15 June 2012

CFA TRAINING COLLEGE, FISKVILLE, VIC

Preliminary Site Assessment

Submitted to:
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REPORT

Report Number. 117613201-002-R-Rev0

Distribution:

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1.0 INTRODUCTION

Golder Associates Pty Ltd (Golder Associates) was engaged to assist Professor Rob Joy in his *Independent Investigation into the CFA Facility at Fiskville (1971 – 1999) (*the Independent Investigation*)*. Golder was commissioned to undertake a Preliminary Site Assessment (PSA) at the CFA Training College, Fiskville (the Site) in February 2012. The work undertaken was consistent with our proposal (P17613413-001-P-Rev0) dated 13 December 2011 and addendum letters (117613201-001-L-Rev0, 117613201-004-L-Rev0) dated 18 January 2012 and 2 February 2012 respectively. The general site details are listed in Table 1.

Table 1: General Site Detail

Summary Information	Details
Property Name	CFA Training College, Fiskville
Site Address	4549 Geelong - Ballan Rd, Fiskville, Victoria, 3342
Legal Description	Lots 1,2,3 and 4 on Title Plan 845669K, Vol 03555 Folio 516
GIS Coordinates of Site Centroid (MGA94, Zone 55))	254742 5825843
Site Area	146 hectares
Site Owner	Country Fire Authority
Description of Key Site Activity	The site operates as a training college for emergency response and incident management. The site is primarily used by members of the CFA but personnel from other public organisations and private industry have received training at the Site in the past.

Your attention is drawn to the document - “Limitations”, which is included in Appendix A of this report. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be. The document is not intended to reduce the level of responsibility accepted by Golder Associates, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

2.0 OBJECTIVE

The objective of the investigation is to undertake a preliminary site assessment that is consistent with the timeframe of the Independent Investigation and the Investigation Terms of Reference 1(e) which states that:

> *"on the basis of available information, assess the risk that there are buried flammable substances, drums and/or other related contaminants on the Site; where possible identify the location of such materials and make recommendations about any clean up and remediation required; identify where information is considered to be inadequate to enable a risk assessment and recommend action to improve the information base (which may include carrying out exploratory sampling of soils)."*

2.1 Scope of Works

In order to achieve our objective, the following scope of works was undertaken and is described further within this report:

- Completion of a desktop review of information relevant to the Site including: local planning scheme and zoning, regional topography, geology and hydrogeology and regulatory agency records;
- Review of relevant historical documents, previous reports completed for the Site and aerial photography; and
- Limited targeted site investigation of soil, sediment, surface water and tree material on site.

3.0 SITE DESCRIPTION

3.1 Site Location

The site is located in Fiskville, Victoria, approximately 93 km north-west of Melbourne, Victoria. Fiskville is located on the Geelong – Ballan Road approximately 10 km south of Ballan. The site is bounded by Lennox's Lane to the north, Geelong-Ballan Road to the east and agricultural land to the south and west. It is defined as Lots 1, 2,3 and 4 on Title Plan 845669K. The title plans are included in Appendix B.

A site location plan which includes the Site boundary is presented as Figure 1 - Site Location Plan in Appendix C.

3.2 Planning Scheme and Zoning

The site is located within the Shire of Moorabool. Pursuant to the Local Planning Scheme, the Site is zoned as Farming Zone (FZ) and is subject to the following planning overlays:

- Design and Development Overlay – Schedule 2 (DDO2); and
- Environmental Significance Overlay – Schedule 1 (ESO1).

The Farming Zone applies to land that has been identified for agricultural use. The purpose of this zoning includes: to encourage the retention of productive agricultural land; to ensure that non-agricultural uses do not adversely affect the use of this land for agriculture; to encourage use and development of land based on comprehensive and sustainable land management practices and infrastructure provision and to protect and enhance natural resources and the biodiversity of the area.

The Design and Development Overlay - Schedule 2 requires development within this area to meet the design objectives specified in the schedule. The objectives apply to new or future development within the area. The key objectives of Schedule 2 are: to enhance visual amenity in rural, township and vegetated areas of the Moorabool Shire and to encourage the use of external cladding, such as non-reflective materials for building construction; to discourage the use of materials such as reflective cladding for building construction which could have a detrimental effect on amenity.

The Environmental Significance Overlay - Schedule 1 requires development within this area to meet the environmental objectives specified in the schedule. The objectives apply to new or future development within the area. The Moorabool Shire contains several water catchment areas including the Werribee Catchment. Therefore, the key objectives of Schedule 1 are: to protect the quality and quantity of water produced within proclaimed water catchments and to provide for appropriate development of land within proclaimed water catchments.

The planning zoning map for the Site is included in Appendix B.

3.3 Current Site Use

The site currently operates as a training college for emergency response and incident management and is operational all-year round. The site is primarily used by members of the CFA but personnel from other public organisations and private industry have received training at the Site in the past.

Training exercises include fire fighting exercises at various props, which have been ignited with Liquid Petroleum Gas (LPG) and other flammable liquids including unleaded petrol and diesel.

Site Users

It is understood the following people currently use the Site:

- Site management, administration, support and training staff, who work in the administration buildings, training centre and classrooms;
- Pad Supervisors and Operators who operate and maintain the 'Outdoor Fire Training Area';
- Fire Training Instructors who conduct fire training exercises in the "Outdoor FTA;
- General maintenance and landscaping staff who work in the 'Maintenance Workshop' and across the Site;
- Victorian University of Technology (VUT) staff who work in the VUT building;
- Catering and support staff who work in the canteen and temporary accommodation area;
- Families of site staff who live in the residential buildings in the west of the Site (it is understood that no children under 18 years of age live on the Site); and
- Fire fighting and emergency response trainees who include CFA personnel, staff from government departments and private companies who participate in training exercises in the "Outdoor FTA'.

3.4 Current Site Description:

The site is rectangular shaped and covers approximately 150 hectares. The Training College occupies approximately half the Site and the remainder of the Site is a mixture of forestry and grassland paddocks and landscaped land.

3.4.1 Layout

The current site layout at the time of our assessment (2012) is presented in Figure 3 – Current Site Location Plan in Appendix C. Key structures and buildings on the Site include:

1) The 'Outdoor Fire Training Area' (FTA) which includes the following areas/structures:
   - Flammable Liquid Pad (FLP);
   - Training Props (including Fire Attack Building, imitation fish and chip shop, service station; trains, urban training area and several single storey and two storey buildings on concrete pads);
   - Fire prop storage area (which includes miscellaneous drums, transformers, tires, car wrecks and car batteries);
   - Hazardous Material Store;
   - Fuel Above Ground Storage Tanks (ASTs);
   - Triple-Phase Interceptor;
   - Workshop and Storage Buildings;
   - Amenities Buildings;
   - Victorian University of Technology (VUT) Building;
   - Urban Training Area; and
   - 4 Wheel Drive Area.
2) Site Drainage System, including 4 interconnecting dams and Lake Fiskville;
3) Teaching Centre including classrooms;
4) Administration building;
5) Maintenance Workshops, Storage Buildings and Yard;
6) Canteen and temporary accommodation;
7) Golf Course;
8) Residential buildings (for permanent accommodation for site employees);
9) Historical Landfills (1 & 2); and
10) Airstrip, one hanger building and concrete pad.

The Outdoor Fire Training Area, Teaching Centre, Administration and Maintenance buildings are located in the centre of the Site. The Canteen and temporary accommodation are located in the eastern area of the Site and a golf course is located between these buildings and the Outdoor Fire Training Area. The residential buildings and historical landfills are located in the south-western portion of the Site adjacent to Lake Fiskville. The air-strip and hanger building are located along the northern site boundary.

3.4.2 Site Water Use and Drainage

It is understood that potable water on the Site is mains supplied water from Central Highlands Water.

Water used for fire fighting water on the FLP is a mix of mains water from Central Highlands Water and recirculated water from Dam 2.

Wastewater from the FLP drains through a triple interceptor and a series of interconnecting dams (Dams 1-4) before discharging into Lake Fiskville.

Fire fighting water from the FLP is collected within the FLP bund. The bund includes a valved drainage system that can be closed to retain water during fire training exercises. The bund discharges to a surge pit and subsequently the triple interceptor. The triple interceptor discharges into Dam 1, which contains a mechanical aeration pump that is designed to degrade dissolved hydrocarbons and emulsions. Dam 1 subsequently discharges into Dam 2 via an underground drainage pipe. Dam 2 discharges into Dam 3 also via underground pipe work. Overflow from Dam 3 flows via an open channel to Dam 4. Finally Dam 4 discharges via an open channel to Lake Fiskville. Lake Fiskville discharges off-site via Beremboke Creek.

Dams 1-3 are contained within the fenced “Outdoor Fire Training Area”. Dam 4 and Lake Fiskville are within an unfenced area of the Site.

The wastewater treatment system and series of dams has been significantly modified during the operation of the Site. The history of drainage system development is described in Section 7.0.

The surrounding land use is predominantly agricultural. Of particular note in the surroundings of the Site are the following:

- **North:** To the north, the Site is bordered by Lennox Lane with agricultural land beyond;
- **South:** Immediately south of the Site is agricultural land. A farm house and sheds are located adjacent to the southern site boundary;
- **East:** To the east, the Site is bordered by Geelong – Ballan Road, with the Yaloak Polo Club and agricultural land beyond the road; and
- **West**: Immediately west of the Site is agricultural land.

4.0 ENVIRONMENTAL SITE SETTING

4.1 Topography and Drainage

The site is located on an undulating basaltic plateau approximately 440 m above sea level. A topographical map of the Site and surrounding area is presented in Figure 2 – Site Topography in Appendix C.

This site and surrounding area is generally flat with a slight downward gradient to the south. It is inferred that the western portion of the Site drains to Beremboke Creek, which subsequently drains into an onsite dam known as Lake Fiskville before flowing off-site at the south-western site boundary. Beremboke Creek is part of the Moorabool River Catchment. It is inferred that the eastern portion of site drains south easterly into Yaloak Creek, which is part of the Werribee River Catchment. The State Environment Protection Policy (SEPP) Waters of Victoria (WoV, GoV, 2003) lists the Moorabool River and Werribee River within the Cleared Hills and Coastal Plains Segment.

