire training pits be excavated for onsite treatment and the area be backfilled with clean fill;
- Once the improvements have been made and hydrocarbons are being intercepted and removed from surface waters, Dam 1 may be rehabilitated;
- Contaminated soils from Drum Burial Pits be excavated and subject to the presence of drums, be treated onsite or otherwise disposed of off-site to an appropriate landfill. The trenches should be backfilled with clean soil;
- Surface water monitoring be continued at appropriate intervals, including at least one more round of monitoring before the FLP/FMA improvements above are implemented; and
- Groundwater monitoring wells be dipped and sampled annually.

## **2.9 Rio Tinto – Remediation Action Plan (1997)**

Rio Tinto Pty Ltd (Rio Tinto) (formerly Bioremediation Services, Minenco and CRA ATD) were commissioned by CFA to prepare a remedial action plan (RAP) for the Site in 1997 the details of which are provided in the report, Rio Tinto Pty Ltd '*Remediation Action Plan*', dated 11 December 1997 (Reference A912B).

A copy of this report is provided in Appendix D.

Rio Tinto reported that their previous report '*Review of Site Investigations at Fiskville*' (Reference CRA5991rpt1) was provided to the EPA and the EPA indicated their agreement with the conclusions of this review and to the proposed remedial actions.

Rio Tinto stated that the purpose of the RAP was to review contamination present onsite, provide details of the remediation objectives and methodology, and outline the management plans for various aspects of the remedial works.

The RAP considered the following two areas of soil contamination:

- The Flammable Liquids Pad; and
- The Fire Training Pits.

The FLP were described as a large area containing obvious superficial soil contaminations with fuel residues from fire training activities. Crushed rock fill is contaminated with hydrocarbons at depths of 0.1-0.5m, but generally no deeper than 0.8m. Total petroleum hydrocarbon concentrations range up to 1600 mg/kg.

The Fire Training Pits were described as two decommissioned fire training pits, east of the FLP which contained a thin layer (less than 10cm) of black hydrocarbon sludge at a depth of 0.1 to 0.6m bgl. The sludge was covered by a 0.1m to 0.8m thick layer of surface fill comprising of silty clay, silt and gravel. High



## APPENDIX D Historical Information Review

concentrations of TPH up to 88,000 mg/kg were found in the sludge layer and soil from 0.6 to 1.0m bgl. Elevated lead levels (710 mg/kg) were found in one sample.

They also noted that no groundwater contamination was identified requiring remedial action. Rio Tinto concluded that the depth to groundwater in the basalt (greater than 20-25 m), and relative impermeability of the residual silty clay soil affords a high degree of protection to any groundwater resource which might be present.

Rio Tinto noted that the Drum Burial Pits and contaminated sediments in Dam 1 have not been included in the RAP and will be the subject of a future RAP.

Rio Tinto proposed that the remediation would occur in two phases:

- All contaminated soil will be excavated and removed to a treatment facility to be established onsite. The excavations will be backfilled with clean fill although not as part of the present RAP; and
- Excavated soil, contaminated with hydrocarbons, phenols and BTEX, will be treated onsite by a process of soil composting in windrows.

The RAP outlined the methodologies for soil excavation; soil treatment and disposal; and validation and the health, safety and environment management plan.

The proposed adopted criteria for the excavation phase were the Victorian EPA guidelines for off-site disposal of contaminated soil as clean fill, EPA Publication 448 "Classification of Wastes", September 1995.

Rio Tinto outlined that the proposed/agreed actions for each of the participatory organisations are as follows:

- Rio Tinto will provide design and operational support for the composting process, including turning of the windrows; and
- CRA will procure inputs for the process and carry out the field work required for executing the process.

### 2.10 Coffey – Soil Remediation and Validation Program Report (1998)

Coffey were commissioned by CFA for remediation activities at the FLP at the Site on 19 December 1997, the findings of which are provided in the report, Coffey Partners International Pty Ltd 'Soil Remediation and Validation Program, Fiskville Near Ballan, Vic', dated March 1998 (Reference E3523/3-A1).

A copy of this report is provided in Appendix D.

As stated by Coffey the primary objective of the objective of the Site study was to facilitate the implementation of the Draft Remediation Action Plan prepared by Rio Tinto in December 1997, and to conduct a validation sampling and analytical program in areas where contaminated soil had been excavated.

The scope of the works completed during the course of the remediation activities included:

- Overseeing construction of the on-site bioremediation facility.
- Overseeing contaminated soil excavation in each of the two identified areas of environmental concern, i.e. the FLP and the old FTP.
- Conducting field observations and undertaking photo ionisation detector measurements to screen soil samples for volatile ionisable hydrocarbons.
- Collection of soil samples from the base and sides of the excavations to validate the soil condition after soil excavation.
- Overseeing cartage of contaminated soil and stockpiling of soil in the on-site bioremediation facility.
- Liaison with Rio Tinto with regard to windrow management.



## APPENDIX D

### Historical Information Review

During the Stage I works, Coffey reported that approximately 4 300 m<sup>3</sup> of contaminated soil was excavated from the FLP, an area approximately 90 m (east-west) by 80 m (north-south). The depth of excavation was generally 0.6 m bgl, excepting areas in the vicinity of FTPs and the fuel mixing area where excavation was up to 1.2 m bgl.

Evidence of soil staining and hydrocarbon odour (mainly diesel), indicative of soil hydrocarbon contamination, was observed in the field.

Following the break-up and removal of surface concrete structures and pipework, the fill layers were removed to a depth of approximately 0.5 m to 0.6 m. An excavator and trucks were used to remove the contaminated soil and pipework to a depth of 0.7 m to 0.8 m in some areas, and up to 1.2 m in the most heavily contaminated areas.

Agricultural drains resided at a depth of approximately 0.7 m to 0.8 m and contained residual fuel oil with associated diesel odour, causing substantial soil contamination in the FLP area. The general drainage direction was towards Dam 1 from beneath the FLP area. Consequently, significant excavation works were required in the vicinity of these drains.

Approximately 1,000 m<sup>3</sup> of contaminated spoil was excavated from the old FTP during Stage I works. The area of excavation was approximately 55 m long by 40 m wide and located to the east of University Road. The approximate depth of excavation was 0.4 m bgl along the eastern part of the excavated area and up to 1.2 m depth in the western parts near University Road. These deeper excavations occurred in the vicinity of the former fire training pits, and areas further to the east where the scoria cover and the black sludge layer were substantially thinner were excavated due to possible overflow spillage from the former pits.

Soil contamination was visually identified as a black sludge, only millimetres thick but for in the deeper parts of the excavation where it ranged up to tens of centimetres thick. The black sludge layer had since been covered with red scoria gravel. Residual clay associated with basalt occurred below the contaminated soil. The black sludge was most commonly associated with the buried topsoil beneath the scoria fill, and occasionally with the residual clay below. The depth of the scoria layer ranged from 0.2 m to 0.6 m.

Coffey reported that the test results generally indicated that petroleum hydrocarbons (TPH), BTEX, lead and total phenol concentrations were below EPA guidelines for off-site disposal as "clean" fill, except for the following samples that exhibited TPH (>C9) concentrations greater than 1000 mg/kg:

- FLP3S-O.1P, blue metal fill sample, excavation depth of 0.3 m, eastern wall of the easternmost extent of the FLP excavation abutting University Road (approximately 20 m north of the southern boundary and approximately 15 m north of the interceptor), exhibited TPH (>C9) concentrations of 1450 mg/kg.
- FLP40-O.1P, residual clay sample, excavation depth of 1.2 m, base of the excavation in the fuel mixing area located in the north western corner of the FLP adjacent to the green shed, exhibited TPH (>C9) concentrations of 2350 mg/kg.
- FTP14-O.1P, residual clay sample, excavation depth of 0.4 m, western side of the westernmost extent of the FTP excavation abutting University Road, exhibited TPH (>C9) concentrations of 1070 mg/kg.

Coffey reported that the Stage II activities involved additional excavations in the vicinity of FTP14. An area approximately 6m by 10 m located between sample location FTP14 and University Road was excavated to 1.2 m depth, thereby extending the former excavation to the same depth in a westerly direction to University Road. In the northern part of this excavation, the excavation works proceeded to 2.5 m depth where hydrocarbon contaminated waste material had been dumped in a deeper part of the old fire training pits. The contaminated material was subsequently excavated resulting in a small (2 m by 2 m) excavation of 2.5 m depth.

Coffey reported that the test results generally indicated TPH, BTEX, lead and total phenol concentrations were at or below laboratory detection limits, except for a sample collected from the fire training pit location





FTP17 where minor TPH (>C9) concentrations were detected. TPH concentrations at this location, however, were below VICEPA guidelines for off-site disposal as "clean" fill.

Coffey concluded that the results of the validation sampling and analytical program confirmed the absence of contaminants, at levels exceeding the target concentrations adopted in the RAP (RioTinto, 1997), in soil profile samples collected from the base and sides of the FLP and FTP excavations. On this basis Coffey recommend the excavations be backfilled with clean fill.

## **2.11 GHD – Report on Upgrade of Flammable Liquids Pad (May 1998)**

GHD PTY LTD (GHD) were commissioned by CFA to prepare a functional design for an upgrade of the Flammable Liquids Pad in May 1998, the details of which are provided in the report, GHD Pty Ltd '*Report on the upgrade of the Flammable Liquid Pad*, dated May 1998 (Reference MIW10258).

A copy of this report is provided in Appendix D.

GHD reported that the original FLP had reached the end of its life and had been sitting on a depth of contaminated soil. The soil had been removed and at the time of the GHD report was undergoing remediation by Rio Tinto.

GHD set out options and provided recommendations on:

- The most appropriate arrangement and construction of a new FLP and extinguisher training pad (ETP); and
- The most appropriate collection and treatment system for pad run off.

GHD reported that requirements of the EPA applied to the possible discharge of water to watercourses and groundwater.

To meet EPA requirements, GHD proposed that design included:

- Either surface treatments or a subsurface layer to prevent seepage from the FLP reaching groundwater; and
- A treatment system to bring the runoff from the FLP to comply with quality requirements of the SEPP (WoV, GoV, 2003).

GHD made the following recommendations for the new FLP:

- Fire fuels to be used on the FLP include diesel, petrol (unleaded) and LPG. LPG will provide the major proportion of all fuel burnt;
- The main retardant foam to be used on the FLTP is "B" class foam which is primarily used for "B" class (flammable liquids) fires. The occasional use of 3M Aqueous Film Forming Foam (AFFF) may occur;
- The upgraded PAD is proposed to include nine sites for props on an area of 70 x 80 m;
- Runoff will be controlled by bunds and a drainage system. The bunded areas will be constructed with heat resistant concrete. In order to control shrinkage cracks, the slab will have to be jointed at regular intervals or heavily reinforced;
- The bund will include a valved drainage system so that the drainage outlet valves can be closed to retain water during the training exercises. Each area will be connected to a main spoon drain system leading to a surge pit and interceptor pit. The surge pit will have a capacity of 34m<sup>3</sup>;
- Cooling water for props was previously drawn from Dam 1. For the new FLP and ETP, cooling water will be supplied from the backup supply;



- The new fire water reticulation system will be provided from Dam 2; and
- The recommended wastewater treatment system will comprise of the following:
  - Interceptor – Required to remove floating hydrocarbons and debris from wastewater from FLP prior to discharge into Dam 1. Designed to cater for an average flow with 3 equal compartments, each 2.5 m wide by 2.7 m long and 1.7 m deep;
  - Dam 1 – Designed to breakdown dissolved hydrocarbons and emulsions with the assistance of mechanical aeration. The volume of Dam 1 is estimate to be 1700 kL and the average detention time for wastewater is 10 days; and
  - Dam 2 – Design to collect effluent from Dam 1. The volume of Dam 2 is estimated to 6100 kL and the average detention time for waste water is 36 days.

Recommendations for the design of control booths and area lighting were also included in the report.

## **2.12 Rio Tinto – Remediation of Hydrocarbon Contaminated Soil, CFA (1999)**

Rio Tinto reported that the remediation at site was carried out in two stages. The excavation, validation and reinstatement of two contaminated areas was carried out and reported by Coffey. While Rio Tinto was commissioned in February 1998 to manage the onsite treatment of this excavated soil. The details of the treatment works and the results of the final validation sampling in early 1999 are provided in the report, Rio Tinto Pty Ltd '*Remediation of Hydrocarbon Contaminated Soil*', dated 03 June 1999 (Reference TR00025).

A copy of this report is provided in Appendix D.

Rio Tinto reported that contaminated soil from the Flammable Liquids Pad and Fire Training Pits was excavated as per Coffey's original recommendations and the soil was stockpiled onsite.

The total volume of contaminated soil (i.e. TPH concentration >1,000 mg/kg) was 4,300m<sup>3</sup>. The soil was placed into four (4) windrow piles in a bunded area onsite. Approximately 35% (by volume) of raw materials (green tree waste, cow manure, gypsum and nutrients) were added to initiate composting. The windrows were kept moist during the summer months, but no other maintenance was performed.

Two months after composting was initiated, the windrows were sampled and a second round of sampling was conducted after 6 months. The soil samples were analysed for TPH, BTEX, phenols and lead. The average reported TPH concentrations (730 mg/kg) from this second round of validation sampling met the Victorian EPA clean fill criteria. No other contaminants of significance were reported in the treated material.

Rio Tinto reported that the CFA indicated the soil within the compost windrows would be left in place (i.e. stockpiled in the bunded and drained area) for the foreseeable future.

Rio Tinto concluded that the treated material did not pose an unacceptable risk to human health or the environment and they suggested the following disposal options for the treated materials:

- The treated material could be used as fill under the new training pad;
- The treatment area could be levelled to allow revegetation to take place; and
- The treated material could be spread over the surrounding paddocks to provide organic enhancement.



## 2.13 Wynsafe – Perfluorochemicals in Fire fighting Water at CFA Fiskville

Wynsafe Occupational Health Services Pty Ltd (Wynsafe) were commissioned by CFA to determine if fire fighting water at the Site contains Perfluorooctyl Sulfonate (PFOS) or Perfluorooctanoic Acid (PFOA) and if so at in what concentrations. The details of their assessment are provided in the report, Wynsafe Occupational Health Services 'Perfluorochemicals in Fire fighting Water at CFA Fiskville', dated June 2010 (Reference: no reference number provided).

A copy of this report is provided in Appendix D.

Wynsafe reported that the 3M Company after discussions the United States EPA (USEPA) decided to discontinue its AFFF product line with effective end of production occurring around November 2001. The reason for this withdrawal was based on results that determined that a base material used in the production process of PFOS is considered to be Persistent, Bio-accumulative and Toxic (PBT) and as such further use would be harmful to the environment.

As foams containing PFOS were previously used at CFA Fiskville, it was decided that fire fighting water would be analysed for the presence of PFOS and PFOA and determine if concentrations present pose of a risk to site personnel.

Wynsafe collected water samples on 7 June 2010 from the following locations:

- Pit – supplies water to the main hydrant on the FLP;
- Dam 2 – supplies water to the backup hydrant on the FLP; and
- Fiskville Pumper 3 (MYT 543) – used for training and has been onsite for many years.

A sample was also analysed for BOD, Pseudomonas and E.coli, although results were not presented in the report supplied to Golder Associates.

The reported analytical results are summarised in Table 3.

**Table 3: Wynsafe Analytical Results 2010**

Location	PFOS (ug/L)	PFOA (ug/L)
<b>Criteria</b>	<b>0.2*</b>	<b>0.4*</b>
Pit	5.5	17
Dam 2	0.6	11
Pumper 3	0.5	9.9

- Sample not analysed
- \* USEPA health advisory level only (drinking water)

### Water Quality Criteria

In August 2009, following a recommendation from Ecowise and supported by Wynsafe, the water quality criteria for the Site were revised to:

- E Coli = < 150 orgs per 100ml;
- BOD = < 10 mg/L;
- pH = 6.0 – 9.0;
- Suspended Solids = <5 mg/L; and
- Pseudomonas Aeruginosa = <10 organisms (orgs) per 100mL.



## APPENDIX D

### Historical Information Review

Wynsafe reported that the Victorian EPA and DHS have no objections to the revised water quality criteria.

Wynsafe reported that the USEPA has recommended a provisional drinking water advisory for PFOA and PFOS of 0.4 ug/L and 0.2 ug/l respectively. While the United Kingdom (UK) Committee for Chemicals in Food, Consumer Products and the Environment (COT) has recommended a Tolerable Daily Intake of 0.3 ug/kg for PFOS and 3 ug/kg for PFOA. There are currently no Australian Standards or guidelines for either PFOS and PFOA in drinking water or occupational exposures to PFOS or PFOA.

Wynsafe reported that the fire fighting foam currently used at the Site (Tridol 3-6 ATF) does not contain PFOS or PFOA according to their product information and material safety data sheets (MSDS).

Wynsafe concluded that although the reported concentrations of PFOS and PFOA were above the USEPA advisory levels for drinking water, the normal exposure pathway for CFA personnel would be by the ingestion or inhalation of water and spray during training. The National Water Commission document "Quantitative chemical exposure assessment for water recycling schemes" estimates that the median ingestion of water and spray for a fire fighter is 20ml per fire. Thus the estimated exposures will produce daily intakes several hundred times lower than the recommended Tolerable Daily Intake (TDI) for both PFOS and PFOA.

Wynsafe concluded that if current Standard Operating Procedures (SOPs) are followed and related Personal Protective Equipment (PPE) is used, personnel will suffer no adverse health effects from exposure to PFOS and/or PFOA in the fire fighting water.

Wynsafe made the following recommendations:

- CFA should monitor closely further research on the health effects of fluorosurfactants in fire fighting foams to determine whether the current foam (Tridol) remains recommended with no potential risks to personnel;
- CFA should also monitor any changes in current advisory levels for drinking water or the introduction of any new (particularly Australian) standards or guidelines for occupational exposure to PFOA or PFOS; and
- Water samples should be collected from Pit, Dam2 and Pumper 3 on a bi-annual basis. This will monitor any change in PFOA/PFOS concentrations and help to determine whether the compound is being flushed from the system or whether a 'cleanup' is required.



### 3.0 INFORMATION FROM FISKVILLE INVESTIGATION TEAM AND CFA PERSONNEL

Information provided by CFA personnel to the Independent Fiskville Investigation Team during this PSA which may be relevant to the Site contamination status is summarised in Table 4.

**Table 4: Information from Fiskville Investigation Team and CFA Personnel**

Information Source	Description
CFA Personnel	In 1972 theoretical fire fighting training commenced at the Site.
CFA Personnel	In 1973 practical fire fighting training commenced at the Site.
CFA Personnel	Between approximately 1977 and 1985 drums of flammable liquids were stored in an area directly west of the Training Centre. On the 22 <sup>nd</sup> December 1982, several drums stored in this area ignited. The fire was reportedly quickly extinguished but approximately 20 to 30 drums were damaged in the fire. The following day (23 December 1982), CFA personnel were overcome by vapours while moving the 'fire damaged drums. The drums were subsequently moved and buried at a later date. The exact drum burial location is unknown however CFA personnel have indicated to the Independent Investigation Team that the drums may have been buried in a treed area north of the Administration Building.
CFA Personnel	A further 100 drums remained in the area west of the Training Centre after the fire affected drums were buried. CFA personnel have advised the Independent Investigation Team that these drums were buried in 3 trenches to the east of the Administration Building, sometime between 1983 and 1984. The golf course is now located in this area.
CFA Personnel	CFA personnel reported to the Independent Investigation Team, that drums were also buried in an area to the south of the Airstrip during the 1980s, the exact date of the burial is unknown
CFA Personnel	In 2002, an excavator driver was exposed to fumes during the ripping of soil for tree planting in the vicinity of the Drum Burial Area to the south of the Airstrip.

COUNTRY FIRE AUTHORITY.

WASTE DISPOSAL SITE.

FISKVILLE TRAINING CENTRE.

REPORT No. 72024

DATE 1/7/1988

GEOTECHNICAL INVESTIGATION

BY

**A. S. JAMES PTY. LTD.**  
15 LIBBETT AVENUE, CLAYTON SOUTH, VIC. 3169  
TEL.: 547 4811

THIS REPORT SHALL ONLY BE REPRODUCED IN FULL.

Country Fire Authority



D0035094



## 1. INTRODUCTION

- 1.01 Investigation requested by: [REDACTED] Country Fire Authority.
- 1.02 Purpose of Investigation: Industrial Waste has been buried in a small site at the Fiskville Training Centre and it was required to determine the nature of the waste and to recommend an appropriate long term approach to future utilisation of the area.
- 1.03 Local Geology: Quaternary basalt deposits consisting of residual clays overlying boulder or weathered rock.
- 1.04 Field methods: Consisted of disturbed sampling from excavated test pits.

## 2. RESULTS

- 2.01 From observations on site it would appear disposal had been in a series of three trenches each trench being some 20 - 30m. in length and the drums placed in these trenches.
- Typical drums were pierced and/or removed when damaged and samples taken at locations 1 - 9. A test pit was also excavated at Location 10 and some 3.0 - 4.0m away and samples taken of the clay.
- 2.02 Samples were sent to East Melbourne Laboratories for Chemical Analysis and their report is attached as Appendix 1. This report is self explanatory and does not require further comment.
- 2.03 In order to define the properties of the clay further Atterberg Limit testing has been carried out and the results are given on Figure 2.
- These tests define the clay as CH in accordance with the Unified Classification System and equally as a material of low permeability.
- 2.04 No ground water was encountered to the depths excavated, some 2.5m.

