Due Diligence Environmental Investigation
RAAF Williams – Point Cook
Point Cook, Victoria

06 February 2003

Prepared for:
Department of Defence
Property Disposals Task Force
Estate Management Branch
BP-2-A017, CANBERRA ACT 2600

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	06 February 2003
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ABBREVIATIONS

AHD	Australian height datum
AMG	Australian map grid
ANZECC	Australian and New Zealand Environment and Conservation Council
AST	Above-ground storage tank
BTEX	Benzene, toluene, ethylbenzene, xylenes
COC	Chain of custody
DCA	Dichloroethane
DCE	Dichloroethene
DO	Dissolved oxygen
EC	Electrical conductivity
EO	Exploded Ordnance
Mbgl	metres below ground level
MAH	Monocyclic aromatic hydrocarbons
NATA	National Association of Testing Authorities
NEPM	National Environment Protection Measure
OCP	Organochlorine pesticides
OPP	Organophosphorus pesticides
PAH	Polycyclic aromatic hydrocarbons
PCB	Polychlorinated biphenyls
PCE	Tetrachloroethene
PCR	Primary Contact Recreation
RPD	Relative percentage difference
SEPP	State Environment Protection Policy
SVOC	Semivolatile organic compounds
SWL	Static water level
TCE	Trichloroethene
TDS	Total dissolved solids
TPH	Total petroleum hydrocarbons
UST	Underground storage tank
UXO	Unexploded Ordnance
VC	Vinyl chloride
VOC	Volatile organic compounds

EXECUTIVE SUMMARY

HLA-Envirosciences Pty Ltd (HLA) was commissioned by the Department of Defence (Defence) to undertake a Due Diligence Environmental Investigation as part of the planned divestment of RAAF Williams - Point Cook. The objectives of these works were to reduce the uncertainty associated with known contamination issues at the site, thereby enabling frank disclosure of potential liabilities associated with land contamination to prospective purchasers. In addition to the investigative works, all known redundant underground storage tanks (USTs) and associated hydrocarbon contaminated soils were excavated and removed to the extent practicable.

Prior to undertaking the investigation, eight previous site contamination investigations or studies undertaken on behalf of Defence were reviewed, and a Workplan was developed to investigate uncertainty associated with contamination issues across the site. The following list summarises the potential contamination issues across the seven general land use areas (Areas A to G) that were identified and the corresponding results of the due diligence environmental investigation works:

Area A

Underground Storage Tanks	All known disused USTs in Area A have now been excavated and removed, the former tank pits validated with hydrocarbon concentrations below NSW EPA sensitive land use guidelines and reinstated with validated clean fill. One operational UST remains in commission in Area A. Soil boring adjacent to the remaining UST reported hydrocarbon concentrations below the laboratory limit of reporting.
Chemical Store	Analysis of targeted soil samples from exposed soils surrounding the chemical store reported concentrations below sensitive land use (residential) guidelines.
Maintenance (Asset Services) Yard	Some localised hydrocarbon contamination beneath the pavement within fill material. No further assessment or remediation is considered necessary for ongoing commercial/ industrial use of the area whilst the pavement remains in place.
Potential Fill Area	Sampling and analysis in an area historically suspected to be filled did not detect fill material or contamination above NEPM 'A', EIL or sensitive land use criteria.
Chemistry Building	EPA screen of a soil sample obtained from exposed soils surrounding the building reported concentrations below LOR.
Heating Oil ASTs	Several of the heating oil tanks were inspected and no evidence of leakage or failure was noted.
Power House and Substation	Some localised staining of soil was noted around the pipework into the building . No laterally extensive soil contamination was identified during soil boring in the vicinity of the UST, which remains in commission.
Pesticide Use	No pesticides concentrations were detected above sensitive land use guidelines in various samples which were obtained from areas considered the most likely to be affected by historical pesticide treatments.

Area B

Fill Area	Solid inert waste identified. No impact on groundwater was detected. Soil concentrations below NEPM 'F' criteria. The solid inert waste is not considered to pose a hazard and does not represent a significant visual impact.
Southern Fill / Waste Disposal Area	The material presence predominantly comprises solid inert waste. No evidence of groundwater contamination was detected. One chromium concentration exceeded NEPM 'F' criteria. Petroleum hydrocarbons detected at one location. Concentrations of other potential contaminants reported concentrations below commercial / industrial (NEPM 'F') criteria. The waste material is considered to be generally non-hazardous, however it is recommended that this material be consolidated in a suitable location on-site, removed off-site or covered in place to reduce visual impact.
Sewerage Treatment Plant	No evidence of sludge or chemical disposal surrounding plant. No significant difference in groundwater conditions up and down gradient of the pant.
Rifle Range and Offshore Gunnery Firing Position	Particulate lead contamination is expected to be present in the rifle range. Based on HLA's experience on other sites, significant impact on groundwater is considered highly unlikely. Observations during this investigation and experience in other rifle ranges indicates soil contamination will be concentrated on the stop butt. Whole projectiles and large fragments are also likely to be present across the range. However, screening techniques for shallow soils should be adequate to address soil contamination across most of the range. If the range is to cease operation, remediation of the stop butt and screening of shallow soils across the range is likely to be required.
Pyrotechnic Magazine Compound	No contamination detected in the targeted samples.

Area C

USTs	One UST remaining in commission (control tower) and one UST decommissioned in-situ, since removal would have resulted in significant disruption to services. Previously decommissioned USTs located and soil investigations indicated limited impact. Backfill material around in-situ decommissioned UST contains elevated TPH concentrations, however, no groundwater contamination evident in the well immediately downgradient. Soil contamination inferred to be limited to backfill material and possibly localised natural soils surrounding tankpit.
Paint Shop	No evidence of contamination observed or detected in targeted soil samples from the area.
Battery and Hydraulic Bay	No significant heavy metal contamination detected in soil samples from beneath pavements in the area. Some PAH contaminated fill beneath pavements in Area C.
Fuel Farm	No soil or groundwater contamination evident. All facilities above-ground.
Aircraft Maintenance	Samples analyses from shallow soils around hangars reported concentrations below NEPM F criteria and NSW EPA sensitive land use guidelines.
Tanker Compound	Since fuel farm ceased operation, aviation fuel has been supplied from off-site in mobile tankers. Refueling undertaken on concrete apron. No contamination expected.
Aircraft Apron	Samples analyses from shallow soils around hangars and adjacent to apron reported concentrations below NEPM F criteria and NSW EPA sensitive land use guidelines.
Pesticide Use	No pesticides concentrations were detected above sensitive land use guidelines in various samples which were obtained from areas considered the most likely to be affected by historical pesticide treatments.

Area D

USTs	Four disused USTs were excavated and removed, and two USTs which had been previously decommissioned in-situ were investigated by soil boring. Soil and groundwater sampling was also undertaken at a suspected former UST location. The carpenters shop boiler UST excavation was validated to below NSW EPA sensitive land use criteria. No laterally extensive contamination was detected in the vicinity of the previously decommissioned USTs near the apron or at the suspected historical UST location. Some residual (volatile) hydrocarbon impact remains in soils and most likely groundwater from the former POL refueling point. No hydrocarbon impact was detected in groundwater immediately downgradient of the POL refueling area, however groundwater conditions at the downgradient monitoring well are likely to have been affected by the leaking water main in the area (repaired by HLA to enable completion of UST removal works). Ongoing management of the residual soil and possibly groundwater contamination will be required in the future.
Oil, Flammable Goods & Hazardous Goods Stores	Low volatility hydrocarbons detected above the sensitive land use guidelines in surface soils adjacent to drum store. No concentrations were reported above the NEPM F criteria.
Heating Oil ASTs	Inspected where observed and no evidence of leakage or failure reported.
Fill Area	A thin layer (<0.2m) of fill material comprising inert waste material and what appeared to be recycled pavements was observed across the unpaved roadway and grassed area where the former hangars existed in Area D. No further investigation of this material is considered to be warranted assuming an ongoing commercial / industrial use.
Aircraft Maintenance	One open hangar was inspected by HLA. The floor was observed to be completely paved with little evidence of significant stains or spills having occurred. Sampling and analysis around the hangars detected shallow fill material however all concentrations were below NEPM F criteria.
Carpenters, Blacksmiths and other Workshops	UST removed and soil boring in suspected UST location undertaken. No groundwater contamination identified.
Small Arms Range, Gun Test Butts, Store	Particulate lead contamination is expected to be present in the small arms range. Based on HLA's experience on other sites, significant impact on groundwater is considered highly unlikely. Observations during this investigation and experience in other rifle ranges indicates soil contamination will be concentrated on the stop butt. Whole projectiles and large fragments are also likely to be present across the range. However, screening techniques for shallow soils should be adequate to address soil contamination across most of the range. If the range is to be disused in the future, remediation of the stop butt and screening of shallow soils across the range is likely to be required.
Electrical Substation	No contamination was observed or detected in targeted surface soils analysed.
Drum Storage Area	No contamination was observed or detected in targeted surface soils analysed.
Pesticide Use	No pesticides concentrations were detected above sensitive land use guidelines in various samples which were obtained from areas considered the most likely to be affected by historical pesticide treatments.

Area E

Wartime Fuel Storage Area	Solid inert waste (demolition) materials identified. No significant soil contamination detected during grid test pit investigation.
Plane Parking Area	Potential for contamination due to plane parking and possible maintenance in this area was undertaken during the test pit investigation of the wartime refueling area. No significant contamination was detected.
Aircraft Apron	Soil boring adjacent to in-situ decommissioned USTs adjacent to apron did not detect significant contamination.
Runway Pavement Material	Further investigation was not considered warranted for ongoing use. No evidence of groundwater contamination due to leaching from pavement or subgrade materials.
Electrical Substation	Localised contamination in surface fill containing ash encountered above NEPM F criteria. No remediation warranted unless substation was to be decommissioned.

Areas F & G

Waste Disposal	The waste material throughout Area F predominantly comprises solid-inert waste, however localised areas of contamination is likely due to isolated incidences of drum and aircraft part disposal. Asbestos cement fragments were observed at isolated, scattered locations and several isolated mounds of asbestos cement sheeting were observed across Area F. Removal of recyclable materials including concrete, steel etc protruding from the surface is recommended followed by consolidation and capping of the non-recyclable fill. Removal of isolated asbestos cement sheet fragments and isolated piles is also recommended.
Fire Training Area (FTA)	Groundwater contamination within the fire training area which has been the subject of several studies persists, with chlorinated solvents showing signs of degradation (significant increases in breakdown products) and migration towards Port Phillip Bay within surficial sand aquifer (concentrations higher near foreshore than at source area). Concentrations in groundwater exceed the ANZECC 2000 water quality guidelines for the protection of aquatic ecosystems (99% and 95% protection levels) and recreational water quality levels. Remedial action is required to mitigate off-site impacts.
Discharge to Surface Water Bodies	The discharge of contaminated groundwater from the site into Port Phillip Bay is likely to be occurring. The Commonwealths' divestment of the site is likely to trigger the issue of a pollution abatement notice by the Victorian EPA requiring the cleanup of groundwater.

Based on the collective results of the numerous environmental investigations and studies that have been undertaken at RAAF Williams Point Cook, HLA conclude that the site is suitable for divestment as an airfield or a range of commercial or industrial uses. The results also indicate that large portions of the site are also suitable for more sensitive land use (i.e. public open space or residential).

The majority of the environmental issues identified above may be adequately managed by implementation of Environmental Management Plans. If the Commonwealth is to divest the site for ongoing use as an airfield or other commercial / industrial purposes, issues that will require more active management include the following:

- Groundwater remediation in the vicinity of the former fire training area (Area F).
- Solid-inert waste management (Areas B & F).
- Management of the residual soil and potentially groundwater contamination around the former POL refueling area (Area D).

1.0 INTRODUCTION

1.1 General

HLA-Envirosciences Pty Ltd (HLA) was commissioned by the Department of Defence (DoD) Property Disposals Task Force on 15 October 2002 to undertake Due Diligence Environmental Investigation Works, as part of the overall divestment of RAAF Williams - Point Cook. The works were performed by HLA to assist the Planning Manager, Sinclair Knight Merz (SKM), in their task to coordinate and manage site planning investigation and assessment necessary to support divestment of the site on behalf of the DoD.

1.2 Investigation Objectives

It was recognised during the scoping study (HLA, June 2002) that the level and extent of contamination at the site remained uncertain since the previous environmental investigations were undertaken. The objectives of these works were to reduce the uncertainty associated with known contamination issues at the site, thereby enabling frank disclosure of potential liabilities associated with land contamination to prospective purchasers. The objectives more specifically included the collection of data to:

- Provide factual and defensible information relating to what contamination is present at the site;
- Evaluate the extent of contamination where practicable; and
- Assess, where contamination is present, whether any unacceptable risk or harm to applicable beneficial uses of the land and groundwater at the site was occurring.

1.3 Structure of this Report

The structure of the report is as follows:

Section 1	Describes the site background, sources of information relating to contamination issues at the site and the objectives of the additional investigations undertaken.
Section 2	Presents a description of the site and background to the investigation.
Section 3	Outlines the scope of work undertaken.
Section 4	Describes the regional environmental setting of the site.
Section 5	Describes the methodology adopted for this investigation.
Section 6	Presents the rationale behind adoption of assessment guidelines for the investigation.
Section 7	Describes the underground storage tank decommissioning works that were undertaken.
Section 8	Describes the soil investigation works that were undertaken.
Section 9	Describes the groundwater investigation works that were undertaken.
Section 10	Presents the analytical results obtained throughout the investigation.
Section 11	Discusses the implications of the findings of the investigation.
Section 12	Contains HLA's opinion on the land use suitability.
Section 13	Lists the documents referred to throughout the works.

2.0 BACKGROUND

The following sections describe the site and background information relevant to the investigation.

2.1 Site Location

RAAF Base Point Cook is located some 20 kilometres south west of the Melbourne CBD, accessed from Point Cook Road, Point Cook and fronts Port Phillip Bay along the south boundary of the property. The site is described as part of Crown Allotments Thirteen^{A} and Thirteen^{E} Section C, the whole of Crown Allotment Twenty-two Section D, Crown Allotments Ten, Ten^{A}, Eleven, Twelve and Twelve^{A} Section F and part of former Government Roads, Parish of Deutgam County of Bourke. The site is understood to have been in the ownership of the Commonwealth of Australia since 1914.

The site is approximately 344 hectares in area (refer Figure 1), and bounded by:

- The Point Cook Coastal Park to the north and east. This park wraps around the 'RAAF Lake' with the 'boundary' between the site and Melbourne Water Park defined by a fence that traverses the lake.
- Land to the west of the site is used for a mix of low-density residential and intensive agriculture.
- The foreshore of Port Phillip Bay forms the sites southern boundary.

The layout of the site is shown in Figure 2.

2.2 Current Site Use and Description

The site layout plan (Figure 2) shows the locations of improvements across the site.

Most development is in the northwest and central southern portions of the site, which occupy approximately 19% (64 ha) and 4% (17 ha) of the site respectively (HLA, 2002). Approximately 14 ha of the northwest developed area forms a precinct of museum and airfield support buildings.

Approximately 500 individual assets (buildings and other improvements) are numbered at the site, around 200 of which are buildings. Only a few of these buildings are located outside of the northwest and central southern developed areas described above.

Buildings and improvements across the site generally include the following:

- Various garages, aircraft workshops and hangars.
- An aircraft control tower.
- Aircraft fuelling and oil store facilities.
- Parade ground.
- Numerous free-standing residential houses and block style accommodation buildings.
- A number of administrative and office buildings.
- Educational training, school and kindergarten buildings.
- A cinema and a shop / general store.
- A chapel.
- Numerous stores, sheds and hazardous goods stores.
- Numerous laundries, toilet blocks and mess facilities.
- Two rifle ranges.
- A RAAF medical centre.
- A number of electrical sub-stations.
- Sewerage treatment plant and pumping station.
- Magazine, pyrotechnics store and an explosives storage compound (no longer used).
- Fire fighting facilities including water and foam tanks.