4.2 Regional Geology

The Geological Survey of Victoria 1: 50,000 scale map in Appendix B, indicates that the Site is generally underlain with Tertiary Age Newer Volcanics; comprising of olivine basalt which is commonly vesicular with columnar jointing, with minor scoria, tuff and agglomerate. The basalt is variably weathered and the depth to the surface of the basalt can vary significantly over short horizontal distances. Weathered basalt is typically overlain by a residual clay layer.

Beremboke Creek in the western portion of the Site is underlain with Quaternary Age Alluvial deposits consisting of stream alluvium comprising of clay, silt, sand, gravel along with clasts of basalt, quartz, sandstone, quartzite, slate and ironstone.

Regionally, areas to the east and west of the Site are underlain by Tertiary Age Werribee Formation sand and fine gravels which are of granitic origin. These may comprise of clay, sandy and silty clay and minor gravel with clasts of quartz, ligneous clay and brown coal.

South of the Site, Beremboke Creek is underlain with Quaternary Age Paludal Lacustrine deposits. These are swamp and lake deposits which typically consist of white, yellow, grey and brown clay and silty clay and minor sandy and gravelly clay often with plant remains.

4.3 Regional Hydrogeology

Regional groundwater flow is inferred to be controlled by the Werribee River to the east and the Moorabool River to the west. The site is inferred to be located at the centre of the regional groundwater divide, thus it was not possible to infer the groundwater flow direction in the vicinity of site.

The regional water quality data in the Newer Volcanics Aquifer was obtained from the Victorian Groundwater Beneficial Use Map Series. This map suggests that groundwater in the vicinity of the Site as part of the Newer Volcanics Aquifer has a background total dissolved solids (TDS) concentration of 1,001 – 3,500 mg/L TDS.

4.4 Regional Groundwater Use

A search of the Department of Sustainability and Environment (DSE) groundwater database which was most recently updated in September 2011 indicated that there is one (1) groundwater bores registered within a 2 km radius of the Site. This bore is registered for groundwater investigation purposes. A further 19 bores are located with a 6 km radius of the Site. These bores are registered for domestic and/or stock purposes, groundwater investigation or unknown use as summarised in Table 2.

Table 2: Groundwater Bores within 6km of the Site

Number of Bores within 6km radius of site	**19**
Minimum Bore Depth (m)	6.3
Maximum Bore Depth (m)	91.44
Average Bore Depth (m)	41.12
Groundwater Use	
Dewatering	0
Domestic	2
Stock Supply	2
Investigation	4
Irrigation	1
Observation	0
Unknown	10
Distance of Bore from Site (km)	
Dewatering	Not applicable
Domestic	4.1 and 4.6km southeast of the Site.
Stock Supply	3 km southwest and 2.4 km northwest of the site.
Investigation	1.5 south west, 3.4 km northwest and 4.8km and 5.0 km from the Site (direction unknown)
Irrigation	3.0 km southeast of the site.
Observation	Not applicable
Unknown	Between 4.4 km to 5.8 km from the Site (direction unknown).

Coffey Partners International Pty Ltd (Coffey) has installed eight (8) bores at the Site. However these bores are not recorded in the DSE database, which suggests the data set held by DSE may be incomplete.

A table with the details of the registered groundwater bores within a 6 km radius of the Site is included Appendix B.

5.0 SITE WALKOVER

Golder Associates conducted a site walkover on 24 January 2012. The objective of the site walkover was to identify potential contaminant sources at the Site. Observations made during this site walkover are outlined in Table 3.

The site walkover was conducted by Golder Associates, who were accompanied by representatives of the Independent Investigation Team. Weather was dry and cool during the site walkover.

Table 3: Site Walkover Observation

Area	Observation
FLP - Dam 1	Hydrocarbon sheen and foam was noted on water contained within Dam 1.
ASTs in outdoor FTP	Hydrocarbon staining was noted outside the bund surrounding the diesel and petrol AST within the Outdoor FTA adjacent to the Prop Storage Area. It appeared that fuel may have migrated beneath the bund. Hydrocarbon staining was observed adjacent to the fuel fill points and bowsers.
Prop Storage Area	Hydrocarbon staining was noted in the area where cars are stripped before being used a fire training props. The following materials were noted in the Prop Storage Area: ■ Transformers; ■ Several drums which were labelled as pesticides, fire fighting foam and petroleum fuels; and ■ Car Batteries. Overall housekeeping in the Prop Storage Area was quiet poor.
Drum Burial Area 1, south of the Airstrip	It was noted that grass had not grown in the area which was identified by the Investigation Team as a 'Drum Burial Area 1' to the south of the Airstrip.
Landfill Area	Waste was evident in the area identified by the Investigation Team as the 'Historical Landfill 2', which was created by CFA in the mid-1980s.

6.0 REGULATORY AGENCY RECORDS REVIEW

6.1 EPA Priority Site Register

Priority Sites are sites for which EPA has issued a Cleanup Notice pursuant to section 62A or a Pollution Abatement Notice pursuant to section 31A or 31B (relevant to land and/or groundwater) of the Victorian *Environment Protection Act 1970*. Typically, these are sites where pollution of land and/or groundwater presents an unacceptable risk to human health or to the environment.

EPA maintains the Priority Sites Register as a listing of all priority sites and the register is available to the public. The Priority Sites Register is not a listing of all contaminated sites in Victoria, nor is it a list of all contaminated sites of which EPA has knowledge.

A search of the EPA Victoria Priority Sites Register reported that the Site is not listed as a Priority Site, and is not in the vicinity of a site listed on the Priority Site. The results of this search are provided in Appendix B.

6.2 Statutory Environmental Audits

The Environmental Audit System was established in Victoria by the EPA as a means by which planning authorities, site owners, purchasers and others are provided with assurance regarding the condition of a property and its suitability for use, frequently in the context of site redevelopment. Each audit undertaken under Section 53X will have a certificate or statement attached, and a list of completed audits is publicly available. It is important to note that the list is not a register of contaminated or clean sites but rather is a list of properties that have been found to be suitable (in some cases subject to certain conditions) for the proposed land use.

A search of the list of completed audits for properties in the vicinity of the Site found that out of a total of six (6) audits completed within the Shire of Moorabool, no audits were completed within 2.5 km of the Site and the nearest audit was completed approximately 20 km to the east of the Site in Maddingley. The results of this search are provided in Appendix B.

6.3 Cultural Sensitivity

The *Aboriginal Heritage Act 2006* and *Aboriginal Heritage Regulations 2007* provide protection and management for Victoria's Aboriginal heritage. This includes Aboriginal places, objects and human remains regardless of their inclusion on the Victorian Aboriginal Heritage Register or if they are located on public or private land. Based on publicly available information reviewed online on the Victorian Department of Primary Industries website the Site is not a cultural sensitive site. A map obtained from the website showing the areas of cultural sensitivity in the vicinity of Fiskville is presented in Appendix B.

7.0 HISTORICAL INFORMATION

A review of historical site information was undertaken to assess the potential for historical uses or activities at the Site which may have adversely impacted on the contamination status. Historical site information reviewed included certificates of title, historical photographs, key correspondence, anecdotal information obtained from CFA employees, previous assessment reports and other publically available records.

A summary of the historical information which was reviewed as part of this PSA is provided in Appendix D. Key events and the findings of the desktop review are discussed in the following section.

7.1 Summary of Key Events

A chronology of key events at the Site between 1972 and 2011 is summarised in Table 4.

Table 4: Chronology of Events

Date	Event
1972	Theoretical fire fighting training begins at the Site.
1973	Practical fire fighting training begins at the Site.
1974	Flammable Liquid Pad and Fire Attack Building is constructed.
1977	Flammable Liquid Pad and Fire Training Pits have been developed.
22 December 1982	Drum fire occurs in the area immediately west of the classrooms.
23 December 1982	Two personnel are identified as being exposed to fumes while moving the fire damaged drums.
1983	Fire damaged drums are buried onsite. The exact drum burial location is unknown however the drums may have been buried in a treed area north of the Administration Building (Drum Burial Area 2)
1983/1984	Approximately 100 drums are reportedly buried in 3 trenches to the east of the Administration Building (Drum Burial Area 3). Drums were also reportedly buried in an area to the south of the Airstrip (Drum Burial Area 1) during the 1980s, the exact date of the burial is unknown.
1985	Prop Storage Area has been developed and is used for storing drums of flammable liquids. A new landfill has been developed adjacent to the western site boundary. Drums are no longer stored at the rear of the Training Centre.
1988	A.S. James conducts a Geotechnical Investigation in the Drum Burial Area 3 to the east of the Administration Building.
1990	The outdoor FTA has been developed to include Dam 2 and classrooms are built at the Training Centre.
1991	Drums and soil is excavated from the Drum Burial Area 3 to the east of the Administration Building and was disposed of off-site under EPA waste transport certificates.
1996	Rio Tinto (Minenco/CRA) produced a scope of works for site investigation at the Site.
1996	Diomedies and Coffey conduct site investigations at the Site.
1996	Rio Tinto (Minenco/CRA) conduct a review of the site investigations conducted by Diomedes and Coffey and recommend onsite remediation for contaminated soils in the FLP, FMA and Fire Training Pits.
1997	Rio Tinto (Minenco/CRA) issue a Remedial Action Plan for the FLP, FMA and Fire Training Pits.
1998	Coffey carry out the excavation, validation and reinstatement of the FLP, FMA and Fire Training Pits. Coffey concluded that the validation sampling analytical results confirmed the absence of contaminants in the remedial excavations and they recommended the excavations be backfilled with Clean Fill.
1998	Rio Tinto oversees the bioremediation of FLP, FMA and Fire Training Pits. Remediation by onsite composting is completed in 6 months. Dam 3 is observed in aerial photographs.
1998	GHD produce an 'Upgrade of the FLP' document.
1999	Rio Tinto issued a report on the remediation of FLP, FMA and Fire Training Pits.
2002	An excavator driver is identified as being exposed to fumes in the vicinity of Drum Burial Area 1 south the Airstrip during the ripping of soil for tree planting.
2001 – 2010	The site is developed further. The FLP is redeveloped to include a new concrete pad, waste water collection system and triple interceptor. LPG replaces flammable liquids as the main fuel for fire training exercises during this period. Dam 4 is created and additional trees are planted across the Site.
December 2011	Allegations that CFA members and other persons may have been exposed to harmful chemicals at the CFA Training College, Fiskville since 1973. Independent Fiskville Investigation commences chaired by Professor Rob Joy.