### 3. DISCUSSION AND RECOMMENDATIONS

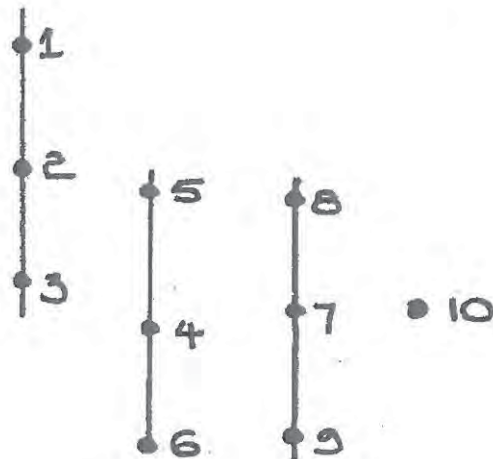
3.01 We enclose Appendix 2 being extracts from Sax, 'Dangerous Properties of Industrial Materials' 4th Edit. (1975) Van Nostrand which discuss some of the major constituents identified and would comment that on the basis and from remarks in the report by E.M.L. precautions should be taken to ensure that the waste is disposed or confined.

While it would appear that little significant contamination of the adjacent soil has occurred it must be accepted that if the chemicals are to remain in place there will be long term break down of the containers. The affect of this could be restricted by, in effect, forming an "unbrella" over and around the storage area by the placement of an impermeable membrane with permanently welded or glued joints. Such a membrance should be spread over and turned down at the perimeters in trenches taken to a depth equivalent to at least the storage depth and the surface should be covered and the surface should be covered with soil or alternative protective surfacing. Details of suitable membranes can be obtained from such organisations as the Nylex Corporation, 25 Nepean Highway, Mentone or Sarlon Industries, 95 Bell Street, Coburg.

Even with this approach it is thought that there must be a risk of some leacheat eventually reaching the ground water system. It is difficult if not impossible to forecast the time span or concentration but nevertheless the risk must be there and should be recognised. If this risk is not acceptable then the materials should be removed from the site and disposed in a suitable manner. In this regard there are commercial organisations which specialise in this and one such organisation would be Cleanaway which has been operating a disposal system near Tullamarine Airport.

3.02 We understand concern has also been expressed as to the influence of the materials on human contact and would comment that this is not within our area of expertise and medical and or legal advice should be sought.

~~\_\_\_\_\_~~  
A.S. JAMES M.I.E. AUST.



LAYOUT

Drawn/Typed

Checked

Figure

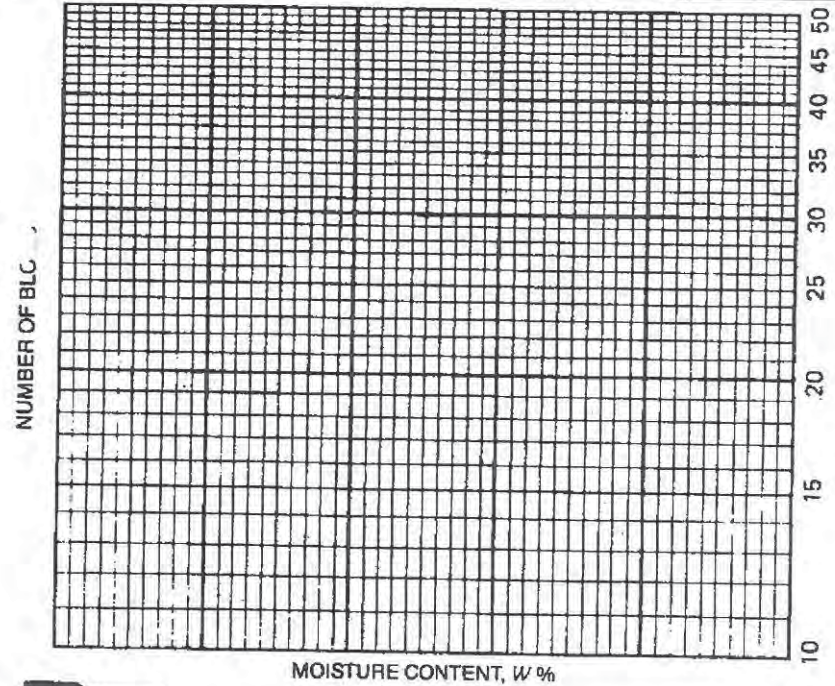
1



SAMPLE No.: 10660 BORE No.: 10 DEPTH: 0.5

SAMPLE DESCRIPTION: GREY BROWN CLAY

CONDITION OF SAMPLE: NATURAL / AIR-DRIED / OVEN-DRIED / UNKNOWN				BOWL No. ....		
SIEVING METHOD: WET / DRY		PASSING 0.425mm SIEVE ..... %		CURING TIME: .....		
LIQUID LIMIT, $W_L$				Number of blows	Factor	PLASTIC LIMIT, $W_p$
L.L. Machine No. ....						
Container No.				15	0.95	
Container and Wet Soil	g			16	0.96	
Container and Dry Soil	g			17	0.96	
Container	g			18	0.97	
Moisture Loss	g			19	0.97	
Dry Soil	g			20	0.98	
Moisture Content	%	93.0	94.0	21	0.98	
Number of Blows		24	25	22	0.99	
				23	0.99	
				24	1.00	
				25	1.00	
				26	1.00	
				27	1.01	
				28	1.01	
				29	1.02	
				30	1.02	
				31	1.02	
				32	1.03	
				33	1.03	
				34	1.03	
				35	1.03	
METHOD — OVEN DRYING ONE POINT				$W_L = \text{FACTOR} \times W \dots\dots\%$		



LINEAR SHRINKAGE	
Mould No.	
Initial Length	mm
Final Length	mm
Longitudinal Shrinkage	mm
LS	% 21.1
Liquid Limit, $W_L$	% 94
Plastic Limit, $W_p$	% 30
Plasticity Index, $I_p$	% 64
Linear Shrinkage, LS	% 21.1



This laboratory is registered by the National Association of Testing Authorities, Australia. The tests reported herein have been performed in accordance with its terms of registration. This document shall not be reproduced except in full.

AS1289.C1-C4 DETERMINATION OF ATTERBERG LIMITS

Tested  
Checked  
Figure 2

(\*Information Redacted due to Privacy Obligations)

APPENDIX 1

REPORT EAST MELBOURNE LABORATORIES 31/5/1988



# THE EAST MELBOURNE LABORATORIES PROPRIETARY LIMITED

CONSULTING CHEMISTS AND MICROBIOLOGISTS  
(Incorporated in Victoria)

425-427 Canterbury Road, Surrey Hills, Victoria. 3127.

OUR REF.: 42,836

YOUR REF.:

31st May, 1988

A.S. James Pty.Limited,  
15 Libbett Avenue,  
Clayton South,  
Victoria 3169

Attention Mr. T. Holt

Dear Sirs,

re: Examination of Soils and Waters from C.F.A. Tip Site

Ten samples of the above, delivered to the laboratory on 6th May 1988, were examined by Infra Red Spectroscopy and computer aided data reduction in an attempt to identify the principle chemical types present at the site.

Unfortunately sample identifications were destroyed due to the use of a solvent soluble pen by the sampler. They are nevertheless described by their appearance as follows:-

<u>EML File Ref.</u>	<u>Description</u>
16	No. 3 Amber Gum
17	No.10 Clay
18	Soil Sample
19	Brown Liquid in Jar
20	Black Granular Sample
21	Orange Clay Solution
22	No.3 Soil Sample
23	Clay Sample
24	Brown Liquid
25	Brown Liquid Clay

All samples were extracted with dichloromethane to remove organic compounds for characterisation. This pretreatment excludes inorganic materials such as metals or salts, which remain behind.

Dichloromethane extracts were evaporated on Potassium Bromide windows and the infra red spectrum of the residue was measured between  $4000\text{ cm}^{-1}$  and  $400\text{ cm}^{-1}$  using a Hitachi Model 270-30 ratio recording Infra Red Spectrophotometer.

Copies of spectra obtained are attached.

continued.....



-2-

These data were then subjected to computer analysis for functional groups. In this process absorption bands are compared with known patterns corresponding to the various vibrational frequencies characteristic of the molecule, and results are produced in the form of a probability of the presence of a particular species. A probability of 1.00 indicates the certain presence of a specific compound but in a situation where mixtures of chemicals are present such precision is rarely obtained.

The search was programmed to report only those groups with a probability of 0.8 or better. Experience suggests that such data will reliably identify the major components of a gross mixture, but it should be remembered that other materials will certainly be present in lesser amounts.

The Table below summarises the results obtained and demonstrates the similarity of the various samples.

Sample File	16	17	18	19	20	21	22	23	24	25
Aromatic Ring	+		+		+	+	+	+	+	+
Monosubstituted - $C_6H_5$	+		+		+	+	+	+	+	+
1-2 Substituted - $C_6H_4$	+		+				+			+
Furan ring -	+					+	+	+		
Aromatic Tertiary Amine - Nitrile or Thiocyanate -			+							
Pyridine ring - Non Aromatic Thiocyanate -									+	+
Phenol or Aromatic Ring and Hydroxyl -			+		+	+	+	+		
Aromatic Halogenated Compound -				+		+		+		
Methyl- $CH_3$				+						
Isopropyl -				+						
Dimethyl -				+						
Tertbutyl -				+						
Double Bond $C = C$	+							+		

It will be seen that two samples fall outside the general description that emerges from the data. One of these, File No. 17 - No.10 Clay - would appear to represent a clean, uncontaminated sample whilst the other - File No.19 - Brown Liquid in jar - would appear to be composed chiefly of aliphatic (i.e. paraffinic) species.

The remainder consistently demonstrated the presence of an aromatic ring group, principally monosubstituted, although other materials were also present, notably furan rings. Monosubstituted -  $C_6H_5$  is synonymous with Phenol or Aromatic Ring and hydroxyl, which tends to reinforce the primary data.

continued.....

-3-

It can therefore be concluded that the principle contaminant at the site consisted of aromatic compounds i.e. resins or solvents, and may include benzene, toluene, Xylene and phenol. Materials of this type are only slowly biodegraded and their presence would normally constitute an environmental problem.

Should there be any queries regarding this work, please do not hesitate to contact us.

Yours faithfully  
THE EAST MELBOURNE LABORATORIES PTY. LIMITED





## ENVIRONMENTAL SERVICES

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**MINENCO** Pty Limited

A.C.N. 004 429 335

File Ref: 5991

31 May, 1996

Mr D. Owen  
Manager Community Risk Management  
Country Fire Authority  
PO Box 701  
Mt Waverley Vic 3149

Dear David,

**RE : CFA SITE VISIT BY PHILIP PECK, 14 MAY 1996**

This report presents our findings from Philip Peck's visit to the Country Fire Authority Training College at Fiskville on 14 May.

The report

- summarises our observations of general nature and distribution of contamination at the site
- briefly canvasses remediation options that may be applicable to the site, and
- makes recommendations for immediate actions required by the CFA to characterise the site sufficiently for remediation planning to take place.

**1. Summary of Observations and Environmental Issues**

**1.1 Fuel Mix Area and Flammable Liquid Pad**

The Fuel Mix Area (FMA) and the Flammable Liquid Pad (FLP) appear to represent the major areas of hydrocarbon contamination at the Fiskville site. Chronic releases of a diesel/petrol mixture during fire training activities have occurred over a period of approximately 25 years. The current arrangements have been in place for the past 15 years.

Flammable liquid fuel usage over the past 12 months is reported to be in the range of 150,000 to 160,000L. It is estimated that as much as 25% of this product may be lost to ground during fire fighting activities (verbal communication, David Clancy CFA, 16 May





1996). If current fuel usage is representative of that over the operational life of the training area then approximately 40,000L of fuel may have been 'lost to ground' at the site every year since the installation of the FLP.

Contamination issues identified at the FLP include:

- extensive areas of ground saturated with hydrocarbons
- pools of free phase hydrocarbons
- perimeter drains filled with water and fuel
- probable contamination of soils in the deeper subsurface
- potential for migration of hydrocarbon contamination to the groundwater
- source of hydrocarbon contamination to Dam 1 (contamination includes both free product and contaminated water)

Contamination issues at the FMA include:

- ground saturated with hydrocarbons
- free phase hydrocarbons in sumps and drains
- probable contamination of soils in the deeper subsurface
- possible migration of hydrocarbon contamination to the groundwater
- direct source of hydrocarbon contamination to Dam 1 (contamination includes both free product and contaminated water)

These areas represent the most serious contamination sources observed at the Fiskville facility. It is not known to what depth the contamination at these areas persists. It is not known whether groundwater has been affected by the contamination at the surface. The sheer volumes of liquid hydrocarbons present in the area, and the length of time that the facility has been in use suggest that significant contamination of the deep subsurface is to be expected, unless soil conditions are such as to confine contamination to the near-surface.

### 1.1.1 Removal of Contaminated Materials

The FLP and FMA areas in their current condition represent ongoing sources of soil and groundwater contamination. Any course of action at these sites must be performed in conjunction with a planned remediation strategy for the whole Fiskville facility.

Any action plan for the FLP and FMA areas will require the removal or treatment of contaminated soils. The volumes of affected soil that will required excavation are not known.

A treatment strategy for these soils has not been identified at the present time. It is likely that on site *ex situ* biotreatment of the contaminated soils will be the most cost effective methodology for remediation of the soils. Remediation options will need to be assessed in more detail after appropriate site characterisation (see Section 3 below).



### 1.1.2 Bunding

There is no bunding of the FLP or FMA facilities with the exception of localised pits around various props.

Full bunding and drainage control will be a requirement for the area if fire fighting activities utilising flammable liquids is to be continued in the area after redevelopment. All drainage will need to be directed to a suitable product/water separation facility.

### 1.1.3 Surface Seals

Redevelopment of the facility will require sealing of all surface areas that are subject to inundation with fuel or fire fighting foams. Unsealed surfaces provide a direct conduit to the subsurface.

### 1.1.4 Interception of product

The interception of all effluent from the FLP and FMA would be a minimum requirement for protection of environmental receptors downstream of the site.

An engineered product interception facility is required to address:

- separation of product and water
- recovery of free product
- storage and recycling of separated product
- monitoring of water quality discharging to downstream receptors.

## 1.2 Dam 1

Dam 1 currently receives all surface run-off from the FLP. The dam is heavily contaminated with hydrocarbons. Accumulation of free hydrocarbons on the surface of the dam is a common occurrence. There is evidence of heavy hydrocarbon contamination on the sides of the dam. There is no vegetation in Dam 1. The dam is reported to have a rock base.

Sediment on the bottom of Dam 1 is likely to be highly contaminated.

## 1.3 Underground Storage Tanks (USTs)

The following underground fuel storages have been identified :

- Diesel and petrol USTs at the ablutions block
- Diesel UST at the ablutions block, capacity ~ 2000L (500 gallon), current status decommissioned, known to have leaked.
- Diesel UST at the training centre, current status decommissioned.

There is potential for soil and groundwater contamination associated with some or all of these USTs. The impacts of USTs on the subsurface should be assessed subsequent to their removal.



#### 1.4 Drum Burial Pits

Three drum burial pits are located to the north of Deep Creek Road, adjacent to the East-West Airstrip. These pits were reported to have been excavated approximately 12 years ago. Three parallel trenches were excavated to a depth of approximately 1 metre. Waste drums were then placed in the trenches. The drums contained residual solvent sludges, thinners and paint sludges. The original contents of the drums had been used in fire training exercises in burning pits adjacent to the FLP.

Residual material in the drums reportedly ran into the bottom of the trenches. The trenches were then lit and allowed to burn. The pit locations remain evident due to reduced grass growth along the lines of the pit. Anecdotal evidence of excavation since the drum burial exercise suggests that the drums may have rusted away completely since burial.

It is highly likely that there is residual soil contamination at the drum burial site. Contamination of the groundwater in the area may also have occurred. It is also known that waste material from paint manufacture was dumped at the site. Due to the unknown mixture of materials burnt in the pits, there is a wide range of potential contaminants, including BTEX compounds, chlorinated solvents and heavy metals.

#### 1.5 Decommissioned Fire Training Pits

Anecdotal evidence suggests that a wide range of petrochemicals were burnt in fire training pits that were located immediately to the east of the FLP. These pits were reportedly excavated and backfilled in the late 1980s. There is no visual evidence of their existence.

The pits were unlined. It is reported that staining and visual evidence of contamination was present for less than 150mm into the clay soil surfaces of the pit. It is believed that the pits were in use for nearly 20 years.

The unlined fire pits were likely to have been serious contamination sources during their operational phase. Despite the visual evidence to the contrary, it is highly probable that they have contributed to soil, and potentially groundwater, contamination. The pits were excavated when decommissioned.

Due to the unknown mixture of materials burnt in the pits, there is a wide range of potential contaminants.

#### 1.6 Sludge Burial Pit

Material excavated from the fire pits discussed in section 1.5 was buried in a deep hole excavated approximately 40 metres to the east of the pits. The exact location of this hole is not known. The hole was reportedly excavated to the full extent of a KATO excavator arm. This suggests a burial depth of 6 metres or greater.

This pit represents a significant potential source for groundwater contamination. The materials buried in the pit may contain mobile contaminants.



## 1.7 Fuel Storage Facility

No contamination has been reported in the area. Pressure testing of tanks has not been undertaken, and may reveal potential contamination. Pressure testing of transfer lines should also be undertaken.

It is reported that an estimated \$25,000 is required to pressure test, paint and make safe the existing fuel storage tanks. Metering of fuel should be installed on all fuel transfer lines.

## 1.8 OH&S considerations

While not the principle focus of MES' brief for the site inspection, some Health and Safety issues were raised. The following are highlighted in this context, since they are associated with environmental risks also.

- The quantities of fuel lying around is regarded as representing a hazard.
- Water from Dam 1, containing hydrocarbons, is used in fire training, with potential health risks.
- Improved housekeeping will provide opportunities for identifying and minimising environmental impacts of fuels and chemicals stored and used on the site.

## 1.9 Sewage Treatment Plant

It was noted that the tank at the sewage treatment plant had subsided and cracked. This has resulted in leakage of sewage to ground, and into an open drain. It was reported that blue-green algae had been observed in water bodies receiving drainage from this area. While our brief specifically related to hydrocarbon contamination, we also recommend that the sewage treatment plant should be addressed to minimise risks of downstream impacts from sewage effluent.

## 2. Actions Required at the Site

### 2.1 Stage I Investigation

An initial investigation is urgently required in order to define key site characteristics, and focus more detailed investigations of site contamination and its associated risks.

#### 2.1.1 Objectives

A stage I investigation should have the following objectives:

1. examine the subsurface geology of the site.
2. define the depth to groundwater.
3. determine the direction of groundwater flow.
4. examine the quality of groundwater under the site.
5. determine the likely depth of soils affected by hydrocarbon contamination in the FLP and FMA.



6. look for the presence of free product floating at the groundwater interface below the FLP and FMA facilities.
7. examine the quality of the silt in Dam 1.
8. examine soil contamination at the drum burial pits.
9. examine the soil and groundwater contamination at the decommissioned fire pits.

### 2.1.2 Scope

The Stage I investigation should involve a campaign of drilling, soil testing and groundwater testing (Table 1).

It is suggested that proposals from suitably qualified environmental consultants in the Melbourne metropolitan area be sought. If possible, a consultant should be identified that has prior experience in the investigation and management of contamination at fire training or similar facilities.

It is recommended that Minenco be appointed in a review capacity to oversee, on CFA's behalf, the proposed investigation (planning, field campaign and data interpretation), and then make recommendations regarding further investigations (including risk assessment) and remediation.

Table 1. Preliminary Scoping Guide for Stage I Investigation

Location	Number of Bores	Approx. Number of Samples	Type
Fuel Mix Area	1	5 discrete level samples	Deep borehole, finish as groundwater monitoring bore
Flammable Liquids Pad	6	5 discrete level samples	Medium to deep boreholes
Solvent Burning Pits	1 per pit	5 discrete level samples	Deep boreholes, finish 1 hole as a groundwater monitoring bore
Drum Burial Pits	3 per trench	3 discrete level samples	Shallow boreholes or backhoe pits to approximately 3.5 metres
Deep Burial Pit	1 hole	5 discrete level samples	Deep borehole; finish as groundwater monitoring bore
Dam 1	3 samples	Sediment samples	Hand auger or sludge grab sample

### 2.2 Stage II Investigation

An secondary investigation will be required after the results of the initial investigation have been obtained. Information from a stage I investigation should be applied to plan further investigative drilling to fully determine the extent of all contamination. A secondary investigation targeted at key parameters of concern would provide



information essential to a structured risk management and/or remediation plan for the site.

### 2.2.1 Objectives

A stage II investigation should have the following objectives:

1. to further characterise areas found to have contamination at concentrations of concern by the stage I investigation
2. to adequately characterise the chemistry of groundwater in any areas where groundwater contamination is found
3. to extend contamination investigations as required into those areas not addressed by the stage I investigation
4. to assess those parameters deemed to be critical to a risk based assessment of the contamination at the Fiskville site.

### 2.2.2 Scope

At the present stage, only a conceptual scope can be defined for a secondary investigation at the Fiskville site.

A stage II investigation would be likely to include some or all of the following elements:

- Installation of investigative boreholes and/or groundwater wells downstream of the drum burial pits
- Installation of investigative boreholes and/or groundwater wells downstream of the UST facilities at the training centre and at the Ablutions block
- Installation of investigative boreholes and/or groundwater wells downstream of the zones of contamination associated with the FLP and FMA
- Characterisation of the sediment and waters from Dams 1, 2 and 3
- Installation of groundwater bore(s) to assess and monitor the quality of regional (uncontaminated) groundwater.
- A program of soil sampling to assess the contamination (if any) present at the current fuel storage facility.

## 3. Remediation Options

Hydrocarbon contamination of soil and water can be remediated by a range of technologies, including both *in situ* and *ex situ* techniques.

The most commonly adopted in Australia in recent years include

- excavation and landfill disposal
- *ex situ* bioremediation
- *in situ* bioremediation
- thermal soil treatment.