The central (approximately) 40% of the site is occupied by the airfield, which includes two tarmac runways running north - south and northeast - southwest respectively. Several, less frequently used grass runways also exist in the airfield region.

During this investigation, reference to the seven preliminary land use areas (Areas A to G – Figure 2) which were arbitrarily defined in the Scoping Study (HLA, 2002) was continued for the purposes of differentiating regions of the site with varying historical use, potential for contamination and possible uses in the future. These areas included:

Area A – encompassing the developed area on the north-western side of Williams Road including the sporting fields, parade ground, primary school, RAAF college, officers mess and various other buildings used for accommodation, storage and other purposes.

Area B – comprising the south-western corner of the site which largely comprises open space, currently used for training and rifle shooting. The operational sewerage treatment plant and firing range reside in this area.

Area C – comprises the hangars, control tower, RAAF Museum and plane parking / refuelling areas which are located between the airfield and immediately east of Williams Road.

Area D – comprises the area to the south of the airfield occupied by hangars, former workshops and lecture rooms and associated buildings.

Area E –contains the existing airfield and runways.

Areas F – comprises the open space, lake and bay foreshore areas in the east and south-east corner of the site.

Area G – is the area occupied by the RAAF Lake.

2.3 Previous Contamination Assessments

Eight previous site contamination investigations or studies have been undertaken on behalf of DoD. These works were documented in the following reports:

1. Stage 2 and 2a Audits – Combined Reports on Site Assessments. Dames & Moore – August 1993;
2. Site Contamination Survey and Remediation Strategy – Priority Area 1. CMPS&F – May 1995
3. Site Contamination Survey and Remediation Strategy – Priority Area 2. CMPS&F – May 1995
4. Site Contamination Survey and Remediation Strategy – Priority Area 3. CMPS&F – May 1995
5. Screening Level Assessment of Human Health Risks, Soil and Groundwater Contamination at RAAF Williams, Point Cook Foreshore. CMPS&F – December 1997
6. Environmental Audit Report – Point Cook RAAF Airbase NASMA Lease Site. January 1996
7. Soil and Water Acceptance Criteria. CMPS&F – September 1995
8. *Unexploded Explosive Ordnance Historical Survey of RAAF Williams Laverton and Point Cook.* ADI Services. December 1994

A brief summary of the works undertaken during these investigations is included below.

Stage 2 and 2a Audits –Dames & Moore, 1993

The first land contamination investigations of the RAAF Point Cook site are believed to be the site facilities audits undertaken by Dames & Moore Pty Ltd (D&M) in 1992/93, which included RAAF Williams Laverton. These consisted of Stage 1, 2 and "2A" audits, including desktop research studies, audit site inspections and interviews etc. The objectives of these audits included:

- identify compliance of operating facilities with regulations and good environmental management practices;
- identify activities, facilities and areas that might be sources of land contamination; and
- prepare a comprehensive investigation plan and recommend strategies for investigation that would meet the requirements of an Environmental Auditor.

The investigation plan and strategy objective above is addressed by the Stage 2 and 2A Audits Combined Reports on Site Assessments and Chemical Screening Programs, D&M 1993. This report identifies land contamination sources (including a comprehensive figure showing known potential land contamination sources across the site) and provides a pre-cursor to the CMPS&F Work Plans described below. It assigned levels of priority, 1 to 4, with lowest to highest probability of being contaminated. In all, this D&M report recommended up to 157 soil sampling locations, up to 36 groundwater sampling locations, 13 sediment and 13 surface water samples (from Port Phillip Bay, the RAAF Lake, stormwater drains and other natural and man-made drainage features).

Site Contamination Survey and Remediation Strategy – Priority Areas 1, 2 & 3 - CMPS&F,1995

The D&M audits formed the basis for the development of Field Investigation Workplans by CMPS&F in 1993/94. For the purposes of investigation, CMPS&F divided the site into three areas, designated "Priority Areas" 1, 2 and 3. The Workplans formed comprehensive investigation plans that prescribed areas for soil and groundwater sampling, proposed (preliminary) sampling locations, sampling depths, analytical programmes and investigation methodologies. The Workplans appear to have been drafted during 1993 and amended in 1994 to take into account the results of a Review of Site History Prepared by ADI-IDD and Recommendations for Revisions to CMPS&F Work Plan in February 1994. In addition to soil and groundwater sampling, the Workplans prescribed the following investigations:

- A number of locations to be visually inspected for asbestos;
- Collection and analysis of numerous sediment samples from the RAAF lake, foreshore and stormwater drains;
- Soil gas sampling in the vicinity of volatile hydrocarbon (petrol) sources such as underground fuel storage tanks (USTs);
- Numerous geophysical surveys, such as ground electro-magnetics, to identify contamination sources, unexploded ordnance and for safety clearance purposes;
- Collection and analysis of surface water samples from the RAAF Lake and foreshore, and
- Biota surveys from the RAAF Lake and the foreshore.

To further summarise, the Workplans prepared by CMPS&F detailed the following scope of soil and groundwater sampling:

Priority Area 1

- A total of 17 areas/features targeted for sampling;
- Approximately 200 soil sampling locations;
- 6 groundwater bores; and
- Analysis for a broad of organic and inorganic contaminants.

Priority Area 2

- A total of 21 areas/features targeted for sampling;
- Approximately 180 soil sampling locations;
- 6 groundwater bores; and
- Analysis for a broad of organic and inorganic contaminants.

Priority Area 3

- A total of 3 areas/features targeted for sampling;
- Approximately 55 soil sampling locations;
- 9 groundwater bores; and
- Analysis for a broad of organic and inorganic contaminants.

The Environmental Site History report prepared by ADI-IDD (January 1994) supplemented the earlier D&M reports by providing some additional historical site use information. CMPS&F reviewed ADI-IDD's recommendations and incorporated some of those into the Workplans.

Soil and groundwater investigations were undertaken by CMPS&F in 1995 and reported as "Site Contamination Survey and Remediation Strategy" reports for each of the three Priority Areas. The reports imply that the complete scope of works detailed in the 1994 Investigation Workplans described above was implemented and do not refer to any variation in the scope detailed in those. The results of the soil and groundwater sampling and analysis undertaken by CMPS&F were reviewed with respect to the current land contamination issues. In summary, the CMPS&F investigations identified a number of areas on the site that contained land contamination which required further investigation or clean up to support open space and recreation use. The majority of site areas investigated were found to be suitable for open space and recreational land use, and therefore inferred to also be suitable for airfield, industrial and commercial land uses. Much of the site was also found to be suitable for more sensitive land use such as residential. However, the reports note that further investigation would be necessary to support this conclusion

One of the most significant areas of contamination identified by the 1995 CMPS&F studies was to the east of the airfield, where waste disposal and fire training activities have been carried out over a long period of the RAAF Base history. The studies identified, amongst other contaminants, elevated levels of chlorinated solvents in the shallow groundwater. The relevant report recommended further investigation of these, including more groundwater bores in the deeper (basalt) groundwater aquifer and human health and ecological risk assessment.

Screening Level Assessment of Human Health Risks, Soil and Groundwater Contamination at RAAF Williams, Point Cook Foreshore - CMPS&F, 1997

The Point Cook Foreshore Risk Assessment and Screening Level Assessment of Environmental Impacts reported by CMPS&F in late 1997 addressed the risk assessment recommendations from the 1995 studies. However, the recommendation (from 1995) to investigate the deeper aquifer does not appear to have been implemented.

The risk assessments concluded that the risks to human health due to groundwater contamination detected in soil and groundwater east of the airfield were within acceptable limits and adverse health effects to the environment (in particular marine organisms) were unlikely based on basic dilution calculations.

Environmental Audit Report: Point Cook RAAF Airbase NASMA Lease Site – AXIS Environmental Consultants, 1996

The Environmental Audit Report, Point Cook RAAF Airbase – National Air and Space Museum of Australia (NASMA) Lease Site (Axis Environmental, January 1996) reported on a Statutory Environmental Audit of approximately 6 hectares in the northern part of Area C. The reason for this Audit was to support the lease of the site to the NASMA, which was to have been established at Point Cook in the late 1990's. The NASMA proposal fell through in the late 1990's when (it is understood) NASMA was disbanded. The Statement of Environmental Audit issued as part of this project stated, that at the time, the land was suitable for aircraft storage and museum type activities with controlled public access provided that a number of conditions are maintained including sealed ground (with paving or concrete etc).

2.4 Synopsis of Significant Contamination Issues

Based on HLA's review of the previous environmental investigations and studies undertaken at the site, summarised below and grouped by the land use areas (A-G) described above is a description of the contaminated land issues that were considered to require additional investigation for due diligence purposes prior to disposal of the site.

2.4.1 Area A

Underground Storage Tanks
The location and status of USTs across the entire site had only been partially assessed in the past prior to this investigation. USTs were reported by Dames & Moore in 1993 to be located at 11 separate locations within Area A. During HLA's initial site inspection, the existence of three USTs at the Service Station and USTs at four other locations identified by Dames & Moore were visually confirmed by a HLA Senior Environmental Scientist with many years of experience in relation to underground petroleum storage systems. USTs at the other six locations identified by Dames & Moore either showed evidence of having been removed, actually represented above ground storage tanks (ASTs) which appeared to be incorrectly identified as a UST, or there was no evidence of a UST remaining in-situ. USTs at locations other than the former service station appear to have predominantly been used to store fuel oil feeding boiler plants, and have not been in use for some time. Natural gas connections to several of the plant rooms where Dames & Moore reported USTs, but USTs were not observed to remain present, may indicate that these tanks had been removed at the time of conversion to natural gas. The Dames & Moore report also indicated that some of the USTs have been decommissioned in-situ by filling with sand (further information in Section 6 of this report), however no information was provided on the motives for decommissioning or their integrity upon decommissioning.

Chemical Store
A range of chemicals and solvents may have been stored in the Chemical Store in the RAAF College.

Asset Services Yard
The Asset Services Yard included workshops, paint storage, flammable goods store and potential mixing of herbicides.

Potential Fill Area
Based on historical aerial photographs there is a potential area of fill in the northwest corner of Area A. If present, this fill area was placed before the current development at the site.

Chemistry Building
A Chemistry building was located in Area A where anecdotal evidence suggested disposal of chemicals to drains and kerosene used for engine tests.

Heating Oil ASTs
Disused heating oil ASTs were attached to the external walls of many of the buildings in Area A.

Power House and Substation
There was a power station and associated substation with surface oil staining.

Pesticide Use
Termaticide treatments of foundations of timber buildings may have been conducted using arsenic and organochlorine pesticides.

2.4.2 Area B

Fill Area
The lateral extent and concentrations within the heavy metal affected fill material within Area B (inferred by CMPS&F to potentially extend over an area of 6-8ha) had not been thoroughly evaluated. Previous investigations indicated that the heavy metal contamination was likely to be limited to within the fill material and not be impacting on the groundwater in the area.

Southern Fill / Waste Disposal Area
The waste disposal area in the south of Area B (behind stop butt) had been partially investigated and no significant soil or groundwater contamination was detected. It was noted however that the investigation locations were located away from area of buried metallic refuse due to the risk of encountering UXO. Leachate was detected in a groundwater monitoring bore installed hydraulically down-gradient of the waste disposal area.

Sewerage Treatment Plant
A sewerage treatment plant exists on the southern boundary of Area B. The plant consists of digester and trickle tanks. Contamination issues include impacts of nutrients and trace organics on groundwater. Sewerage sludges may also have been disposed at the site which may contain elevated levels of metals and organics. Treated effluent from the plant is believed to discharge to Port Phillip Bay.

Buried Ordnance
There was anecdotal evidence that there may be buried ordnance in the fill area.

Rifle Range and Offshore Gunnery Firing Position
There is a rifle range and stop butt in Area B. Soils in these areas are likely to be contaminated with heavy metals, particularly lead, copper and antimony in solid particulate form.

Pyrotechnic Magazine Compound
Soil may have been contaminated with a range of organic compounds associated with pyrotechnics. CMPS&F noted odorous material in this area.

2.4.3 Area C

An Environmental Audit was conducted on the part of Area C referred to as the NASMA Lease Area. It has been assumed that the Audit addressed contaminated land issues in the NASMA Lease Area at the time of the Audit (1996). Any issues remaining in the NASMA Lease area relate to releases and contamination that has occurred since that time.

USTs
Two USTs were reported by CMPS&F (May 1995) to be located within the NASMA Lease area of Area C. Groundwater contamination was assessed around these as part of the Audit in 1996 and no groundwater contamination was noted. There may have been additional USTs in parts of Area C not covered by the Audit in 1996 (UST investigations discussed later in Sections 6 and 7).

Paint Shop
A Paint Shop was located in the NASMA Lease area of Area C and was assessed as part of the Audit in 1996. Ongoing storage and handling of paints and solvents and paint stripping represent potential for contamination.

Battery and Hydraulic Bay
A battery and hydraulic maintenance area was located in the NASMA Lease area of Area C and was assessed as part of the Audit in 1996.

Fuel Farm
A disused aboveground fuel farm is located in the western portion of Area C. It was noted during HLA's inspection that the tank was enclosed within a low earthen bund. CMPS&F installed a bore hydraulically down-gradient of the AST. No contamination was detected in groundwater in the bore.

Aircraft Maintenance
Storage and handling of oils, solvents, fuels and other chemicals. Not all hangers and aircraft maintenance areas were covered by the Audit of the NASMA Lease area.

Tanker Compound
Standing area for aircraft fueling tanker. Lubricating oils and fuel spills may have occurred in this area.

Aircraft Apron
Fuel spills on aircraft pavement areas may have run off pavements to soils.

Pesticide Use
Termaticide treatments of foundations of timber buildings may have been conducted using arsenic and organochlorine pesticides.

2.4.4 Area D

USTs
Visual observations and geophysical surveying in this area by CMPS&F (May 1995) indicated the potential for six USTs to be present. These findings differed from that of the site history review and indicated that USTs may be located on the southern sides of Hangers 211 and 212, between Hangars 212 and 213 and at the southwest corner of Hangar 214. A thorough investigation into the presence of USTs was warranted and undertaken during this investigation.

Oil, Flammable Goods & Bivouac Stores & Several Hazardous Goods Stores
All contained potentially contaminating substances including fuels, insecticides, adhesives, oils etc.

Heating Oil ASTs
Numerous disused heating oil ASTs (i.e. <500L in volume) are attached to the external walls of the classrooms.

Potential Fill Area
Based on historical aerial photographs (1950's to 1970's) there is a potential area of fill or disturbed ground.

Aircraft Maintenance
Aircraft maintenance activities were conducted in the hangers. Activities may have involved storage and handling of oils, solvents, fuels and other chemicals.

Carpenters Shop, Blacksmiths Shop and other Workshops
These workshops have operated throughout Area D and are considered to represent potential sources of various contaminants.

Small Arms Range, Gun Test Butts, Store
Were located in Area D and were described by Dames & Moore to also have been used for drum storage. Metals contamination of soil and UXO (small arms) may be present in these areas.

Electrical Substation
There was a substation located within Area D potentially containing PCBs.

Drum Storage Area
The drum storage area and open compound (location of former hangers which were demolished in 1960's) represent areas of potential contamination.

Berm Pushed into Bay
Potentially contaminated fill containing heavy metals.

Pesticide Use
Termaticide treatments of foundations of timber buildings may have been conducted using arsenic and organochlorine pesticides.

2.4.5 Area E

Wartime Fuel Storage Area
A wartime fuel storage area was known to have existed within Area E at the north-eastern end of Runway 22. Investigations indicated low-level TPH contamination. Groundwater had not been investigated in the past.

Plane Parking Area
The eastern side of Area E was used for aircraft parking. Aircraft maintenance and fuelling may have been conducted in this area.