A summary of the key events relevant to potential site contamination onsite between 1972 and 2011 based on historical documents, previous reports and information provided by CFA personnel is provided below.

1970's

Theoretical fire fighting training began at Fiskville in 1972. Practical fire fighting training commenced the following year in 1973. Development of the Outdoor Fire Training Area began in 1974 with the construction of the Flammable Liquid Pad and Fire Attack Building. The Fire Training Pits had been developed by 1977. Information from CFA personnel indicates that drums of flammable liquids from various sources were used as fuel during practical fire fighting training sessions from approximately 1973. The drums contained a variety of flammable compounds including hydrocarbon fuels, solvents, thinners and paints.

1980's

Between approximately 1977 and 1985 drums of flammable liquids were stored in an area directly west of the Training Centre. On the 22nd 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.

Reportedly 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. A.S. James conducted a Geotechnical Investigation in this 'Drum Burial Area 3' (east of the Administration Building) in 1988. They reported that the drums were buried in 3 trenches which were approximately 20 to 30 m in length. The drums were laid horizontally in each trench and were olive green in colour, unmarked and in good condition. A.S. James personnel noted that the drums appeared to be full. A.S. James 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 if the risk to groundwater is unacceptable, the material should be removed from the Site and disposed of in a suitable manner.

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. The approximate locations of the three (3) suspected Drum Burial Areas are presented in Figure 9 in Appendix C.

1990's

The Independent Investigation Team advised that the 'Drum Burial Area 3' to the east of the Administration Building was excavated in mid January 1991 and drums and soil was disposed of off-site under EPA waste transport certificates. A summary of the waste transport certificates is provided in Appendix D.

A number of environmental site assessments were undertaken at the Site in 1996 by Diomedies, Coffey and Rio Tinto (CRA). Rio Tinto concluded from these assessments that localised soil, sediment and surface water contamination was present onsite as a result of the storage and use of flammable liquids for fire fighting training activities. Rio Tinto reported that TPH concentrations in soil samples collected from several locations including the FLP, the Fire Training Pits and the Drum Burial Pits (south of the Airstrip) exceeded soil investigation guidelines. TPH was also detected in sediment samples collected from Dam 1 and near the Dam 2 inlet. Eight (8) groundwater monitoring wells were installed as part of the ESA, however groundwater samples were only collected from two (2) wells as the other six (6) wells were dry. The reported analyte concentrations in these two (2) groundwater samples were below the groundwater assessment criteria. Therefore, it was concluded by Rio Tinto that no significant groundwater contamination was identified at the Site.

Rio Tinto recommended that onsite soil bioremediation was the most appropriate remedial option for hydrocarbon impacted soil from the FLP, Fuel Mixing Area (FMA) and Fire Training Pits. Offsite disposal

was the recommended remedial option for soil from Drum Burial Area 1 (south of the Airstrip), as the area may contain drums and other containers, so onsite treatment would be difficult.

In 1997, Rio Tinto (CRA) produced a Remediation Action Plan (RAP) for the FLP, FMA and Fire Training Pits which recommended excavation of soil from these areas followed by onsite soil composting. Rio Tinto noted that the Drum Burial Area (south of the Airstrip) and contaminated sediments in Dam 1 have not been included in the RAP and will be the subject of a future RAP.

The following year, 1998, the soil from the FLP, FMA and Fire Training Pits was excavated and remediated onsite by composting. The remediation at site was carried out in two stages. The excavation, validation and reinstatement was carried out and reported by Coffey. While Rio Tinto was commissioned in February 1998 to manage the onsite treatment of this excavated soil. In the same year, GHD produced a design specification document for the FLP.

A soil remediation and validation report for the FLP, FMA and Fire Training Pits was issued by Coffey in March 1998. Coffey collected soil validation samples from the base and sides of the remedial excavations. They concluded that the validation sampling analytical results 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 recommended the excavations be backfilled with clean fill.

Rio Tinto issued a report in June 1999 that outlined that the excavated soil was stockpiled in 4 compost windrows in a bunded area onsite. The soil was composted for approximately 6 months. Rio Tinto sampled the composted soil after 6 months and concluded from the reported results that the treated material did not pose an unacceptable risk to human health or the environment. CFA indicated to Rio Tinto that the soil within the compost windrows would be left in place (i.e. stockpiled in the bunded and drained area) for the foreseeable future.

2000s

In 2002, an excavator driver was exposed to fumes during the ripping of soil for tree planting in the vicinity of Drum Burial Area 1 to the south of the Airstrip. Between 2000 and 2010, the Site was developed to its current layout. The FLP was redeveloped; a new concrete pad, props and interceptor were installed and the waste water collection system was improved. LPG replaced flammable liquids as the main fuel for fire training exercises during this period.

In June 2012, Wynsafe were commissioned by the CFA to assess PFOS and PFOA concentrations in fire fighting water at the Site.

In December 2011, allegations were made that CFA members and other personal may have been exposed to harmful chemicals at the CFA Training College, Fiskville from 1973. Subsequently the Independent Fiskville Investigation commenced chaired by Professor Rob Joy.

7.2 Findings of Historical Information Review

Since the development of the Site as a fire training college in the 1970's, a range of activities have been conducted at the Site which had the potential to contaminate the Site and surrounding environment.

Various flammable liquids from unknown sources were used as fuel during fire fighting training sessions. The flammable liquids reportedly included a variety of flammable compounds such as hydrocarbon fuel, solvents, thinners and paints. Fire training areas were largely unsealed and untreated waste water from these areas drained directly into Dam 1 and the surrounding paddocks.

Several drums of flammable liquid, stored directly west of the Training Centre caught on fire in December 1982. Following this incident, drums of flammable liquids and waste were reportedly buried in three locations on the Site during the early to mid 1980s. The Drum Burial Area 3 to the east of the Administration Building was reportedly excavated in mid January 1991 and drums and soil was disposed of off-site under EPA waste transport certificates.

Following the drum fire and burial, flammable liquid practices appear to have improved at the Site. Several environmental site assessments were undertaken at the Site in the mid to late 1990s. Excavation and remediation of hydrocarbon contaminated soils from the historical FLP, FMA and Fire Training Pits was subsequently undertaken. Dams 2 and 3 were also constructed during this period and waste water treatment improved at the Site.

An excavator driver is identified as being exposed to fumes in the vicinity of Drum Burial Area 1 south the Airstrip during the ripping of soil for tree planting in 2002. Improvements to the FLP were made during 2000s to include a new concrete pad, waste water collection system and triple interceptor. LPG replaced flammable liquids as the main fuel for fire training exercises during this period.

8.0 POTENTIAL SOURCES OF CONTAMINATION

A number of activities associated with potential site contamination have been identified following the review of historical documents, previous reports, information provided by CFA personnel and the Site walkover. These identified activities include:

- Fire training exercises involving the use of flammable liquids and foams in unsealed areas;
- Storage of flammable liquids and wastes onsite;
- Burial of flammable liquids and wastes onsite; and
- Waste water drainage from the FLP.

A list of the identified areas where these activities may have occurred at the Site is provided in Table 5: Areas with Potential Sources of Contamination. Areas where these activities may have occurred are also presented on Figure 7 – Areas with Potential Sources of Contamination in Appendix C.

Table 5: Areas with Potential Sources of Contamination

Area Name	Description
Outdoor Fire Training Area	
Historical Flammable Liquid Pad and Fuel Mixing Area	Gravel covered area where flammable liquids of unknown origin were mixed and burnt during fire fighting training exercises. It is noted that hydrocarbon contamination in this area was remediated in 1997/1998.
Historical Fire Training Pits	Unlined pits into which flammable liquids were poured and burnt during fire fighting training exercises.
Historical Sludge Burial Pit	A pit was referred to in the Minenco (Rio Tinto/CRA) (1996) report, where sludge from the Fire Training Pits was placed before the pits were covered in scoria. The Independent Investigation Team has advised, based on its interviews with CFA personnel, that there is some doubt as to the existence of this 'pit', rather that there may have been shallow 'scrapes' in the ground.
Soil Composting Area	Area where Rio Tinto remediated excavated soil from FLP, FMA and FTP in 1998.
Dam 1	A dam which has collected surface runoff and waste water from the FLP since the 1970s.
Dam 2	A dam which has collected surface runoff and waste water from Dam 1 since the 1990s.
Dam 3	A dam which has collected surface runoff and waste water from Dam 2 since the 1998.
Prop Storage Area	Historically used to store drums of inferred flammable liquids. Now used to store fire training props and materials including: miscellaneous drums, transformers, batteries car tyres, old fire extinguishers.
AST	Diesel and petrol ASTs currently located south of the Prop Storage Area.
USTs	Historical petrol and diesel USTs potentially located adjacent to the 'Ablution Blocks'.
Training Centre Area	
Drum Fire Area	This area pre-1985 was used to store drums of inferred flammable liquids. Information from CFA personnel suggested that this area is where drums caught fire on 22 December 1982.
UST	Historical diesel UST located at the rear of the classrooms.
Drum Burial Area 2 north of the Administration Building	Information provided by CFA personnel to the Independent Investigation Team suggest that fire damaged drums may have been buried in a treed area north of the Administration Building in 1983.
Drum Burial Area 3 east of the Administration Building	Information provided by CFA personnel to the independent Investigation Team suggests that approximately 100 drums are reportedly buried in 3 trenches to the east of the Administration Building between 1983 and 1984.
Northern Area	
Drum Burial Area 1 south of the Airstrip	Information from CFA personnel suggests that drums were buried in this area during the 1980s.
South Western Area	
Lake Fiskville	This dam is connected to the Dam 1 – 4. Water in this dams flows off-site via Beremboke Creek which is part of the Moorabool River Catchment.
Dams 4	A dam which has collected surface runoff and waste water from Dam 3 since approximately 2005.
Landfill 1	Area where AWM reportedly disposed of unknown materials between 1950 and 1970. CFA disposed of waste including potentially drums of flammable liquids and sludge from the Fire Training Pits during the 1970s and 1980s. CFA ceased using this landfill in the early 1990s.
Landfill 2	This area was developed by CFA sometime between 1977 and 1985. CFA reportedly disposed of partially burned plastics, props and sludge from the Fire Training Pits in this landfill.