Final selection of a remediation technique will be highly influenced by the overall risk management strategy developed for the site, in the context of continuing use of the site for its current activities. However, it appears likely that one of the bioremediation approaches would be a cost effective option for the Fiskville site.

The simplest such technique will be land treatment, involving excavation of contaminated soils and 'land farming'. Given the large areas of suitable property on the site, this would be an attractive treatment option.

Petroleum products spilled at the surface are subject to natural weathering processes. The utilisation of this phenomenon for site remediation is now called *intrinsic bioremediation*, and has recently evolved as a viable remediation alternative. In particular this is used to address groundwater contamination, but may under some circumstances be appropriate for soil. It is not clear at this time whether intrinsic bioremediation at Fiskville would be feasible from technical, environmental or other perspectives, however, the potential cost advantages warrant its further investigation.

It will be critical that the investigations of site contamination (both Stage I and Stage II) be designed to address remediation of sub-surface contamination as well as excavated materials.

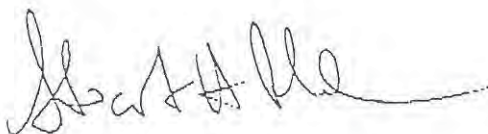
#### 4. Conclusion

In conclusion, it was agreed at the time of the site visit that urgent action was required to commence investigation of contamination at the Fiskville site.

This report documents the primary targets of these investigations. As indicated at the time of the visit, it is recommended that CFA retain the services of Minenco to oversee the planning and execution of such investigations, with a view to subsequent involvement in the remediation assessment and planning phases.

Thank you for the opportunity to inspect the site. I hope the visit and the report prove to be of value, and we look forward to working with you again.

Best regards



Stuart Rhodes  
Manager, Bioremediation Services

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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 Partners International Pty Ltd

A.C.N. 003 692 019

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E3517/1-AD MKSP:MW  
7 August 1996

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Attention: Mr David Clancy

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**

*for* **T W MARSHALL**

Distribution: Original held by Coffey Partners International Pty Ltd  
1 copy Coffey Partners International Pty Ltd Library  
3 copies C.F.A. Training College





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**Important Information about your Environmental Site Assessment**



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- 3-1** Summary of Samples Selected for Analysis (4 pages)
- 3-2** Laboratory Analytical Methods (4 pages)
- 4-1** Generalised Soil Profile Conditions (6 pages)
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## **FIGURES**

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- A** Borehole Logs
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  - Borehole Logs (20 pages)
- B** Summary of Soil Petroleum Hydrocarbon Results (1 page)
- C** NATA Certified Laboratory Results (3 pages)



## 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 Mr David Clancy (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 olfactory 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 Mr David Clancy 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 Mr Clancy's 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<sup>2</sup>. 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.



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9.



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<sup>3</sup>, 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.

A handwritten signature in blue ink, appearing to read "Jan Beella". The signature is fluid and cursive.

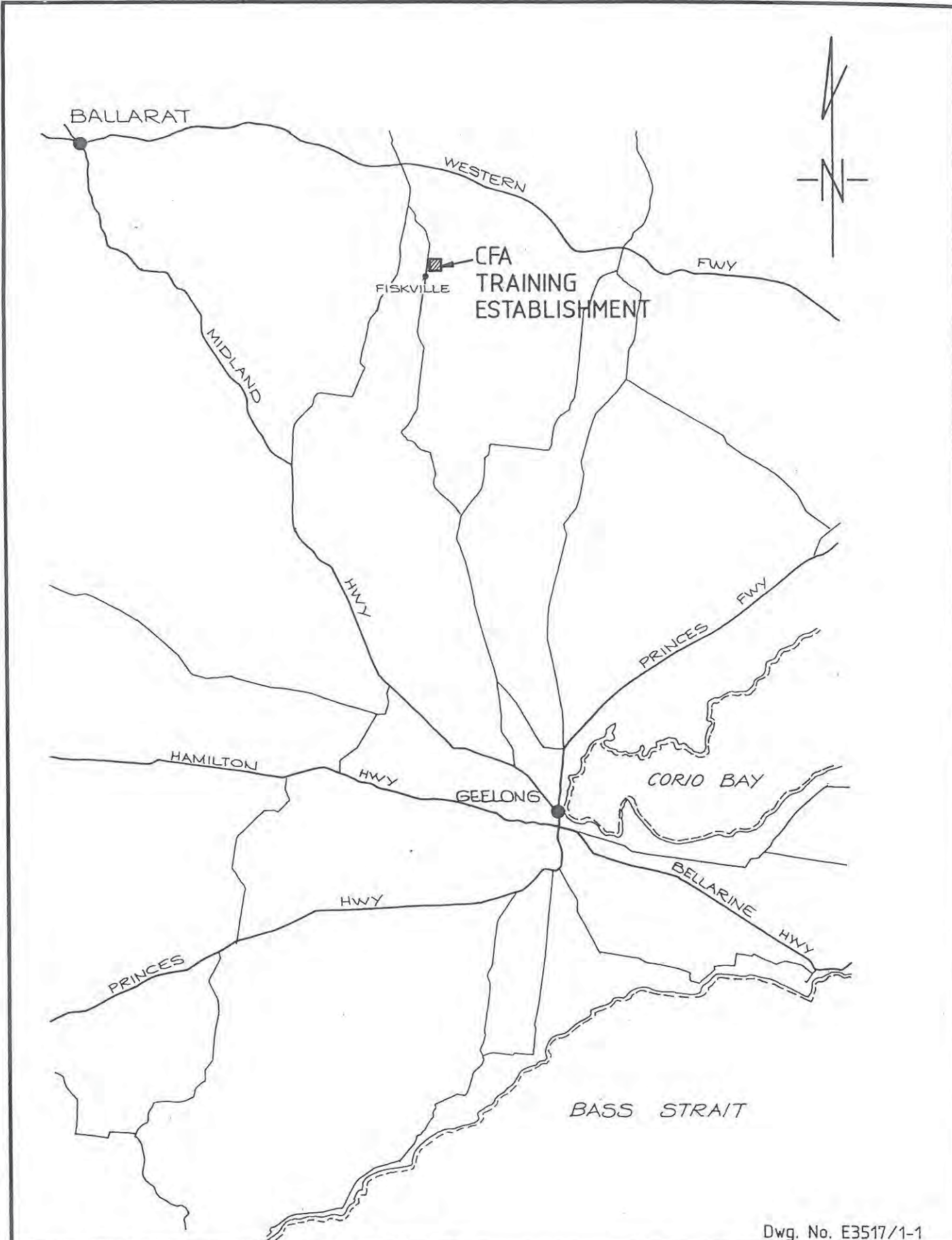
For and on behalf of  
**COFFEY PARTNERS INTERNATIONAL PTY LTD**





REFERENCES

- ANZECC, (1990). "*Draft Australian Guidelines for the Assessment and Management of Contaminated Sites*", publ Australian & New Zealand Environment and Conservation Council, National Health & Medical Research Council, June, 1990.
- 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.



Dwg. No. E3517/1-1

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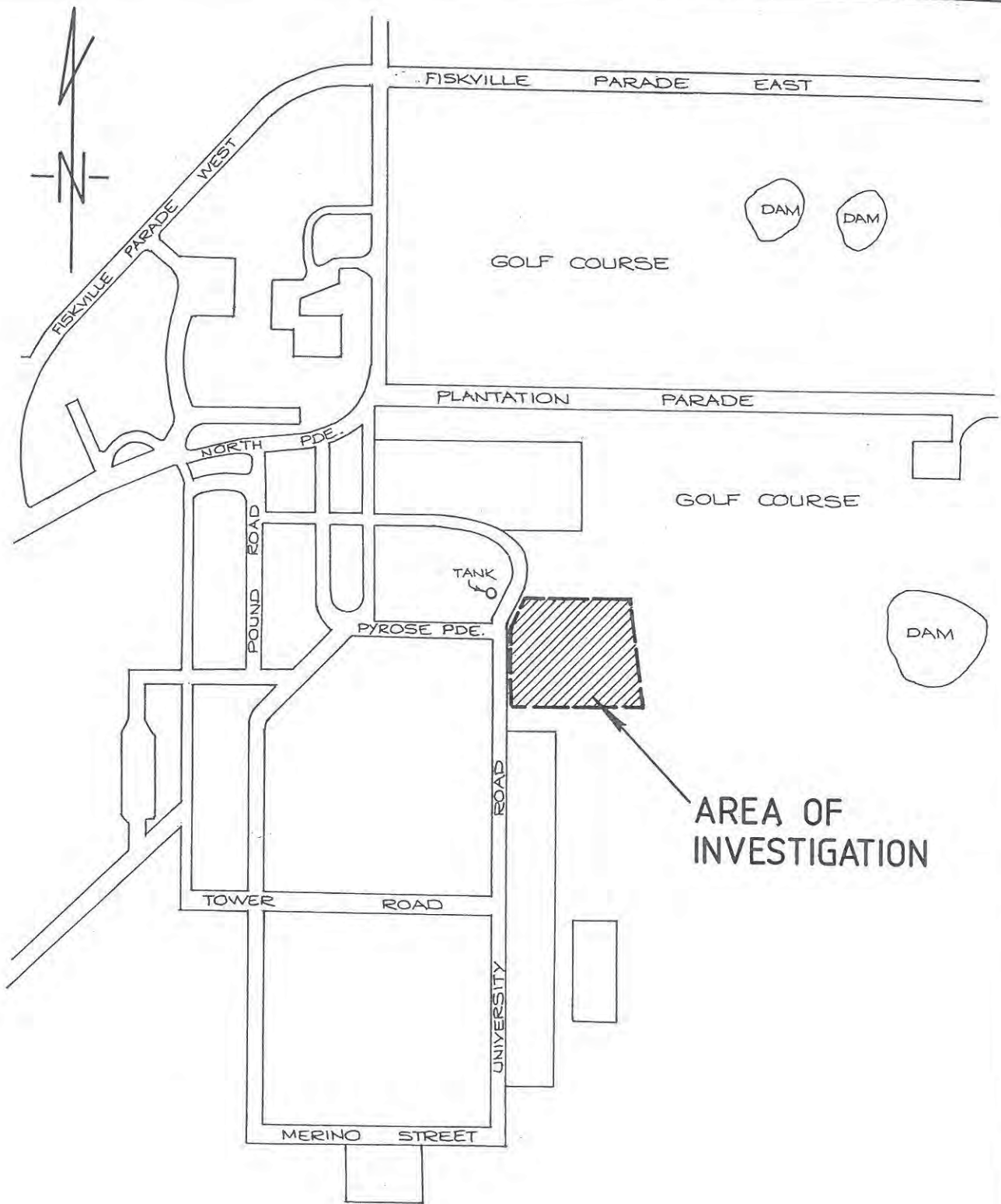
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approved	<i>MP</i>
date	29/7/96
scale	1:500,000

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 FIELD SITE APPRAISAL AND SAMPLING  
 LOCALITY PLAN



**FIGURE 1**

job no: E3517/1



Dwg. No. E3517/1-2

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scale	1:3000 approx.

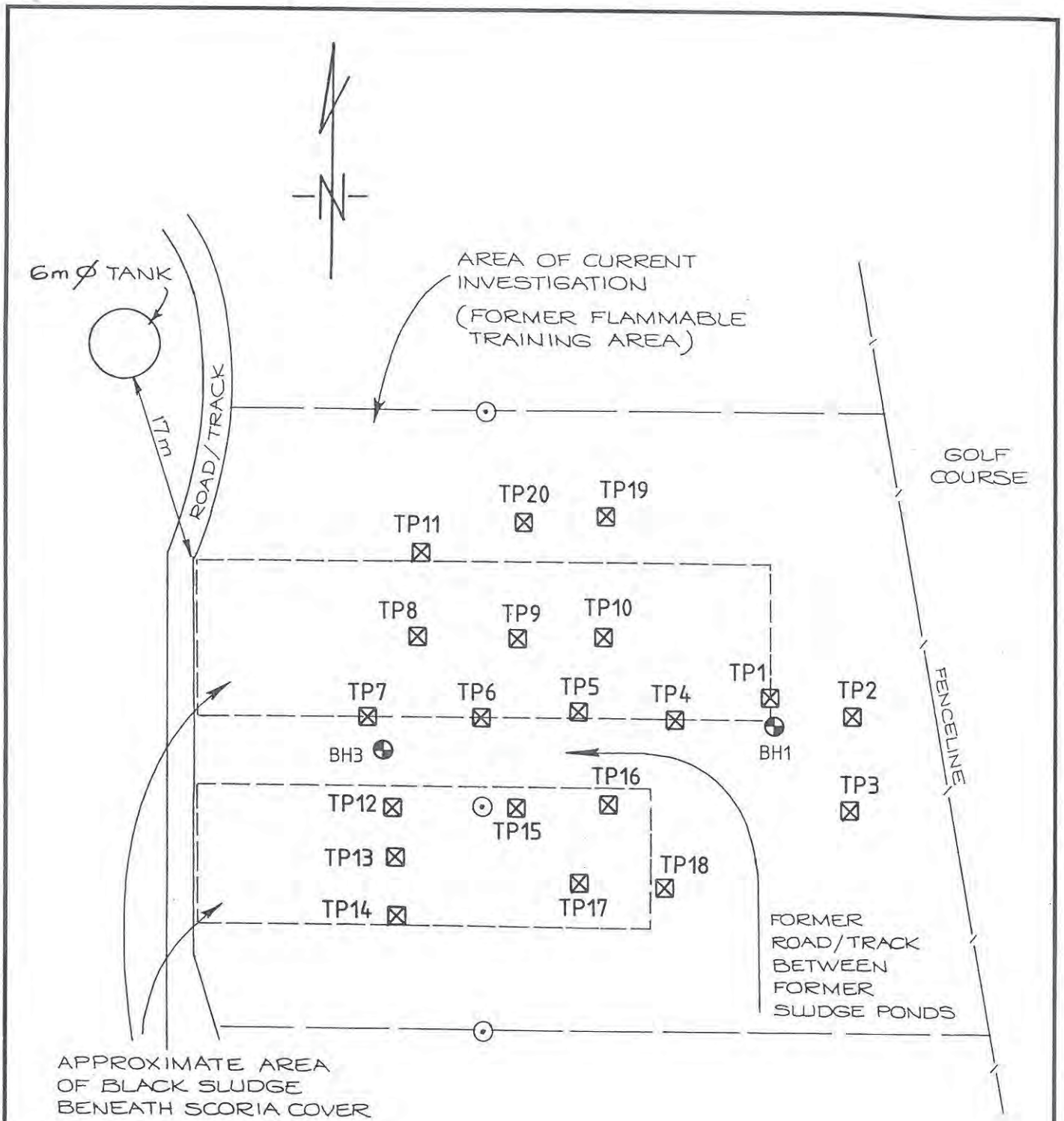
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BALLAN, VICTORIA  
FIELD SITE APPRAISAL AND SAMPLING  
SITE PLAN



**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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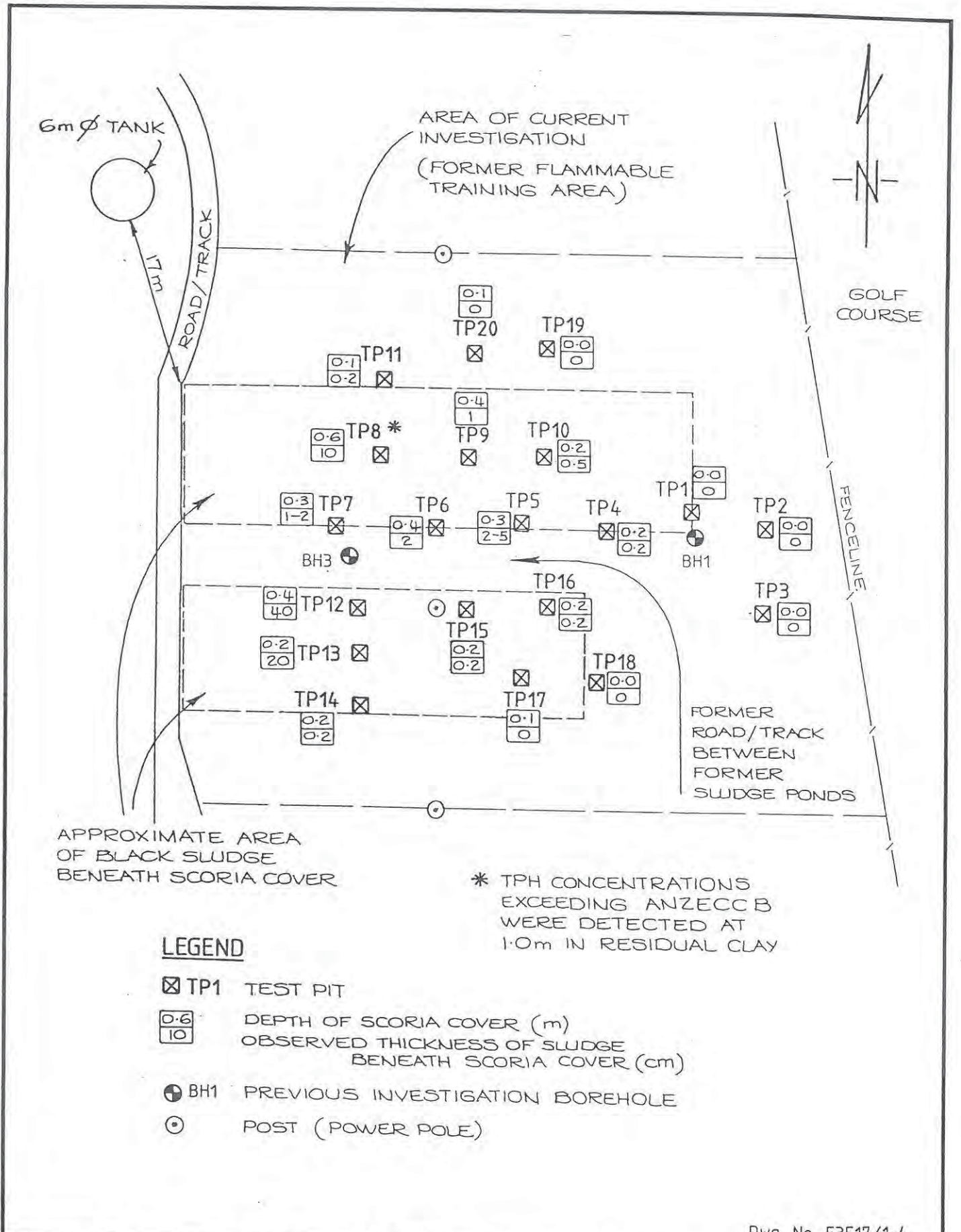
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approved	<i>Mp</i>
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scale	1:500

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BALLAN, VICTORIA  
FIELD SITE APPRAISAL AND SAMPLING  
TEST PIT SAMPLING LOCATIONS



**FIGURE 3**

job no: E3517/1



Dwg. No. E3517/1-4

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approved	<i>mp</i>
date	7/8/96
scale	1:500

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FIELD SITE APPRAISAL AND SAMPLING  
EXTENT OF SLUDGE BENEATH SCORIA COVER



**FIGURE 4**

job no: E3517/1



## 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 ground-water 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.



### **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**

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APPENDIX A

BOREHOLE LOGS



# 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:  
x 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  $20 \times I_{s50}$  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.).

# graphic symbols soil and rock

soil			
	asphaltic concrete or hotmix		gravelly clay (CL, CH)
	concrete		sandy silt (ML)
	topsoil		clayey sand (SC)
	fill		silty sand (SM)
	peat, organic clays and silts (Pt, OL, OH)		sand (SP, SW)
	clay (CL, CH)		clayey gravel (GC)
	silt (ML, MH)		silty gravel (GM)
	sandy clay (CL, CH)		gravel (GP, GW)
	silty clay (CL, CH)		
rock			
	claystone (massive)		limestone
	siltstone (massive)		coal
	shale (laminated)		dolerite, basalt
	sandstone (undifferentiated)		tuff
	sandstone, fine grained		porphyry
	sandstone, coarse grained		granite
	conglomerate		pegmatite
			schist
			gneiss
			quartzite
			talus
			alluvium
seams			
	seam > 0.1m thick (on a scale of 1:50)		
	seam 0.01m to 0.1m thick (on a scale of 1:50)		
inclusions (special purposes only)			
	rock fragments		ironstone, gravel, laterite
	swamp		shale breccia in sandstone
water level			
surfaces	_____ known boundary	_____ probable boundary	_____ ? _____ ? possible boundary



**SOIL CLASSIFICATION AND IDENTIFICATION INCLUDING IDENTIFICATION AND DESCRIPTION**

FIELD IDENTIFICATION PROCEDURES (Excluding particles larger than 60 mm and basing fractions on estimated mass)		GROUP SYMBOLS	TYPICAL NAMES	INFORMATION REQUIRED FOR DESCRIBING SOILS	USE GRAIN SIZE CURVE IN IDENTIFYING THE FRACTIONS AS GIVEN UNDER FIELD IDENTIFICATION	LABORATORY CLASSIFICATION CRITERIA
COARSE GRAINED SOILS (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.	GW	Well graded gravels, gravel-sand mixtures, little or no fines.	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-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.	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:  Less than 5% More than 12%	C <sub>u</sub> = D <sub>60</sub> / D <sub>10</sub> Greater than 4 C <sub>c</sub> = (D <sub>30</sub> ) <sup>2</sup> / (D <sub>10</sub> x D <sub>60</sub> ) Between 1 & 3  Not meeting all gradation requirements for GW.  Atterberg limits below "A" line or I <sub>p</sub> less than 4.  Atterberg limits above "A" line with I <sub>p</sub> greater than 7.  C <sub>u</sub> = D <sub>60</sub> / D <sub>10</sub> Greater than 6 C <sub>c</sub> = (D <sub>30</sub> ) <sup>2</sup> / (D <sub>10</sub> x D <sub>60</sub> ) Between 1 & 3  Not meeting all gradation requirements for SW.
	SANDS More than half of coarse fraction is smaller than 2.0 mm.	GP	Poorly graded gravels, gravel-sand mixtures, little or no fines.			
FINE GRAINED SOILS (The 0.06 mm particle is smaller than 60 mm)	SANDS AND SILTS Liquid limit less than 50	GM	Silty gravels, poorly graded gravel-sand-silt mixtures.	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).	PLASTICITY INDEX p	Atterberg limits below "A" line or I <sub>p</sub> less than 4.  Atterberg limits above "A" line with I <sub>p</sub> greater than 7.
		GC	Clayey gravels, poorly graded gravel-sand-clay mixtures.			
	SW	Well graded sands, gravelly sands, little or no fines.				
	SP	Poorly graded sands, gravelly sands, little or no fines.				
	SM	Silty sands, poorly graded sand-silt mixtures.				
	SC	Clayey sands, poorly graded sand-clay mixtures.				
SILTS AND CLAYS Liquid limit greater than 50	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with low plasticity. Silts of low to medium Liquid Limit.	CL	CL	CL	CL
	CL	Inorganic clays of low to medium plasticity, * gravelly clays, sandy clays, silty clays.				
HIGHLY ORGANIC SOILS Readily identified by colour, odour, spongy feel and frequently by fibrous texture.	OL	Organic silts and organic silt - clays of low to medium plasticity.	Pt	Peat and other highly organic soils.	OH	OH
	MH	Inorganic silty, micaceous or diatomaceous fine sandy or silty soils, silts of high Liquid Limit.				
	CH	Inorganic clays of high plasticity, *				
	OH	Organic clays of high plasticity, *				

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.