Aircraft Apron
Fuel spills on aircraft pavement areas may have run off pavements to soils.

Runway Pavement Material
The sub-base of runways may have been constructed using bitumen stabilised materials.

Electrical Substation
Sampling and analysis in the vicinity of the substation in the north-western corner of Area E was deliberately undertaken at some distance from the base of the substation since clearance for the presence of UXO could not be obtained due to interference with the electromagnetic survey. The results indicated that extensive contamination in the area has not occurred, however the presence of localised PCB contamination immediately adjacent to or beneath the substation could not be discounted without close proximity sampling of near-surface soils.

2.4.6 Areas F & G

Waste Disposal
Mixture of inert, municipal and industrial waste was disposed over much of the foreshore and near coastal area within Area F. Wastes potential included a range of solid and liquid industrial wastes. Visual inspection of the area indicated relatively ad hoc disposal of waste and little to no capping of waste disposal areas. Liquid waste is also believed to have been disposed to the RAAF Lake. Chemical drums and asbestos cement construction materials were observed during HLA's inspection.

Fire Training Area (FTA)
Fuels and solvents were believed to have been used in the FTA towards the eastern boundary of Area F. Past groundwater investigations have indicated groundwater contamination extending across the site boundary and potentially discharging to Port Phillip Bay. In addition, HLA considered that further groundwater investigation, particularly including investigation of the deeper basalt aquifer in the vicinity of the former FTA was required to investigate the potential for dense non-aqueous phase liquid (DNAPL) contamination.

Discharge to Surface Water Bodies
Contamination from the sources identified above may discharge, via surface run-off or groundwater flow, to the RAAF Lake and Port Phillip Bay.

2.4.7 General

UXO

Specific UXO and EO investigations were not undertaken as part of this investigation. However, during preparation of the Environment, Health and Safety Plan (HLA 2002) for the works, the ADI report was reviewed and discussions were held with GTEK Australia regarding the risk of encountering UXO at the site.

The ADI 1994 report described the various levels of risk of the presence of EO and UXO across the site. Subsequent discussions G-TEK Australia indicated that the risk of UXO and EO across the site is generally low, and limited to specific areas including the foreshore and RAAF Lake areas of the site where only practice bombing has occurred. The practice bombs, where present on-site, were described as having a low potential to contain active (flammable) flare material. In addition, GTEK indicated that ordnance from small arms are likely to be found across the site, particularly in the firing range areas.

Hazardous Building Materials

A survey or inspection of buildings and structures on-site for hazardous materials was not undertaken as part of this investigation. It is understood that an asbestos register is maintained at the Asset Services offices at RAAF Williams Laverton.

3.0 SCOPE OF WORK

A summary of the scope of work undertaken during the investigation is presented in Table 1. Briefly, the works included:

- Development of a Workplan (HLA 2002b) and Environment, Health & Safety Plan (HLA 2002c) for the works.
- Location of the existing monitoring wells across the site using a differential Global Positioning System (GPS) and metal detector.
- Installation, development and surveying (level and location) of 14 new 50mm diameter groundwater monitoring wells.
- Purging and sampling the 14 new and 22 existing groundwater monitoring wells. Samples were selectively analysed for a broad range on contaminants depending on the location and proximity to potential contamination sources (refer to Figure 2 for the monitoring well locations and land use areas and Figure 3 for potential sources of contamination).
- Excavation of 43 test pits located on a targeted basis across the site for the purpose of ascertaining the shallow soil profile and enable collection and samples for analysis of potential contaminants of concern.
- Hand augering of 52 shallow soil bores located on a targeted basis across the site for the purpose of ascertaining the shallow soil profile and enable collection and samples for analysis of potential contaminants of concern.
- Auger drilling of nine soil bores for the purpose of ascertaining the shallow soil profile and enable collection and analysis samples adjacent to USTs previously decommissioned in-situ by others. (Refer to Figures 4 to 11 for the locations test pits, hand augers and soil bores for each investigation area).
- The excavation and removal of 11 USTs from the site, with excavation validation sampling, stockpile soil characterisation sampling, and backfilling of excavations with re-usable soil or clean imported backfill. One UST was decommissioned in-situ. (Refer to Figures 12 to 17 for the excavation plans and decommissioning works details conducted at each UST location).
- Interpretation of the level and extent of soil and groundwater contamination at the site.

In general, the works were undertaken as described in the Workplan, however, some modification to locations and numbers of investigation locations was required. As described in Sections 6, 7 & 8.

4.0 REGIONAL GEOLOGY & HYDROGEOLOGY

4.1 Regional Geology

A copy of a portion of the 1:250,000 Digital Geology – Melbourne GIS Data CD showing outcrop of the regionally significant formations in the site vicinity is presented on Figure 1. The geology of the region in which the site is located is described, from youngest to oldest, as follows:

Quaternary	Quaternary aged (Pleistocene/Holocene) Aeolian deposits consisting of calcareous sands and some swamp sediments forming coastal and inland dunes systems.
	Quaternary aged (most Holocene) Paludal swamp and lagoonal deposits consisting of silts and clays. Paludal sediments are distributed within a zone of several kilometres of the current shoreline in former and present inland and tidal swamps and lagoons.
	Quaternary aged Newer Volcanics consisting of tholeiitic to alkaline basalts, minor scoria and ash deposits. The basalts are typically coarsely vesicular with minor interbedded silty sand and baked soil horizons.
Tertiary	Tertiary aged Brighton Group sediments occurring disconformably across the region (Leonard 1992). The sediments are typically red-brown, yellow and white and are well bedded to cross-bedded with silty sand and minor gravels sometimes including clay balls.
	Tertiary aged (Miocene/Oligocene) Fyansford (Newport) Formation consisting of glauconitic and carbonaceous sands, silts, clays and shelly sand. In the area west of Melbourne the lithology of the formation is dominantly clay and marl with a typical thickness of greater than 50 m although locally absent around the fringes of Port Phillip Bay (Leonard 1992).
	Tertiary aged (Eocene) Werribee Formation consisting of sand, sandy and silty clay with pyritic and lignitic quartz sand.
	Tertiary aged (Eocene) Altona Coal Seam consisting of brown coal and minor lignitic sands and clay. The coal seam is interbedded with the upper section of the Werribee Formation to the west of Melbourne.
Silurian / Ordovician	Silurian and Ordovician aged sediments primarily consisting of sandstone and siltstone. These sediments are, in places up to 4,500 m in thickness (Leonard, 1979) and form the basement or bedrock unit across the western portion of the Port Phillip region.

Coastal and inland dune systems are found along the margins of Port Phillip Bay in the western region of Melbourne. Generally these are restricted to within 1 km of the current shoreline, however more widespread deposits are found in the Werribee area where outcropping deposits extend up to 10 km inland. These dunes are formed by Quaternary aeolian deposition of sands including calcareous sands and some swamp deposits associated with inter-dune swale deposition.

Paludal deposits consisting of Quaternary silts and clays were deposited in swamps and lagoons across the western region of Melbourne where they are typically found within 5 km of the coastline. These deposits typically outcrop either adjacent to or behind coastal sand dunes and taper in extent inland. Small isolated deposits are also found inland associated with localised swamps and lagoons.

The Newer Volcanic basalts are the surface outcropping unit in the region west of Melbourne. Widespread volcanic activity of the northern and western plains of Victoria resulted in the emplacement of Newer Volcanics basalt over much of the western region of Melbourne. In the western and northern suburbs of Melbourne, the basaltic plains are characterised by a near planar surface, which has almost entirely blanketed the pre-existing topographical surface. The basalt is the result of lava flows from eruption points distributed across northern and western

Melbourne, and is characterised by several flows of variable thickness (generally less than 10 m), which are highly vesicular and display variable degrees of weathering.

The initial lava flows of the Early Quaternary covered the landscape and in-filled the pre-existing valleys and resulted in displacement of drainage systems across the region. Later flows arising from eruption points to the north were less extensive flowing along drainage features and resulted in drainage displacement.

The Newer Volcanics is observed to outcrop at the surface across much of the western portion of Melbourne and occurs as basaltic rock at the surface or as highly modified basaltic clay soils. Former soil profiles (palaeosols) commonly occur at depth within the Newer Volcanics where lava flows were exposed at the surface for sufficient time periods. The clays in the palaeosols are frequently baked and vitrified by subsequent lava flows. Highly vesicular basalts tend to be more extensively weathered due to increased porosity, whereas denser basalts tend to be more prone to weathering along jointing planes and as such result in spheric weathering features, often observed as basalt 'floaters' near the surface.

4.2 Regional Hydrogeology

4.2.1 Regional Groundwater Use

A review of the Department of Natural Resources and Environment (DNRE) Groundwater Database revealed that a total of thirteen (13) groundwater bores exist within a one kilometre of the site boundary. No specific information is available for three (3) of these bores drilled in 1968/69. Groundwater bore information obtained from the DNRE Database for the remaining 10 bores drilled between 1981 and 1990 is summarised below:

Summary of Groundwater Bores Within 1 km of the Site Boundary

Bore Number	Geology	Total Depth (m)	Screen Depth (m)	Static Water Level (mbgl)	Usage	TSS (mg/L)
59970	Sand	12.19	9.1-12.19	1.8	Domestic and Stock Watering	-
59988	Basalt	9.48	2.8-9.48		Domestic and Stock Watering	-
60040	Basalt	15.24	4.5-15.24	4.3	Domestic and Miscellaneous	-
60053	Basalt	18	4.0-18.0	3	Domestic and Stock Watering	-
60055		37	-	-	-	-
60056		23	9.0-23.0	6	-	-
60058	Basalt	18	4.0-18.0	3	Domestic and Stock Watering	-
60062	Basalt	12	4.0-12.0	1.5	-	6,049
60064	Basalt	10.6	6.1-10.2	3.6	-	6,686
306039		213	-	-	-	-

Notes:

"-" denotes data not included in database

mbgl – metres below ground level

Data from the registered groundwater bore database indicates that groundwater from both the surficial sand and deeper basalt aquifers is used in the region for domestic and stock watering purposes. The highest density of groundwater use in the vicinity of the site occurs to the west, where bores are screened within the shallow sandy deposits. These bores are inferred to be predominantly irrigation bores associated with the numerous market gardens operating throughout the Werribee area. Figure 1 indicates the location of registered bores within 2.5km of the site. There are numerous more distant bores located to the west of the site, however these were omitted from Figure 1 for clarity.

4.2.2 Regional Aquifers

Various hydrogeological regimes occur within the western region of Melbourne. Typically, the primary water bearing lithologies of concern occurs within the basement sediments and the upper Cainozoic formations, which unconformably overlie the basement bedrock. The principal aquifers within the Port Phillip Basin are described, from deepest to uppermost, in this section.

Silurian (Bedrock) Aquifer

The regional basement aquifer of the Port Phillip Basin occurs within the heavily lithified sediments of the Silurian bedrock. The Bedrock Aquifer typically displays low primary porosity and hydraulic conductivity. The high degree of deformation, and the resultant folds and faults, characteristic of the bedrock has resulted in a fractured rock aquifer with high secondary porosity and low to moderate hydraulic conductivity.

Groundwater within the fractured rock aquifer of the Silurian bedrock typically has salinity in the range of 1,000 mg/L to 8,000 mg/L (Lane et al 1992), but may be lower where overlain by Cainozoic aged aquifers of lower salinity. Groundwater within the bedrock aquifer is expected to discharge to Port Philip Bay and ultimately Bass Strait.

Water bearing sequences are expected to occur within each of the units comprising the overlying Cainozoic aged lithologies. The following sections outline the expected hydrogeological regimes for the western region of Melbourne.

Werribee Formation Aquifer and Altona Coal Seam

The Werribee formation in the vicinity of the Point Cook consists of thick beds of clays, silts, coarse sands and gravels. The Werribee formation thickens towards the coast and in this region is a regionally viable aquifer with water quality in the range of 1,500 mg/L to 2,000 mg/L in the Bacchus Marsh area where the aquifer receives recharge from the Werribee River. Further towards the bay however groundwater quality deteriorates with salinities in excess of 4,000 mg/L recorded (Leonard, 1992). To the west of Melbourne, the aquifer is confined to semi-confined by the interbedded Altona Coal Seam and the overlying Fyansford Formation both of which are of low hydraulic conductivity. The interbedded lignite and coal beds result in anisotropic hydraulic conductivity.

Groundwater recharge is expected to occur via direct infiltration where the formation outcrops or sub-crops in the Bacchus Marsh area and the Ballen Graben to the west. Some vertical recharge from the overlying Newer Volcanic aquifer may occur around the margins of Port Phillip Bay where the overlying Fyansford Formation aquitard is locally absent (Leonard 1992). Groundwater is not expected to discharge to surface water bodies in the region or to Port Phillip Bay, but to Bass Strait due to the overlying and underlying confining units (Leonard, 1979). Some dissipation via vertical leakage into other aquifers in the stratigraphic sequence could also occur (Leonard 1992).

Fyansford Formation

To the west of Melbourne the Fyansford Formation lacks the hydraulic conductivity for significant groundwater flow and acts as an aquitard instead. The formation yields only limited supplies of poor quality groundwater with salinity ranging from 4,000 mg/L to 15,000mg/L (Leonard 1992).

Brighton Group Aquifer

The occurrence of Brighton Group sediments in the western region of Melbourne is somewhat limited in both extent and thickness and as such, groundwater of good quality but small yields occurs. The overlying Newer Volcanics basaltic cap in the region is expected to reduce surface water infiltration to the Brighton Group aquifer.

Newer Volcanics Aquifer

Groundwater flow in the Newer Volcanics aquifer forms a very complex regime. Groundwater occurs within fractures, vesicular openings and joints of the basalt formations and within the interflow palaeosol formations. The hydraulic parameters of the aquifer are highly variable on a relatively small scale due the heterogeneous and anisotropic nature of the basalt aquifer. The interflow palaeosol formations act as discontinuous aquitards between individual basalt flows. Groundwater quality typically averages about 3,500 mg/L TDS in the north and west of Melbourne, but may be improved close to recharge points (Leonard, 1979). Given the nature of the basalt, high hydraulic conductivities can occur, however they are difficult to predict and may not be of large aerial extent (Dames and Moore 1993). Conductivities can range from 0.01 m/day to 35 m/day with a storage co-efficient of between 1×10^{-6} and 1×10^{-1} resulting from variable porosity.

Quaternary Aeolian and Paludal Sediment Aquifers

Groundwater is expected to occur within various Paludal sediments deposited along the coastal shoreline and within tidal/inland lagoons and swamps. These aquifers are expected to discharge to Port Phillip Bay, however local conditions could result in discharge to local surface water bodies. Recharge of these sediments is expected to be predominantly rainwater infiltration.

The quaternary sedimentary aquifers are not anticipated to be regionally significant due to the limited regional extent and expected poor groundwater quality (high salinity) due to the close proximity to Port Phillip Bay.

4.3 Topography and Site Drainage

The site is predominantly flat-lying with a gentle slope southwards towards Port Phillip Bay, and is reasonably well serviced by stormwater drains, all of which are understood to discharge to the Bay (refer Figures 2 & 3). The latest underground services plan available (provided to HLA in electronic from Defence on 21 January 2002), depicts nine stormwater drain discharge points to Port Phillip Bay. The drain diameters range from 230 to 910mm and some open drains are also understood to discharge to the Bay. Due to the flat land around the lake (area G and F), flooding is likely to occur during periods of heavy rainfall.

5.0 WORKS METHODOLOGY

Details of the methodologies adopted for the due diligence works are described in the following HLA documents:

- HLA Envirosciences Pty Limited. 2002. Work Plan: Due Diligence Environmental Works RAAF Williams – Pt Cook', October.
- HLA Envirosciences Pty Limited. 2002. Environment, Health and Safety Plan, Due Diligence Environmental Works, RAAF Williams, Pt Cook, October.