9.0 FIELD INVESTIGATION

9.1 Scope

The field work component of this PSA was intended to provide an initial assessment of the areas that are related to the terms of reference for the Independent Investigation, particularly areas associated with buried flammable liquids, drums and/or other related contaminants.

The scope of the field investigation of this PSA was therefore targeted at selected 'Areas of Interest' where drums of flammable liquids may have been stored, used or buried as well as the dams which collected surface runoff from the FTA.

When Golder Associates commenced this PSA, the Independent Investigation Team was only aware of one (1) Drum Burial Area which was a small area within Drum Burial Area 1. The additional two (2) Drum Burial Areas (2&3) and remainder of Drum Burial Area 1 were identified by the Independent Investigation Team based on advice from CFA personnel, following the completion of the Golder Associates intrusive investigation. Therefore only a small area of Drum Burial Area 1 to the south of the Airstrip and north of Deep Creek Road was intrusively investigated during this PSA. However, subsequent to the completion of the intrusive investigation, the three (3) suspected Drum Burial Areas were surveyed with Ground Penetrating Radar (GPR) to assess if any subsurface features (e.g. drums or trenches) were present. The results of this GPR are discussed in Section 9.2.4 and the suspected Drum Burial Areas are presented in Figure 9 in Appendix C.

It was beyond the scope of this PSA to undertake a comprehensive assessment of all potential sources of contamination across the entire Site. Therefore, a number of areas identified in Table 5 have not been assessed further in this report. The areas which were not investigated but may be sources of soil, surface water or groundwater contamination are:

- Historical Flammable Liquid Pad and Fuel Mixing Area;
- Historical Fire Training Pits;
- Part of Drum Burial Area 1 (south of the Airstrip and south of Deep Creek Road);
- Drum Burial Area 2 (north of the Administration Building);
- Drum Burial Area 3 (east of the Administration Building);
- Historical Sludge Burial Pit;
- ASTs;
- USTs; and
- Landfill 1 and Landfill 2.

Additional investigation of these areas could include:

- Collection of soil samples from test pits and soil bores; and
- Groundwater monitoring well installation and sampling.

9.2 Methodology

Discrete shallow soil samples were collected from identified drum storage and burial areas (i.e. Drum Burial Area 1 (south of the Airstrip), Drum Fire Area and Prop Storage Area). The current FLP is located in the area which previously included the Historical FLP, FMA and Fire Training Pits. Shallow soils from these areas were excavated and bio-remediated onsite in the 'Soil Composting Area' in the 1990's. Composite soil samples were collected from stockpiled 'bio-remediated' soil in the Soil Composting Area.

Sediment and surface water samples were collected from Dam 1, adjacent to the current FLP. Dam 1 has collected surface water runoff from the FLP since the FLP was constructed in the mid 1970s. Sediment and surface water samples were also collected from Dams 2 - 4 and Lake Fiskville, as these dams are connected to Dam 1.

Tree core samples were collected from eucalyptus trees within Drum Burial Area 1 (south of the Airstrip), as analysis of the Volatile Organic Compounds (VOC) content of tree cores can be used to detect subsurface VOC contamination.

The three (3) accessible groundwater bores (BH3, BH4 and BH5) onsite, were gauged with an oil/water interface probe during fieldworks, however all three bores were found to be dry. Therefore, it was not possible to collect and analyse groundwater samples during this site investigation.

Fieldwork was undertaken between the 7 February and 1 March 2012. The sampling programme is presented in Table 6.

Table 6: Sampling Program

Area of Interest	Sample Type	Chemicals of Interest
Outdoor Fire Training Area		
Soil Composting Area	Soil	TPH, BTEX, Metals, VOC*, SVOC*, Phenols, Perchlorates, PFOA/PFOS, PCDD and PCDF, PCB, Pesticides
Prop Storage Area	Soil	TPH, BTEX, PAH, Metals, VOC*, SVOC*, Phenols, Perchlorates, PFOA/PFOS, PCB, Pesticides
Dams 1,2,3,4	Sediment	TPH, BTEX, Metals, VOC*, SVOC*, Phenols, Perchlorates, PFOA/PFOS, PCDD and PCDF, PCB, Pesticides, TOC
	Surface Water	TPH, BTEX, PAH, Metals, VOC*, SVOC*, Phenols, Perchlorates, PFOA/PFOS, PCB, Pesticides
Training Centre Area		
Drum Fire Area	Soil	TPH, BTEX, PAH, Metals, VOC*, SVOC*, Phenols, Perchlorates, PFOA/PFOS, PCB, Pesticides
Northern Area		
Drum Burial Area 1 (south of the Airstrip)	Soil	TPH, BTEX, PAH, Metals, VOC*, SVOC* Phenols, Perchlorates, PFOA/PFOS, PCB, Pesticides
	Tree Core	VOC
South Western Area		
Lake Fiskville	Sediment	TPH, BTEX, Metals, VOC*, SVOC*, Phenols, Perchlorates, PFOA/PFOS, PCDD and PCDF, PCB, Pesticides, TOC
Lake Fiskville	Surface Water	TPH, BTEX, PAH, Metals, VOC*, SVOC*, Phenols, Perchlorates, PFOA/PFOS, PCB, Pesticides

Total Petroleum Hydrocarbons (TPH), Benzene, Toluene, Ethylbenzene and Xylene (BTEX), Poly Aromatic Hydrocarbons (PAH)Metals (As, Cd, Cr, Cu, Hg, Ni, Pb & Zn), , Perfluoroctyl Sulfonate (PFOS), Perfluoroctanoic Acid (PFOA), Polychlorinated biphenyls (PCBs); and Semi Volatile Organic Compounds SVOC (SVOC)

* Standard suite and tentatively identified compounds

In total, Golder Associates collected and analysed 19 primary soil samples from Drum Burial Area 1 (south of the Airstrip), Drum Fire Area, Prop Storage Area and Soil Composting Area. A total of 10 sediment samples and six (6) surface water samples were collected and analysed from the Dams 1-4 and Lake Fiskville.

Additional samples were collected as necessary based on Golder Associates Quality Assurance/Quality Check (QA/QC) protocols. Additional soil and tree core samples were collected during the intrusive works and were placed on hold for analysis at a later date if deemed necessary.

A sample location plan is presented as Figure 8 – 2012 Sampling Location Plan in Appendix C.

A summary of the sampling methodology is presented in Appendix E.

Environmental data (soil, sediment, surface water) collected from the Site were compared to available generic risk-based criteria protective of humans and the environment in a screening level risk assessment. Where criteria were lacking, assessment of risks to humans and the environment could not be made. Not all samples were screened for impacts to ecology and humans. The samples were screened based on the beneficial uses identified under the applicable State Environmental Protection Policies (SEPPs) and the likelihood of exposure to receptors as interpreted by Golder based on the understanding of activities at the Site, and observations made during the Site inspection. The objectives of the screening are described in the appropriate sections for assessment of soil, sediment and water. Where exclusions apply to the screening assessment (i.e., if exposure to ecology and/or humans was not considered for areas or media identified at the Site), this is stated for transparency.

9.2.1 Tentatively Identified Compounds

In addition to the wide range of compounds analysed, samples were also analysed for tentatively identified volatile and semi-volatile compounds. This analytical method identifies chemicals that are not included as target compounds in the standard VOC and SVOC analytical suite. The purpose of this analysis was to identify if there were any additional compounds which would warrant further assessment.

Tentatively Identified Compounds (TICs) were detected in a number of soil samples collected in the Drum Burial Area and Prop Storage Area. TICs were also identified in all sediment and surface water samples collected from Dams 1-4 and Lake Fiskville. The TICs laboratory reports are presented in Appendix J.

The TICs results were screened to identify if the compound was a ‘suspected or known human carcinogen’, or a ‘suspected or known human mutagen’. For the purposes of screening, classifications by expert international organisations or Australian/overseas regulatory authorities were used. In particular classifications were sought from:

- International Agency for Research on Cancer (IARC);
- Australian Hazardous Substances Information System (HSIS);
- European Chemicals Agency (ECHA);
- United States National Toxicology Program (NTP);
- United States Environment Protection Authority (US EPA);
- American Conference of Industrial Hygienists (ACGIH); and
- DFG Commission for the Investigation of Health Hazards of Chemical Compounds in the Work Area (German MAK, presented in ACGIH).

In the absence of a classification information on similar substances was considered. If no information was available the status of the substances was designated as unknown.

Since each of the organisations have different science policies for considering a chemical as a potential human carcinogen, a hierarchical approach was adopted during screening. The hierarchy is consistent with Australian science policy (enHealth 2004).

The TICs screening process did not identify compounds that were 'suspected or known human carcinogens or mutagens. Thus, no TICs warranting further assessment were identified during this PSA.

9.2.2 Assessment of Dioxins

Polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) are poly-chlorinated dioxin like compounds that are considered to be structurally and toxicologically related. PCDDs are represented by up to seven isomers, while PCDFs are represented by up to ten isomers. The structural differences between each isomer, results in differences in toxicity or potency. The overall toxicity of PCDD/F mixtures is expressed using the International Toxic Equivalents (TEQ). The TEQ scheme assigns each isomer a specific Toxic Equivalency Factor (TEF) relative to the most toxic isomer (TCDD (2,3,7,8-TCDD) - which is given a value of one).

To calculate the total PCDD or PCDF TEQ of a dioxin/furan mixture, the amounts of each isomer are multiplied by the respective TEF and summed. In this report the TEQ were calculated using World Health Organisation TEF's.