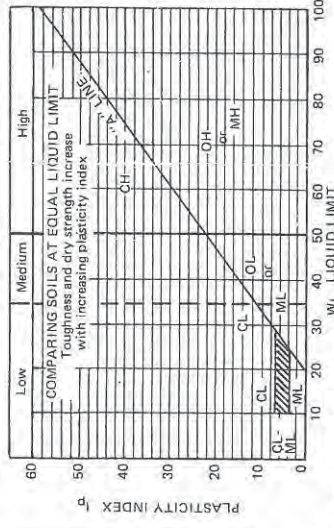
\* Low plasticity - Liquid Limit W<sub>L</sub> less than 35%. Medium plasticity - W<sub>L</sub> between 35% and 50%.

**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 10cm<sup>3</sup> 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 rolled 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. The pieces should be lumped together and a slight kneading action continued until the lump is uniform. The tougher the thread near the plastic limit, and the stiffer the lump when it finally crumbles, the more plastic 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 soft but not sticky. Add enough water if necessary to make the pat pliable. 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 lean sands give the loudest and most distinct reaction whereas a plastic clay, such as a typical rock flour, shows a moderately quick reaction.



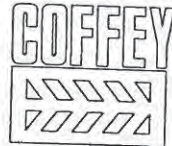
PLASTICITY CHART (For laboratory classification of fine grained soils)  
Adapted from A.S. 1726-1981 (App.D)

**† 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 by breaking and crumbling, or air drying, and then test its strength by breaking and crumbling. The dry strength is the weight of water 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.







pit no  
TP1  
sheet 1 of 1

# engineering log - excavation

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	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	meter	structure and additional observations
BH		Nil	0					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
								CH	SILTY CLAY: high plasticity, yellow-brown, mottled orange-yellow.		VSt			RESIDUAL
						1								
						2								
								CL	SILTY CLAY: medium plasticity, yellow.		St			
									BASALT: brown, moderately to highly weathered					TERTIARY BASALT
									Pit TP1 Terminated at 2.40 m					
						3								
						4								

<b>METHOD</b> N natural exposure X existing excavation BH backhoe bucket B bulldozer blade R bulldozer ripper E excavator HA hand auger HT hand tools <b>SUPPORT</b> SH shoring SC shotcrete Nil no support RB rockbolts	<b>PENETRATION</b> 1 2 3 4  little resistance ranging to very slow progress <b>WATER</b> D none observed X not measured  water level  water outflow  water inflow	<b>SAMPLES, TESTS, ETC</b> 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	<b>CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION</b> based on unified classification system <b>MOISTURE</b> D dry M moist W wet Mp plastic limit Wl liquid limit	<b>CONSISTENCY/DENSITY INDEX</b> 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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pit no  
TP2  
sheet 1 of 1

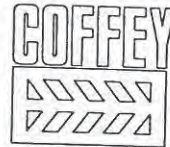
# engineering log - excavation

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 4800 BACKHOE  
 excavation dimensions: 2 m long 0.8 m wide orientation: R.L. Surface: NOT MEASURED datum:

method	penetration				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	structure and additional observations
	1	2	3	4											
BH					D			1	CL	SILTY CLAY: medium plasticity, dark brown,	M	Fb		TOPSOIL	
									CL	SILTY CLAY: medium plasticity, grey-brown,		St		SUBSOIL	
									CH	SILTY CLAY: high plasticity, yellow and grey, mottled orange,		VSt		RESIDUAL	
								2						Basalt floaters, approx. 200-300mm in the clay	
									CL	SILTY CLAY: medium plasticity, yellow,		St			
										BASALT: brown, moderately to highly weathered				TERTIARY BASALT	
										Pit TP2 Terminated at 2.40 m					

<b>METHOD</b> N natural exposure X existing excavation BH backhoe bucket B bulldozer blade R bulldozer ripper E excavator HA hand auger HT hand tools	<b>PENETRATION</b> 1 2 3 4  WATER D none observed X not measured ▽ water level ▽ water outflow ▽ water inflow	<b>SAMPLES, TESTS, ETC</b> 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	<b>CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION</b> based on unified classification system <b>MOISTURE</b> D dry M moist W wet Mp plastic limit Wl liquid limit	<b>CONSISTENCY/DENSITY INDEX</b> 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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pit no  
TP3  
sheet 1 of 1

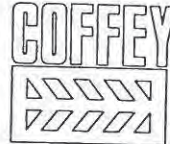
# engineering log - excavation

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	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	structure and additional observations
BH		Nil	D			1		CL CL CH	SILTY CLAY: medium plasticity, brown, SILTY CLAY: medium plasticity, grey, SILTY CLAY: high plasticity, yellow-grey, mottled orange-yellow,	M	Fb St VSt	100 200 300 400	TOPSOIL SUBSOIL RESTOVAL
						2			Pit bottomed on basalt				
						3			Pit TP3 Terminated at 1.90 m				
						4							

<b>METHOD</b> N natural exposure X existing excavation BH backhoe bucket B bulldozer blade R bulldozer ripper E excavator HA hand auger HT hand tools <b>SUPPORT</b> SH shoring SC shotcrete Nil no support RB rockbolts	<b>PENETRATION</b> 1 2 3 4  little resistance ranging to very slow progress <b>WATER</b> D none observed * not measured  water level  water outflow  water inflow	<b>SAMPLES, TESTS, ETC</b> 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	<b>CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION</b> based on unified classification system <b>MOISTURE</b> D dry M moist W wet Wp plastic limit Wl liquid limit	<b>CONSISTENCY/DENSITY INDEX</b> 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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pit no  
TP4  
sheet 1 of 1

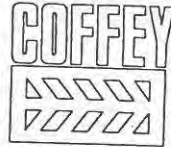
# engineering log - excavation

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			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			structure and additional observations	
	1	2	3										100 kPa	200 kPa	300 kPa		400 kPa
BH				Nil	D			1		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	SILTY CLAY: medium plasticity, grey,		St				SUBSOIL
										CH	SILTY CLAY: high plasticity, yellow-grey, mottled orange-yellow,		VSt				RESIDUAL
								2			Pit bottomed on basalt						
								3			Pit TP4 Terminated at 2.00 m						
								4									

<b>METHOD</b> N natural exposure X existing excavation BH backhoe bucket B bulldozer blade R bulldozer ripper E excavator HA hand auger HT hand tools <b>SUPPORT</b> SH shoring SC shotcrete Nil no support RB rockbolts	<b>PENETRATION</b> 1 2 3 4  little resistance ranging to very slow progress <b>WATER</b> D none observed * not measured  water level  water outflow  water inflow	<b>SAMPLES, TESTS, ETC</b> 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	<b>CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION</b> based on unified classification system <b>MOISTURE</b> D dry M moist W wet Mp plastic limit Wl liquid limit	<b>CONSISTENCY/DENSITY INDEX</b> 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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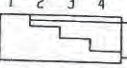





pit no  
TP5  
sheet 1 of 1

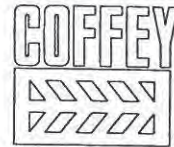
# engineering log - excavation

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: **PCD**  
 equipment type and model: CASE 4800 BACKHOE  
 excavation dimensions: 2 m long 0.8 m wide  
 orientation: -  
 R.L. Surface: NOT MEASURED  
 datum: -

method	penetration				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	structure and additional observations
	1	2	3	4												
BH					Nil				1	[diagonal hatching]	GW	FILL: SANDY GRAVEL, fine to coarse grained, red, sand, fine to coarse grained, with some clay, medium plasticity.	M	MD		SCORIA FILL
						E				[diagonal hatching]	CL	SILTY CLAY: medium plasticity, brown, with 20mm to 50mm of black, hydrocarbon sludge incorporated into the surface		Fb		TOPSOIL
										[diagonal hatching]	CL	SILTY CLAY: medium plasticity, grey,		St		SUBSOIL
						E			2	[diagonal hatching]	CH	SILTY CLAY: high plasticity, brown-yellow, mottled orange-yellow,		VSt		RESIDUAL
										[diagonal hatching]						
												Pit bottomed on basalt				
									3			Pit TP5 Terminated at 2.50 m				
									4							

<b>METHOD</b> N natural exposure X existing excavation BH backhoe bucket B bulldozer blade R bulldozer ripper E excavator HA hand auger HT hand tools <b>SUPPORT</b> SH shoring SC shotcrete Nil no support RB rockbolts	<b>PENETRATION</b> 1 2 3 4  little resistance ranging to very slow progress <b>WATER</b> D none observed X not measured  water level  water outflow  water inflow	<b>SAMPLES, TESTS, ETC</b> 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	<b>CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION</b> based on unified classification system <b>MOISTURE</b> D dry M moist W wet Wp plastic limit Wl liquid limit	<b>CONSISTENCY/DENSITY INDEX</b> 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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pit no  
TP6  
sheet 1 of 1

# engineering log - excavation

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 460D BACKHOE  
excavation dimensions: 2 m long 0.8 m wide orientation:  
R.L. Surface: NOT MEASURED  
datum:

method	penetration				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			structure and additional observations
	1	2	3	4											100 kPa	200 kPa	300 kPa	
BH					Nil	D			0		GW	FILL: SANDY GRAVEL, fine to coarse grained, red, sand, fine to coarse grained, with some clay, medium plasticity,	M	MD				SCORIA FILL
							Bs		0.5		CL	SILTY CLAY: medium plasticity, brown, with black hydrocarbon contamination of upper 20mm		Fb				TOPSOIL
									1.0		GW	CLAYEY SANDY GRAVEL: fine to medium grained, brown-grey, sand, fine to coarse grained, clay medium plasticity, with buckshot gravel 2-5mm		MD				SUBSOIL
							Bs		1.5		CH	SILTY CLAY: high plasticity, yellow-grey, mottled orange-yellow.		VSt				RESIDUAL
									2.0									
									2.80									
									3.0									
									4.0									

Pit bottomed on basalt

Pit TP6 - Terminated at 2.80 m

<b>METHOD</b> N natural exposure X existing excavation BH backhoe bucket B bulldozer blade R bulldozer ripper E excavator HA hand auger HT hand tools	<b>PENETRATION</b> 1 2 3 4  <b>WATER</b> D none observed * not measured ▽ water level ▽ water outflow ▽ water inflow	<b>SAMPLES, TESTS, ETC</b> 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	<b>CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION</b> based on unified classification system  <b>MOISTURE</b> D dry M moist W wet Wp plastic limit Wl liquid limit	<b>CONSISTENCY/DENSITY INDEX DESCRIPTION</b> 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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pit no  
TP7  
sheet 1 of 1

# engineering log - excavation

office job no: E3517/1

pit commenced: 17/7/96

pit completed: 17/7/96

logged by: GWE

checked by: PCJ

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

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				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	structure and additional observations
	1	2	3	4											
BH								1		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
										CH	SILTY CLAY: medium plasticity, grey, SILTY CLAY: high plasticity, yellow-grey, mottled orange-yellow.		Vst		SUBSOIL
								2							RESIDUAL
								3							
								4							
Pit TP7 Terminated at 2.60 m															

**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

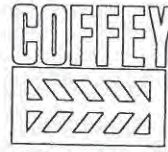
**PENETRATION**  
1 2 3 4  
  
little resistance ranging to very slow progress  
**WATER**  
D none observed  
X not measured  
 water level  
 water outflow  
 water inflow

**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  
Mp plastic limit  
Wl liquid limit

**CONSISTENCY/DENSITY INDEX DESCRIPTION**  
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





pit no  
TP8  
sheet 1 of 1

# engineering log - excavation

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				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	structure and additional observations
	1	2	3	4											
BH										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
						Bs				CH	SILTY CLAY: high plasticity, yellow-grey, mottled-orange-yellow		VSt		RESIDUAL
											Bottomed on basalt				
											Pit TP8 Terminated at 2.50 m				

**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**  
O none observed  
X not measured  
▽ water level  
▽ water outflow  
▽ water inflow

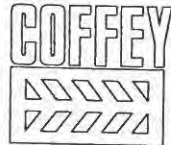
**SAMPLES, TESTS, ETC**  
U undisturbed sample (mm)  
D disturbed sample  
Bs bulk sample  
E environmental sample  
VS vane shear  
DP dynamic penetrometer  
FD field density  
WS water sample

**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





pit no  
TP9  
sheet 1 of 1

# engineering log - excavation

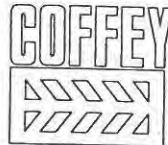
office job no: E3517/1  
pit commenced: 17/7/96  
pit completed: 17/7/96  
logged by: GWE  
checked by: PCA

client: C.F.A. TRAINING COLLEGE  
principal: -  
project: FIELD SITE APPRAISAL & SAMPLING, BALLAN  
pit location: REFER TO DRAWING NO. E3517/1-3  
equipment type and model: CASE 4800 BACKHOE  
excavation dimensions: 2 m long 0.8 m wide orientation:  
R.L. Surface: NOT MEASURED datum:

method	penetration			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	structure and additional observations
	1	2	3												
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
								0.5		CL	SILTY CLAY: medium plasticity, brown, with black, hydrocarbon sludge, approximately 10mm thick		Fb		TOPSOIL
								1.0		GC	CLAYEY SANDY GRAVEL: fine to coarse grained, brown-grey, sand, fine to coarse grained, clay medium plasticity,		MD		SUBSOIL/Buckshot-gravel-layer
								1.5		CH	SILTY CLAY: high plasticity, yellow-grey, mottled orange-yellow,		VSt		RESIDUAL
								2.0			Pit bottomed on basalt				
								2.30			Pit TP9 Terminated at 2.30 m				

<b>METHOD</b> N natural exposure X existing excavation BH backhoe bucket B bulldozer blade R bulldozer ripper E excavator HA hand auger HT hand tools <b>SUPPORT</b> SH shoring SC shotcrete Nil no support RB rockbolts	<b>PENETRATION</b> 1 2 3 4  little resistance ranging to very slow progress <b>WATER</b> D none observed X not measured ∇ water level ∇∇ water outflow ∇∇∇ water inflow	<b>SAMPLES, TESTS, ETC</b> 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	<b>CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION</b> based on unified classification system <b>MOISTURE</b> D dry M moist W wet Wp plastic limit Wl liquid limit	<b>CONSISTENCY/DENSITY INDEX</b> 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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pit no  
TP10  
sheet 1 of 1

# engineering log - excavation

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: **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			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	structure and additional observations
	1	2	3												
BH				Nil	D			1		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
										CH	SILTY CLAY: high plasticity, yellow-grey, mottled orange-yellow		VSt		RESIDUAL
								2			Pit bottomed on basalt				
								3			Pit TP10 Terminated at 2.00 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

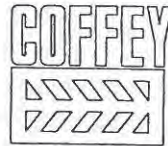
**PENETRATION**  
1 2 3 4  
  
little resistance ranging to very slow progress  
**WATER**  
D none observed  
X not measured  
▽ water level  
▽| water outflow  
▽| water inflow

**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  
Mp 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





pit no  
TP11  
sheet 1 of 1

# engineering log - excavation

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

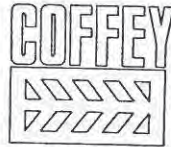
client: C.F.A. TRAINING COLLEGE  
principal:  
project: FIELD SITE APPRAISAL & SAMPLING, BALLAN  
pit location: REFER TO DRAWING NO. E3517/1-3

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				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	meter	structure and additional observations
	1	2	3	4													
BH					Nil	D			1		GC CL CL CH	FILL: CLAYEY GRAVEL, fine to coarse grained, red, clay high plasticity. SILTY CLAY: medium plasticity, brown, with trace (approx. 2mm) of black, hydrocarbon sludge at surface SILTY CLAY: medium plasticity, grey. SILTY CLAY: high plasticity, yellow-grey, mottled orange-yellow.	M	MD Fb St VSt	100 200 300 400		SCORIA FILL TOPSOIL SUBSOIL RESIDUAL
												Pit bottomed on basalt					
									2			Pit TP11 Terminated at 1.60 m					
									3								
									4								

<b>METHOD</b> N natural exposure X existing excavation BH backhoe bucket B bulldozer blade R bulldozer ripper E excavator HA hand auger HT hand tools <b>SUPPORT</b> SH shoring SC shotcrete Nil no support RB rockbolts	<b>PENETRATION</b> 1 2 3 4  little resistance ranging to very slow progress <b>WATER</b> O none observed X not measured  water level  water outflow  water inflow	<b>SAMPLES, TESTS, ETC</b> 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	<b>CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION</b> based on unified classification system <b>MOISTURE</b> D dry M moist W wet Wp plastic limit Wl liquid limit	<b>CONSISTENCY/DENSITY INDEX</b> 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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pit no  
TP12  
sheet 1 of 1

# engineering log - excavation

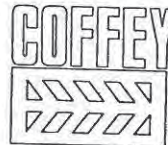
client: C.F.A. TRAINING COLLEGE  
principal: -  
project: FIELD SITE APPRAISAL & SAMPLING, BALLAN  
pit location: REFER TO DRAWING NO. E3517/1-3  
office job no: E3517/1  
pit commenced: 17/7/96  
pit completed: 17/7/96  
logged by: GWE  
checked by: *PCA*

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				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	structure and additional observations
	1	2	3	4											
BH									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		1		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					200mm cement pipe at approx. 1m					
										Pit bottomed on basalt					
										Pit TP12 Terminated at 1.40 m					

<b>METHOD</b> N natural exposure X existing excavation BH backhoe bucket B bulldozer blade R bulldozer ripper E excavator HA hand auger HT hand tools <b>SUPPORT</b> SH shoring SC shotcrete Nil no support RB rockbolts	<b>PENETRATION</b> 1 2 3 4  <b>WATER</b> O none observed * not measured water level  water outflow  water inflow 	<b>SAMPLES, TESTS, ETC</b> 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	<b>CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION</b> based on unified classification system <b>MOISTURE</b> D dry M moist W wet Wp plastic limit Wl liquid limit	<b>CONSISTENCY/DENSITY INDEX</b> 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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pit no  
TP13  
sheet 1 of 1

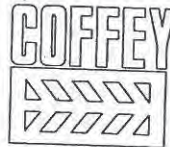
# engineering log - excavation

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: GME  
 checked by: PCA  
 equipment type and model: CASE 4800 BACKHOE  
 excavation dimensions: 2 m long 0.8 m wide orientation:  
 R.L. Surface: NOT MEASURED datum:

method	penetration				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	structure and additional observations
	1	2	3	4												
BH					Nil				1		GC CL GC CH Bs	M Fb MD VSt	MD Fb MD VSt	SCORIA FILL TOPSOIL SUBSOIL with buckshot gravel RESIDUAL		
									2			Pit bottomed on basalt				
									3							
									4			Pit TP13 Terminated at 1.30 m				

<b>METHOD</b> N natural exposure X existing excavation BH backhoe bucket B bulldozer blade R bulldozer ripper E excavator HA hand auger HT hand tools	<b>PENETRATION</b> 1 2 3 4  WATER D none observed X not measured  water level  water outflow  water inflow	<b>SAMPLES, TESTS, ETC</b> 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	<b>CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION</b> based on unified classification system <b>MOISTURE</b> D dry M moist W wet Mp plastic limit Wl liquid limit	<b>CONSISTENCY/DENSITY INDEX</b> 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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pit no  
TP14  
sheet 1 of 1

# engineering log - excavation

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: *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				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	structure and additional observations
	1	2	3	4												
BH					Nil	D			1		GC	FILL: CLAYEY GRAVEL, fine to coarse grained, red, clay high plasticity.	M	MD	100 200 300 400	SCORIA FILL
						Bs					CL	SILTY CLAY: medium plasticity, brown, containing traces of black, hydrocarbon staining (approx. 2mm)		St		TOPSOIL
											CH	SILTY CLAY: high plasticity, yellow-brown, mottled orange-yellow.				RESIDUAL
Pit TP14 Terminated at 1.00 m																