The environmental investigation and decommissioning works were conducted in accordance with HLA's standard fieldwork and quality procedures as described in the Work Plan.

6.0 ASSESSMENT GUIDELINES

6.1 Land Protection Policy

The regulatory requirements for management of soil quality and protection of beneficial uses of land in Victoria are detailed in the State Environment Protection Policy (SEPP) *Prevention and Management of Contamination of Land*, June 2002 (Land SEPP). The Land SEPP broadly defines six beneficial uses of land to be protected and provides guidance on which of these beneficial uses are applicable under a range of land use scenarios. The applicable beneficial uses to be protected based on the predominance of commercial activities across the site are shaded in the table below. However, It should be noted that beneficial uses applicable to several portions of the site including the officers accommodation areas and the primary school are more appropriately defined as a sensitive use.

Protected Beneficial Uses of Land

Beneficial Uses	Land Use						
	Parks & Reserves	Agricultural	Sensitive Use		Recreational / Open Space	Commercial	Industrial
			High Density	Other			
Maintenance of Ecosystems							
Natural Ecosystems	✓						
Modified Ecosystems	✓	✓		✓	✓		
Highly Modified Ecosystems		✓	✓	✓	✓	✓	✓
Human Health	✓	✓	✓	✓	✓	✓	✓
Buildings & Structures	✓	✓	✓	✓	✓	✓	✓
Aesthetics	✓		✓	✓	✓	✓	
Production of Food, Flora & Fibre	✓	✓		✓			

Soil quality objectives are defined in the SEPP to ensure that contamination does not adversely affect the applicable beneficial uses. In accordance with the SEPP, soil quality guidelines for the protection of human health or relevant ecosystems can be derived from three sources including:

- Investigation levels documented in the *National Environmental Protection (Assessment of Site* Contamination*) Measure* published by the National Environmental Protection Council (NEPC 1999) – Schedule B(1).
- Site-specific levels derived through applying the risk assessment methodology described in the National Environmental *Protection (Assessment of Site Contamination) Measure* published by the National Environmental Protection Council (NEPC 1999) – Schedule B(4).
- Levels approved by the EPA in consultation with other relevant statutory public health programs for alternate objectives for human health.

6.2 Adopted Soil Assessment Criteria

Given the generally commercial use of the site at the time of the investigation, the health based NEPM "F" criteria and interim urban Ecological Investigation Levels (EILs) soil criteria have been adopted to assess soil analytical results for the majority of the site under its current use. Reference has also been made to the NEPM "A", NEPM "D" & NEPM "E" criteria based on open space and potential residential use of portions of the site. In addition to the NEPM criteria, the New South Wales Environment Protection Authority (NSW EPA) *Guidelines for Assessing Service Station Sites* - threshold concentrations for sensitive land use were adopted to assess the potential impact of petroleum hydrocarbons. Victorian EPA Bulletin 448 Classification of Wastes guidelines were applied to classify material where off-site disposal may be required.

6.3 Groundwater Protection Policy

The protection of groundwater quality in Victoria is controlled by the State Environment Protection Policy (SEPP) Groundwaters of Victoria. This SEPP divides the groundwater environment into five segments (A1, A2, B, C, D) with each segment being defined by background levels of Total Dissolved Solids (TDS) within the groundwater. The SEPP then outlines the beneficial uses that are protected and identifies which beneficial uses are protected in each segment. The beneficial uses identified include: maintenance of ecosystems, potable water supply, potable mineral water supply, agriculture, parks and gardens, stock watering, industrial water use, primary contact recreation and building / structures. Provided below is a summary of the beneficial uses as defined by the SEPP and the corresponding wells that fell within each segment based on the TDS.

Aquifer Classification Based on Background TDS Level

	Segments Based on TDS Range (mg/L)				
	A1	**A2**	**B**	**C**	**D**
	0 - 500	500 – 1,000	1,000 – 3,500	3,500 – 13,000	Greater than 13,000
Beneficial Uses					
Maintenance of Ecosystems	✓	✓	✓	✓	✓
Potable Water Supply					
Desirable	✓				
Acceptable		✓			
Potable Mineral Water Supply	✓	✓	✓		
Agriculture, Parks and Gardens	✓	✓	✓		
Stock Watering	✓	✓	✓	✓	
Industrial Water Use	✓	✓	✓	✓	✓
Primary Contact Recreation	✓	✓	✓	✓	✓
Buildings & Structures	✓	✓	✓	✓	✓

Based on the historical and current TDS data, the groundwater salinity across the site within the surficial and basalt aquifers appears highly variable, however with the majority or water samples reported TDS concentrations classifying the groundwater as beneficial use Segment C.

Increased TDS was reported in wells in the southeast corner of the site (Area F), considered to be due to a combination of tidal mixing and saline intrusion within the aquifers. A localised area of fresh groundwater was encountered at monitoring well D23MW, however this anomaly was assumed to be attributed to the nearby and upgradient leaking water main, which was discovered and subsequently repaired during the UST decommissioning works.

Beneficial uses to be protected under Segment C based solely on TDS are shown in the above table. It is inferred that continued abstraction and use of groundwater at the site, particularly in the foreshore area would result in an increased groundwater salinity due to the coastal saline intrusion. Little consideration has therefore been given to the stock watering and industrial beneficial uses during this assessment given the more saline (i.e. Segment D) groundwater supply that would be sustainable.

6.4 Surface Water Protection Policy

The protection of surface water quality in Victoria is achieved by the SEPP *Waters of Victoria*. The SEPP divides the surface waters into five segments: Aquatic Reserves, Parks and Forests, Estuarine, Coastal and General Surface Waters. In August 1997, Schedule F6 – *Waters of Port Phillip Bay* was gazetted as a variation to the Waters of Victoria SEPP, and at this time the SEPP – The Waters of Port Phillip Bay was revoked. The newer Schedule F6 defined the boundaries of specific segments of Port Phillip Bay and the beneficial uses within each segment that required protection. Since the southern boundary of the site adjoins the foreshore of Port Phillip Bay, the surface water beneficial uses to be protected within the bay are defined by the Inshore segment as shown below:

Beneficial Use	Segment					
	Aquatic Reserves	Corio	Hobsons	Werribee	Inshore	General
Maintenance of aquatic ecosystems and associated wildlife						
Natural ecosystems	✓					
Substantially natural ecosystems with some modification					✓	✓
Highly modified ecosystems with some habitat values		✓	✓	✓		
Water based recreation						
Primary Contact (e.g. swimming, water skiing)	✓	✓	✓		✓	✓
Secondary Contact (e.g. boating, fishing)	✓	✓	✓	✓	✓	✓
Aesthetic Enjoyment (e.g. walking by the water)	✓	✓	✓	✓	✓	✓
Production of molluscs for human consumption						
Natural populations	✓					✓
Aquaculture	✓				✓	✓
Commercial and recreational use of edible fish and crustacea	✓	✓	✓	✓	✓	✓
Navigation and shipping	✓	✓	✓	✓	✓	✓
Industrial water use		✓	✓	✓	✓	✓

The SEPP is considered applicable to groundwater quality, as groundwater from the site is likely to discharge to Port Phillip Bay. It should be noted that the Point Cooke Marine Sanctuary is situated approximately 1km east of the eastern boundary of the site.

6.5 Adopted Groundwater Assessment Criteria

The levels of groundwater quality required to protect respective surface and groundwater beneficial uses are specified by a range of groundwater quality indicators and objectives. Based on the groundwater beneficial uses of the aquifers (Segment C) and the segment of Port Phillip Bay (Inshore) adjoining the site, the adopted assessment criteria for this investigation is as follows:

- ANZECC AWQG, Guidelines for the Protection of Aquatic Ecosystems – *Trigger Values for Marine Waters*.
- ANZECC AWQG Water Quality Guidelines for Recreational Purposes. These guidelines default back to the ANZECC (1992) AWQG *Raw waters for drinking purposes subject to coarse screening* guidelines when assessing toxicant concentrations.
- ANZECC AWQG Water Quality Guidelines for the Protection of Human Consumers of Aquatic Foods. These guidelines default back to the ANZECC (1992) AWQG *Guidelines for chemical compounds in water found to cause tainting of fish flesh and other aquatic organisms*.

Adopted assessment criteria will be limited to those mentioned above for the purposes of this investigation since use of groundwater at the site for irrigation or stock watering is considered unlikely in the future, and that the groundwater TDS is generally higher than the maximum acceptable salinity of 3,000 mg/L TDS for stock watering (ANZECC 1992). Industrial water use criteria also been deliberately omitted on the basis that the AWQG list very specific industrial processes, which may or may not be applicable to the future use of the site. Where comparative industrial criteria are not available, the guidelines default to the Raw waters for drinking purposes guidelines, which are already included as part of other beneficial use criteria.

It is noted that Section 4.4 of ANZECC AWQG (2000) indicates that protection of wild fish for human consumption is best achieved through maintenance of a healthy ecosystem to support them through their life cycle, therefore it is best to apply the water quality guidelines for managing aquatic ecosystems. The aquatic ecosystem protection criteria are designed to be applied within the water body, therefore use of these guidelines for the assessment of groundwater quality must take into account the dilution that may occur between the point of measurement (i.e. monitoring well closest to the surface water body) and the point of discharge to the surface water body. Significant mixing of groundwater and surface water within the aquifer would be expected due to tidal effect in addition to dilution due to tidal and bay currents as the groundwater discharges to the surface water through the Bay sediments.

Estimates of the expected concentrations in the surface water of Port Phillip Bay due to the discharge of contaminated groundwater have been made in the past (CMPS&F 1997). The conservative estimates used the concentrations within the groundwater sampled from the monitoring well closest to the high tide line, and assumed no dilution prior to discharge through the sediments of the Bay. Tidal and Bay currents were also considered.

The criteria values for each of the beneficial uses for respective analytes as well as the adopted criteria are shown with the analytical results. The final criteria adopted for the site is the lowest threshold concentration between respective criteria for each analyte (where available). For the purposes of this investigation, groundwater contaminant concentrations have been compared to the ecosystem criteria without taking into account dilution between the aquifer and the point of discharge, or dilution within the surface water.

7.0 UST DECOMMISSIONING

As a part of the due diligence environmental works, all known USTs used for fuel and oil storage were decommissioned excluding two USTs associated with operational backup power supply facilities. The decommission process involved the breaking open of ground, removal of the UST and its associated pipe-work and validation of the excavations. Removing these primary sources of petroleum impact was undertaken since most of these facilities were disused and to ensures there were no future or continued product losses to soil and groundwater receptors at the site.

Site works commenced on 18 November 02 in Area A and were completed on 10 December 02 in Area D.

7.1 UST Identifiers

Each UST location was arbitrarily allocated a location number as described below to assist in uniquely describing sampling and analysis undertaken at each UST. The UST identifiers for decommissioned plant in each area were:

- Area A: A40 to A46
- Area C: C17 to C18
- Area D: D30 to D33

USTs were not found in Areas B and E were found to not contain USTs. The locations of the USTs that were decommissioned, are remaining and those previously decommissioned inclusive are presented on Figures 4 to 10.

7.2 Decommissioning Works

The following sections review the decommissioning works completed for each area of the site.

7.2.1 Area A

Area A held a total of eight USTs, seven of which were decommissioned during this investigation and one that remain in commission.

7.2.1.1 UST A40

Excavation works were commenced on 19 November 02. The UST was removed and the backfill placed on the 21 November 02. Reinstatement of the surface concrete was completed 9 December 02.

UST Description
UST A40 was a 5.5 kL steel tank measuring 3.7m by 1.55m and previously supplied a boiler room in Building 3 (now natural gas supplied). The tank held approximately 3 KL of product, water and sand prior to removal. Substantial corrosion and scale was noted over the surface, and several cracks formed upon removal.

The fill line was also severely corroded with large rust holes. These may have formed after the UST became redundant as only minor hydrocarbon impact was observed in the soil beneath. The fill and suction lines were cut off at the face of the excavation.

Excavation Observations
The liquids and solids within the UST were removed by breaking open the UST by the excavator. This highly odorous material was stockpiled separately onto plastic sheeting and bunded appropriately.

Once the UST was removed, the sand backfill was excavated until the natural soils were exposed. The backfill sand was slightly odorous, however natural soils on the base and walls were visually clean with no indications hydrocarbon impact.

The geological profile on the walls generally comprised concrete to 0.20 m, crushed rock to 0.30m and a medium to high plasticity basaltic silty clay to the base.

7.2.2.1 UST A41

Excavation works commenced on 19 November 02. The UST was removed and the backfill completed on 21 November 02. The reinstatement works were completed on 9 December 02.

UST Description
UST A41 was a 16 kL steel tank measuring 2.70m by 4.45m, which previously supplied fuel oil to a boiler room in Building 6 (now natural gas supplied). The tank held approximately 8 KL of product, water and sand which was removed by breaking open the UST by the excavator. This highly odorous material was stockpiled separately onto plastic sheeting and bunded appropriately.

Excavation Observations
The UST was in good condition with no indications of structural compromise. The fill and suction lines were cut off at the excavation. The pit excavated was completed when natural silty clay soils were exposed on the walls and base which had no visual or olfactory indications of hydrocarbon impact.

The geological profile on the walls generally comprised concrete to 0.20 m, crushed rock to 0.30m and a medium plasticity basaltic silty clay to the base.

7.2.3.1 USTs A42, A43, A44

These USTs were positioned adjacent to the Caltex Service Station (building 454). Excavation and validation works commenced on 22 November 02 and were completed on 25 November 02. The resulting excavation was securely fenced and backfill works commenced on the 4 December 02, and completed on the 9 December 02. The surface was reinstated with crushed rock and compacted by excavator track rolling.

UST Descriptions
UST A42 was a 20 kL tank unleaded petrol tank measuring 5.5m by 2.2 m. USTs A43 and A44 were both 40 kL leaded petrol tanks measuring 11m by 2.2m. UST A43 contained approximately 600 L of hydrocarbon product. The other two USTs were empty upon decommissioning.

Each UST was in good condition, however the fuel delivery system showed indications of corrosion. Refer to Figure 14 for the excavation validation plan and to Plate Collection 2 in Photographs.

Excavation Observations
The USTs were covered by a thick concrete anchor at 0.8 mbgs, overlain by sand backfill to 0.35mbgs. This sand was found to be odorous and stained close to the anchor. This impact originated from either surface spillage that infiltrated from the surface, and or leaks from the suction – return line system. Sand backfill around the USTs beneath the anchor was also slightly odorous yet appeared visually clean.

The base of the pit was cleaned out to 3.3 mbgs, at which highly weathered basalt bedrock was encountered and no further excavation could be accomplished. Discontinuous patches of grey clay (assumed to be potentially hydrocarbon stained) were noted beneath USTs A42 and A44 at which points validation samples were collected.

The walls of the excavation were observed to be free of hydrocarbon staining. The general geological profile consisted of bitumen or concrete at the surface, crushed rock to 0.3 m bgs beneath which a dry basaltic silty clay extended down to weathered basalt bedrock at 3.3 m. Groundwater seepage was observed at approximately 3.2mbgs.

7.2.4.1 UST A45

Excavation and UST removal works were commenced and completed on the 23 Nov 02. The excavation was backfilled immediately with Class 3 non descript crushed rock (NDCR). The surface was reinstated with bitumen on 12 December 02.

UST Description
UST A45 was a 5 kL in volume measuring 5.5m by 2.2 m, and was formerly used for waste oil storage originating from the service station garage. The tank contained approximately 4 KL of waste oil.

The UST was in found to be in reasonable condition, with no indications of compromise. Refer to Figure 14 for the excavation validation plan and sample locations.

Excavation Observations
The backfill sands were visually clean and exhibited no odour. The walls and base of the excavation also appeared visually clean. Some perched water seepage was observed in the crushed rock fill beneath the bitumen around the excavation. The base of the excavation reached 2.3 m, however weathered basalt rock was not encountered.