Where isomers are reported at concentrations less than the laboratory LOR), there are a number of standard methods that the TEQ can be calculated for PCDD/Fs. The TEQ can be calculated by assuming that the isomers reported below the LOR are present at zero, 50% or 100% of the LOR. These give an indication of a conservative best-case to worst-case estimate of actual concentrations, respectively, of total PCDD/D TEQ. This assessment calculates the TEQ based on 50% of the LOR.

9.2.3 Tree Core Samples

Tree core samples were collected from eucalyptus trees which are growing in the Drum Burial Area 1 (south of the Airstrip). Shallow groundwater and water in the unsaturated groundwater zone is absorbed by tree roots and is transported up the tree trunk. VOC from subsurface contamination can also be taken up by tree roots into the tree trunks. Thus the VOC content of tree cores can be used as an indication of the presence of subsurface VOC contamination. A number of factors influence the VOC concentrations in tree cores including the type of VOC, tree species, rooting depth, depth to groundwater, groundwater chemistry and depth to contamination.

This method was adopted as a rapid and cost effective method to screen for the potential presence of a range of VOCs in the subsurface soil vapour in the suspected Drum Burial Area 1 (south of the Airstrip).

Tree core sampling was undertaken in general accordance with Golder Associates standard sampling protocols and in accordance with the United States Geological Society 5008 – 2008 *"User guide to the collection and analysis of tree cores to assess the distribution of subsurface volatile organic compounds.* The results of the laboratory tree core sample analysis are summarised in Appendix H.

The reported analytical results for all tree core samples collected from eucalyptus trees growing in the Drum Burial Area 1 (south of the Airstrip) were below the laboratory LOR for VOC.

The absence of VOC in tree core samples does not mean that VOC contamination in the soil vapour is absent in the subsurface of the Drum Burial Area. It simply indicates that this method is not able to be used on this site as a rapid screening tool. The results are hence not discussed any further in this report.

9.2.4 Ground Penetrating Radar Survey

Golder Associates engaged Cardno Australia Pty Ltd (Cardno) to undertake a GPR survey of three (3) suspected Drum Burial Areas at the CFA Training College at Fiskville between the 1 and 2 May 2012.

The three (3) suspected burial areas were surveyed with GPR to assess if any subsurface features such as drums or trenches were present. Cardno reported that no anomalies were detected that resembled buried drums or trenches.

The suspected Drum Burial Areas are presented in Figure 9 in Appendix C.

A copy of Cardno's report is provided in Appendix E.

9.3 Soil Assessment

The SEPP 2002 (Prevention and Management of Contamination of Land) (Land SEPP, GoV, 2002) outlines land use categories and specifies beneficial uses that are to be protected for each category.

The site operates as a training college for emergency response and incident management and will remain in this use for the foreseeable future. There are a number of land uses at the Site:

- Industrial land use (areas directly associated with fire training);
- Residential land use (houses for site staff and temporary accommodation for trainees); and
- Parks and Recreation land use (open space such as the golf course and running tracks).

The field investigation component of this PSA has focussed on areas associated with fire training. Therefore Industrial was determined to be the most appropriate land use category for the areas investigated during this PSA and 'Industrial' criteria have been used to assess soil results.

A summary of beneficial uses which must be protected for Industrial land use categories is provided in Appendix F. A summary of the soil criteria used to assess soil samples collected at the Site is also provided in Appendix F.

9.3.1 Field Observations

The subsurface conditions encountered in the boreholes are summarised in Table 7 and presented in borehole logs in Appendix G.

Table 7: Summary of Subsurface Condition in Boreholes

Sub-surface units	Approximate Depth (m bgl)	Description
Unit 1 – Fill	0.0 – 0.5	Sandy Silt, low liquid limit, pale brown, sand is fine to coarse grained
Unit 2 – Silty Clay	0.2 – 1.8	Silty Clay, high plasticity, pale grey to dark brown, trace of fine to coarse sub-rounded gravel and fine to course sand.

An assessment of each soil sample was made in the field and involved ranking based on both odorous and visible evidence of contamination. Each soil sample recovered was given a ranking according to Table 8.

Table 8: Environmental Ranking System for Soil Samples

Visible Contamination		Odorous Soil	
Rank	**Description**	**Rank**	**Description**
0	No visible evidence of contamination	A	No odour
1	Slight evidence of visual contamination (trace quantities)	B	Slight odour
2	Visible contamination (more than trace quantities)	C	Moderately offensive odour
3	Obviously contaminated (significant colour and staining)	D	Strongly offensive odour

During the soil sampling works, the following field observations were recorded:

Drum Burial Area, Drum Fire Area and Soil Composting Area

- Recorded PID headspace results were less than 1ppm;
- Samples collected were assigned a ranking of 0A indicating no visual or olfactory evidence of contamination; and
- Groundwater was not encountered during the assessment.

Prop Storage Area

- PID headspace results ranged from a minimum of 0ppm to a maximum of 2.0ppm in soil sample H8HA1/2001 collected and tested from hand auger hole H8HA1;
- One sample collected (A8HA1) was assigned a ranking of 0B indicating no evidence of visual of contamination and a slight odour;
- Three samples collected (A8HA2, A8HA4, A8HA5) were assigned a ranking of 1D indicating slight evidence of visual of contamination and a strong odour; and
- Groundwater was not encountered during the assessment.

Details of each soil sample including PID readings and contamination rankings are presented in the borehole logs included in Appendix G.

9.3.2 Soil Results

The results of the laboratory soil analysis are summarised in Table H1 (results excluding PCDD/Fs) and Table H2 (PCDD/Fs only) in Appendix H and are discussed in comparison with the adopted assessment criteria below.

A summary of the reported COI detected above the laboratory LOR is presented in Table 9 below.

Table 9: Reported Chemicals of Interest in Soil Results

Sample Location	Sample ID with Maximum Concentration	Chemicals of Interest	Maximum Reported Concentration mg/kg
Drum Burial Area, Prop Storage Area, Soil Composting Area	A6PT8/2002	TPH	600 (TPH C_{15}–C_{28})
Drum Burial Area, Drum Fire Area, Prop Storage Area, Soil Composting Area	A9HA1/3001	Metals	91 (Zinc)
Prop Storage Area, Soil Composting Area	A8HA2/2001	PFOA	0.027
Drum Burial Area, Drum Fire Area, Prop Storage Area, Soil Composting Area	A9HA2/3001	PFOS	2.19
Prop Storage Area (1 sample)	A8HA5/2001	Phenols	4.6 (3 & 4 methylphenol)
Soil Composting Area	A9HA2/3001	PCDD & PCDF	3.48 (TEQ)*

* PCDD & PCDF reported in pg/g

The reported analytical results for soil samples collected from Drum Burial Area 1 (south of the Airstrip), Drum Fire Area, Prop Storage Area and Soil Composting Area were below the laboratory LOR for BTEX, PAH, PCB, pesticides, perchlorates, VOC (standard suite) and SVOC (standard suite).

Assessment of Ecological Risk

A summary of the reported COI detected above the laboratory LOR and the available ecological assessment criteria is presented in Table 10.

Table 10: Summary of COI in Soils Above Ecological Assessment Criteria

Sample Location	Sample ID with Maximum Concentration	Chemicals of Interest	Maximum Reported Concentration mg/kg	Ecological Criteria mg/kg
Prop Storage Area (1 sample)	A8HA5/2001	Phenols (3 & 4 methylphenol)	4.6	**2.6**

The analytical results for soil samples collected from Drum Burial Area 1 (south of the Airstrip), Drum Fire Area, Soil Composting Area and Prop Storage Area were below the adopted NEPM (1999) *EILs* for metals (where EILs are provided) .

Reported TPH concentrations were below the adopted CCME (2008) – *Canada-Wide Standard for Petroleum Hydrocarbons in Soils* criteria.

The reported 3- & 4-methylphenol concentration of 4.6 mg/kg in sample A8HA5/2001 exceeded the adopted Dutch RIVM (Verbruggen et al., 2001) SRC_{eco} soil assessment criteria of 2.6 mg/kg for p-cresol (4-methylphenol). The reported concentration is approximately twice the adopted criterion.

The reported 3- & 4-methylphenol concentration in sample A8HA5/2001 from the Drum Burial Area 1 (south of the Airstrip) exceeded the adopted Dutch RIVM (Verbruggen et al., 2001) SRC_{eco} soil assessment criterion for 4-methylphenol (p-cresol). The criterion adopted represents p-cresol only but has been used to screen the sum of 3- & 4-methylphenol (m- and p-cresol) for which the relative proportions present are unknown. The criterion is of low reliability indicating there were insufficient data to derive a higher reliability criterion. In derivation of risk-based criteria where there are limited data, standard risk-based practice is to apply additional safety factors to reduce the likelihood of a criterion being under-protective. This may in turn result in a criterion being over-protective. Measured 3- & 4-methylphenol concentrations therefore do not indicate the potential for a risk of ecological impact at the Site.

The impact of 6:2 Fluorotelomer Sulfonate, PFOA and PFOS on the beneficial use; “maintenance of modified ecosystems” was not assessed, as no ecological assessment criteria were found during the preparation of this report.

Assessment of Human Health Risk

A summary of the reported COI detected above the LOR and the available human health assessment criteria is presented in Table 11.

Table 11: Summary of COI in Soils Above the Human Health Assessment Criteria

Sample Location	Sample ID with Maximum Concentration	Chemicals of Interest	Maximum Reported Concentration mg/kg	HH Criteria Industrial mg/kg
Soil Composting Area	A9HA2/3001	PFOS	2.2	**2.1**

The analytical results for soil samples collected from the Drum Burial Area 1 (south of the Airstrip), Drum Fire Area, Soil Composting Area and Prop Storage Area were compared to the adopted NEPM *HILs F* for metals, PAHs, OCPs, PCBs, phenols and petroleum hydrocarbon constituents (where provided) and were found to be below the adopted criteria.

Reported TPH concentrations were below the adopted CCME (2008) – *Canada-Wide Standard for Petroleum Hydrocarbons in Soils* criteria. Reported 3- & 4-methylphenol concentrations were below the adopted US EPA (2011) *Regional Screening Levels for Industrial use*.