<b>METHOD</b> N natural exposure X existing excavation BH backhoe bucket B bulldozer blade R bulldozer ripper E excavator HA hand auger HT hand tools <b>SUPPORT</b> SH shoring SC shotcrete Nil no support RB rockbolts	<b>PENETRATION</b> 1 2 3 4  little resistance ranging to very slow progress <b>WATER</b> O none observed * not measured  water level  water outflow  water inflow	<b>SAMPLES, TESTS, ETC</b> 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	<b>CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION</b> based on unified classification system <b>MOISTURE</b> D dry M moist W wet Mp plastic limit Wl liquid limit	<b>CONSISTENCY/DENSITY INDEX</b> 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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pit no  
TP15  
sheet 1 of 1

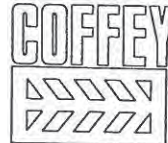
# engineering log - excavation

client: C.F.A. TRAINING COLLEGE  
principal: -  
project: FIELD SITE APPRAISAL & SAMPLING, BALLAN  
pit location: REFER TO DRAWING NO. E3517/1-3  
equipment type and model: CASE 4800 BACKHOE  
excavation dimensions: 2 m long 0.8 m wide orientation: R.L. Surface: NOT MEASURED  
office job no: E3517/1  
pit commenced: 17/7/96  
pit completed: 17/7/96  
logged by: GWE  
checked by: PCA

method	penetration				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	structure and additional observations
	1	2	3	4												
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
Pit TP15 Terminated at 0.80 m																

<b>METHOD</b> N natural exposure X existing excavation BH backhoe bucket B bulldozer blade R bulldozer ripper E excavator HA hand auger HT hand tools	<b>PENETRATION</b> 1 2 3 4  little resistance ranging to very slow progress <b>WATER</b> D none observed X not measured  water level  water outflow  water inflow	<b>SAMPLES, TESTS, ETC</b> 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	<b>CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION</b> based on unified classification system <b>MOISTURE</b> D dry M moist W wet Mp plastic limit Wl liquid limit	<b>CONSISTENCY/DENSITY INDEX</b> 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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pit no  
TP16  
sheet 1 of 1

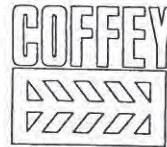
# engineering log - excavation

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: GME  
 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				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	structure and additional observations
	1	2	3	4												
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																

<b>METHOD</b> N natural exposure X existing excavation BH backhoe bucket B bulldozer blade R bulldozer ripper E excavator HA hand auger HT hand tools	<b>PENETRATION</b> 1 2 3 4  little resistance ranging to very slow progress <b>WATER</b> D none observed X not measured  water level  water outflow  water inflow	<b>SAMPLES, TESTS, ETC</b> 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	<b>CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION</b> based on unified classification system <b>MOISTURE</b> D dry M moist W wet Wp plastic limit Wl liquid limit	<b>CONSISTENCY/DENSITY INDEX</b> 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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pit no  
TP17  
sheet 1 of 1

# engineering log - excavation

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

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

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				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			structure and additional observations
	1	2	3	4											100 kPa	200 kPa	300 kPa	
BH					Nil	D			0		GC CL CL CH	FILL: CLAYEY GRAVEL, fine to coarse grained, red, clay high plasticity. SILTY CLAY: medium plasticity, brown. SILTY CLAY: medium plasticity, brown-grey. SILTY CLAY: high plasticity, grey.	M	MD Fb St VSt				SCORIA FILL TOPSOIL SUBSOIL RESIDUAL
Pit TP17 Terminated at 0.60 m																		
<div style="display: flex; justify-content: space-between;"> <div style="width: 15%;">1</div> <div style="width: 15%;">2</div> <div style="width: 15%;">3</div> <div style="width: 15%;">4</div> </div>																		

**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 DESCRIPTION**  
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



pit no  
TP18  
sheet 1 of 1

# engineering log - excavation

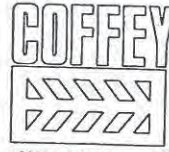
office job no: E3517/1  
pit commenced: 17/7/96  
pit completed: 17/7/96  
logged by: GWE  
checked by: PCA

client: C.F.A. TRAINING COLLEGE  
principal: -  
project: FIELD SITE APPRAISAL & SAMPLING, BALLAN  
pit location: REFER TO DRAWING NO. E3517/1-3  
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			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 meter	structure and additional observations
	1	2	3												
BH				Nil	D			0		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
Pit TP18 Terminated at 0.60 m															
								1							
								2							
								3							
								4							

<b>METHOD</b> N natural exposure X existing excavation BH backhoe bucket B bulldozer blade R bulldozer ripper E excavator HA hand auger HT hand tools <b>SUPPORT</b> SH shoring SC shotcrete Nil no support RB rockbolts	<b>PENETRATION</b> 1 2 3 4  little resistance ranging to very slow progress <b>WATER</b> D none observed X not measured  water level  water outflow  water inflow	<b>SAMPLES, TESTS, ETC</b> U undisturbed sample (mm) D disturbed sample Bs bulk sample E environmental sample VS vane shear DP dynamic penetrometer FD field density MS water sample	<b>CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION</b> based on unified classification system <b>MOISTURE</b> D dry M moist W wet Wp plastic limit Wl liquid limit	<b>CONSISTENCY/DENSITY INDEX</b> 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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pit no  
TP19  
sheet 1 of 1

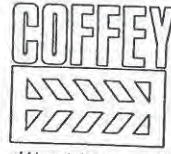
# engineering log - excavation

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: GME  
 checked by: **PCA**  
 equipment type and model: CASE 4800 BACKHOE  
 excavation dimensions: 2 m long 0.8 m wide  
 orientation: -  
 R.L. Surface: NOT MEASURED  
 datum: -

method	penetration				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 meter kPa	structure and additional observations
	1	2	3	4											
BH					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
Pit TP19 Terminated at 0.60 m															

<b>METHOD</b> N natural exposure X existing excavation BH backhoe bucket B bulldozer blade R bulldozer ripper E excavator HA hand auger HT hand tools <b>SUPPORT</b> SH shoring SC shotcrete Nil no support RB rockbolts	<b>PENETRATION</b> 1 2 3 4  little resistance ranging to very slow progress <b>WATER</b> D none observed * not measured  water level  water outflow  water inflow	<b>SAMPLES, TESTS, ETC</b> 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	<b>CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION</b> based on unified classification system <b>MOISTURE</b> D dry M moist W wet Wp plastic limit Wl liquid limit	<b>CONSISTENCY/DENSITY INDEX</b> 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 YD very dense
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# engineering log - excavation



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 4800 BACKHOE  
excavation dimensions: 2 m long 0.8 m wide  
orientation:  
R.L. Surface: NOT MEASURED  
datum:

method	penetration				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	structure and additional observations
	1	2	3	4											
BH					D					GC CL CL	FILL: CLAYEY GRAVEL, fine to coarse grained, red, clay high plasticity, SILTY CLAY: medium plasticity, brown, SILTY CLAY: medium plasticity, brown-grey,	M	MD Fb St	100 200 300 400	SCORIA FILL TOPSOIL SUBSOIL
											Pit TP20 Terminated at 0.50 m				

<b>METHOD</b> N natural exposure X existing excavation BH backhoe bucket B bulldozer blade R bulldozer ripper E excavator HA hand auger HT hand tools <b>SUPPORT</b> SH shoring SC shotcrete Nil no support RB rockbolts	<b>PENETRATION</b> 1 2 3 4  little resistance ranging to very slow progress <b>WATER</b> D none observed * not measured  water level  water outflow  water inflow	<b>SAMPLES, TESTS, ETC</b> 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	<b>CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION</b> based on unified classification system <b>MOISTURE</b> D dry M moist W wet Wp plastic limit Wl liquid limit	<b>CONSISTENCY/DENSITY INDEX</b> 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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E3517/1-AD  
7 August 1996



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
		<i>Lab Detection Limits:</i>	0.02	0.02	0.02	0.02	20	20	20	20
		ANZECC B	1	3	5	5	100	{ --- 1000 --- }		
		Dutch B	1	30	50	50	800	{ --- 5000 --- }		
		Dutch C	5				100	{ --- 1000 --- }		
		VicEPA (Clean Fill)	{ --- 7 --- }				1000	{ --- 10000 --- }		
		VicEPA (Low Level Fill)	{ --- 70 --- }							
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







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  
Mr M Probert

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



National Association of Testing  
Authorities, Australia  
NATA ENDORSED DOCUMENT  
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except in full

Approved By

  
E D Jones BSc M R A C I  
CHIEF CHEMIST

Authorised By

  
Dr G J Baxter PhD M R A C I  
MANAGING DIRECTOR

JULE8265...1 of3





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

Page : 3 of ... 3 FINAL 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		C10-C14		C15-C28		TPH		C29-C36		BENZENE		TOLUENE		ETHYL XYLENES		BENZENE	
		C6-C9	C10-C14	TPH	TPH	TPH	TPH	BENZENE	TPH	TPH	TPH	BENZENE	TPH	TPH	TPH	TPH	TPH		TPH
JULE8605	19/07/96	BLANK	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
JULE8606	19/07/96	QA/QC SPIKE	730	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	0.88	0.84	0.78	1.6	1.6	1.6	spike/JULE8605	
JULE8606	19/07/96	QA/QC SPIKE	740	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	1.1	1.0	0.95	2.0	2.0	2.0	Expected Result	
JULE8606	19/07/96	BLANK	98.6	100	100	0	0	0	0	0	0	80.0	84.0	82.1	80.0	80.0	80.0	% Recovery	
JULE8605	19/07/96	BLANK	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
JULE8671	19/07/96	BLANK	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
JULE8672	19/07/96	TP1 0.3-P	< 20	< 20	< 20	140	140	260	260	260	260	< 20	< 20	< 20	< 20	< 20	< 20	< 20	duplt/JULE8273
JULE8273	19/07/96	TP1 0.3-P	< 20	< 20	< 20	170	170	300	300	300	300	< 20	< 20	< 20	< 20	< 20	< 20	< 20	Rel % Difference
JULE8672	19/07/96	TP1 0.3-P	0	0	0	19.4	19.4	14.3	14.3	14.3	14.3	< 20	< 20	< 20	< 20	< 20	< 20	< 20	
JULE8673	19/07/96	TP1 0.3-P	730	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	spike/JULE8273
JULE8673	19/07/96	TP1 0.3-P	740	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	Expected Result
JULE8673	19/07/96	TP1 0.3-P	98.6	100	100	0	0	0	0	0	0	< 20	< 20	< 20	< 20	< 20	< 20	< 20	% Recovery
JULE8273	19/07/96	TP1 0.3-P	< 20	< 20	< 20	170	170	300	300	300	300	< 20	< 20	< 20	< 20	< 20	< 20	< 20	
JULE8674	19/07/96	TP1 0.3-P	730	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	spike/JULE8273
JULE8674	19/07/96	TP1 0.3-P	740	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	Expected Result
JULE8674	19/07/96	TP1 0.3-P	98.6	100	100	0	0	100	100	100	100	< 20	< 20	< 20	< 20	< 20	< 20	< 20	% Recovery
JULE8273	19/07/96	TP1 0.3-P	< 20	< 20	< 20	170	170	300	300	300	300	< 20	< 20	< 20	< 20	< 20	< 20	< 20	

A blank space indicates no test performed.





ENVIRONMENT  
PROTECTION  
AUTHORITY

SOUTH WEST  
REGION

**25 years of  
making a  
difference**

21 August 1996

Mr David Clancy  
Fire Officer  
CFA Training College - Fiskville  
RMB 300  
Ballan 3342

Our Ref: 25151

Dear Mr Clancy

### CFA TRAINING COLLEGE, FISKVILLE - SITE CONTAMINATION

Thank you, and Fire Officer Mark Gunning for accompanying me during my inspection, on 23 July 1996, of the CFA's Fiskville Training College.

The site is likely to be contaminated due to poor practices in the past. This is supported by the results of the initial site investigation commissioned by the CFA.

We encourage the CFA's proactive approach to determining the extent of contamination of the Fiskville site. The aim for the CFA is to minimise environmental impact of any contamination, especially off-site impacts.

Further site investigation should be carried out, in-line with that suggested in the consultants report. This should cover groundwater (levels, directional flows, quality and impact of contamination, if any), surface water quality (the lake, inflows and outflows), and further soil testing. CFA should consider retaining the services of a consultant with specific expertise in groundwater investigation.

Further investigations will allow the most informed decision to be made on the appropriate management option for the site. EPA is willing to review any proposals put to the CFA by consultants for further site investigations and remediation, to ensure that all the issues of concern are adequately addressed.

Measures should also be considered at this point for ensuring that activities do not cause similar problems in the future (eg. construction of a bunded flammable liquids pad with satisfactory treatment of run-off before discharge).

If no further action is taken on the contamination issues already identified, the Authority may require further investigation and clean-up to be undertaken through the issue of a pollution abatement notice and/or clean-up notice.


There are two other issues which need to be addressed. These are the discharge of effluent from the sewage treatment plant and the landfilling activities. Both these activities are listed as scheduled premises under Table A - Scheduled Premises, Sections 1(d) and 1(e), of the Environment Protection (Scheduled Premises and Exemptions) Regulations 1996.

Therefore, they should be licensed and will need licensing if the CFA intends continuing their use. Current practices associated with these activities may not meet with licensing requirements (eg. landfilling and sewage effluent disposal methods). Please contact me for further information on these requirements.

Please provide the Authority with written confirmation of the CFA's intentions toward the activities requiring licensing by 16 September 1996. Please also keep us informed of the progress and findings of further site investigations.

If you have any further questions regarding any of the above matters, please contact me on (052) 264 502

Yours sincerely

A handwritten signature in black ink, appearing to read 'Paul Day', written over a light blue horizontal line.

PAUL DAY  
SOUTH WEST REGION



## SITE INSPECTION REPORT

### CFA FISKVILLE TRAINING COLLEGE

Inspection of the CFA Training College, Fiskville was conducted on 23 July 1996.

Present: Paul Day - EPA  
David Clancy - Fire Officer, CFA  
Mark Gunning - Fire Officer, CFA

Inspection focused on several areas of the site, and covered a number of issues relating to recent and past activities at the site. Firefighting exercises at the site have given rise to a number of the issues, but disposal of the wastes associated with these exercises and the general running of the site have also contributed significantly to them.

### Waste Treatment and Disposal

#### *Drum Burial Pits*

Through investigation of historical records and accounts, areas where drums of liquid waste had been buried were identified. There had been three burial pits identified in an area lying to the north of the training area (approx. 500m), adjacent to airstrip.

The areas were discernible by a lack of longer grass growing on the surface covering the drums. The quantity of drums is not known, nor are contents. It was explained that the drums could contain a variety of compounds (understood to be solvent sludges, thinner & paint sludges, including waste from paint manufacture). Flammable liquid wastes from a number of sources (known and unknown) had been used in the past for firefighting exercises (practice now ceased).

Analyses of soil samples has been carried out and show appreciable levels of a variety of organic compounds (phenols, TPH and BTEX). It is intended to put down a bore to establish groundwater quality (will probably require more than one bore).

The burial pits are located approximately 100m east of a small water course which drains southward into a lake located immediately behind (west) of the training area.

#### *Landfill/Tip*

At the far west of the site, a tip has been established for the burial of burnt and partially burnt plastics, furniture and other debris used in firefighting exercises, along with some scrapings of contaminated soil from the bottom of fire pits (used for holding flammable liquids which are ignited).



Tip consists of holes dug to a depth of approximately 1.5 - 2m for placement of waste. It was estimated that waste is deposited 5 times per year, in volumes of 4 - 5m<sup>3</sup>.

Close to the site of the active tip, another area has been used for the burial of various unknown materials by a previous occupier of the site (AWA). This area is situated immediately adjacent to a small watercourse which is the outlet of the lake referred to above.

### *Sewage Handling Systems*

On the site there are several residential houses and units (units used to house volunteers in training) and associated facilities, as well as administrative blocks. Sewage from these buildings is conveyed to an on site sewage treatment plant. The residential units are serviced by a holding tank for settling solids, with liquid effluent pumped to the sewage treatment plant. Solids are removed from the holding tank at least once a year. This is also the case for one of the houses which was built well before any of the others in the housing area.

The treatment plant has not been maintained particularly well, and several areas of the plant need attention. The CFA has had an initial assessment of the plant carried out (undertaken by Water Authority staff in unofficial capacity), the conclusion of which was the plant's performance could be restored to meet the needs of the site. The CFA is in the process of making the necessary repairs to the plant.

The estimated flow to the plant (if serving all buildings, and assuming a full occupancy) is approximately 20,000 litres per day. The trickling filter of the sewage treatment plant has sufficient capacity to handle this flow. Actual flows to the plant are not known but are likely to be considerably less.

The discharge from the plant is to land. The effluent is discharged via a pipe at a point about 100m from a watercourse draining to the lake. The sewer line from the housing area must run under the lake or watercourse draining into the lake, and there may be some question of the integrity of this line. An algal bloom occurred in the lake in early 1995, there have been none since. Water quality tests have been undertaken (and continue to be) to monitor the condition of the lake (results should be forwarded to EPA).

### **Training Area and Activities**

The Flammable Liquids (flam. liquids) Area or Pad is used for firefighting exercises using props and flammable liquids (as the name suggests). Fuel (diesel, petrol and fuel oil) is poured out of the props (tankers, drums etc.) and ignited. Some of the area is sealed, however this surface is extensively cracked and broken.

The fuel and burnt residue has been allowed to escape to the soil surrounding, and beneath the flam. liquids area, as clearly evident by the gross black oily contamination of these areas. The flam liquids pad is serviced by a relatively small



interceptor sump which discharges to a small artificial lake (pond) adjacent to the pad. This installation is clearly overwhelmed by the hydrocarbon loading and does not prevent discharge of contaminants to the pond. The liquid within the interceptor was thick and black, being heavily contaminated with fuel and oil.

The soil around the interceptor was also highly contaminated, suggesting that the installation had overflowed (on many occasions it appeared). There was also signs of direct run-off from the pad to the pond. Oily water level marks were observed indicating the contamination of the water in the pond. Water quality tests have confirmed relatively high level hydrocarbon contamination (also phenolic compounds and zinc), in the sediments also.

*Training in this area has now ceased due to concern for the contamination of surrounding soils, water, and sediments.*

The pond drains into a second similar pond within the vehicle accident training area. This is a new area relative to the flam liquids area and training within this area is controlled so that no flammable liquids area used. Vehicles used in training exercises are drained of all oils and fuels prior to use, and natural gas is used for fuelling fires. Water quality tests of the pond in this area indicate it is of a much higher quality (but same contaminants still measurable). This pond drains to the (natural) lake mentioned in the waste treatment and disposal section.

Some concern was expressed concerning contamination of the waterbodies by firefighting foams used in exercises because they are not biodegradable. No testing has been done for these compounds.

Adjacent to the flam liquids pad (to the east) is a grassed area which had been used in the past for burning pits. Holes were dug in the ground, liquid fuels poured in and ignited. When these pits were no longer required, they were covered in without the removal of any residues. Soil samples of these areas have shown some contamination (TPH, and lead in some areas).

## **Site Investigations**

CFA have had a consultant undertake an (initial) site investigation, which has included a soil and limited water sampling program. See accompanying copy of consultants report.

The investigation identified and confirmed contamination of some areas of the site. It also identified a need for further investigation of these areas before any clean-up work is commenced. This would be carried out to determine the extent of the contaminated areas of most concern (eg. drum burial pits), and allow the development of an excavation plan.

There is also a need to investigate the groundwater in the area to determine the impact of the activities carried out at the site (this should include the landfill area).



Sampling of the surface waters should also be undertaken to provide an indication of the quality of the watercourses and bodies draining to the lake, the lake itself, and the outflow of the lake in the vicinity of the old landfill.

## Legislative Requirements

The Environment Protection (Scheduled Premises and Exemptions) Regulations 1996 requires the following, under Table A - Scheduled Premises:

### Description of Premises

- 1(d) Premises on or from which **sewage (including sullage) effluent**, exceeding a design or actual flow rate of 5000 Litres per day, is discharged or deposited;
- 1(e) **Landfills** used for the discharge or deposit of solid wastes onto land being-
- (i) .....
  - (ii) land disposal facilities for **solid wastes** (including solid industrial wastes) except premises, with solely land discharges or deposits, used only for the discharge or deposit of mining wastes and in accordance with the **Extractive Industries and Development Act 1955** or the **Mineral Resources Development Act 1990**.

*All category 1(e) premises are also schedule five premises.*

Therefore, the on-site sewage treatment plant operated by the CFA strictly speaking requires a works approval as well as a licence (unless commenced prior to 1985, then only a licence). In addition, the landfilling currently being carried out by the CFA also requires a works approval as well as a licence (only municipal landfills serving less than 5000 people are exempt from licensing).

## Further Action

Letter forwarded to the CFA:

- supporting the approach taken thus far and the commitment displayed to ensure the environmental problems at the site are remedied;
- stating further investigation needed;
- offering of assistance with reviewing any proposals for further investigation work;
- pointing out enforcement options available to EPA should no further action be taken;
- outlining need for licences for landfill and sewage treatment.



CFA Training College

**SEDIMENT & SURFACE WATER SAMPLING  
BALLAN, VIC**

Report E3523/2-AD October 1996

**Coffey Partners International Pty Ltd**

A.C.N. 003 692 019

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



# Coffey Partners International Pty Ltd

A.C.N. 003 692 019

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



E3523/2-AD MKSP:MW  
15 October 1996

CFA Training College  
RMB 300  
BALLAN VIC 3342

Attention: Mr Grant James

Dear Sir

RE: SEDIMENT & SURFACE WATER SAMPLING  
CFA TRAINING COLLEGE, BALLAN VIC

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

Should you have any questions related to the report please do not hesitate to contact the undersigned.

For and on behalf of  
COFFEY PARTNERS INTERNATIONAL PTY LTD

  
T.W. MARSHALL

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E3523/2-AD  
15 October 1996

ii.