7.2.5.1 UST A46

Excavation works commenced on the 25 November 02 and the UST was removed on 26 November 02. The excavation was backfilled immediately with Class 3 NDCR. The surface was reinstated with bitumen on 12 December 02.

UST Description
UST A46 was an 18 kL tank measuring 5.0 m by 2.2 m, and previously supplied fuel oil to the laundry boiler (Building 297). Approximately 11 kL of muddy water was pumped out prior to excavation works.

The UST was in good condition, with only minor surface scale. Refer to Figure 15 for the excavation validation plan and sample locations.

Excavation Observations
The backfill sands were slightly stained and odorous near the surface. There were no indications of system failure. The walls and base were visually clean, apart from significant rust staining on the eastern face. Further excavation in this direction was limited due to the presence of a natural gas service. Natural silty clays were exposed on all walls and at the base which reached 2.3 m bgs.

7.2.2 Area C

Two aviation re-fuelling USTs existed in Area C, which have been previously decommissioned by others and one disused boiler UST decommissioned in-situ by HLA (December 02). One operational UST remains in the vicinity of the control tower.

7.2.1.2 UST C17

UST Description UST C17 is a 5 kL fuel oil UST previously supplying fuel to a boiler located in the museum (Building 184), and was found to contain approximately 1.7 kL of product. The tank is overlain by a concrete anchor, above which 415 KV 3 phase power lines were encountered. Two stormwater services are also in close proximity to the UST.

Preliminary Excavation Works
An attempt at removing UST C17 was conducted on 29 November 02. A licensed electrician first isolated the electrical service. Upon initial excavation, the electrical service was found to overlie the anchor supporting the UST. Considering the potential for severe disruption to the electrical service supplying the RAAF Museum and the need to temporarily remove both storm-water services, decommissioning the UST in-situ was considered appropriate.

A small stormwater service which drains a nearby electrical service pit was intersected and damaged and subsequently repaired during the preliminary excavation works. The pipe was reinstated on the 6 December 02.

In-situ Decommissioning Work
The tank was first pumped of residual product (28 November 02), then in-filled with (cement) stabilised sand (4 December 02).

7.2.2.2 UST C18 and C19

Defence site service plans viewed at the Asset Services Offices (RAAF Williams – Laverton) showed the locations of USTs C18 and UST C19 as underground fuel tanks, and presumably they stored aviation fuel. Refer to Figure 8 for the locations.

Indications are these USTs were decommissioned in the past as indicated by the concreted area over the former fill and dip points. Soil bores were drilled by truck mounted rig down to 5 m bgs around each UST to investigate for the presence of lateral hydrocarbon impact. Refer to Section 7 for the results of the drilling investigation.

7.2.3 Area D

7.2.1.3 UST D30

Excavation and UST removal works were commenced and completed on the 27 November 02. The excavation was securely fenced off and backfilled on 9 December 02 with site-derived validated clean fill. The surface was compacted by machine track rolling.

UST Description
UST D30 was a 5.5 kL tank measuring 3.7 m by 1.55 m, supplying fuel oil to the boiler house located on the west side of Building 95. The tank contained approximately 1,000 L of hydrocarbon liquid. The liquid within the UST resembled waste oil, indicting a potential change in use after the boiler was decommissioned (date unknown).

The UST was in found to be in a poor condition, with severe surface rust and significant rust holes at the base. Product had consequently leaked into backfill and natural soils at the base.

Refer to Figure 16 for the excavation validation plan and sample locations. Refer to Plate Collection 2 in the photographs section for the UST condition.

Excavation Observations
The backfill sands were found to be to be visually clean on the top half of the pit. Backfill sands around the bottom half and beneath the tank was impacted in varying degrees. A small quantity of free product pooled at the base once the tank was removed, which was pumped and disposed off site by a liquid waste contractor.

All backfill sands were excavated and stockpiled separately on plastic sheeting. The natural clay soils on the north, west and south walls were impacted with staining and strong odours from approximately 1.8 m bgs. The base was extended to 2.6m, until PID headspace readings were low. Validation samples were taken and the excavation secured and left open until analytical results were received.

The general geological profile consisted of medium grained dune sands to 1.20 m bgs and basaltic silty clays with natural green mottling to the base. Highly weathered basalt floaters were encountered at the base.

Groundwater seepage filled the pit to 1.8mbgs. This water pumped from the excavation prior to backfill placement.

7.2.2.3 UST D31

Excavation and UST removal works commenced on the 27 November 02 and the UST was removed on 28 November 02. The pit was backfilled with NDCR (Class 4) and compacted by machine track rolling.

UST Description
UST D31 was a 38 kL tank measuring 10 m by 2.2 m, and serviced the nearby leaded petrol fuel bowser. The tank was found to be full of water, which was removed and disposed off site by a liquid waste contractor. The UST was in good condition, with no indications of structural failure. The unique style of construction, suggest the tank was tailor made for the location. The suction – return line system showed indications of corrosion and leakage, particularly around the tank and bowser manifolds. Refer to Figure 17 for the excavation validation plan and sample locations. Refer to plate Collection No. 2 in the photograph section.

Excavation Observations
Hydrocarbon impact was present around most of the UST, predominantly confined to the natural clay soils from approximately 1.2mbgs down to the base of the excavation. The northern wall and eastern face were the most visually impacted. The natural sands above the clay appeared visually clean.

The heavily impacted soils at the base could not be removed past 3.3m due to the excavation restraints (located between two hangars). A sheen inferred to be due to hydrocarbon product was evident on groundwater that pooled in the excavation. Validation samples were taken from base and walls except for the west wall and the excavation was backfilled immediately due to the risk of collapse. The west wall was not sampled at the time due to the presence of an unexpected water main which was damaged and replaced during the works.

The general geological profile consisted of medium grained sands to 1.5 mbgs and basaltic silty clays to the base of the excavation.

7.2.3.3 UST D32

Excavation works commenced on the 28 November 02 and the UST was removed on 29 November 02. The pit was backfilled with site derived clean fill and NDCR (Class 3). Compaction by machine track rolling was conducted after all three UST pits were backfilled.

UST Description
UST D32 was a 42 kL tank measuring 11 m by 2.2m, and serviced the nearby diesel bowser. The UST was full of water prior to the works which was removed and disposed off off-site by a liquid waste contractor. The UST was in good condition, with no indications of structural failure. The suction – return line system, as with D31, showed indications of corrosion.

Refer to Figure 17 for the excavation validation plan and sample locations. Refer to photograph No. 9 in Collection No. 2 for west wall profile.

Excavation Observations
As with D32, hydrocarbon impact was confined to the natural clay soils from approximately 1.0mbgs and below. Staining and strong odours were observed on the base and west wall. Hydrocarbon staining and odours appeared to decrease towards the southern end of the pit.

The heavily impacted soils at the base could not be pursued past 2.8 m bgs due to the excavation restraints and the heavily saturated conditions. A sheen was observed on groundwater that pooled in the excavation. Validation samples were taken from the walls and the excavation was backfilled immediately.

The general geological profile consisted of medium grained sands to 1.0 mbgs and basaltic silty clays to the base of the excavation.

7.2.4.3 UST D33

Excavation and UST removal works were commenced and completed on the 3 December 02. The pit was backfilled with NDCR (Class 3) and track rolled by machine.

UST Description
UST D33 was a 20 kL tank measuring 5.6 m by 2.2 m, and serviced the leaded fuel bowser. The UST was partially full of water with a small volume of product which was removed and disposed off site by a liquid waste contractor.

The UST appeared in excellent condition. The suction – return line system did not show indications of corrosion or leakage.

Refer to Figure 17 for the excavation validation plan and sample locations. Refer to plate Collection No. 2 in the photograph section.

Excavation Observations
There were no visual indications of hydrocarbon impact within the backfill sands or in the natural materials. The general geological profile consisted of medium grained dune sands to 1.5 mbgs and basaltic silty clays to the base of the excavation.

7.2.5.3 Interruption to Services near USTs D31, D32, D33

During the initial excavation of UST D31, a 150 mm cast iron water main not shown on the site service plans was encountered at 1.5 m bgs. The service cracked soon after exposure, and the water mains were shut off until backfill works were complete. The service was reinstated on 6 December 2002 by Asset Services. Refer to photograph No 9 in plate Collection No 2.

A half inch copper water pipe that connects from the water main to building 104 was removed during excavation works on UST D33, and reinstated on the 6 December 02.

Refer to Figure 17 for the location of these services.

7.3 USTs Remaining in Commission

Two of the USTs originally ear marked for removal were found to be operational and left in commission including:

- Building 25 (Area A) – Sub Station No.2. Backup generator supplied by 11 kL UST (diesel).
- Building 197 (Area C) – Control tower plant room supplied by a 7 kL UST (diesel)

After discussions with Asset Services and the Site Planning Manager, it was decided to leave these USTs in-situ as operational assets.

Refer to Table 2 for the schedule of UST assets for the whole site.

7.4 Backfill and Re-instatement Works

Imported fill consisting of “Class 3 - 3% stabilised NDCR” was placed in all trafficable areas to ensure immediate consolidation and to provide a stable platform for hard-standing reinstatement. NDCR was placed in area D for USTs D31, D32 and D33 because of the immediate need to backfill the excavations for structural reasons.

Refer to Table 3 for the schedule of backfill types and quantities placed in each UST excavation.

7.5 Soil Validation Sampling

The validation soil sampling procedures employed during the works were outlined in the Work Plan (HLA 2002). Generally the procedure for excavation sampling involved collecting grab samples from the walls and base via the excavator bucket. For stockpile sampling, a shovel and trowel were used to dig into the pile at least 20 cm to gain a representative sample. All hand sampling equipment was decontaminated or sampling was undertaken using a new disposable glove.

The locations and information relating to each excavation validation sample are presented on Figures 12 –17 and Table 4 respectively. Information relating to the stockpile validation samples is presented in the Tables 5.

7.6 Laboratory Analysis

Analytical testing was performed by MGT Environmental Consulting (MGT). The analysis was performed using NATA registered methods.

- Validation samples obtained from the UST excavations were analysed for TPH, BTEX and lead; and selectively for PAHs. Analytical results from the excavation validation sampling are presented in Table 9.
- Stockpile validation samples were analysed for the EPA Bulletin 448 (1995) list for the classification of material. Analytical results are presented on Table 10.
- Summary analytical results for the imported crushed rock used on site is presented in Appendix G.

7.6.1 Excavation Validation

The NSW EPA (1994) sensitive land use guidelines for TPH concentrations were conservatively adopted for the assessment of the excavation validation results. NEPM "F" criteria were adopted for PAH and metal concentrations.

7.6.2 Stockpile Validation

The EPA Bulletin 448 Guideline (1995) was used to assess the stockpile sample results. Stockpiles with analyte concentrations within acceptable limits for 'clean fill' were re-used on site to backfill the excavations. Stockpiles with concentrations exceeding clean fill were classified as low level contaminated soil (LLCS), and disposed of off-site to an appropriately licensed landfill. Refer to Table 5 for a summary of the material classification results.

7.7 Off Site Disposal

The solid (sand) fill removed from within USTS A41 and A42 returned analytical results above the clean fill criteria. This material was disposed of off-site to the Boral Laverton Landfill as LLCS (27 Tonnes). Refer to Appendix H for the EPA waste disposal documentation.

7.8 Summary of Validation Results

Each UST excavation was validated by taking representative soil samples from the walls and base. Analytical results for USTs in Area A reported concentrations either below the laboratory LOR or below the adopted NSW EPA sensitive land use criteria. Analytical results from Area D reported concentrations above the NSW EPA criteria in three sample locations. No UST excavation works were conducted in Area C, however each decommissioned UST location was investigated for the presence of hydrocarbon impact.

A summary of soil validation results each area is presented below.

Area A

- Soil Validation results from the excavations of USTs A40, A41, A42, A43. A45 and A46 reported concentrations less than the laboratory limits of reporting (LOR).
- Hydrocarbon concentrations below the NSW EPA sensitive guidelines were reported at the base of UST A44 at the interface of the weathered horizon and basalt bedrock.

Area C

- The UST decommissioned in-situ by HLA (C17) was found to have residual hydrocarbon impact to the fill material on top of the UST and within the tank pit backfill sands greater than the adopted NSW EPA sensitive land use guidelines. Refer to section 11.1.3 for the discussion of these results in association with the groundwater sampling results.
- The two previously decommissioned USTs (C18 and C19) were investigated for the presence of hydrocarbon impact by soil bore drilling adjacent to each location to 5 m depth. The analytical results for soil samples at depth indicate no laterally extensive contamination exists in natural soils surrounding these USTs. Analytical results for one sample in the fill material reported TPH concentrations greater than the NSW EPA criteria. Refer to Section 11.1.3 for the discussion on these results.

Area D

The results for each UST excavation are discussed individually. Refer to Figures 16 and 17 for the excavation validation plans relating to these USTs.

- UST D30: Soil validation results reported residual hydrocarbon impact in natural soils on the north and south walls below the NSW EPA sensitive land use guidelines.
- UST D31 and D32: Validation soil results reported Benzene concentrations greater than the NSW EPA sensitive land use criteria for samples taken on the base of D31 and the walls of D31 and D32. Concentrations of TPH in the volatile fraction were reported above the NSW EPA criteria on the west wall of D32. These results were consistent with the presence of visually impacted soils remaining in the natural soils of these excavations. Further excavation of impacted soils at the time of the works was not possible due to the proximity of buildings 101 and 104. Further soil remediation will be necessary in the event of redevelopment or construction in and around these excavations. The discussion on the significance of results refer is presented in section 11.1.4 and 11.4**.**

8.0 SOIL INVESTIGATION

The soil investigations comprised the drilling of soil bores via hand auger and drill rig methods, and the excavation of test pits in targeted areas. Experienced HLA fieldwork personnel supervised each investigation activity. Information relating to the investigation is presented as follows:

- Refer to the Work Plan (HLA, October 02) for the drilling, sampling and decontamination procedures employed during the works for each method.
- Refer to Section 1.5 for the contaminant issues which formed the basis for selecting the locations investgated and the analytical regime.
- Refer to Section 2.0 for the scope of works completed in each area.
- Refer to Table 6 for and area by area presentation of the rationale and analytical regime for each soil investigation location.
- Refer to Appendix A for the geological logs of hand augers, soil bores and test pits.
- Refer to Figures 4 to 10 for the investigation locations as described below.

8.1 Hand Auger Sampling

A total of 52 hand auger boreholes were drilled in Areas A, B, C, D and E in order to gain representative surface and shallow soil samples to address the surface contamination issues. Refer to Table 6 the rationale and the analytical regime for each hand auger location.

8.2 Soil Boring Sampling

A total of nine soil bores were drilled by truck mounted rig around operational and previously decommissioned USTs in Areas A, C and D to investigate the presence of any lateral hydrocarbon impact. The drilling depths ranged from 4 m to 5 mbgs. The USTs investigated were:.

Area A Building 25 Electrical Substation.

Area C Previously decommissioned USTs C18 & C19.

Area D Previously decommissioned USTs D34 & D35, and in the location of a potential / unconfirmed UST.

8.3 Test Pit Sampling

The test pit program aimed to provide representative samples of fill and natural materials, and to allow visual investigation of sub surface conditions in targeted areas. A total of 43 test pit works were conducted in Areas B, E and F. In summary, the specific contamination issues targeted were:

Area B: Areas of earthworks, potential land filling and sludge deposition associated with the sewage treatment works.

Area E: Former WWII refuelling area

Area F: Areas of earthworks, dumping, land fill activities and fire training.

8.4 Sediment Sampling

A total of four sediment samples were obtained from the RAAF Lake approximately 50m from the edge of the current water line. Analytical results are discussed in Section 9.