The reported PFOS concentration of 2.2 mg/kg in sample A9HA2/3001 collected in the Soil Composting Area exceeded the adopted Minnesota PCA (1999) *SRV* criterion of 2.1 mg/kg for Industrial land use. However, the exceedance was marginal and as such the concentration measured does not indicate the potential for a risk of impact to humans at the Site.

6:2 Fluorotelomer Sulfonate (6:2 FtS) was detected in soils, however, published human health criteria for this compound could not be sourced during the preparation of this report.

9.3.3 Summary of Soil Assessment

The reported soil analytical results were compared to the ecological and human health based assessment criteria with the majority of compounds reported below the adopted soil criteria. PFOS and 3- & 4-methylphenol concentrations were found above adopted criteria, however the reported concentrations do not indicate the potential for an adverse impact on potential receptors as:

- PFOS concentrations in soils do not indicate the potential for an adverse impact on human health at the Site, as the criteria exceedance is marginal and the location where the exceedance was found, is a soil stockpile in an area of the Site infrequently accessed by site users; and
- 3- & 4-methylphenol concentrations in soils do not indicate the potential for an adverse impact on ecology at the Site due to the conservative nature of the adopted criteria.

Overall, where applicable criteria are available, the soil analytical results from Drum Burial Area 1 (south of the Airstrip), Drum Fire Area, Prop Storage Area and Soil Composting Area do not indicate the potential for an adverse impact on the beneficial uses; “maintenance of modified ecosystems” and “human health”.

9.4 Surface Water Assessment

The protected beneficial uses of surface water in Victoria are outlined in the SEPP (WoV, GoV, 2003) (Variation S 107). The SEPP (GoV, 2003) classifies surface water into the following four segments:

- Aquatic Reserves Segments;
- Wetland and Lakes Segments;
- River and Stream Segments; and
- Marine and Estuarine Segments.

Each segment has defined beneficial uses and surface water in each segment must be of a suitable quality and quantity to support the defined beneficial uses.

The assessment of surface waters has been considered in two parts:

- Lake Fiskville; and
- Dams 1-4.

Lake Fiskville is located in the south western portion of the Site, and discharges into Beremboke Creek which is part of the Moorabool River Catchment. It is inferred that the eastern portion of site drains south easterly into Yaloak Creek, which is part of the Werribee River Catchment. The Moorabool and Werribee rivers are listed within the Cleared Hills and Coastal Plains (River and Stream) Segment in the SEPP (WoV, GoV, 2003) (S 107).

A detailed summary of beneficial uses which must be protected for Cleared Hills and Coastal Plains Segment is provided in Appendix F.

Dams 1-4 have been constructed by CFA and form part of the wastewater treatment system for collected runoff from the fire training areas prior to discharge to Lake Fiskville. Beneficial uses as established under the SEPP (WoV) do not therefore apply in the Dams as they are considered 'waters within artificial wastewater treatment systems'.

A summary of the surface water criteria used to assess surface water samples collected at the Site is provided in Appendix F.

9.4.1 Field Observations

Sampling was performed in general accordance with the Golder Associates' standard surface water sampling procedures and the Monitoring Guidelines Summary in ANZECC and ARMCANZ (2000) WQG.

Surface waters from Dams 1- 4 and Lake Fiskville were sampled using dedicated disposable bailers. Water Quality Parameters (pH, electrical conductivity (EC), temperature, and dissolved oxygen (DO)) were measured in-situ using a Hanna Multi-Meter Probe. The recorded water quality parameters are summarised in Table 12.

Table 12: Surface Water Quality Parameters

Sample Details		Water Quality Parameters			
Sample Location	**Sample ID**	**Temperature (ºC)**	**Dissolved Oxygen (ppm)**	**Electric Conductivity (µS/cm)**	**pH**
Dam 1	SW6	19.8	9.51	460.9	9.11
Dam 2	SW5	20.4	21.18	573	8.81
Dam 3	SW4	20.3	12.21	663	9.61
Dam 4	SW3	17.4	9.59	553	9.21
Lake Fiskville (inlet)	SW2	17.6	7.79	285.3	7.70
Lake Fiskville (outlet)	SW1	17.6	5.90	269.4	7.25

9.4.2 Surface Water Assessment Results

The results of the laboratory surface water sample analysis are summarised in Table H3 for Lake Fiskville and Table H4 for the Dams 1-4 in Appendix H and are discussed in comparison with the adopted assessment criteria below.

A summary of the reported COI detected above the laboratory LOR is presented in Table 13 below.

Table 13: Reported Chemicals of Interest in Surface Water Results

Sample Location	Sample ID with Maximum Concentration	Chemicals of Interest	Maximum Reported Concentration mg/L
Dam 1, Dam 2, Dam 3	SW6 (Dam 1)	TPH	2.1 (TPH C_{15}-C_{28})
Dam 1, Dam 2	SW6 (Dam 1)	BTEX	0.002 (xylene (m&p))
Dam 1 - 4 and Lake Fiskville	SW6 (Dam 1)	Metals	0.026 (zinc)
Dam 1 - 4 and Lake Fiskville	SW5 (Dam 2)	PFOA	0.0132
Dam 1 - 4 and Lake Fiskville	SW5 (Dam 2)	PFOS	0.202

The reported analytical results for the surface water samples were below the laboratory LOR for PAH, pesticides, phenols, perchlorates, PCBs, VOC (standard suite) and SVOC (standard suite).

9.4.3 Lake Fiskville

Assessment of Ecological Risk

The analytical results for surface water samples from Lake Fiskville (SW1 and SW2) were compared to the available assessment criteria protective of the beneficial use for the maintenance of aquatic ecosystems.

The reported analytical concentrations which exceeded the adopted ecological assessment criteria are summarised in Table 14.

Table 14: COI in Surface Water Above Ecological Assessment Criteria

Sample Location	Sample ID	Chemicals of Interest	Reported Concentration (mg/L)	Ecological Criteria (mg/L)
Lake Fiskville (inlet)	SW2	Copper (Filtered)	0.003	**0.0014**
		Zinc (Filtered)	0.013	**0.008**
Lake Fiskville (outlet)	SW1	Copper (Filtered)	0.002	**0.0014**

Reported concentrations of copper in samples SW1 and SW2 and zinc in sample SW2 were found to exceed the available ecological assessment criteria.

The analytical results for surface water samples from Lake Fiskville (SW1 and SW2) were below the available ecological assessment criteria for the majority of compounds with the exception of copper and zinc. The metal exceedance were less than two times the criteria for copper in sample SW1 and zinc in sample SW2. The exceedence of copper in sample SW2 was slightly greater than two times the criterion. The results for water samples from Lake Fiskville indicate limited potential for water quality in Lake Fiskville to adversely impact on the beneficial use “maintenance of aquatic ecosystems”. Coffey (1996, Reference E3523/2-AD) suggested that elevated heavy metal concentrations in surface water and groundwater samples may be typical of background concentrations. However as Golder Associates was unable to sample groundwater and background surface water quality has not been assessed as part of this PSA, it is not possible to determine if copper and zinc concentrations in Lake Fiskville are indicative of background concentrations.

Assessment of Human Health Risk

The analytical results for surface water samples from Lake Fiskville (SW1 and SW2) were compared to the adopted drinking water criteria.

The majority of the reported analytical results for surface water samples were below the drinking water criteria. The reported analytical concentrations which exceeded the drinking water criteria are summarised in Table 15.

Table 15: COI above adopted Human Health Assessment Criteria

Sample Location	Sample ID	Chemicals of Interest	Reported Concentration (mg/L)	Drinking Water Criteria (mg/L)
Lake Fiskville (inlet)	SW2	PFOA	0.00146	**0.0004**
		PFOS	0.035	**0.0002**
Lake Fiskville (outlet)	SW1	PFOA	0.00135	**0.0004**
		PFOS	0.0272	**0.0002**
		TPH C16-C34	0.13	**0.09 (aromatic fraction only), 0.3 (aliphatic)**

Concentrations of TPH C16-C34 in SW1 exceeded aromatic fraction criteria. However, concentrations of TPH C16-C34 do not indicate the potential for an adverse impact on human health as:

- The criteria adopted were developed in regard to aromatic hydrocarbons, and PAHs were not detected above the laboratory LOR in this sample; and
- The exceedance of the criterion is only marginal and since these criteria were developed to be protective of an adult drinking 2 Litres of water per day, the criteria would be conservative relative to a primary contact recreation exposure.

The concentrations of PFOA and PFOS in surface water samples from Lake Fiskville were found to exceed the US EPA (2009) *HAL* assessment criteria. Concentrations of PFOS were several orders of magnitude greater than the drinking water criteria.

As Lake Fiskville is hydraulically connected to the Moorabool River Catchment area, the beneficial uses “human consumption” and “contact recreation” have the potential to be realised with pathways potentially linking PFOA and PFOS in waters of Lake Fiskville to human receptors downstream. These criteria are conservative in that they are based on a daily consumption of around 2 litres of water, which for downstream users, will not come from Lake Fiskville alone. Furthermore, dilution of the PFOA and PFOS concentrations in the Moorabool River Catchment following discharge from Lake Fiskville is likely to result in reduced exposure concentrations compared to that reported in Lake Fiskville. In addition, the exposure concentrations may be further reduced via mechanisms of environmental fate and transport.

With respect PFOA and PFOS, further investigation is recommended to:

- Better quantify the potential for risk to downstream human receptors taking into account downstream dilution and environmental fate and transport mechanisms; and
- Investigate potential sources of PFOA and PFOS discharges to Lake Fiskville and identify potential means of reducing PFOA and PFOS concentrations in Lake Fiskville and discharging off site, if the potential risk of adverse impact to downstream human health receptors is found to be unacceptable.

Assessment of Risk to Agriculture, Irrigation and Aquaculture

The analytical results for surface water samples from Lake Fiskville (SW1 and SW2) were below the available criteria protective of the beneficial uses for agriculture and irrigation and aquaculture. It is noted that the assessment criteria were below the laboratory LOR for some VOC and pesticides. The impact of 6:2 Fluorotelomer Sulfonate, PFOA and PFOS on this beneficial use was not assessed, as no assessment criteria were found during the preparation of this report.