## FIGURES

- 1 Site Locality Plan
- 2 Surface Water Sampling Locations
- 3 Sediment Sampling Locations

## APPENDICES

- A NATA Certified Laboratory Analytical Results (7 pages)





## 1.0 INTRODUCTION

This report presents the results of a sediment and surface water sampling and analytical program carried out at the Country Fire Authority (CFA) Training College site at Fiskville, near Ballan VIC (refer Figure 1), as outlined in our proposal dated 12 September, 1996 (Reference EP3613/1-AA).

The project was commissioned by Mr Grant James of the CFA in a verbal communication to Mr Grant Eggleston on 26 September, 1996.

## 2.0 STUDY METHODOLOGY

### 2.1 Objectives

The primary objective of the study was to undertake a preliminary assessment of water and sediment contamination status in the drainage system of the Fiskville site.

### 2.2 Scope of Work

The scope of work was prescribed in faxed advice (dated 28 August, 1996) from Minenco Pty Ltd to Mr David Clancy of CFA. The Minenco advice prescribed a scope of work which included:

- surface water sampling at 7 locations;
- sediment sampling at 3 locations;
- laboratory analytical program; and
- data interpretation and reporting.

The Minenco brief prescribed all sampling locations and defined analytical requirements for the project.

## 3.0 FIELDWORK AND LABORATORY PROGRAM

### 3.1 Surface Water Sampling

Fieldwork was undertaken on 26 September, 1996 by a Coffey Environmental Scientist. Surface water samples (refer Figure 2) were collected from the following locations:

- Dam 1-inlet;
- Dam 2-inlet;
- Dam 2-outlet;



- Lake Fiskville-Sandy Creek inlet;
- Lake Fiskville-Inlet from Dam 2;
- Lake Fiskville-outlet;
- Creek draining from Lake Fiskville, down-gradient and downstream from landfill.

Prior to sample collection, field measured water quality parameters (pH, electrical conductivity and temperature) were recorded. The field water quality results are presented in Table 3-1.

**TABLE 3-1**  
**SUMMARY OF FIELD MEASURED WATER QUALITY PARAMETERS**

Location	Date Sampled	Comments	Stabilised Field Measured Parameters		
			pH	Temp. (°C)	EC (µS/cm)
Dam 1 inlet	26/9/96	light brown, oily film	8.97	9.3	270
Dam 2 inlet	26/9/96	light brown	8.50	10.0	316
Dam 2 outlet	26/9/96	light brown	9.57	9.7	707
L Fiskville-Inlet from Dam 2	26/9/96	light brown	8.70	11.2	351
L Fiskville-Sandy Ck inlet	26/9/96	light brown, slightly turbid	8.42	9.3	240
L Fiskville outlet	26/9/96	light brown, slightly frothy	8.09	11.2	190
Creek-downstream of L Fiskville	26/9/96	light brown, slightly frothy	8.30	11.5	215

The surface water samples were collected using a stainless steel jug and samples were transferred immediately into appropriately labelled pre-treated sample containers (e.g. field filtration of samples for heavy metal analysis) and then placed in ice boxes prior to dispatch to the laboratory. A summary of the sample preservation protocols used is presented in Table 3-2.

### 3.2 Sediment Sampling

Sediment samples were collected from the side of the dam at three locations within Dam 2 (refer Figure 3) using a stainless steel trowel. An odourous sludge, apparently affected by hydrocarbon contamination, was collected from location Dam 2A whilst sediment samples collected from locations Dam 2B and Dam 2C consisted of a brown/black sludge with fine charcoal pieces incorporated.





**TABLE 3-2**  
**SUMMARY OF SURFACE WATER**  
**PRESERVATION PROTOCOLS**

Analytes	Sample Container	Preservative	Dispatch to
Metals: As Cd Cu Cr Ni Pb Zn Hg total P	500mL amber glass	0.45µm filter, nitric acid	NAL
pH TDS TSS NO <sub>3</sub> -N Total N	500mL HDPE bottle	nil	NAL
BOD	500mL HDPE bottle	nil	NAL
NH <sub>3</sub> -N Total Phenols	1L amber glass	sulphuric acid	NAL
TPHs	1L amber glass	sulphuric acid	NAL

Collected sediment samples were transferred to glass jars (500gm), labelled and then placed in ice boxes prior to dispatch to the laboratory.

### 3.3 Sample Transfer

All sample transfers were subject to standard chain of custody procedures in accordance with Coffey environmental protocols.

### 3.4 Laboratory Program

All samples were analysed by NATA registered National Analytical Laboratories (NAL) in Melbourne. Analytical methods were based on VicEPA, USEPA and APHA standard methods as shown in Table 3-3. Laboratory detection limits were set at one-tenth of ANZECC (1992) background criteria wherever possible in accordance with standard protocols.

**TABLE 3-3**  
**SUMMARY OF ANALYTICAL METHODS**

Analyte	Method
Heavy Metals (As Cd Cr Cu Hg Ni Pb Zn total P)	NAL E102.31, E102.32, 102.C3, E102.34
Total Petroleum Hydrocarbons (TPHs)	NAL E104.12; E104.52 (GC:PID)
pH TDS TSS NO <sub>3</sub> -N Total N	APHA 17th Edition, NAL E118.11, E118.22, G512.41
NH <sub>3</sub> -N Total Phenols	NAL G512.71, NAL E122.61 (colorimetric)
BOD	1.08 (5 day test)



A summary of abbreviations used by the laboratory for each analyte is presented in Table 3-4.

**TABLE 3-4**  
**SUMMARY OF LABORATORY ABBREVIATIONS**

Heavy Metals	Organics	Others
As = Arsenic	TPH = Total Petroleum Hydrocarbons	TDS = Total Dissolved Solids
Cd = Cadmium		TSS = Total Suspended Solids
Cu = Copper		NO <sub>3</sub> -N = Nitrate-Nitrogen
Cr = Chromium		NH <sub>3</sub> -N = Ammonia-Nitrogen
Hg = Mercury		Total N = Total Nitrogen
Ni = Nickel		Total P = Total Phosphorus
Pb = Lead		BOD = Biological Oxygen Demand
Zn = Zinc		

A summary listing of all analytical results is presented in Table 4-1 to 4-3 and copies of the certified laboratory result sheets are provided in Appendix A.

#### 4.0 RESULTS AND DISCUSSION OF LABORATORY PROGRAM

##### 4.1 Surface Waters

The surface water test results (refer Table 4-1) have been compared with the VicEPA State Environment Protection Policy (SEPP) for Waters of Victoria and the ANZECC (1992a) reference criteria for protection of aquatic ecosystems (AQUATIC) and raw drinking water (DRINK). For contaminants where no criteria are available, the Dutch standards have been used (ANZECC, 1990). Dutch B criteria have been used in the past by the VicEPA as guideline notification levels for potable groundwater with further investigation being warranted where the criteria have been exceeded. Dutch C criteria have been used as an upper limit for potable use and guideline Notification Level for non-potable use (VicEPA, 1991).

##### \* Dam 1 and Dam 2

Surface waters collected from Dams 1 and 2 exhibit mildly alkaline pH ranging from 7.5 to 7.9 and are relatively low in total dissolved solids. Elevated suspended solids, at levels exceeding SEPP criteria, are apparent in samples collected from Dam 1-inlet, Dam 2-outlet and Dam 2-inlet-to Lake Fiskville. An elevated BOD concentration of 95 mg/L exceeding SEPP criteria was also apparent in a sample collected from the Dam 1-inlet.



**TABLE 4-1**  
**SUMMARY OF SURFACE WATER RESULTS**



Job Reference : E3523/2  
Location: CFA Training College, Fiskville near Ballan VIC  
Results expressed in mg/L.

Location	Date Sampled	TPH C6-C9	TPH C10-C14	TPH C15-C28	TPH C29-C36	TOTAL PHENOLS
<i>Lab Detection Limits:</i>		0.1	0.1	0.1	0.1	0.1
<i>VicEPA (SEPP)</i>		No visible oil, grease, etc				
<i>ANZECC (AQUATIC)</i>						
<i>ANZECC (DRINK)</i>						
<i>Dutch B:</i>		0.04	{ --- 0.2 --- }			0.015
<i>Dutch C:</i>		0.15	{ --- 0.6 --- }			0.05
Dam-1-inlet	26-Sep-96	<0.1	1.2	3.5	0.2	<0.05
Dam-2-inlet	26-Sep-96	<0.1	<0.1	0.2	0.1	<0.05
Dam-2-outlet-P	26-Sep-96	<0.1	<0.1	0.4	0.1	<0.05
LFiskville-Inlet from Dam-2	26-Sep-96	<0.1	<0.1	<0.1	<0.1	<0.05
LFiskville-Sandy Ck-inlet	26-Sep-96	<0.1	<0.1	<0.1	<0.1	<0.05
LFiskville-outlet	26-Sep-96	<0.1	<0.1	<0.1	<0.1	<0.05
Ck-downgradient	26-Sep-96	<0.1	<0.1	<0.1	<0.1	<0.05

Location	Date Sampled	As	Cd	Cr	Cu	Hg	Ni	Pb	Zn
<i>Lab Detection Limits:</i>		0.005	0.0002	0.005	0.002	0.0001	0.01	0.001	0.005
<i>VicEPA (SEPP)</i>		0.5	0.1	0.3	0.2	0.005	0.500	0.1	0.5
<i>ANZECC (AQUATIC)</i>		0.05	0.0002	0.01	0.002	0.0001	0.015	0.001	0.005
<i>ANZECC (DRINK)</i>		0.05	0.005	0.05		0.001	0.100	0.05	5.0
Dam-1-inlet	26-Sep-96	<0.005	<0.0002	0.006	0.013	<0.0001	<0.01	0.002	<0.005
Dam-2-inlet	26-Sep-96	<0.005	<0.0002	<0.005	0.010	<0.0001	<0.01	0.002	0.021
Dam-2-outlet-P	26-Sep-96	<0.005	<0.0002	0.009	0.003	<0.0001	0.037	0.002	<0.005
LFiskville-Inlet from Dam-2	26-Sep-96	<0.005	<0.0002	<0.005	0.013	<0.0001	<0.01	0.004	<0.005
LFiskville-Sandy Ck-inlet	26-Sep-96	<0.005	<0.0002	<0.005	0.004	<0.0001	<0.01	<0.001	<0.005
LFiskville-outlet	26-Sep-96	<0.005	<0.0002	<0.005	0.013	<0.0001	0.015	0.006	0.014
Ck-downgradient	26-Sep-96	<0.005	<0.0002	<0.005	0.005	<0.0001	<0.01	<0.001	<0.005

Location	Date Sampled	pH (units)	TDS	TSS	NO <sub>3</sub> -N	NH <sub>3</sub> -N	Total N	Total P	BOD
<i>Lab Detection Limits:</i>					0.3	0.01		0.3	7
<i>VicEPA (SEPP)</i>		6-9		80					40
<i>ANZECC (AQUATIC)</i>		6.5-9	1000						
<i>ANZECC (DRINK)</i>		6.5-8.5	1000		10	0.01			
Dam-1-inlet	26-Sep-96	7.5	320	190	<0.3	<0.01	1.1	<0.3	95
Dam-2-inlet	26-Sep-96	7.9	300	41	<0.3	<0.01	1.1	<0.3	11
Dam-2-outlet-P	26-Sep-96	7.9	370	270	<0.3	<0.01	0.8	<0.3	6
LFiskville-Inlet from Dam-2	26-Sep-96	7.6	570	300	<0.3	0.03	2.0	<0.3	8
LFiskville-Sandy Ck-inlet	26-Sep-96	7.1	320	35	0.4	<0.01	2.2	<0.3	<7
LFiskville-outlet	26-Sep-96	7.2	340	45	<0.3	<0.01	3.1	<0.3	7
Ck-downgradient	26-Sep-96	7.2	320	47	<0.3	<0.01	2.8	<0.3	6



Elevated TPH concentrations are exhibited for samples collected from the Dam 1-inlet, at levels exceeding Dutch C criteria, and for samples collected from the Dam 2- inlet and outlet at levels exceeding Dutch B criteria. Total phenol concentrations in all samples tested are below laboratory detection levels of 0.05 mg/L.

Heavy metal concentrations in all surface waters tested are below the SEPP criteria. However, copper, nickel, lead and zinc concentrations in selected samples exceed the AQUATIC criteria.

\* Down-gradient of Dam 1 and 2

Surface water samples collected from areas down-gradient of Dam 1 and 2, i.e. Sandy Ck-inlet-to-Lake Fiskville, the Lake Fiskville-outlet and from a down-gradient point in the Creek (refer Figure 2) exhibit very mildly alkaline pH ranging from 7.1 to 7.2 and are also relatively low in total dissolved solids. Suspended solids and BOD concentrations are below the SEPP criteria.

Heavy metal concentrations in all surface waters tested are below the SEPP criteria. However, copper, lead and zinc concentrations in selected samples exceed the AQUATIC criteria.

TPH and total phenol concentrations in all samples tested are below laboratory detection levels.

4.2 Sediments

The sediment analytical results have been compared with soil contamination reference criteria published by the Australian and New Zealand Environment Conservation Council (ANZECC, 1992) and the relevant Dutch standards (ANZECC, 1990). These criteria provide a guide to acceptable levels of contamination in soils.

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 sediment analytical results are presented in Table 4-2.



**TABLE 4-2  
SUMMARY OF SEDIMENT RESULTS**



Job Reference : E3523/2  
 Location: CFA Training College, Fiskville near Ballan VIC  
 Results expressed in mg/kg dry weight

Sample No	Depth (m)	As	Cd	Cr	Cu	Hg	Ni	Pb	Zn
<i>Lab Detection Limits:</i>		2	1	2	2	0.01	2	2	2
<i>ANZECC B</i>		20	3	50	60	1	60	300	200
Dam 2A-P	0-0.1	<2	<1	52	14	0.06	25	12	81
Dam 2B-P	0-0.1	<2	<1	66	8	0.04	13	23	29
Dam 2C-P	0-0.1	5	<1	70	6	0.04	18	19	65

Sample No	Depth (m)	TPH	TPH	TPH	TPH	TOTAL PHENOLS
		C6-C9	C10-C14	C15-C28	C29-C36	
<i>Lab Detection Limits:</i>		20	20	20	20	1
<i>ANZECC B</i>						
<i>Dutch B</i>		100	{ ----- 1000 - ----- }			7
<i>Dutch C</i>		800	{ ----- 5000 - ----- }			10
Dam 2A-P	0-0.1	<20	670	4200	130	0.3
Dam 2B-P	0-0.1	<20	<20	130	<20	0.2
Dam 2C-P	0-0.1	<20	<20	110	<20	0.2



Generally heavy metal concentrations are commensurate with ANZECC B criteria except for chromium which exhibits concentrations ranging from 52 to 70 mg/kg in each of the 3 samples tested. Elevated TPH chain length C<sub>10</sub>-C<sub>36</sub> concentrations are apparent, at levels exceeding Dutch B and approaching Dutch C criteria, for a sample collected from the vicinity of the inlet at location Dam-2A (refer Figure 3). The detected TPH concentrations are consistent with field observations which indicated highly odourous hydrocarbon contaminated material collected at this point.

Minor TPH concentrations (C<sub>15</sub>-C<sub>28</sub>) were also detected in the sediments collected from location Dam-2B and Dam-2C, however, concentrations were well below Dutch B criteria.

Total phenol concentrations in each of the 3 tested sediments were below Dutch B criteria.

#### 4.3 Quality Control (QC) Results

QC samples comprising 1 sediment duplicate and 1 surface water duplicate were coded-blind and dispatched to the laboratory for analysis with the primary samples. The duplicate results are presented in Table 4-3. 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 A.

Data validation was carried out by calculation of relative percent differences (RPDs) between samples, as prescribed by APHA 17th edn (1989), as the difference between duplicate results divided by the average and expressed as a percentage. Zero percent corresponds to perfect agreement whilst 200% corresponds to total disagreement.

For the intra-laboratory coded-blind sediment duplicate pair (Dam-2C-P:Dam-2D-P), sample heterogeneity has resulted in poor agreement for arsenic and TPH compounds.

For the intra-laboratory coded-blind surface water duplicate pair (Dam 2-outlet-P : Dam 2-outlet-D), generally reasonable agreement was observed between the duplicate pair except for chromium, nickel, lead, total nitrogen and total suspended solids (TSS). Observed differences are probably due to poor field duplication during sampling. Field observations indicated that sample Dam-2-outlet-P contained more sediment than sample Dam-2-outlet-D, a result which is confirmed by the higher TSS and other analytes of concern.



**TABLE 4-3**  
**SUMMARY OF FIELD QC RESULTS**



Job Reference : E3523/2  
Location: CFA Training College, Fiskville near Ballan VIC  
Results expressed in mg/kg dry weight unless otherwise specified

Sample No	Sample Type	As	Cd	Cr	Cu	Hg	Ni	Pb	Zn
Dam-2D-P	sediment-duplicate	<2	<1	47	6	0.03	10	21	41
Dam-2C-P	sediment	5	<1	70	6	0.04	18	19	65
	RPD(%)	133	0	39	0	29	57	10	45
Dam-2-outlet-D	surf-w-duplicate-mg/L	<0.005	<0.0002	<0.005	0.004	<0.0001	<0.01	<0.001	<0.01
Dam-2-outlet-P	surfacewater-mg/L	<0.005	<0.0002	0.009	0.003	<0.0001	0.037	0.002	<0.01
	RPD(%)	0	0	113	29	0	152	120	0

Sample No	Sample Type	TPH	TPH	TPH	TPH	TOTAL PHENOLS
		C6-C9	C10-C14	C15-C28	C29-C36	
Dam-2D-P	sediment-duplicate	<20	32	290	51	0.3
Dam-2C-P	sediment	<20	<20	110	<20	0.2
	RPD(%)	0	105	90	134	40
Dam-2-outlet-D	surf-w-duplicate-mg/L	<0.1	<0.1	0.2	<0.1	<0.1
Dam-2-outlet-P	surfacewater-mg/L	<0.1	<0.1	0.4	0.1	<0.1
	RPD(%)	0	0	67	67	0

Sample No	Sample Type	pH (units)	TDS	TSS	NO <sub>3</sub> -N	NH <sub>3</sub> -N	Total N	Total P	BOD
Dam-2-outlet-D	surf-w-duplicate-mg/L	7.9	340	42	<0.3	<0.01	<0.1	<0.3	9
Dam-2-outlet-P	surfacewater-mg/L	7.9	370	270	<0.3	<0.01	0.8	<0.3	6
	RPD(%)	0	8	146	0	0	176	0	40

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Good agreement was observed between laboratory duplicates. Results of laboratory blanks were below detection limits indicating that no significant sample contamination had occurred as a result of sample handling in the laboratory.

The laboratory also conducted sample spikes to assess the extent of matrix bias or interference on analyte recovery and sample-to-sample precision. Percentage recoveries between spiked matrix samples and spiked laboratory blanks were generally within acceptable limits.

On the basis of the field and laboratory QC results, it is considered that the laboratory has provided an acceptable QA/QC program and accurate data confirmation. The overall data quality for this investigation is considered acceptable and the results of the samples collected can be taken as quantitative.

## 5.0 DISCUSSION AND CONCLUSIONS

The program of surface water and sediment sampling undertaken as part of this project represents a preliminary appraisal of contaminant distribution in the on-site drainage system. The results confirm hydrocarbon contamination is impacting on the quality of water held in Dam 1 and Dam 2. Drainage from the flammable pad discharges into Dam 1 which subsequently drains into Dam 2 via an underground drain. By the time drainage from the dams reaches Lake Fiskville, hydrocarbon contaminants are below laboratory detection limits, presumably as a consequence of dilution.

Heavy metal concentrations, specifically copper and lead, and to a lesser extent nickel and zinc, are also elevated in surface waters. The spatial distribution of measured heavy metal concentrations is not indicative of any specific source. The measured values are also commensurate with similar concentration ranges observed in limited groundwater sampling on the site (refer Coffey report E3523/1-AK dated October, 1996). As such, it is likely that the observed heavy metal concentrations are typical of normal "background" conditions in the area rather than being the result of on-site activities.

Sediment samples were collected only in Dam 2. As such, the results provide only a limited profile of drainage system contamination impacts. All three sediment samples contained TPH compounds at detectable concentrations and in one instance at concentrations exceeding Dutch B criteria. Given the nature of the drainage system, it would be expected that more extensive lake sediment contamination would be found in Dam 1. The presence of significant volumes of hydrocarbon contaminants in the lake bed sediments may well be providing a secondary contaminant source which will cause on-going water quality impacts in those dams affected. The measured water quality data tends to support this inference.



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On the basis of these results, we recommend additional sediment sampling be undertaken in Dam 1.

For and on behalf of

COFFEY PARTNERS INTERNATIONAL PTY LTD



## REFERENCES

- ANZECC, (1990). "*Draft Australian Guidelines for the Assessment and Management of Contaminated Sites*", publ Australian & New Zealand Environment and Conservation Council, National Health & Medical Research Council, June, 1990.
- 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.
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- APHA (1989). "*Standard Methods for the Examination of Water and Wastewater*", 17th edn, publ by American Public Health Association (APHA), American Water Works Association, Water Pollution Control Federation.
- Coffey Partners International Pty Ltd, (1996). "*CFA Training College Field Site Appraisal and Sampling, Ballan VIC*". Report E3517/1-AD dated 7 August 1996.
- VicEPA (1988). "*State Environment Protection Policy (Waters of Victoria)*", No S13, 26 February.
- VicEPA (1991). "*Draft State Environment Protection Policy-Groundwaters of Victoria*", Publication No 288, December.



## 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 ground-water 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.