8.5 Fill

The soil investigation works encountered various fill material types across the site. Two types of filled ground were identified:

- Engineered and miscellaneous fill in developed areas of variable thickness associated with previous ground works and building construction.
- Fill material associated with landfilling and general tipping in undeveloped areas of the site.

By area, fill material was characterised as:

Area A

- Silty/sandy gravel ballast beneath hard standings with anthropogenic inclusions of wire, bricks, terracotta pipe and concrete fragments with areas of gravely clay around buildings and UST installations. The maximum depth proven was to 1.1m.
- A discontinuous layer of slag-ash and charcoal, generally from 0.1 m to 0.2 mbgs, was found around the service station (Building 454), beneath the locations of the previous welding and paint shops (A28HA and A29HA).

Area B

- Test pits north of the sewerage treatment plant encountered fill consisting of reworked natural gravely clays, bricks, concrete block and miscellaneous metal debris to 1 mbgs.
- Test pits within the area of solid inert waste dumping south of the sewage plant encountered fill consisting of natural sand with bricks, concrete and minor charcoal inclusions to from 0.3 – 0.4m m bgs.

Area C

- Silty gravel and well sorted engineered gravel fill was encountered beneath all hard standing surfaces, the maximum depth of which was 1.0 mbgs at C14HA.
- A 100 mm thick layer of slag, ash and charcoal was encountered between the museum hanger buildings.

Area D

- Engineered gravels and reworked natural soils with anthropogenic debris were encountered beneath all hard standing surfaces. Minor traces of slag ash were noted in several locations around the old hanger buildings.
- Fill material consisting bituminous material gravel of was observed from 0.1-0.2m bgs on the driveway surface between the horizon tank and the hanger buildings. Minor inclusions of glass and metal scrap were noted during the excavation of ground in attempt to find the missing groundwater monitoring well PCMB16

Area E

- Fill was encountered within artificially raised ground associated with the wartime re-fuelling area, beneath which two bitumen and crushed rock layers with metal and construction debris were observed to a depth of 1.0mbgs.

Area F
Fill materials have been classified into three categories in association with the financial risk analysis employed and reported separate to this report.

Refer to Figure 11 for the delineation of the solid inert waste disposal areas as inferred from the high-resolution digital aerial photograph, site inspections and the site investigation works.

- *Non-Recyclable Solid Inert Waste* : Two main areas of waste disposal were identified on Area F, consisting of dumped soil, construction debris and miscellaneous corroded metal scrap. Refer to Figure 11 for the inferred areas these disposal areas.
- *Recyclable Solid Inert waste:* Solid inert materials consisting of large concrete pieces and metal debris have been placed ad-hoc around the perimeter of the large waste disposal area south of the lake (Area G). These areas have been estimated from the aerial photograph site observations and are presented on Figure 11. Solid inert waste, consisting of concrete pieces and steel scrap (eg aircraft pieces), is also present in small discrete piles (1-2 m^3) scattered across the area.
- *Asbestos Cement Sheeting:* Small discrete piles of broken asbestos sheeting pieces were observed in several locations (1 to 3 m^2) predominantly in and around the solid waste disposal areas. The fragment size ranged from 10 mm – 300 mm in length. An example of such a 'hot spot' is shown on photograph 7 in plate collection 4. Isolated, scattered fragments of asbestos cement ranging from 5 mm-50 mm were also noted over Area F during the soil and groundwater investigation. (note, the areal extent of asbestos fragments on the ground surface was not surveyed during the works). Refer to Photograph 3 in collection plate 4 for an example.

Refer to Figure 11 for the inferred areas relating to the materials described above. Refer to Collection 4 in Photographs for examples of these types of fill. The estimated quantities of the various areas of fill material in Area F are summarised in Table 17.

8.6 Natural Geology

Drilling of groundwater monitoring wells, soil bores, hand auger holes and the excavation of test pits confirm the views of previous surveys that the Point Cook site is extensively underlain by a layer of extrusive volcanic basalt overlain by various Quaternary sediments.

A description of the lithological sequence encountered during the investigations is discussed below.

Quaternary Sedimentary Deposits

A surficial layer of brown silt is found widely across site and is most likely of Aeolian (wind blown) origin. The silt and clayey/sandy silt equivalents often form topsoil with a moderate organic content associated with vegetation. The depth of this unit varied across the site but was typically in the order of less than 2m thick.

Along the coastal boundaries of the site, deposition of Quaternary aged sediments has lead to formation of a beach barrier sand dune system. Dunes and Aeolian sand sheets of variable thickness extend back from the high tide reaches of Port Phillip Bay to form a barrier along the entire southern coastal margin.

Beach deposits comprising sands rich with coarse shell fragments are found underlying the dune sands in most locations. These deposits represent past marine environments subsequently covered following a lowering of local sea levels or increase in depositional rates in the near shore environment.

Alluvial deposits of sandy and silty clays along former and present stream courses and paludal sediments from inland and tidal swamp and lagoonal areas are also intermittently present along the southern margins of the site. The wide variety of resulting sediments include sands, gravels, clays and silts. These are often covered by more recent aeolian or beach sand deposits.

Quaternary Basalt Deposits

The geology of the site is dominated by a layer of Newer Volcanic Basalt that extends underneath the entire site except for a small section in the eastern coastal corner (discussed below). The basalt encountered is typically highly vesicular grey/blue basalt. A characteristic weathering profile accompanies the encountered basalt and comprises a downward profile of:

- Heavily mottled grey/brown - orange/brown high plasticity clay.
- Highly weathered basalt consisting of partially consolidated basalt fragments, soft white calcareous grains and associated clay minerals.
- Grey/brown to orange brown basalt with formation of basalt floaters.
- Hard grey vesicular basalt.

The layer of basalt-derived clay was encountered in all of the bores drilled by HLA that encountered consolidated basalt rock, however previous investigations (CMPS&F 1995a) have suggested that the layer of clay is not continuous across the site. The thickness of the basalt was confirmed to be greater than 4 m (A17MW) and is expected to be in the order of 10-20m thick (Dames and Moore 1993).

Local Geology of Area F

A small section of the site in Area F directly south of the lake is the only portion of the site in which the geology varies markedly from the sequence of relatively shallow New Volcanic basalts overlain by a thin layer of Quaternary sediments. A conceptual model of the geological profile based on monitoring well, soil bore and test pit logs is presented in Figure 18.

Gauging by the depth of bores previously installed in the basalt aquifer (PCMB4, PCMB8A and PCMB3A) and recently installed monitoring wells and soil bores (F01SB and F02MW), it appears that the upper surface of the unweathered basalt dips in a south easterly direction underneath this section of the site. This in turn corresponds to an increasing profile of quaternary sediments and clays derived from basaltic weathering.

Bores both in the north (F01SB) and south (F02MW) of Area F were drilled to 15 m below ground level without intersection of fresh basalt rock. Rather, a sequence of aeolian, beach, alluvial and paludal sedimentary deposits of variable thickness, extent and permeability were encountered overlying a thick sequence of basaltic clay.

The sedimentary sequence varied widely across the area as would be expected in a dynamic near shore environment. Monitoring well F04MW displays a typical sedimentary profile for the area, with a sequence of aeolian dune sands, coarse orange/brown beach sand with shell fragments and possible alluvial gravels.

Underlying much of this intermittent profile in the area is a sequence of paludal deposits that are typically grey to grey-blue in colour with an increasing clay content, ranging from clayey sands (F04TP) to silty clays (F01SB). The depth to this unit varies across the site but is generally in the range of 1.05 m to 1.6 m below ground surface. Paludal sediments appear to occur at a slightly shallower depth on western edge of Area F (F06TP) and at a increased depth (2.0 m at F02MW) close to the shoreline in the south eastern corner of the site.

In bores drilled to 15 m depth in the area (F01SB and F02MW), a layer of firm, high plasticity grey to grey-green clay was encountered that varies in thickness from 1.0 m in the north to 0.3 m adjacent to the coast. The continuity of this clay layer across Area F cannot be extrapolated from the current data. The variety of high energy environments suggested by the overlying sediments may have resulted in partial and/or complete erosion or reworking of any continuous stratigraphic sequence originally deposited.

A further paludal unit of soft sandy/silty clay to clayey silt is found beneath the clay layer with a thickness of 0.3 m (F02MW) to 0.5 m (F01SB) at a depth of 3.3 m to 4.5 m. The paludal deposits located under the western edge of the lake (E16TP) are possibly of a continuous nature with this layer and/or the overlying paludal sediments.

A sequence of high plasticity basaltic clays (greater than 10 m thick) was then encountered. A deep clay profile such as that encountered can be the result of conducive weathering conditions for the basalt such as aquatic/marine submergence. This is generally consistent with the paludal type deposits found overlying the basaltic clay sequence.

9.0 GROUNDWATER INVESTIGATION

The following sections describe the results of the groundwater investigation. The locations of all monitoring wells existing on the site are shown on Figure 2.

9.1 Location and Condition of Existing Monitoring Wells

The existing monitoring wells (installed by CMSP&F in 1994) were located using a differential GPS (approximately +/- 0.15m accuracy) and a metal detector. PCMB5 and PCMB16 could not be located by HLA even after GPS location, hand excavation of fill material in the area and further sweeping with the metal detector. It is believed that both these bores were destroyed during filling activities appear to have occurred across this region of Area D.

Some of the existing wells which had been installed with protective covers flush with the ground surface were found to be covered with vegetation which required localised clearing to permit access for sampling. At several locations these covers had been disturbed and were no longer protecting the top of the wells. The metal standpipe protecting PCMB4 had been completely removed and the bore casing appeared to have been shortened to sit flush with ground level. No PVC end cap was found sealing the top of this well or at PCMB13 and PCMBB2. The end caps were replaced by HLA during the course of the investigation.

9.2 Installation of Additional Monitoring Wells

Location and summary analytical information is presented as follows:

- Refer to Figure 2 for the location of each existing and additional groundwater monitoring well.
- Refer to Table 7 for the individual rationale for each additional monitoring well and the analytical regime selected for individual groundwater samples.
- Refer to Table 15 for the groundwater analytical results.

The additional monitoring wells were installed to further characterise the groundwater systems beneath the site and address the data gaps from the previous investigations, namely:

Area A — Characterisation of the up-gradient and down gradient groundwater quality and to target potential hydrocarbon impact from the service station USTs.

Area B — Further investigate groundwater up gradient and down gradient of the sewage treatment plant and the landfill area.

Area C — No additional wells were deemed necessary.

Area D — Replacement of monitoring well PCMB5 which could not be located and was originally situated directly downgradient of the three USTs.

Area E — Investigate groundwater beneath the war time refuelling area for the presence of hydrocarbon impact.

Area F — Further delineate the dissolved phase hydrocarbon plume associated with the FTA and determine whether the presence of dense non-aqueous phase liquids was likely.

9.3 Level Survey

The top of the PVC casing of all new and existing monitoring wells were surveyed to Australian Height Datum (AHD) to an accuracy of ± 0.005mAHD by a licensed surveyor under the guidance of a HLA Environmental Scientist. The surveyed heights of many of the existing bores (PCMB series) were found to be inconsistent with previously reported surveyed level data (CMPS&F 1995a). The variation in recorded survey levels was considered to be due to either inaccuracy in the previous survey data, damage or alteration to the surface casings at the wells (this was observed at several of the existing wells upon inspection) or possible settlement. Due the variation in levels, all monitoring wells were resurveyed to AHD to provide consistency. The results of the survey are included in Table 8.

9.4 Aquifers

Based on borelogs and lithological interpretations, two principal aquifers systems have been intercepted and monitored at the site. The aquifers of concern consist of a:

- Surficial Sedimentary Aquifer.
- Newer Volcanic Basalt Aquifer.

Figure 18 shows a conceptual geological cross section across the south-eastern portion of the site depicting this profile.

The general distribution and relationships of these aquifers is discussed below.

9.4.1 Surficial Sedimentary Aquifer

Groundwater was intercepted at shallow depths within the various sedimentary units of the aquifer. Typically, groundwater was first encountered at a depth of approximately 1-1.5 m below the surface within the coarse shelly beach sands underlying more recently deposited Aeolian dune sands. Groundwater extends to the base of the sedimentary deposits where it was frequently found to be perched upon the weathered basalt clay profile.

Recharge of the surficial aquifer is expected to occur via infiltration of rainfall and from local surface water bodies under suitable conditions. In areas where the basaltic clay layer is not present, as found in previous investigations (CMPS&F 1995a) it is expected that the surficial sedimentary aquifer and deeper basalt aquifer will be acting as unconfined aquifers.

9.4.2 The Newer Volcanic Basalt Aquifer

Based on the geology and screen intervals of bores installed across the entire site, cation and anion ratios, TDS concentrations and static water level (SWL) measurements, it has been interpreted that a significant basalt aquifer exists across the entire site although it's extent under Area F can only be extrapolated based on the current data.

Groundwater was found to occur within both the:

- The basalt weathering profile - generally perched on top of the basalt bedrock in the zone of highly weathered basalt consisting of partially consolidated basalt fragments, soft white calcareous grains and associated clay minerals, and
- Unweathered basalt bedrock.

Groundwater was intercepted at depths below ground level ranging from 0.718 m (PCMB8A – foreshore area) to 4.515 m (A22MW – adjacent to the northern site boundary). A wide variation in the permeability of the aquifer as reported previously (CMPS&F 1995a) reflects the heterogeneous nature of the basalt encountered whilst drilling. The higher permeability zones are expected to represent fracture and jointing features within the basalt that are likely to form the preferential flow pathways of groundwater within the aquifer. During the drilling of monitoring well F02MW (immediately adjacent to foreshore in Area F), a relatively homogeneous profile of basaltic clay greater than 15m in thickness (maximum depth of drilling) was encountered below the surficial deposits.

As the base of the basalt aquifer was not intercepted during the current investigation, the nature of any contact with underlying units is unknown, however based on regional geology it is expected that the clays within the palaeosols that commonly occur at depth between subsequent basalt lava flows may restrict downward groundwater flow from the upper basalt aquifer.

9.4.3 Brighton Group, Werribee Formation and Silurian Bedrock Aquifers

Groundwater is also expected to occur within sedimentary framework of the Brighton Group and Werribee Formations and within the fractures and joints of the Silurian bedrock formation. These aquifer systems have not been assessed as part of this investigation due to the low probability of being adversely affected by site activities.

9.5 Groundwater Levels and Well Gauging

All monitoring wells were gauged for water level and the potential presence of non-aqueous phase liquid (NAPL) on 17 December 2002. The gauging was undertaken by a single HLA hydrogeologist over a three hour period to ensure consistency between measurements. The SWLs measured and AHD reduced water levels are presented in Table 8. No NAPL was recorded during the gauging.

Surficial Sedimentary Aquifer

SWLs in the surficial sedimentary aquifer ranged from 1.003 m AHD (B02MW) to 0.115 m AHD (F02MW) at the time of measurement.

Static water levels and hence groundwater flow directions within the aquifer would be expected to vary:

- Seasonally, based on the frequency of recharge events (localised rainfall) and,
- Daily, based on the tidal rise and fall of surface water within Port Phillip Bay

The following analysis of groundwater flow directions have been based on conditions at the time of measurement, however it should be noted that seasonal and tidally derived variations will effect groundwater flow within the surficial aquifer.

The relatively elevated SWL in bore D23MW along the western boundary of the site suggest possible mounding of the water table in the immediate vicinity of this well. The groundwater gauging and sampling rounds coincided with the discovery of a ruptured water pipeline in close proximity to this well. The TDS of the sampled groundwater (460 mg/L) suggests that the aquifer surrounding D23MW has been artificially recharged by the leaking service and that the observed mounding does not represent a natural condition. As such the static water level measured for this bore was not considered during further data interpretation.