The analytical results for surface water samples from Lake Fiskville do not indicate the potential for an adverse impact on beneficial uses associated with "agriculture and irrigation and aquaculture".

9.4.4 Dams 1-4

Assessment of Human Health Risk

The analytical results for the surface water samples from Dams 1-4 (SW6-SW3) were compared to the adopted drinking water criteria. The majority of the reported analytical results for surface water samples were below the drinking water criteria.

As listed in Table 16 the concentrations of PFOA and PFOS in surface water samples from Dams 1-4 were found to exceed the US EPA (2009) HAL assessment (Drinking Water) criteria. Screening the dam water quality against these criteria is a conservative approach as the criteria are based on daily consumption of 2 L of water. As Dams 1-4 form part of the wastewater treatment at the Site, consumption of this volume of water from these dams is unlikely. The more likely exposure scenarios are associated with limited dermal contact, inhalation or ingestion of water from these Dams during routine maintenance activities, accidental exposures, and use of dam water during fire training (Dam 2 only). The exposure doses in these exposure scenarios are significantly reduced compared to the exposure doses upon which the drinking water criteria are based.

Concentrations of TPH were found to exceed WHO 2008 guidance, though it is noted that these criteria were developed for individual aromatic and aliphatic fractions. The comparison of TPH concentrations detected in surface water against criteria for aromatic fractions is also conservative given that (with the exception of 2ug/L xylene detected in SW6) MAHs and PAH were not detected in surface water samples. Concentrations of TPH C10-C16 in SW6 exceeded both aromatic and aliphatic fraction criteria. It is also noted that these criteria were also developed to be protective of an adult drinking 2 Litres of water per day and as such would be conservative relative to the likely exposure scenarios; routine maintenance activities, accidental exposures, and use of dam water during fire training (Dam 2 only). .

In summary, these data indicate that appropriate occupational health and safety procedures need to be undertaken when personnel and trainees are involved in activities or works associated with the Dam water.

A previous assessment of PFOS and PFOA concentrations in fire fighting water at the Site, undertaken by Wynsafe Occupational Health Services Pty Ltd in June 2010, made similar recommendations. Wynsafe concluded that if 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. A copy of the report is provided in Appendix D.

Table 16: Dams 1-4 Surface Water Results which exceed Human Health Assessment Criteria

Sample Location	Sample ID	Chemicals of Interest	Reported Concentration, mg/L	Drinking Water Criteria, mg/L
Dam 1	SW6	PFOA	0.0113	**0.0004**
		PFOS	0.122	**0.0002**
		TPH C10 – C16	0.47	**0.09 (aromatic), 0.3 (aliphatic)**
		TPH C16 – C34	2.00	**0.09 (aromatic), no aliphatic criteria**
		TPH C34 – C40	0.11	**0.09 (aromatic), no aliphatic criteria**
Dam 2	SW5	PFOA	0.0132	**0.0004**
		PFOS	0.202	**0.0002**
		TPH C10 – C16	0.11	**0.09 (aromatic), 0.3 (aliphatic)**
		TPH C16 – C34	1.36	**0.09 (aromatic), no aliphatic criteria**
		TPH C34 – C40	0.15	**0.09 (aromatic), no aliphatic criteria**
Dam 3	SW4	PFOA	0.00888	**0.0004**
		PFOS	0.153	**0.0002**
		TPH C16 – C34	0.32	**0.09 (aromatic), no aliphatic criteria**
Dam 4	SW3	PFOA	0.0082	**0.0004**
		PFOS	0.115	**0.0002**

9.5 Sediment Assessment

Sediment samples were collected from Dams 1 – 4 and Lake Fiskville. The assessment of sediments has been considered in two parts:

- Lake Fiskville; and
- Dams 1-4.

Beremboke Creek flows through Lake Fiskville thus sediments in Lake Fiskville must be of a suitable quality and quantity to support the defined beneficial uses within the Cleared Hills and Coastal Plains Segment. The beneficial uses for Lake Fiskville listed under the Cleared Hills and Coastal Plains Segment (and identified above) are considered unlikely to be realised given the use of the Site. The beneficial uses of "maintenance of aquatic ecosystems", "human health" and "aesthetics" are protected by the SEPP (WoV). The sediment in Lake Fiskville has been assessed against these indicators and objectives.

There is the potential for site users to come into contact with sediment in these dams as a consequence of accidental exposures, or during routine maintenance activities (e.g. dredging, installing aeration pumps). Noting that humans undertaking planned maintenance activities, are likely to be wearing appropriate PPE which will further limit the likelihood for exposure. On this basis, sediments in Dams 1-4 have been assessed for the beneficial uses: "human health".

9.5.1 Field Observations

An assessment of each sediment sample was made in the field and each sediment sample recovered was given a ranking based on both odorous and visible evidence of contamination. These field observations are summarised in Table 17.

Table 17: Sediment Sampling Field Observations

Sample Location		PID Headspace Reading (ppm)	Observations
Dam 1	(inlet)	29.5	2C = Hydrocarbon Sheen and Moderate Hydrocarbon Odour
	(outlet)	23.7	IC = Hydrocarbon Sheen and Moderate Hydrocarbon Odour
Dam 2	(inlet)	13.6	IC = Hydrocarbon Sheen and Slight Hydrocarbon Odour
	(outlet)	0.0	0A = no visual or olfactory evidence of contamination
Dam 3	(inlet)	0.0	0A = no visual or olfactory evidence of contamination
	(outlet)	0.0	0A = no visual or olfactory evidence of contamination
Dam 4	(inlet)	0.0	0A = no visual or olfactory evidence of contamination
	(outlet)	0.0	0A = no visual or olfactory evidence of contamination
Lake Fiskville	(inlet)	0.0	0A = no visual or olfactory evidence of contamination
	(outlet)	0.0	0A = no visual or olfactory evidence of contamination.

9.5.2 Sediment Assessment Results

The results of the laboratory sediment analyses are summarised in Table H5 (Lake Fiskville excluding PCDD/Fs), Table H6 (Dams 1-4 excluding PCDD/Fs) and Table H7 (Lake Fiskville and Dams 1-4 PCDD/Fs) presented in Appendix H and are discussed in comparison with the assessment criteria below.

A summary of the reported COI detected above the laboratory LOR is presented in Table 18.

Table 18: Reported Chemicals of Interest in Sediment Samples

Sample Locations	Sample ID with Maximum Concentration	Chemicals of Interest	Maximum Reported Concentration mg/kg (dry weight)
Dam 1, Dam 2, Dam 3, Dam 4	SD9 (Dam1 outlet)	TPH	21,600 (TPH C_{10}-C_{36})
Dam 1, Dam 2	SD10 (Dam1 inlet)	BTEX	1.4 (xylene (m&p))
Dam 1	SD10 (Dam1 inlet)	Mono Aromatic Hydrocarbons	3 (1,3,5-trimethylbenzene)
Dam 1 - 4 and Lake Fiskville	SD9 (Dam1 outlet)	Metals	399 (zinc)
Dam 1, Dam 2	SD9 (Dam1 outlet)	PAH	10 (fluoranthene), 20 (pyrene)
Dam 1 - 4 and Lake Fiskville	SD10 (Dam1 inlet)	PFOA	1.2
Dam 1 - 4 and Lake Fiskville	SD10 (Dam1 inlet)	PFOS	66
Dam 1, 2 and Lake Fiskville	SD8 (Dam 2 inlet)	PCDD & PCDF	5.52*

* PCDD & PCDF reported in pg/g

The reported analytical results for all sediment samples were below the LOR for PCB, perchlorates, pesticides, phenols, VOC (standard suite) and SVOC (standard suite).

9.5.3 Lake Fiskville

Assessment of Ecological Risk

The analytical results for sediment sample SD1 and SD2 from Lake Fiskville were below the available ecological sediment assessment criteria for the compounds assessed with the exception of PCDD/Fs. A summary of the reported concentrations of PCDD/Fs greater than the adopted assessment criterion is presented in Table 19.

Table 19: COI in Sediments Above Ecological Assessment Criteria Lake Fiskville

Location	Sample ID	Contaminant	Reported Concentration (TEQ)	Ecological Criterion (pg/g)
Lake Fiskville (Outlet)	SD1	PCDD & PCDF	2.92*	**0.85**

Reported PCDD and PCDF TEQ values in samples SD1 from Lake Fiskville exceeded the adopted CEQG (2012) *Sediment Quality Guidelines for Protection of Aquatic Life* by an approximate factor of 3 and are consistent with the highest concentrations found in aquatic sediments as part of the National Dioxins Program (2004). These criteria are considered to be conservative and an exceedance of this type does not necessarily demonstrate evidence of an adverse impact to aquatic life. However, it is recommended that an assessment of the ecological condition of Lake Fiskville be undertaken, to determine if COI are likely to have an adverse impact on aquatic ecosystems.

Assessment of Human Health Risk

The reported analytical results for sediment samples collected from Lake Fiskville were below the available human health assessment criteria.

9.5.4 Dams 1- 4

Human Health Risk Assessment

A summary of the reported concentrations of contaminants that were greater than the available assessment criteria is presented in Table 19.

Table 20: COI in Sediment Results above Adopted Human Health Assessment Criteria Dams 1- 4

Location	Sample ID	Contaminant	Units	Reported Concentration	Human Health Criteria Industrial
Dam 1 Inlet	SD10	PFOS	mg/kg	66	**2.1**
Dam 1 Outlet	SD9	TPH C10-C14	mg/kg	1550	**260**
		TPH C15-C28	mg/kg	19300	**2500**
		PFOS	mg/kg	13.7	**2.1**
Dam 2 Inlet	SD8	TPH C10-C14	mg/kg	685	**260**
		TPH C15-C28	mg/kg	3720	**2500**
		PFOS	mg/kg	7.53	**2.1**

TPH C10-C14 and TPH C15-C28 concentrations in samples from Dams 1 and 2 were above the CCME (2008) *Canada-Wide Standard for Petroleum Hydrocarbons in Soils* human health assessment criteria for Industrial land use.