**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

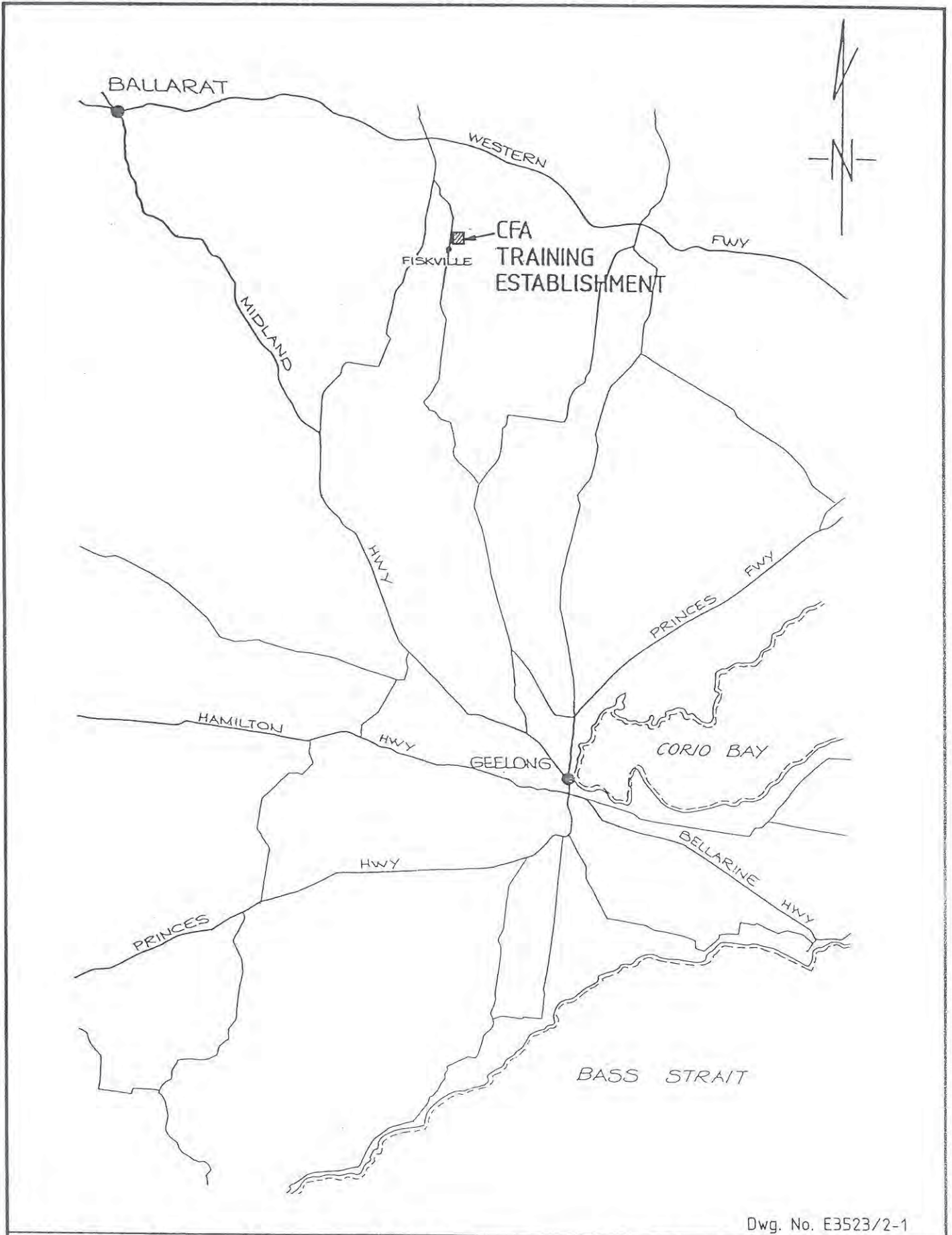
customarily included in our reports. These logs should not under any circumstances be redrawn for inclusion in site remediation or other design drawings, because drafters may commit errors or omissions in the transfer process. Although photographic reproduction eliminates this problem, it does nothing 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.





Dwg. No. E3523/2-1

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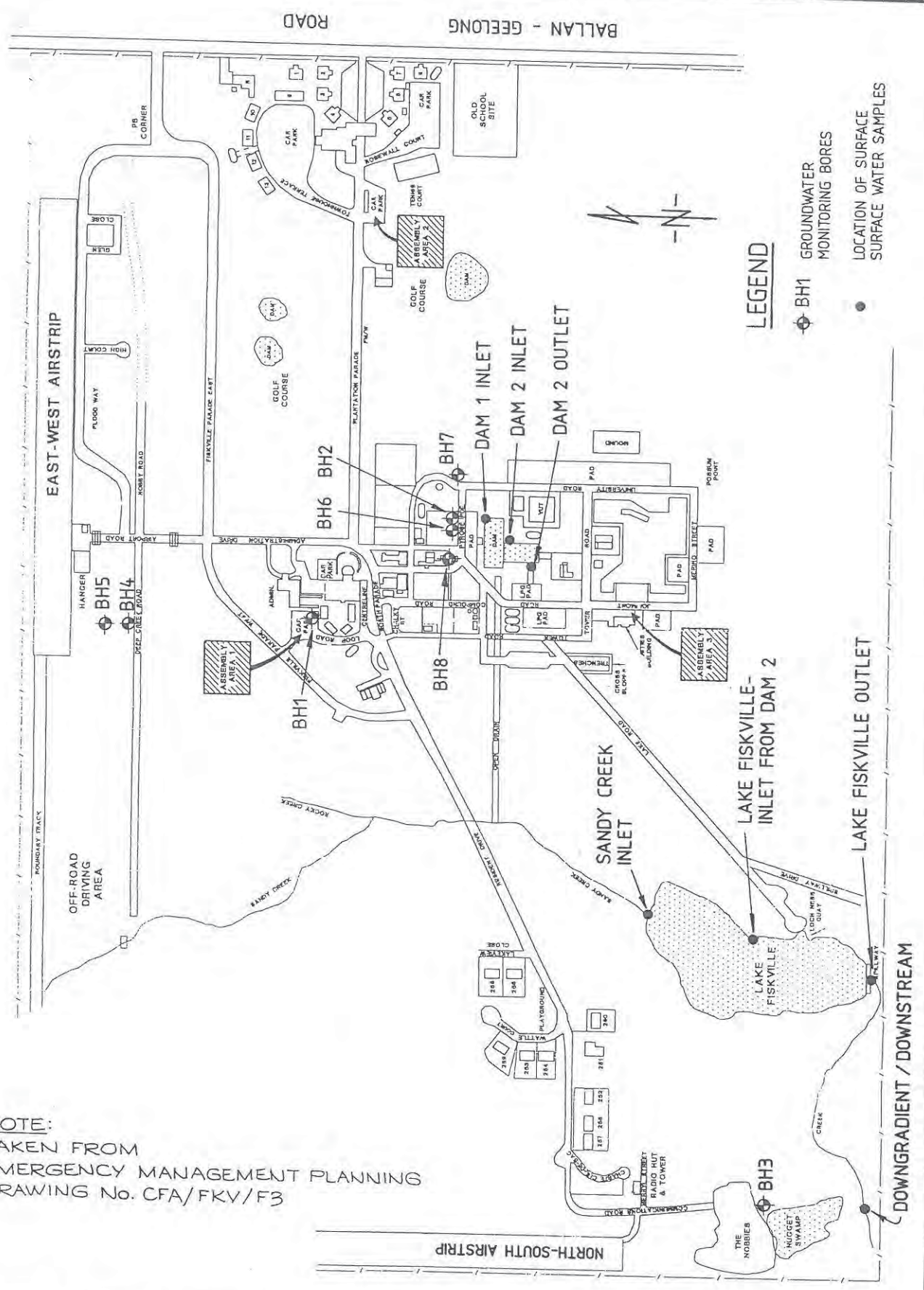
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approved	<i>Mp</i>
date	7/10/96
scale	1:500,000

**CFA TRAINING COLLEGE**  
 SEDIMENT AND SURFACE WATER SAMPLING  
 BALLAN, VICTORIA  
 LOCALITY PLAN



FIGURE 1

job no: E3523/2



NOTE:  
 TAKEN FROM  
 EMERGENCY MANAGEMENT PLANNING  
 DRAWING No. CFA/FKV/F3

Dwg. No. E3523/2-2

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approved	mp
date	7/10/96
scale	N.T.S.

CFA TRAINING COLLEGE  
 SEDIMENT AND SURFACE WATER SAMPLING  
 BALLAN, VICTORIA  
 SURFACE WATER SAMPLING LOCATIONS



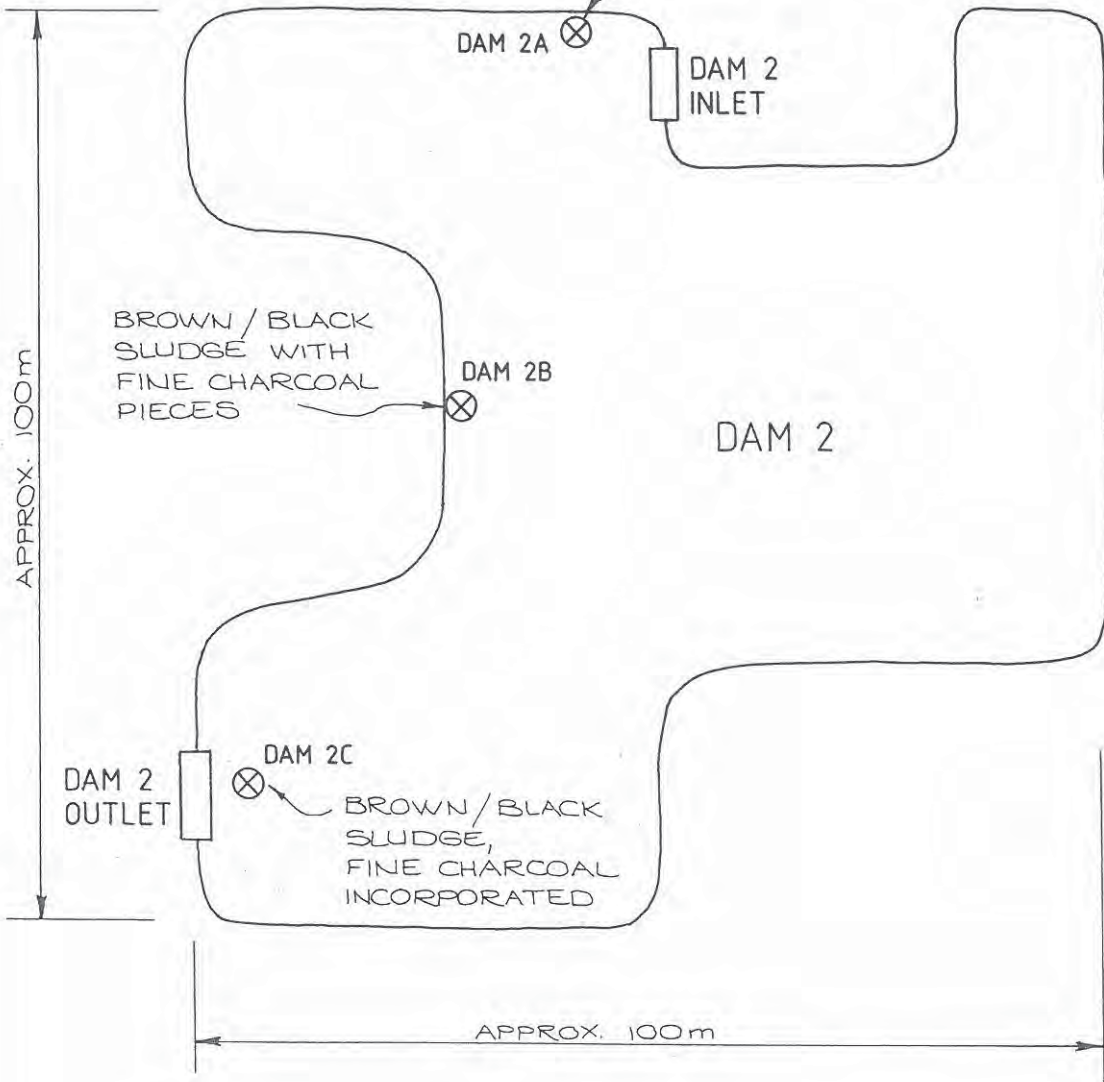
FIGURE 2

job no: E3523/2





BLACK SLUDGE, OBVIOUS HYDROCARBON CONTAMINATION, ODOUR AND VISUAL OILY FILM ON SLUDGE



LEGEND

⊗ DAM 2A SEDIMENT SAMPLES

Dwg. No. E3523/2-3

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approved	<i>mp</i>
date	7/10/96
scale	N.T.S.

CFA TRAINING COLLEGE  
SEDIMENT AND SURFACE WATER SAMPLING  
BALLAN, VICTORIA  
SEDIMENT SAMPLING LOCATIONS



FIGURE 3

job no: E3523/2





**APPENDIX A**



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15 October 1996



APPENDIX A

NATA CERTIFIED LABORATORY ANALYTICAL RESULTS



pg : 2 of ... 8 FINAL REPORT

DATE : 7/10/96 Client : COFFEY PARTNERS INTERNATIONAL PTY. LTD. Job Reference : EP3613/1

units expressed in mg/L, where applicable

LABID Received Sample

LABID	Received	Sample	TOTAL PHENOLS	CI	TOTAL-P	TOTAL-N	TKN	NO2-N	NH3-N	NO3-N	SO4	pH	TDS	TSS	BOD
PFS453	27/09/96	DAM 1 INLET	<0.1	20	<0.30	1.1	1.1	<0.3	<0.01	<0.3	7	7.5	320	190	95
PFS454	27/09/96	DAM 2 INLET	<0.1	31	<0.30	1.1	1.1	<0.3	<0.01	<0.3	8	7.9	300	41	11
PFS455	27/09/96	DAM 2 OUTLET-P	<0.1	35	<0.30	0.8	0.8	<0.3	<0.01	<0.3	8	7.9	370	270	6
PFS456	27/09/96	L. FISKVILLE DAM 2 INLET	<0.1	32	<0.30	2.0	2.0	<0.3	0.03	<0.3	7	7.6	570	300	8
PFS457	27/09/96	DAM 2 OUTLET-D	<0.1	36	<0.30	<0.1	<0.1	<0.3	<0.01	<0.3	9	7.9	340	42	9
PFS458	27/09/96	L. FISKVILLE SANDY CREEK INLET	<0.1	22	<0.30	2.2	1.8	<0.3	<0.01	0.4	4	7.1	320	35	<7
PFS459	27/09/96	L. FISKVILLE OUTLET	<0.1	18	>0.30	3.1	3.1	<0.3	<0.01	<0.3	3	7.2	340	45	7
PFS460	27/09/96	DOWNGRADIANT	<0.1	18	<0.30	2.8	2.8	<0.3	<0.01	<0.3	3	7.2	320	47	6

blank space indicates no test performed.





DATE : 7/10/96 Client : COFFEY PARTNERS INTERNATIONAL PTY. LTD. Job Reference : EP3613/1  
 Results expressed in mg/L.

ABID	Received	Sample	pH	As	Cd	Cr	Cu	Hg	Ni	Pb	Zn	TPH C6-C9	TPH C10-C14	TPH C15-C28	TPH C29-C36
EPF5453	27/09/96	DAM 1 INLET	7.5	> 0.005	< 0.00020	0.006	0.013	< 0.000	< 0.010	0.002	< 0.01	< 0.1	1.2	3.5	0.2
EPF5454	27/09/96	DAM 2 INLET	7.9	> 0.005	> 0.00020	< 0.005	0.010	< 0.000	< 0.010	0.002	0.02	< 0.1	< 0.1	0.2	0.1
EPF5455	27/09/96	DAM 2 OUTLET-P	7.9	> 0.005	> 0.00020	0.009	0.003	< 0.000	0.037	0.002	< 0.01	< 0.1	< 0.1	0.4	0.1
EPF5456	27/09/96	L. FISKVILLE DAM 2 INLET	7.6	> 0.005	> 0.00020	< 0.005	0.013	< 0.000	< 0.010	0.004	< 0.01	< 0.1	< 0.1	>	< 0.1
EPF5457	27/09/96	DAM 2 OUTLET-D	7.9	> 0.005	> 0.00020	< 0.005	0.004	< 0.000	< 0.010	< 0.001	< 0.01	< 0.1	< 0.1	0.2	< 0.1
EPF5458	27/09/96	L. FISKVILLE SANDY CREEK INLET	7.1	> 0.005	> 0.00020	< 0.005	0.004	< 0.000	< 0.010	< 0.001	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1
EPF5459	27/09/96	L. FISKVILLE OUTLET	7.2	> 0.005	> 0.00020	< 0.005	0.013	< 0.000	0.015	0.006	0.01	< 0.1	< 0.1	< 0.1	< 0.1
EPF5460	27/09/96	DOWNGRADIANT	7.2	> 0.005	> 0.00020	< 0.005	0.005	< 0.000	< 0.010	< 0.001	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1

blank space indicates no test performed.



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DATE : 7/10/96 Client : COFFEY PARTNERS INTERNATIONAL PTY. LTD. Job Reference : EP3613/1  
 results expressed in mg/kg dry weight.

ABID	Received	Sample	TOTAL PHENOLS	As	Cd	Cr	Cu	Hg	Ni	Pb	Zn	TPH C6-C9	TPH C10-C14	TPH C15-C28	TPH C29-C36
EPF5461	27/09/96	DAM 2A-P	0.3	< 2	< 1	52	14	0.06	25	12	81	> 20	670	4200	130
EPF5462	27/09/96	DAM 2B-P	0.2	< 2	< 1	66	8	0.04	13	23	29	> 20	< 20	130	< 20
EPF5463	27/09/96	DAM 2C-P	0.2	5	< 1	70	6	0.04	18	19	65	> 20	< 20	110	< 20
EPF5464	27/09/96	DAM 2D-P	0.3	< 2	< 1	47	6	0.03	10	21	41	> 20	32	290	51

blank space indicates no test performed.





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DATE : 7/10/96 Client : COFFEY PARTNERS INTERNATIONAL PTY. LTD. Job Reference : EP3613/1

Results expressed in mg/L, where applicable

LABID Received Sample

LABID	Received	Sample	TOTAL PHENOLS	CI	TOTAL-P-TOTAL-N	TKN	NO2-N	NH3-N	NO3-N	SO4	pH	TDS	TSS	BOD
EPF5553	27/09/96	BLANK						< 0.01						
EPF5554	27/09/96	QA/QC SPIKE						1.7						spike/SEP5553 Expected Result % Recovery
EPF5554	27/09/96	QA/QC SPIKE						1.7						
EPF5554	27/09/96	BLANK						100						
EPF5553	27/09/96	BLANK						< 0.01						
KTF5649	27/09/96	DAM 2 OUTLET-D	< 0.1											
EPF5457	27/09/96	DAM 2 OUTLET-D	< 0.1											
KTF5649	27/09/96	DAM 2 OUTLET-D	0											dupli/SEP5457 Rel % Difference
KTF5650	27/09/96	DAM 2 OUTLET-D	1.8											
KTF5650	27/09/96	DAM 2 OUTLET-D	2.0											spike/SEP5457 Expected Result % Recovery
KTF5650	27/09/96	DAM 2 OUTLET-D	90.0											
EPF5457	27/09/96	DAM 2 OUTLET-D	< 0.1											
KTF5838	27/09/96	BLANK		< 1			< 0.3		< 0.3					
KTF5839	27/09/96	QA/QC SPIKE		25			7.2		5.7					spike/OCT5838 Expected Result % Recovery
KTF5839	27/09/96	QA/QC SPIKE		25			7.6		5.6					
KTF5839	27/09/96	BLANK		100			94.7		102					
KTF5838	27/09/96	BLANK		< 1			< 0.3		< 0.3					
CTF5953	27/09/96	DAM 2 INLET												
EPF5454	27/09/96	DAM 2 INLET												
CTF5953	27/09/96	DAM 2 INLET												dupli/SEP5454 Rel % Difference
CTF5954	27/09/96	DAM 2 INLET												
CTF5954	27/09/96	DAM 2 INLET												spike/SEP5454 Expected Result % Recovery
CTF5954	27/09/96	DAM 2 INLET												
EPF5454	27/09/96	DAM 2 INLET												
CTF6174	27/09/96	DAM 1 INLET												
EPF5453	27/09/96	DAM 1 INLET												
CTF6174	27/09/96	DAM 1 INLET												dupli/SEP5453 Rel % Difference

blank space indicates no test performed.

< 0.30  
< 0.30  
0



DATE : 7/10/96 Client : COFFEY PARTNERS INTERNATIONAL PTY. LTD. Job Reference : EP3613/1

Results expressed in mg/L, where applicable

LABID	Received	Sample	TOTAL PHENOLS	CI	TOTAL-P	TOTAL-N	TKN	NO2-N	NH3-N	NO3-N	SO4	pH	TDS	TSS	BOD	spike/SEPF5453 Expected Result % Recovery	
0CTF6175	27/09/96	DAM 1 INLET															
0CTF6175	27/09/96	DAM 1 INLET	2.2														
0CTF6175	27/09/96	DAM 1 INLET	2.0														
SEPF5453	27/09/96	DAM 1 INLET	110														
			< 0.30														

A blank space indicates no test performed.

# QUALITY ASSURANCE REPORT





# QUALITY ASSURANCE REPORT

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DATE : 7/10/96 Client : COFFEY PARTNERS INTERNATIONAL PTY. LTD. Job Reference : EP3613/1  
 Results expressed in mg/L.