Newer Volcanic Basalt Aquifer

SWLs measured in the Newer Volcanic Basalt aquifer ranged from 2.700 mAHD (A22MW) to 0.262 mAHD (PCMB8A). Tidally derived fluctuations in SWLs and hence groundwater flow are not expected to be as pronounced as for the surficial sedimentary aquifer due to the increased distance of from the site to the expected point of connection with Port Phillip Bay.

The monitoring well PCMB4 had been damaged in the past resulting in the loss of its protective stand pipe, PVC casing stick-up and casing end cap. The drilled depth of the well was reported to be 8.5 m (CMPS&F 1996), however the total depth measured during recent sampling was 3.075 m from the top of the casing, therefore indicating that some soils have fallen into the well casing or some blockage has occurred. Given the condition of the well, the anomalous (elevated) SWL measured at PCMB4 is not considered representative of hydraulic conditions within the basalt aquifer and as such was not used in further analyses.

9.6 Groundwater Flow

The inferred groundwater flow directions for the surficial sedimentary aquifer and Newer Volcanic basalt aquifer are presented as Figures 19 and 20.

Quaternary Sediment Aquifer

Groundwater flow within the surficial aquifer is inferred to be to the south and south-east towards Port Phillip Bay. Based on relative groundwater elevations and the likely continuity of the sediments between the site and the Bay, groundwater in the surficial sedimentary aquifer would discharge to Port Phillip Bay. Inferred groundwater elevation contours for the aquifer in Area F are shown in Figure 19.

The close proximity of the surficial aquifer to the surface and its unconfined nature suggests aquifer recharge to occur primarily via direct infiltration of incidental rainfall. Recharge of the aquifer from the nearby lake to the north during seasonal periods of high water can be inferred based on the elevation of the seasonal high water line (1.0m AHD). As SWLs within the aquifer were all equal to or below 0.3 m AHD during the gauging period, leakage of surface water from the lake to the shallow aquifer would appear likely. No evidence was apparent under the existing conditions of a groundwater divide located in Area F associated with groundwater flow northwards towards the lake. It should be noted however that given the very local nature of the shallow aquifer, conditions may occur during which such a flow regime may exist. This would most likely occur when surface water levels within the lake were lowest, i.e. during low rainfall events, as such was acting as a local groundwater sink.

Where present, the underlying weathered basaltic clay profile is likely to restrict vertical flow of groundwater to the underlying strata. However, it is expected that there would be some groundwater interchange between the upper sedimentary aquifer and the underlying deeper basalt aquifer where the clay layer is absent.

Newer Volcanic Basalt Aquifer

Groundwater flow within the basalt aquifer is inferred to be towards the south-east in the direction of Port Phillip Bay. Groundwater elevation contours are shown on Figure 20.

The basalt aquifer is likely to display variable vertical and horizontal flow characteristics given the heterogeneous and anisotropic nature of the basalt. The low permeability sandy clays and clays in the fining-up portion of the alluvial terraces are likely to have limited horizontal flow and greater vertical flow, whereas the coarser and more permeable sands and gravels at the base of the aquifer are likely to exhibit greater lateral flow, with the weathered surface of the Older Volcanics, restricting downward migration.

Groundwater recharge of the upper portions of the aquifer is likely to result from infiltration of incident rainfall and runoff where the aquifer is not overlain by the surficial sedimentary aquifer. Underlying the sedimentary aquifer, groundwater movement between the two aquifers is expected to occur. However, as inferred above, where a layer of weathered basaltic clay is present, the basalt aquifer will be in a semi-confined state, such as in the foreshore area where basaltic clay thicknesses of greater than 15m were encountered. The difference in SWLs of nested bores along the coastal margin (PCMB3 / 3A and PCMB8 / 8A) indicates that confinement of the aquifer exists at these location.

The net hydraulic head of between 0.045 m and 0.010 m suggests that where the aquifers are in hydraulic connectivity, net groundwater flow will be from the basalt aquifer towards the surficial sedimentary aquifer. A previous site survey of the area (CMPS&F 1996) indicated that groundwater exchange may occur in either direction based on 1994 SWL gauging data. The hydraulic gradient between the two aquifers would be expected to vary as SWLs change within the sedimentary aquifer. This is expected to occur both tidally and seasonally.

9.7 Groundwater Chemistry

Cation and anion analysis of the groundwater from several bores suggests that both aquifers are dominated by a Na-Cl chemistry, with elevated bicarbonate concentrations suggesting surface water infiltration of the aquifers is an important recharge mechanism.

Despite the different character of the aquifer material, the cation and anion ratios of the Newer Volcanics and sedimentary aquifers plot in a similarly tight cluster on a Piper Trilinear Diagram (plot not provided). The slight variations in cation and anion ratios (and SWLs) support the concept of a semi-confined aquifer system with similar recharge sources.

Salinity within the two monitored aquifers varies across the site. TDS values for all bores are presented in Table 15 - Groundwater Analytical Results.

Surficial Sedimentary Aquifer

Groundwater within the Surficial Sedimentary aquifer displayed a highly variable level of salinity with TDS values ranging from 1,800 mg/L (PCMB10) to 33,000 mg/L (PCMB1). The large variation in salinity is to be expected due to the localized nature of recharge within the aquifer, the shallow thickness of the aquifer material and the close proximity to Port Phillip Bay. As the surficial aquifer system appears to be directly discharging into the Bay, saline intrusion is to be expected within the aquifer. A saline ‘wedge’ of higher salinity groundwater is expected to be present in the base of the aquifer, resulting in the higher salinities measured in F02MW and PCMB3.

Recharge of the aquifer by the surface infiltration of rainfall will result in the upper portion of the aquifer containing water of a lower salinity as found in F03MW (3,700 mg/L) and F04MW (5,100 mg/L). This may also be cause of the low salinity groundwater sampled from PCMB10 (1,800 mg/L). The occurrence of this lower salinity groundwater is likely to be restricted to the top of the aquifer and to localised areas of preferential recharge. It is not considered that this groundwater represents a viable lower TDS water resource due its limited extent and susceptibility to increased saline intrusion under pumping conditions.

The high salinity of groundwater sampled from PCMB1 (33,000 mg/L) would appear to support the model of aquifer recharge from the nearby lake (hyper saline).

Newer Volcanic Basalt Aquifer

The salinity of groundwater occurring in the Newer Volcanics basalt aquifer generally fell within the range of 2,700 mg/L to 8,100 mg/L. The only exceptions to this occurred at PCMB9 (19,000 mg/L) and in wells located closest to the coastal margins. These results, whilst variable, are generally consistent with groundwater found in the Newer Volcanic Basalt aquifer west of Melbourne (Leonard 1992).

The elevated TDS results found in groundwater from PCMB9 may be the result of variability in TDS due to localized perching of groundwater within the basalt. Bores located in close proximity to Port Phillip Bay such as PCMB8A and PCMP3A produced higher salinity groundwater than other areas of the site (13,000 mg/L and 21,000 mg/L respectively). This is inferred to be due to saline intrusion into the aquifer given their proximity to Port Phillip Bay.

10.0 ANALYTICAL RESULTS

10.1 Soil Analysis

The rationale for soil analysis was designed to address the contamination issues discussed in Section 1.5. Analytical results have been evaluated in terms of potential ongoing commercial / industrial use (NEPM 'F') and the potential for redevelopment of the site for more sensitive land uses such as residential or open space (i.e. NEPM 'A' and NEPM 'E'). Where applicable, the NEPM Interim Urban EILs were used to make an assessment of potential ecological impact due to soil contamination. A summary of all analytical results and assessment criteria is included in Tables 9 to 14. Laboratory analytical certificates are presented in Appendix B. All sampling locations are shown on Figures 4 to 17.

Results which were reported above the NEPM 'F' guidelines are noted as being greater than the commercial/industrial guidelines. The NEPM 'A', NEPM 'E' and the NSW EPA guidelines are collectively referred to as sensitive land use guidelines in comparison to the results. The following sections briefly discuss the analytical results Refer to Section 10 for the discussion of the sources and significance of the identified contamination.

10.1.1 Area A

Concentrations were reported above the commercial industrial guidelines in one location:

- Sub Station No 1: Surface fill, containing bitumen and ash, reported benzo(a)pyrene above the NEPM F.

Hydrocarbons were reported above the NSW EPA sensitive land use guidelines, notably:

- Building 25 UST: TPH (C_{15}-C_{36}) compounds in the near surface soil adjacent the suction line building entry.
- Building 454 (Service Station): TPH (C_{10}-C_{28}) compounds in the fill adjacent the fuel bowsers.
- Building 309 Compound: TPH (C_{15}-C_{36}) compounds in fill beneath the drum stack and in natural soil beneath the fuel AST.
- Other soil samples from fill material around buildings and beneath hard standings reported hydrocarbon concentrations below the adopted guidelines.

Concentrations of metals above the sensitive guidelines and EILs were encountered in several locations, notably:

- Zinc in fill around the UST at building 25 was greater than the NEPM 'A', and exceeded the EIL in surface soils around buildings in several locations.
- Copper and Arsenic in fill around buildings in isolated locations were greater than the EIL.

Residual concentrations of pesticide compounds (DDT, DDE and Dieldrin) were reported in isolated locations adjacent wooden buildings at levels below the adopted guidelines.

10.1.2 Area B

A test pit program was conducted across Area B to investigate the potential of filled ground and for possible sludge dumping from the sewerage treatment plant (STP).

Elevated concentrations of metals and hydrocarbon compounds were present in one location north of the STP in filled ground (B07TP):

- Chromium was reported above the industrial/commercial use guidelines (NEPM 'F').
- Lead was reported above the NEPM 'E' guidelines and Zinc above the EIL.
- Hydrocarbon concentrations were reported above the NSW EPA sensitive land use guidelines.

Minor concentrations of hydrocarbon compounds below the guideline levels were present in filled ground north and south of the STP.

10.1.3 Area C

Decommissioned UST Investigation

A soil bore investigation was conducted adjacent the decommissioned UST locations (refer to Figure 8). The HLA-decommissioned UST was investigated via hand auger drilling and the sampling of groundwater monitoring well PCMB22.

The analytical results above the guidelines are listed below:

UST C18

- Elevated concentrations of benzo(a)pyrene, total PAH and TPH above the sensitive guidelines were encountered in fill adjacent the UST.
- There were no elevated concentrations in the natural soils around the UST.

UST C19

- The lead concentration in fill material was reported above the NEPM E public open space guidelines.

UST C17 (Museum)

- The backfill sands sampled via hand augering in the tank pit backfill material were significantly impacted with absorbed phase hydrocarbons (30,300 mg/kg),

Soil samples taken from surface fill and soils around the hanger buildings reported concentrations of hydrocarbons and metals below the sensitive guideline levels and EILs.

10.1.4 Area D

Two main soil contamination issues were identified in Area D.

Surface Soils Around Buildings

Concentrations of hydrocarbons and metals reported in near surface fill around the buildings, notably:

- Building 211 drum store (refer to photo 8): TPH (C_{15}-C_{36}) concentrations were reported above the sensitive guidelines, and metals (arsenic, lead and zinc) were greater than the EILs.
- Copper, lead and zinc adjacent the sub station, hazardous store (building 122), and buildings 93 and 95 were reported above the EILs.
- The concentrations of other analytes reported in surface soils were below the adopted guidelines and include BTEX compounds, TPH, PAH and organochlorine pesticide compounds.

UST Farm - D31, D32 and D33

The validation sample results of the excavations for the area D UST farm reported significantly elevated concentrations of volatile petroleum hydrocarbons greater than the sensitive guidelines, notably:

- BTEX and TPH (C_6-C_9) compounds on the north end and west wall UST D31, and the west wall of D32.
- Soil samples from a hand auger borehole drilled immediately north of the UST area reported hydrocarbon concentrations below the guidelines in the fill and in natural soils at 1.9 mbgs.

10.1.5 Area E

The test pit program aimed to investigate the potential presence of hydrocarbon impact in the historical war-time refuelling area (refer Figure 11). By all indications, the area has not been used for some decades, and only broken concrete, crushed rock layers and bitumen (i.e. solid inert waste materials) were encountered in the test pits. Only one instance of petroleum hydrocarbon concentrations was reported. All analytical concentrations were either below the sensitive land use guideline levels or less than the laboratory limit of reporting.

10.1.6 Area F

Concentrations above the adopted guidelines were reported in test pits within the following areas:

- Fire training area (FTA): Concentrations of lead above the industrial commercial guidelines. Chromium above the NEPM E guidelines and zinc above the EILs (F11TP). Benzene and TPH (C_{15}-C_{36}) compounds in natural soils at the depth of the groundwater table (F15TP and F18TP) greater than the NSW EPA guidelines.
- Surface dumps: TPH (C_{15}-C_{36}) in natural soils (F19TP).
- Landfill area: Zinc in the fill (F05TP) greater than the EIL.

Selected surface samples were analysed for asbestos fibres. Chrysotile fibres were detected in two locations, namely:

- F05TP (0.5m) within the fill material.
- F11TP(0.7m) adjacent to the fire training area.

10.2 Groundwater Analysis

Laboratory analytical results are presented in Table 15. Laboratory analytical certificates are presented in Appendix B.

The groundwater analytical results indicated concentrations either below the laboratory limit of reporting or the adopted ANZECC 2000 assessment criteria excluding samples obtained from the foreshore area in the southeast corner of the site (Area F).

Groundwater results in Area F are discussed in detail in Section 10, summarised on Figure 21 and briefly described as follows in terms of the criteria exceeded:

- Contaminant concentrations exceeded the ANZECC 2000 guidelines for recreational purposes in wells PCMB2 and PCMB18 for benzene, 1,2-DCA, TCE and arsenic. 1,1-DCE concentrations in monitoring well PCMB18 also exceeded the guidelines for recreational purposes. It should also be noted that the laboratory limit of reporting for 1,1-DCE in well PCMB2 was raised to above the recreational purposes criteria due to analytical interference.
- The concentration of benzene reported in samples from monitoring wells PCBM2, PCMB18 and F02MW exceeded the ANZECC 2000 99% ecosystem protection level for marine waters. The benzene concentrations in PCBM2 and PCMB18 also exceeded the 99% ecosystem protection level for marine waters applicable for a slightly – moderately disturbed ecosystem.
- No other of the criteria published in ANZECC 2000 for marine ecosystem protection or recreational purposes was exceeded for the analytes targeted during the groundwater analysis.

It should be noted that health and ecologically based criteria have not been developed for a large proportion of the compounds detected. Figure 21 summarises the analytes detected in groundwater in the southeast corner of the site and depicts the inferred extent of groundwater contamination. The gradational shading on Figure 21 has been applied to qualitatively indicate the trend of increasing contaminant concentrations based on the current analytical results.

10.3 RAAF Lake Sediment Analysis

Laboratory analytical results are presented in with the laboratory analytical results and certificates in Appendix B. All concentrations detected were below the NEPM “A” criteria with all organic compounds reported to be below the laboratory limit of reporting. Concentrations of copper, lead and zinc appeared to be marginally higher in sample SS03 compared to the three other sediment samples, possibly due to leaching of metals from the nearby waste disposal areas or impact from the historical practice bombing activities.

10.4 Data Quality

The assessment of a number of specific quality assurance (QA) and quality control (QC) protocols was undertaken to assure both the quality and reliability of the data reported by HLA during the investigation undertaken at the site was of an acceptable standard for interpretation.

A summary of the QA/QC samples collected in the field and analysed by the primary laboratory is presented in Appendix D. Laboratory QA/QC results were included with the laboratory certificates.

The overall assessment of the quality of the data obtained during the investigation is discussed in Appendix C in terms of the data quality objectives and indicators outlined in the Workplan.

Based on the overall data set, HLA believe that the accuracy, precision, comparability, representativeness and completeness of the field and MGT analytical data and is considered sufficient for the purposes of the investigation.

11.0 DISCUSSION AND CONCLUSIONS

A discussion and the conclusions arising from the results of the due diligence works are presented in this section, grouped in terms of the media in which the contamination issues have been identified.