Reported PFOS concentrations in samples SD8, SD9, SD10 were above the Minnesota PCA (1999) *SRV* assessment human health criteria.

The reported PCDD and PCDF TEQ values in all sediment samples were below the adopted criteria for Industrial land use.

In summary, these data indicate that appropriate occupational hygiene precautions must be taken when involved in activities or works associated with the Dam water. This is consistent with previous assessments made by Wynsafe (2010).

9.6 Summary of Surface Water and Sediment Assessment

Lake Fiskville

The assessment of surface water and sediment results in Lake Fiskville found that with respect to potential human health risk:

- The reported analytical results for sediment samples collected from Lake Fiskville were below the available human health assessment criteria;
- The majority of the reported analytical results for surface water samples were below the drinking water criteria;
- The concentrations of PFOA and PFOS in surface water samples from Lake Fiskville exceed the Drinking Water criteria by up to several orders of magnitude; and
- Concentrations of TPH C16-C34 in Lake Fiskville do not indicate the potential for an adverse impact on human health as the adopted criteria were developed in regard to aromatic hydrocarbons, and PAHs were not detected above the laboratory LOR in this sample.

With respect to potential ecological risk:

- The analytical results for surface water samples from Lake Fiskville were below the ecological assessment criteria for the majority of compounds with the exception of copper and zinc. Coffey (1996, Reference E3523/2-AD) suggested that elevated heavy metal concentrations in surface water samples and groundwater samples may be typical of background concentrations. However as Golder Associates was unable to sample groundwater and background surface water quality has not been assessed as part of this PSA, it is not possible to determine if copper and zinc concentrations in Lake Fiskville are indicative of background concentrations;
- The analytical results for sediment samples from Lake Fiskville were below the adopted ecological sediment assessment criteria for the compounds assessed with the exception of PCDD/PCDF;

It is recommended that further investigation of Lake Fiskville is undertaken to;

- Better quantify the potential for risk to downstream human health receptors taking into account downstream dilution and environmental fate and transport mechanisms;
- Investigate potential sources of PFOA and PFOS discharges to Lake Fiskville and identify potential means of reducing PFOA and PFOS concentrations in Lake Fiskville and discharging off site, if the potential risk of adverse impact to downstream human health receptors is found to be unacceptable
- Collect surface water samples at a representative location to assess if the reported copper and zinc concentrations are consistent with background levels; and
- Assess the ecological condition of Lake Fiskville.

Dams 1 -4

The assessment of surface water and sediment results in Dams 1-4 found that with respect to potential human health risk:

- The majority of the reported analytical results for surface water samples from Dams 1–4 were below the drinking water criteria;
- Concentrations of PFOA, PFOS and TPH in surface water samples from Dams 1–4 were found above drinking water criteria. However application of these criteria are considered conservative as the more likely exposure scenarios are limited dermal contact, inhalation or ingestion of water from these Dams during routine maintenance activities, accidental exposures, and use of dam water during fire training (Dam 2 only). The exposure doses in these exposure scenarios are reduced compared to the exposure doses on which the drinking water criteria are based;
- Concentrations of PFOA, PFOS and TPH in sediment samples from Dam 1 and 2 were found above the available human health assessment criteria; and
- These exceedances of surface water and sediment assessment criteria do not indicate the potential for an immediate human health risk. Procedures should be established to manage the risks to individuals who have the potential to come into contact with surface water and sediments in Dams 1-4 during training and routine maintenance activities, consistent with the previous advice to CFA from Wynsafe.

10.0 CONCLUSIONS

Golder Associates has undertaken a PSA at the CFA Training College, Fiskville, Victoria. The objective of this PSA was to undertake a preliminary assessment that was consistent with the timeframe of the Independent Investigation and the Investigation Terms of Reference 1(e). This PSA consisted of the two phases of work; a desktop review of information relevant to the Site and a targeted site investigation.

In preparing this report there are a number of uncertainties and gaps in data that should be acknowledged:

- The exact location of buried drums of flammable liquids is not known. Three (3) potential areas were identified by CFA personnel during interviews with the Independent Investigation Team. However, the GPR survey of these areas did not detect anomalies that resembled buried drums or trenches;
- The precise nature and volume of flammable liquids used at the Site between 1973 and 1990s is not known. The lack of formal records regarding the receipt of flammable liquids during this period suggests this information is unlikely to be obtained.
- The depth to groundwater underlying the Site and the local groundwater flow direction has not been determined; and
- The soil, sediment and surface water sampling was preliminary in nature and targeted at key source areas identified from the desktop review and was aimed at identifying whether there was a risk to beneficial uses of the environment.

10.1 Historical Information Review

Since the development of the Site as a fire training college in the 1970's, a range of activities have been conducted at the Site which had the potential to contaminate the Site and surrounding environment.

These identified activities include:

- Fire training exercises involving the use of flammable liquids and foams in unsealed areas;
- Storage of flammable liquids and wastes onsite;
- Burial of flammable liquids and wastes onsite; and
- Waste water drainage from the FLP.

The following areas have been identified as potential sources of contamination; they are thought to be the locations where the above activities took place:

- Outdoor Fire Training Area;
- Training Centre Area (including Drum Burial Areas 2 and 3);
- Northern Area (specifically the Drum Burial Area 1 (south of the Airstrip)); and
- South Western Area (Landfills 1 and 2 and Lake Fiskville).

10.2 Site Investigation

A targeted site investigation was undertaken as part of this PSA which comprised of the collection of shallow soil, composite soil, surface water, sediment samples and tree core samples in several identified Areas of Interest. It was not possible to collect and analyse groundwater samples during this site investigation as the three (3) accessible groundwater bores onsite were found to be dry.

Based on the findings of this PSA, Golder Associates provides the following conclusions.

10.2.1 Soil

The reported soil analytical results were compared to the adopted ecological and human health based assessment criteria with the majority of compounds reported below the adopted soil criteria.

PFOS and 3- & 4-methylphenol concentrations were found above adopted assessment criteria, however the reported concentrations do not indicate the potential for an adverse impact on potential receptors as:

- PFOS concentrations in soils do not indicate the potential for an adverse impact on human health at the Site, as the criteria exceedance is marginal and the location where the exceedance was found, is a soil stockpile in an area of the Site infrequently accessed by site users; and
- 3- & 4-methylphenol concentrations in soils do not indicate the potential for an adverse impact on ecology at the Site due to the conservative nature of the criteria adopted.

Overall, where applicable criteria are available, the soil analytical results from Drum Burial Area 1 (south of the Airstrip), Drum Fire Area, Prop Storage Area and Soil Composting Area do not indicate the potential for an adverse impact on the beneficial uses; “maintenance of modified ecosystems” and “human health”.

10.2.2 Surface Water and Sediment

Lake Fiskville

The majority of the reported analytical results for surface water samples were below the drinking water criteria, with the exception of PFOA and PFOS.

The reported analytical results for sediment samples collected from Lake Fiskville were below the available human health assessment criteria.

The surface water and sediments results from Lake Fiskville are unlikely to have an adverse impact on human health receptors, however further investigation is recommended to better quantify the potential risk to downstream receptors.

The assessment of surface water samples from Lake Fiskville found that the majority of compounds were below the ecological assessment criteria with the exception of copper and zinc. Similarly the analytical results for sediment samples from Lake Fiskville were below the ecological sediment assessment criteria for the majority of compounds assessed with the exception of PCDD/Fs.

The surface water and sediments results from Lake Fiskville are unlikely to have an adverse impact on aquatic ecosystems in Lake Fiskville. However, it is recommended that an assessment of the ecological condition of Lake Fiskville be undertaken.

Dams 1 -4

The assessment of surface water in Dams 1-4 found that the majority of the reported analytical results for surface water samples were below the drinking water criteria with the exception of PFOA, PFOS and TPH.

The assessment of sediment in Dams 1-4 found that the majority of the reported analytical results for sediment samples were below the human health criteria with the exception of PFOA, PFOS and TPH in Dams 1 and 2.

These exceedances of surface water and sediment assessment criteria in Dams 1-4 do not indicate the potential for an immediate human health risk. Procedures should be established to manage the risks to

individuals who have the potential to come into contact with surface water and sediments in Dams 1-4 during training and routine maintenance activities, consistent with the previous advice to CFA from Wynsafe.

11.0 RECOMMENDATIONS

To provide a more comprehensive understanding of site conditions, Golder Associates recommends that soil and groundwater quality be assessed in the following areas which were not included in site investigation phase of the PSA:

- Part of Drum Burial Area 1 (south of the Airstrip and south of Deep Creek Road);
- Drum Burial Area 2 (north of the Administration Building);
- Drum Burial Area 3 (east of the Administration Building);
- Fuel storage tanks (above ground and underground) (historical and current); and
- Historical Landfills 1 & 2.

Golder Associates also recommends that additional groundwater investigations are undertaken in the vicinity of the Historical Flammable Liquid Pad, Fuel Mixing Area, Historical Fire Training Pits, Sludge Burial Pits, Drum Burial Area 1 (south of the Airstrip), Drum Fire Area, Soil Composting Area and Prop Storage Area to assess water quality and flow conditions.

Groundwater assessment is recommended as whilst many solvents can readily volatilise from near surface soils over time, they can be more persistent when they migrate deeper in to the subsurface or to groundwater where they can then migrate laterally.

With respect to surface waters in and discharging from Lake Fiskville, it is recommended that further investigation is undertaken to:

- Better quantify the potential for risk to downstream human health receptors taking into account downstream dilution and environmental fate and transport mechanism;
- Investigate potential sources of PFOA and PFOS discharges to Lake Fiskville and identify potential means of reducing PFOA and PFOS concentrations in Lake Fiskville and discharging off site, if the potential risk of adverse impact to downstream human health receptors is found to be unacceptable;
- Collect surface water samples at a representative location to assess if the reported copper and zinc concentrations are consistent with background levels; and
- Assess the ecological condition of Lake Fiskville.

Assess the ecological condition of Lake Fiskville. Suitable occupational health and safety procedures should be established to manage the risks to individuals who have the potential to come into contact with surface water and sediments in Dams 1-4 during training and routine maintenance activities.

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APPENDIX A

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