LABID	Received	Sample	pH	As	Cd	Cr	Cu	Hg	Ni	Pb	Zn	TPH C6-C9	TPH C10-C14	TPH C15-C28	TPH C29-C36	
XCTF5827	27/09/96	BLANK										<0.1	<0.1	<0.1	<0.1	spike/OCTF5827 Expected Result % Recovery
XCTF5828	27/09/96	QA/QC SPIKE										1.3				1.3
XCTF5828	27/09/96	QA/QC SPIKE										1.8				1.8
XCTF5828	27/09/96	BLANK										72.2				72.2
XCTF5827	27/09/96	BLANK										<0.1				<0.1
XCTF5835	27/09/96	DOWNGRADIENT														
EPF5460	27/09/96	DOWNGRADIENT														dupl/SEPF5460
XCTF5835	27/09/96	DOWNGRADIENT														Rel % Difference
XCTF5836	27/09/96	DOWNGRADIENT														
XCTF5836	27/09/96	DOWNGRADIENT														spike/SEPF5460
XCTF5836	27/09/96	DOWNGRADIENT														Expected Result
EPF5460	27/09/96	DOWNGRADIENT														% Recovery
XCTF5837	27/09/96	BLANK														
XCTF6174	27/09/96	DAM 1 INLET														
EPF5453	27/09/96	DAM 1 INLET														dupl/SEPF5453
XCTF6174	27/09/96	DAM 1 INLET														Rel % Difference
XCTF6175	27/09/96	DAM 1 INLET														
XCTF6175	27/09/96	DAM 1 INLET														spike/SEPF5453
XCTF6175	27/09/96	DAM 1 INLET														Expected Result
EPF5453	27/09/96	DAM 1 INLET														% Recovery

blank space indicates no test performed.



DATE : 7/10/96 Client : COFFEY PARTNERS INTERNATIONAL PTY. LTD. Job Reference : EP3613/1  
Results expressed in mg/kg dry weight.

LABID	Received	Sample	TOTAL PHENOLS										Zn	Pb	Ni	Hg	Cu	Cr	Cd	As	TOTAL PHENOLS	TPH C6-C9	TPH C10-C14	TPH C15-C28	TPH C29-C36	dupl/SEPF5464	Rel % Difference	spike/SEPF5464 Expected Result % Recovery
			As	Cd	Cr	Cu	Hg	Ni	Pb	Zn	TPH C6-C9	TPH C10-C14																
ICTF6029	27/09/96	DAM 2D-P	<2	<1	48	13					23	13	80							<20	<20	<20	<20					
SEPF5464	27/09/96	DAM 2D-P	<2	<1	52	14					25	12	81							<20	<20	260	33					
ICTF6029	27/09/96	DAM 2D-P	0	0	8.0	7.4					8.3	8.0	1.2							<20	<20	290	51					
ICTF6030	27/09/96	DAM 2D-P																		0	0	10.9	42.9					
ICTF6030	27/09/96	DAM 2D-P																		<20	<20	290	51					
SEPF5464	27/09/96	DAM 2D-P																		0	0	10.9	42.9					
ICTF6031	27/09/96	BLANK																		<20	<20							
ICTF6176	27/09/96	DAM 2A-P	<2	<1	48	13					23	13	80							<20	<20	<20	<20					
SEPF5461	27/09/96	DAM 2A-P	<2	<1	52	14					25	12	81							<20	<20	260	33					
ICTF6176	27/09/96	DAM 2A-P	0	0	8.0	7.4					8.3	8.0	1.2							<20	<20	290	51					
ICTF6177	27/09/96	DAM 2A-P	410	70	190	160					160	160	230							<20	<20	<20	<20					
ICTF6177	27/09/96	DAM 2A-P	460	77	210	170					180	170	240							<20	<20	290	51					
ICTF6177	27/09/96	DAM 2A-P	89.1	90.9	87.3	93.6					87.1	93.7	93.7							<20	<20	290	51					
SEPF5461	27/09/96	DAM 2A-P	<2	<1	52	14					25	12	81							0	0	10.9	42.9					
ICTF6178	27/09/96	BLANK	<2	<1	<2	<2					<2	<2	<2							<20	<20	<20	<20					
ICTF6259	27/09/96	BLANK																		<20	<20	<20	<20					
ICTF6260	27/09/96	DAM 2D-P																		<20	<20	260	33					
SEPF5464	27/09/96	DAM 2D-P																		<20	<20	290	51					
ICTF6260	27/09/96	DAM 2D-P																		0	0	10.9	42.9					
ICTF6261	27/09/96	DAM 2D-P																		<20	<20	<20	<20					
ICTF6261	27/09/96	DAM 2D-P																		<20	<20	<20	<20					
EPF5464	27/09/96	DAM 2D-P																		<20	<20	290	51					

, blank space indicates no test performed.

# QUALITY ASSURANCE REPORT



CFA Training College

**GROUNDWATER MONITORING  
NETWORK INSTALLATION  
BALLAN, VIC**

Report E3523/1-AK October 1996

**Coffey Partners International Pty Ltd**

A.C.N. 003 692 019

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



# Coffey Partners International Pty Ltd

A.C.N. 003 692 019

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



E3523/1-AK MKSP:MW  
15 October 1996

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Fax (03) 9853 0189  
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Attention: Mr Grant James

Dear Sir

**RE: GROUNDWATER MONITORING NETWORK INSTALLATION**  
**CFA TRAINING COLLEGE, BALLAN VIC**

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

Should you have any questions related to the report please do not hesitate to contact the undersigned.

For and on behalf of  
**COFFEY PARTNERS INTERNATIONAL PTY LTD**

  
**T.W. MARSHALL**

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## 1.0 INTRODUCTION

### 1.1 Background

This report presents details of the installation and sampling of a groundwater monitoring network at the Country Fire Authority (CFA) Training College site at Fiskville, near Ballan VIC.

The project was commissioned by Mr David Clancy of the CFA Training College in a facsimile dated 26 August, 1996 accompanied by Purchase Order No. LP127983, Account No: 6310/25 following the submission of our proposal EP3603/1-AA dated 12 August, 1996.

We understand that the CFA wishes to ascertain the potential for groundwater contamination from a number of potential contaminant sources including hydrocarbon storage and handling activities undertaken on the site.

### 1.2 Previous Investigations

Previous investigations on the site undertaken by Coffey (refer Report reference E3517/1-AD dated 7 August, 1996) comprised soil vapour investigations and a soil sampling and testing program. These earlier investigations provided CFA with assistance in the delineation of former buried sludge pits, which were used for flammable liquids fire training.

## 2.0 OBJECTIVES AND SCOPE OF WORK

The objectives of the site investigations which are documented in this report were to:

- Provide a network of groundwater sampling points on the site that would be adequate in terms of establishing overall groundwater quality and flow characteristics; assess localised contaminant occurrence around nominated areas of environmental concern (AEC); and provide an assessment of gross water quality changes associated with the site; and
- Allow for on-going monitoring over the projected life of the site.

To meet the above objectives, the following scope of work has been completed:

- Drilling and installation of eight groundwater monitoring bores targeted at areas of environmental concern (AECs), i.e. drum burial pits, sludge burial pit, underground storage tank (UST) facilities, flammable liquid pad, fuel mix areas, Dam 1 and landfill;



- Soil sampling at selected intervals as indicated by observed or suspected contamination;
- Borehead level surveying; and
- Groundwater sampling and analysis to assess baseline water quality conditions.

### 3.0 SITE CHARACTERISTICS

#### 3.1 Location

The site, which has an area of approximately 146 ha, is located on the Ballan-Géelong Road, approximately 10 km south of Ballan, Victoria (refer Figure 1). The main operational areas of the CFA facility are located in the central part of the site.

#### 3.2 Topography, Site Features and Drainage

The CFA Training College is located on a basaltic plateau. The regional setting is undulating basalt terrain, with swamps and lakes formed in local depressions, e.g. Lake Fiskville.

Site features (refer Figure 2) include the fuel storage area, flammable liquids training pad, fuel mixing area, sludge pits, landfill area, numerous small dams, a lake, golf course, stores and workshops.

Drainage from the area is via Yaloak Creek to the east and Beremboke Creek to the west. The general direction of drainage is towards the south away from the site.

### 4.0 INVESTIGATION METHODOLOGY

#### 4.1 Drilling and Monitoring Bore Installation

Based on the proposed site-wide monitoring program detailed in our proposal (EP3603/1-AA dated 12 August, 1996), a total of 8 monitoring boreholes were drilled and completed over the period 9 to 11 September, 1996.

Initially, it was proposed to install seven monitoring wells, i.e. one at each of the CFA nominated AECs; namely:

- (a) the fuel mixing area;
- (b) the flammable liquids pad;
- (c) the Dam 1 area;
- (d) the underground storage tank (UST);





- (e) the drum burial pit area;
- (f) the sludge burial pit; and
- (g) the landfill area.

However, following the absence of groundwater in bores drilled to approximately 20m depth (bores BH1 (b), BH2 (d), BH3 (e) and BH4 (g)) and subsequent consultation with Mr Grant James of CFA, and Mr Stuart Rhodes of MINENCO, four shallower bores to approximately 2m depth were installed at boreholes BH5, BH6, BH7 and BH8 i.e. (a), (b), (e) and (f) above.

Drilling was carried out principally using down-hole hammer (DHH) methods which allowed rapid penetration through the basalts whilst avoiding the introduction of externally sourced drilling fluids into the holes. The shallow boreholes were drilled with a rotary air method using a blade bit (RAB). Both methods use compressed air to clear drill cuttings from the bore. To prevent possible carry-over of compressor oils into the hole, all compressor equipment was fitted with appropriate filters.

The drilling rig and equipment was washed down and subjected to thorough decontamination procedures prior to commencement of drilling at each location. Decontamination was completed in accordance with standard Coffey environmental procedures (refer discussion in Section 5.2).

Borehole logging and soil profile sampling was undertaken by a Coffey geologist as work proceeded (refer Appendix A).

Piezometer construction comprised 50mm diameter Class 18 PVC screw jointed standpipes fitted with up to 6m of machine slotted screens placed across the selected interval. At the time of drilling, groundwater was not encountered within the drilled depth of most bores. Nevertheless, piezometers were constructed in each bore to assess whether the formation would produce long term inflows sufficient for sampling purposes.

Following piezometer installation, graded filter pack materials were installed to a minimum of 1m above the top of the screen, followed by a bentonite seal (1m) and then backfilling with cuttings to approximately 0.25m below ground surface. All bores were completed with concrete collar seals and upstanding borehead protectors.

At the completion of drilling and piezometer installation, those bores that made water (i.e. bores BH2 and BH5) were "developed" to clear residual drilling fines and confirm hydraulic performance. Development was conducted using manual hand pumping for 15-20 minutes. Development was continued until significant quantities of residual drilling fines had been removed and the discharging water was substantially free of discolouration or until the well was purged dry.



All boreholes assessed as being suitable or potentially suitable for groundwater sampling purposes were fitted with fully dedicated *Waterra* sampling pumps and delivery tube. In each case the pump intake was installed at the base of the standpipe.

All bores were subsequently surveyed by WBCM to provide reference point and ground elevation data (refer Appendix B). The locations of all monitoring boreholes are shown in Figure 2.

A summary of borehole construction details and survey data are included in Table 4-1, whilst detailed construction logs are presented in Appendix A.

**TABLE 4-1**  
**SUMMARY BOREHOLE CONSTRUCTION AND SURVEY INFORMATION**

Borehole No.	AECs Targeted	Formation	Drilled Depth (m)	Screened Interval (m)	SWL (mpvc)*	Easting	Northing	RL Top of PVC (m AHD)	SWL (RL m AHD)
BH1	(d)	Basalt	25.0	15.0-21.0	dry	254652	5825705	441.87	-
BH2	(b)	Basalt	17.0	11.0-17.0	14.8	254752	5825518	440.98	426.18
BH3	(g)	Basalt	21.0	15.0-21.0	dry	253973	5825252	440.30	-
BH4	(e)	Basalt	20.0	14.0-20.0	dry	254649	5825950	443.00	-
BH5	(e)	Residual Clay	1.8	0.3-1.8	0.3	254649	5825952	443.04	442.74
BH6	(b)	Residual Clay	2.0	0.3-2.0	dry	254750	5825518	440.98	-
BH7	(f)	Residual Clay	2.8	1.3-2.8	dry	254780	5825511	440.92	-
BH8	(a)	Residual Clay	2.3	1.3-2.3	dry	254695	5825544	441.39	-

\*NOTE: pvc = below top of PVC casing; AHD = Australian Height Datum

As drilling with down-hole hammer techniques can significantly reduce hydrocarbon contaminant concentrations in the immediate drilling zone by "air-stripping", a delay of 2 weeks between drilling and sampling events was undertaken to allow sufficient time for pre-existing conditions to re-establish and stabilise.

#### 4.2 Soil Sampling

Soil samples were collected from each drilled borehole at selected intervals through the profile. Soil samples were screened using a portable photoionisation detector (PID) for the presence of volatile hydrocarbons such as petroleum vapours (eg. benzene, ethyl benzene, toluene, xylenes (BTEX)) and on the basis of the PID results and visual observation, selected samples were analysed. The measured PID results are documented in Table 4-2.





**TABLE 4-2**  
**SUMMARY OF PID RESULTS**

Location	Sample Depth (m)	Background (ppm)	Maximum Reading (ppm)
BH1	1.5	0.1	0.5
BH1	2.0	0.2	4.5
BH2	1.0	0.8	1.3
BH2	1.5	0.5	1.4
BH4	1.0	0.4	0.8
BH4	2.0	0.4	0.7

#### 4.3 Groundwater Sampling

Groundwater sampling activities were carried out on 26 September, 1996. All bores were dry except for bores BH2 and BH5.

Prior to sampling, the bores were purged of the standing water. This involved purging until dry the two bores that yielded water.

Field measured water quality parameters (pH, electrical conductivity and temperature) were recorded to ensure uniform and representative water quality was established in each borehole prior to sampling. Results of field measured water quality parameters are presented in Table 4-3.

**TABLE 4-3**  
**SUMMARY OF BORES SAMPLED AND**  
**FIELD MEASURED WATER QUALITY PARAMETERS**

Borehole No.	Borehole Depth (m)	Date Sampled	SWL (m bgl)*	Total Volume Purged (L)	Stabilised Field Measured Parameters		
					pH	Temp. (°C)	EC (µS/cm)
BH2	17.0	26/9/96	14.8	4	7.53	14.5	12,900
BH5	1.8	26/9/96	0.3	4	7.46	11.1	2,160

\*bgl = below ground level



Sampling was conducted using dedicated *Waterra* hand pumps (permanently fitted) to reduce the need for sampling equipment decontamination and to minimise the potential for cross contamination.

Collected samples were decanted immediately into appropriate sample containers with pre-treatment as required (e.g. field filtration of samples for heavy metal analysis) and then placed in ice boxes prior to dispatch to the laboratory. A summary of the sample preservation protocols used is presented in Table 4-4.

**TABLE 4-4**  
**SUMMARY OF GROUNDWATER PRESERVATION PROTOCOLS**

Analytes	Sample Container	Preservative	Dispatch to
Metals: As Cd Cu Cr Ni Pb Zn Hg Na K Ca Mg Fe Mn	500mL amber glass	0.45µm filter, nitric acid	NAL
pH EC CO <sub>3</sub> HCO <sub>3</sub> CL SO <sub>4</sub> NO <sub>3</sub> -N	500mL HDPE bottle	nil	NAL
BTEX	20 ml VOC vial	nil	NAL
TPHs	1L amber glass	sulphuric acid	NAL

All sample transfers were subject to standard chain of custody procedures in accordance with Coffey environmental protocols.

#### 4.4 Analytical Program

All samples were analysed by NATA registered National Analytical Laboratories (NAL) in Melbourne. Analytical methods were based on VicEPA, USEPA and APHA standard methods as shown in Table 4-5. Laboratory detection limits were set at one-tenth of ANZECC (1992) background criteria wherever possible in accordance with standard protocols.

**TABLE 4-5**  
**SUMMARY OF ANALYTICAL METHODS**

Analyte	Method
Heavy Metals (As Cd Cr Cu Hg Ni Pb Zn Na K Ca Mg Fe Mn)	NAL E102.31, E102.32, 102.C3, E102.34
Total Petroleum Hydrocarbons (TPHs)	NAL E104.12; E104.52 (GC:PID)
pH, EC, Anions (CO <sub>3</sub> HCO <sub>3</sub> SO <sub>4</sub> CL NO <sub>3</sub> -N)	APHA 17th Edition, NAL E118.11, E118.22
Monocyclic Aromatic Hydrocarbons (BTEX)	NAL E106.01 (GC:PID)





A summary listing of all analytical results is presented in Appendix C and copies of the certified laboratory result sheets are provided in Appendix D.

## 5.0 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC) PROGRAM

All work completed on the CFA site was conducted in accordance with standard environmental protocols designed to ensure that data generated was scientifically valid, defensible and of known precision and accuracy. The essential elements of the QA/QC program are documented in the following sections.

### 5.1 Sampling Plan

The sampling plan designed for these investigations described the method of obtaining samples, number and type of sample containers per sampling location, sample preservation techniques and approved holding times, sample identification codes, frequency of QC samples and documentation procedures.

### 5.2 Decontamination Procedures

All equipment used in the drilling and sampling process was decontaminated between sampling locations to reduce the risks of cross contamination. For this project, decontamination was completed as follows:

- all items used directly in soil boring and sampling procedures were subject to decontamination prior to mobilising onto the site;
- that part of any drilling rig or other vehicle which operated above or adjacent to the borehead was decontaminated prior to site operations commencing;
- all down-hole drilling equipment (eg. hammers, bits, rods, etc) was decontaminated between holes; and
- all sampling equipment (eg. spatulas, trowels) was decontaminated between samples.

Decontamination procedures were undertaken at a centrally located wash bay and comprised:

- removal of encrusted material;
- high pressure wash;
- rinse with high pressure water;
- final rinse with site tap water.



### 5.3 Data Recording

Data recording protocols included:

- Sample Labelling; including details of time and date of sampling, requested analyses, preservation technique and name of sampler. Every sample was assigned a unique identifier describing the sampling location and nature of the sample collected.
- Sample Transfer using Chain of Custody records to detail the persons relinquishing or taking over control, sample descriptions, preservation details and analytical requirements.
- Field Instruments: All field instruments have an associated log book in which all calibration and maintenance events are recorded. Field instruments are normally calibrated at least once per day during use and more often if instrument drift problems occur.

### 5.4 Quality Control Samples - Field

In addition to actual environmental/primary samples, quality control samples such as duplicates, and blanks were collected to assess laboratory performance, identify deficiencies and classify the validity of the laboratory data. QC sample results are presented in Appendix C.

#### 5.4.1 Field Duplicates

Field duplicate samples were collected for all samples in this project.

One intra-laboratory soil and groundwater duplicate were coded-blind and sent to NAL with the primary environmental samples.

#### 5.4.2 Field Blanks

Field wash blanks are samples of analyte free media which have been used to rinse the sampling equipment (eg. drilling rods, etc). Field wash blanks are necessary to document that the sampling equipment is not contaminating the environmental samples. One wash blank and one rinse water, from the final rinse of soil decontamination procedures, was dispatched for analysis.





### 5.5 Quality Control Samples - Laboratory

NAL, the laboratory performing the environmental analyses on this project is certified by the National Association of Testing Authorities (NATA) for the specific analyses and are required to work to strict in-house QA/QC protocols. As a minimum, analytical checks run by NAL included duplicate analysis on 5% of samples, spikes and recoveries on 5% of samples or with each analytical batch, and external standards (USEPA supplied) run to confirm the integrity of analytical methods. All laboratory QC analytical results were made available for assessment by Coffey as part of the overall QA process.

### 5.6 Health & Safety

A site specific health and safety plan was developed for environmental works on the CFA site. A copy of the plan is included as Appendix E.

## 6.0 INVESTIGATION RESULTS AND INTERPRETATION

### 6.1 Sub-Surface Conditions

As documented in Coffey (1996), the Geological Survey of Victoria 1:63,360 Ballarat Sheet, maps the site as Quaternary Olivine Basalts. The Geological Survey of Victoria 1:50,000 Ballan Sheet indicates the site is underlain by Quaternary age Newer Volcanics comprising Olivine basalt, scoria, tuff and agglomerate.

A generalised subsurface profile for the site is presented in Table 6-1. Logs of the individual boreholes are provided in Appendix A.

**TABLE 6-1**  
**GENERALISED SUBSURFACE PROFILE**

Layer	Depth to Top of Layer (m)	Thickness of Unit (m)	Material Description
1	0.0	0.8 - 2.0	RESIDUAL: SILTY CLAY
2	0.8 - 2.0	14.0 - 18.0	BASALT
3	16.0 - 18.8	3.2 - 6.0	VOLCANIC ASH
4	22.0	not penetrated	AGGLOMERATE



Groundwater was not encountered during drilling. Borehole BH1 was drilled to 19m and after approximately 5-10 minutes, no groundwater had entered the bore. This was a consistent observation in each of the deeply drilled boreholes, except for bore BH2 where groundwater seepage was intersected at a depth of 10m below ground surface.

The drilling program suggests that the basalts are generally dense and unjointed without any significant primary or secondary porosity to enable groundwater flow. As such the nature of the basalt in the region appears to preclude any significant groundwater occurrence.

In borehole BH2 where groundwater was intersected, the yields obtained were low and water level recovery following borehole sampling was slow. This is also commensurate with low permeability conditions. Of the four shallow bores which were drilled, only borehole BH5 intersected water. These results suggest the waterbearing potential of the residual clays is also low. At borehole BH5 drilling was immediately adjacent to a backfilled drum burial trench which may be acting as a localised linear recharge feature. Overall, it would appear that the site has only limited groundwater occurrence with low groundwater migration potential.

## 6.2 Soil Vapour Survey

A summary of the PID headspace results is presented in Table 4-2. The PID results indicate negligible soil vapour concentrations in each of the 6 samples tested.

## 6.3 Laboratory Results

### 6.3.1 Soils

The analytical results have been compared with contamination reference criteria published by the Australian and New Zealand Environment Conservation Council (ANZECC, 1992) and the relevant Dutch standards (ANZECC, 1990). These criteria provide a guide to acceptable levels of contamination in soils.

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.