11.1 Soil Contamination

Soil contamination identified during the investigation is summarised in the following sections.

11.1.1 Area A

Elevated hydrocarbon and metal concentrations detected during the shallow hand augering, sampling and analysis was predominantly confined to surface fill materials in Area A. One area of elevated concentrations identified was the fill around substation #1 (refer Figure 4 - location A12HA) where concentrations of benzo(a)pyrene within the surface soils sampled at the surface were reported at over three times the NEPM "F" criteria. This surface fill appeared to be localised, and associated with the foundations of the substation facility.

Fill beneath the Building 309 compound (drum storage and fuel AST (refer Figure 4 - locations A31HA and A32HA) contains TPH and PAH concentrations above the NEPM "F" and NSW EPA sensitive land use criteria. This hydrocarbon impact is limited to fill in discreet areas immediately around the fuel storage systems beneath hard standings.

The reported zinc, copper and arsenic concentrations in several locations around buildings and in areas of fill material exceeded the NEPM "A" and Urban EILs. However, analysis of shallow soil in close proximity to areas of the site currently used for sensitive purposes (i.e. the kindergarten – locations A28HA and A29HA) reported concentrations below the NEPM "A" and NSW EPA sensitive land use criteria.

Based on the results of this and previous investigations, Area A is considered to be suitable for continued mixed land use. However, redevelopment for differing uses that includes subsurface excavation works and hard standing removal (especially around the service station and Building 309) may require limited management of potentially contaminated fill and surface soils. An EMP for the management of the identified soil contamination in Area A has been developed under separate cover.

11.1.2 Area B

The elevated chromium, lead and zinc concentrations reported above the background levels are either derived from the metal debris within the fill, or from projectiles and shell casings from the rifle range activities which have historically occurred throughout Area B. Heavy metal contamination across Area B is expected to occur both as particulate / metallic debris in shallow soils (i.e. projectiles) and as heavy metals absorbed to shallow soils resulting from weathering of the aforementioned particulate sources. There is the potential for concentrated metal contamination in discrete locations across Area B due to the rifle range (i.e. at historical and current firing positions and within the stop butt itself).

Based on the results of this and previous investigations, Area B is considered suitable for continued use as a rifle range. Due to the expected presence of heavy metal (predominantly particulate lead) debris across the area, redevelopment for a more sensitive land use is likely to require remediation. Use of portions of Area B for commercial or industrial purposes is likely to require management of the stop butt and surface soils throughout the firing range by either

restriction of access, reduction of surface exposure by covering with clean fill or removal of the metallic particulate and affected soils. The solid-inert waste that has been deposited across the area south of the STP and stop butt may require consolidation or management depending upon future use of the affected area. The volume of solid-inert waste within Area B was estimated using high resolution aerial photography to be approximately 1,500m^3 (refer Table 17).

An EMP for the management of the identified firing range soils and waste materials in Area B has been developed under separate cover.

11.1.3 Area C

Hydrocarbon impact was identified within the backfill material surrounding the UST decommissioned in-situ adjacent to the RAAF Museum (UST C17 – Figure 9). The hydrocarbon impact identified was inferred to be limited in lateral extent given the absence of dissolved hydrocarbon contamination in the groundwater monitoring well (PCMB22) which exists immediately down hydraulic gradient of the UST. The stiff natural clay soils found beneath the surface fill would limit lateral migration of the hydrocarbon impact identified. Since the UST has now been emptied and decommissioned by filling with cement-stabilised sand, the source of further contamination in this area has been removed.

USTs 18 and 19: The elevated hydrocarbon and lead concentrations are confined to the fill material beneath the bitumen surface (0.7mbgs), and is likely to derive from spills and overflow events. Hydrocarbon concentrations were not detected within natural soils at depth, indicating that marginal impact from these formerly decommissioned USTs has occurred.

Based on the results of this and previous investigations, Area C is considered suitable for ongoing commercial / industrial uses. Given the low volatility and limited extent of the petroleum impact around the decommissioned USTs in Area C, the residual contamination is not considered to pose a significant risk to site users. In the event of future excavation works in these areas, management of the impacted soil may be required. An EMP for the management of the identified soil contamination in Area C has been developed under separate cover.

11.1.4 Area D

Concentrations of BTEX and volatile TPH compounds exceeding the NSW EPA sensitive land use criteria remain in the natural soils around USTs D31 and D32. Delineation and excavation of these impacted soils was not possible since these USTs resided in the narrow space between buildings 101 and 104 (hangars). However, analytical results from the down gradient monitoring well D23MW (and historically from well PCMB5 which could not be located during the investigation) were below the laboratory LORs, suggesting that soil and groundwater impact is likely to be confined locally around the former UST area. The impact to soil or groundwater may extend laterally beneath the buildings depending on the characteristics of the fill and natural ground (refer to Section 11.3 that follows for discussion on groundwater contamination).

The excavations of USTs D30 (boiler UST) and D33 (most down-gradient UST at former POL refuelling facility) were found to be either free from detectable hydrocarbon concentrations or with levels below the NSW EPA sensitive land use guidelines.

The isolated hydrocarbon and metal concentrations identified around the buildings over the area were considered to be associated with localised surface soils and fill, and are not considered to represent unacceptable levels assuming ongoing commercial use.

Based on the results of this and previous investigations, Area D is considered suitable for ongoing commercial/ industrial uses. An EMP for the management of the identified soil contamination and monitoring for potential groundwater contamination in Area D has been developed under separate cover.

11.1.5 Area E

There was no petroleum hydrocarbon impact identified in the soil or groundwater in the former wartime refuelling area. Further investigation of the runway subgrade material was not considered to be warranted assuming ongoing operation of the airfield.

Based on the results of this and previous investigations, Area E is considered suitable for ongoing use as an airfield. An EMP to inform future users of Area E of the potential for unidentified contamination to exist has been developed under separate cover.

11.1.6 Area F

The presence of elevated hydrocarbon and metal concentrations in the test pits F11TP, F15TP and F18TP confirms the aerial extent of contamination in the fire training area (FTA) inferred by CMPS&F (1995). During the investigation, the elevated concentrations of organic compounds were reported near or within the saturated zone. The source of these compounds is considered to derive from solvents and petroleum fuels used in the FTA and the leaching of metals from burnt materials.

The results and field observations from test pits within the landfill areas indicated inert materials are present below ground, apart from asbestos fibres that were detected at 0.5m in one landfill location. Asbestos was also detected on the surface near the FTA. The raised ground of the landfill is currently unsuitable for construction or redevelopment. Remedial actions will be required to render the land suitable for public access or for other sensitive land uses, particularly considering the presence of asbestos on the surface refer Section 10.2.2.

An EMP for the management of the identified soil contamination in Area F has been developed under separate cover.

11.2 Waste Disposal

The fill material present in Areas B and F are discussed below.

11.2.1 Area F

There were three categories of solid waste identified in Area F. Refer to Figure 11 for the inferred areas of the solid inert waste materials.

Non-Recyclable Solid Inert Waste
The raised ground that comprises the two areas of waste disposal are not considered to pose a significant risk to underlying natural soil or groundwater. However, the areas of waste are considered to represent a physical hazard due to uneven ground. The waste material across the surface of Area F also detracts aesthetically from the coastal fringe adjacent to the site. Potentially contaminating materials may be present beneath the raised ground, since there are poor records of the materials disposed in the area. However, no contamination was identified in the groundwater downgradient, nor in test pits located around the disposal areas apart from the detection of asbestos fibres (refer below). The detection of fibres presents a risk of exposure to human users, and as such landscaping and capping the disposal areas with soil with revegetation is considered a suitable remedial measure. In the event of Area F becoming open to public use, such a measure may be sufficient to render unrestricted access to the area.

Refer to Figure 11 for the inferred areas of waste disposal (Estimated area is 3.5 ha with an estimated thickness of 0.5 to 1.0 m) Management strategies of the solid inert wastes are discussed in more detail in the EMP which has been prepared under separate cover.

Recyclable Solid Inert Waste
The main waste disposal area south of the RAAF Lake is ringed by piles of concrete and steel/aluminium scrap materials. These dumped piles represent a physical hazard to users of the site in the event Area F is opened to public access, in addition to the aesthetic detraction. Based on the recyclable nature of the materials, it is proposed to remove these large, surface piles of concrete and steel to allow the amelioration of the waste disposal areas as discussed above.

Refer to Figure 11 for the inferred areas of recyclable solid inert material. (Estimated area is 0.75 ha with a thickness of 0.5 m – 1.0 m). Management strategies for the these wastes are discussed in more detail in the EMP prepared under separate cover.

Asbestos Cement Sheeting
The 'hot spots' of asbestos cement sheeting were observed only around the areas of waste disposal and the FTA. The analytical results of near surface soil samples confirmed the presence of 'chrysotile' fibres in the soil. The fragments that were visually examined on the ground surface were found to be weathered, and thus considered to represent a moderate risk if disturbed by users of the area. In the event of divestment of the area by Defence and the allowance of unrestricted access to the area, remedial action is considered necessary to reduce risks associated with asbestos cement fragments scattered across the surface soils. The remedial action recommended would be to remove these hot spots and collect the larger pieces scattered across the ground surface.

It should be noted that the aerial extent of the asbestos on the surface was not accurately assessed during these works. Refer to Photograph 3 and 6 in the Area F plates section for an example of surface asbestos fragments and a 'hot spot' location.

11.3 Groundwater Contamination

The two areas of groundwater contamination identified at the site are discussed below.

11.3.1 Area D

Upon removal of the USTs formerly located at the POL refuelling point a sheen of hydrocarbon contamination was observed on the surface of the groundwater that accumulated within the tankpit excavation, indicating that impact to groundwater has occurred. Analysis of groundwater from immediately downgradient of this area reported hydrocarbon concentrations below the laboratory limits of reporting, indicating that laterally extensive groundwater contamination in the inferred downgradient flow direction has not occurred. However, localised mounding of the water table downgradient of this area may have been present in the past due to a due to the leaking water main (refer Section 7.2.5.3), affecting the natural groundwater flow and potentially masking groundwater contamination. The leaking water main was repaired during the UST decommissioning works to enable pumping and off-site disposal of the water that accumulated in the excavation. Since normal groundwater flow conditions have now been restored, future migration of hydrocarbon impacted groundwater and potential requirement for remediation cannot be discounted.

11.3.2 Area F

The results of the current and past groundwater analysis indicates that groundwater quality has been degraded in the south eastern corner of the site (Area F) due to historical fire training activities. Figure 18 summarises analytical data for contaminants that have been detected at concentrations above the laboratory limit of reporting in monitoring wells in the southeast corner of the site over the three sampling events since 1994.

Contaminant concentrations measured in groundwater sampled from PCMB18 are considered to be most representative of residual concentrations in the area where fire training was undertaken (source area). Given the proximity of PCMB2 to Port Phillip Bay, concentrations within this well have been conservatively inferred to represent maximum concentrations of contaminants in the groundwater discharging into Port Phillip Bay, prior to mixing within the aquifer in the foreshore area and dilution effects due to tidal and Bay currents. A summary of the changes in contaminant concentrations in this area since first being assessed in 1994 is provided below:

- Arsenic concentrations in the FTA (PCMB18) and downgradient (PCMB2) have remained consistent since 1994, with concentrations in PCMB2 marginally exceeding the ANZECC 1992 marine ecosystem guidelines.
- Benzene concentrations have increased by approximately 30% in both the FTA area and downgradient since 1994, with concentrations downgradient (PCMB2) exceeding the ANZECC 2000 marine ecosystem protection criteria and the ANZECC 2000 recreational water quality guidelines.
- Ethylbenzene concentrations have increased in both the source area and downgradient since 1994.
- Toluene and xylene concentrations have remained relatively consistent.
- TCE concentrations have significantly decreased since 1994 in both the FTA and downgradient. No ANZECC aquatic ecosystem protection or recreational water guidelines are specified for TCE.
- Total DCE concentrations have generally increased in both the FTA and downgradient. 1,1-DCE concentrations exceed the ANZECC 2000 guidelines for recreational purposes. No ANZECC aquatic ecosystem protection or recreational water guidelines are specified for DCE.
- VC concentrations have increased from below the limit of reporting to significant concentrations, with higher concentrations reported in groundwater downgradient of the FTA. No ANZECC marine aquatic ecosystem protection or recreational water guidelines are specified for VC.
- Methylene chloride concentrations have been variable over the three sampling events. No ANZECC marine aquatic ecosystem protection guidelines are specified.
- TCA has never been detected in groundwater at the site above the laboratory limits of reporting (i.e. <1 μg/L), therefore concentrations are below the ANZECC 2000 marine ecosystem (99% protection level) guideline of 140 μg/L.

The trends in concentration changes since 1994 indicate that degradation of TCE is occurring, indicated by the significant increase in DCE and VC concentrations (degradation products of TCE) and the decrease in TCE concentrations since 1994. Of concern is the relative consistency of the benzene concentrations measured since 1994, which potentially indicates that attenuation of benzene concentrations is not apparent, possibly due to the presence of a significant volume of absorbed or light non-aqueous phase liquid hydrocarbon product remaining in the fire training (source) area.

The discharge of dissolved contaminants to Port Phillip Bay is likely to occur through the shallow sand aquifer as seepage below the high tide line and as discharge through the Bay sediments. Given the presence of clays beneath the foreshore sands and bay sediments (extend to at least 15m depth in foreshore area), and the likelihood of saline intrusion into the thin (<3m thick) sand aquifer, discharge of contaminated groundwater is inferred to predominantly occur through the sands within the tidal zone of the foreshore.

It should be noted that once the property is relinquished by the Commonwealth, the presence of groundwater contamination and likelihood of contaminants discharging off-site is likely to trigger the issue of a pollution abatement notice by the Victorian EPA. The basis for the notice is likely to include at least:

- Identified impact on groundwater beneficial uses;
- Potential impacts on the marine ecosystem and other beneficial uses of Port Phillip Bay as defined by the Inshore segment in the Waters of Victoria SEPP (Schedule F6).
- The risk to off-site passive recreational users (i.e. children digging in the beach area) of being exposed to contaminated groundwater and vapours;
- The risk to recreational swimmers.
- The risk of cancer for consumers of recreationally caught fish.

Measures to mitigate the adverse health and environmental risks associated with the groundwater contamination in the southeast corner of the site (Area F) are included in the EMP for Area F which has been prepared under separate cover.

11.4 Data Gaps

Area D
POL Refueling Area

Natural clay soils significantly impacted with volatile petroleum hydrocarbons exist on the north wall of D31 and the western walls of D31 and D32 UST excavations. Evidence of groundwater contamination (hydrocarbon product sheen) was noted in the groundwater that filled the base of the excavations prior to backfilling. Further assessment of soil and groundwater lateral conditions to the excavations would require additional investigation involving coring through the concrete floor inside the hangars (Buildings 101 and 104).

The water-main service trench that was intersected and reinstated in the west wall of the POL Refueling Point UST pit (refer Figure 17), may act as a preferential pathway for dissolved phase hydrocarbons to migrate from the area. Further assessment of this trench will be necessary in the event of demolition or construction activities.

12.0 RECOMMENDATIONS

Based on the collective results of the numerous environmental investigations and studies that have been undertaken at RAAF Williams Point Cook, HLA conclude that the site is suitable for divestment as an airfield or a range of commercial or industrial uses. The results also indicate that large portions of the site are also suitable for more sensitive land use (i.e. public open space or residential).

The majority of the environmental issues identified above may be adequately managed by implementation of Environmental Management Plans. If the Commonwealth is to divest the site for ongoing use as an airfield or other commercial / industrial purposes, issues that will require more active management include the following:

- Groundwater remediation in the vicinity of the former fire training area (Area F).
- Solid-inert waste management (Areas B & F).
- Management of the residual soil and potentially groundwater contamination around the former POL refueling area (Area D).

13.0 REFERENCES

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