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report

HELLIER McFARLAND PTY LTD

PRELIMINARY SITE INVESTIGATION

27 Hectare Parcel of Land at Pigdon Street, Portarlington, Victoria

October 2004

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21 October 2004

Mr Gerard Holwell
Hellier McFarland Pty Ltd
342 Hawthorn Road
CAULFIELD SOUTH VIC 3162

Dear Mr Holwell,

Re: Preliminary Site Investigation of a 27 Hectare Parcel of Land at Pigdon Street, Portarlington, Victoria

We are pleased to submit this report on the preliminary site investigation of a 27 hectare parcel of land at Pigdon Street, Portarlington, Victoria. The investigation was performed in accordance with established Victorian Environment Protection Authority and National guidelines.

An Executive Summary of our key findings and our conclusions are included in the report.

Should you wish to discuss any matters concerning this report please do not hesitate to contact Mr Peter Ramsay on 03 9690 0522.

Yours sincerely,

PRamsay.

Peter J Ramsay & Associates

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USE OF REPORT

The preparation of this report has been undertaken for the purpose of providing the results of a preliminary site investigation of a 27 hectare parcel of land at Pigdon Street, Portarlington, Victoria and it is not intended that this report should be used for any other purpose.

This report is prepared solely for the benefit of Hellier McFarland Pty Ltd. This report is provided on the condition that it or any part of it, will not be made available to, or relied upon by any other party for any purpose except with the prior written consent of Peter J Ramsay & Associates Pty Ltd (which consent may or may not be given at its discretion). Consent is given to Hellier McFarland Pty Ltd to make this report available to other parties for the purpose of showing the scope of the report and its recommendations.

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EXECUTIVE SUMMARY

A preliminary site investigation of a 27 hectare parcel of land at Pigdon Street, Portarlington, Victoria was performed for Hellier McFarland Pty Ltd for rezoning purposes. The objective of the preliminary site investigation was to establish whether there are any significant environmental exposures relating to site contamination and waste management on the land. The investigation was performed according to Victorian Environment Protection Authority (EPA) and National guidelines for the assessment and management of site contamination.

The site is approximately 27 hectares and slopes moderately to the north-west. The site comprises five parcels of land. Two of the parcels are used for residential purposes, two are used for agricultural purposes and one is vacant. Apart from the building footprints, the site is unsealed.

Eleven buildings are present on the site including four houses, six sheds and an art gallery. Minor quantities of debris are located in unsealed areas on the site. Some chemicals were stored in internal sealed areas. Three above ground storage tanks (AGSTs), used to store water, and three in-use underground septic tank systems were identified on the site. There were no underground petroleum storage systems (UPSSs) or evidence of former UPSSs identified on the site.

The site has been used for farming and agricultural purposes since at least the 1950s. Minor volumes of fill are present in the south-east of the site to a maximum depth of 1.5 m. It is likely that the fill has been sourced from on-site levelling works.

Soil was sampled at ten locations on the site for this preliminary investigation. The analytical results for the soil samples retrieved during this investigation are below the guidelines values considered acceptable for a standard residential land use. Slightly elevated levels of barium, manganese, nickel and vanadium were identified in the near surface soil across the southern and central portions of the site. However, these concentrations are within the typical background ranges for Australian soils and are not considered to be significant for a low density residential land use. Further, it is considered that there is negligible risk of groundwater contamination to have occurred at the site.

In view of the findings of this investigation, the site is considered suitable for a low density residential land use.

LIST OF ABBREVIATIONS

AGST	Above Ground Storage Tank
AIP	Australian Institute of Petroleum
Amdel	Amdel Laboratories
ANZECC	Australian and New Zealand Environment and Conservation Council
AS	Australian Standard
AWQG	Australian Water Quality Guidelines
COC	Chain of Custody
CPS	Cathodic Protection Systems
CUTEP	Clean Up to the Extent Practicable
DQO	Data Quality Objective
DSE	Department of Sustainability and Environment
EIL	Ecological Investigation Level
EPA	Victorian Environment Protection Authority
GQRUZ	Groundwater Quality Restricted Use Zones
HIL	Health Investigation Level
HM	Hellier McFarland Pty Ltd
IWMP	Industrial Waste Management Policy
Labmark	Labmark Pty Limited
MAH	Monocyclic Aromatic Hydrocarbon
mg/kg	milligrams per kilogram
mg/L	milligrams per litre
NATA	National Association of Testing Authorities
NEHF	National Environmental Health Forum
NEPC	National Environment Protection Council
NEPM	National Environment Protection (Assessment of Site Contamination) Measure 1999
OCEI	Office of the Chief Electrical Inspector
OCP	Organochlorine Pesticide
OPP	Organophosphorous Pesticide

PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PID	Photoionisation Detector
ppm	parts per million
QAP	Quality Assurance Plan
QA/QC	Quality Assurance / Quality Control
RHSV	Royal Historical Society of Victoria
RWQC	Recommended Water Quality Criteria
RPD	Relative Percent Difference
SEPP	State Environment Protection Policy
SWL	Standing Water Level
TPH	Total Petroleum Hydrocarbon
UPSS	Underground Petroleum Storage System
USEPA	United States Environmental Protection Agency
VCH	Volatile Chlorinated Hydrocarbon
VOC	Volatile Organic Compound

1. SCOPE

The scope of the preliminary site investigation of the 27 hectare parcel of land at Pigdon Street, Portarlington (the site) included:

- Review of relevant documentation held by Hellier McFarland Pty Ltd (HM);
- Enquiries to the Victorian Environment Protection Authority (EPA), and other agencies for information on the previous land uses and developments;
- Examination of aerial photographs of the site and its surrounds to assist in identifying historical land uses;
- Site inspection;
- Identification of the likelihood of underground facilities and waste disposal areas being present on the site, which may have caused soil or groundwater contamination based on available information and the site inspection;
- Soil vapour survey for volatile organic compounds;
- Soil sampling at ten locations on the site for screening of potential contaminants;
- Review of the Department of Sustainability and Environment (DSE) Groundwater Database and identification of the nearest registered groundwater wells to the site and their locations, use and water quality;
- Assessment of the potential for surrounding land uses to cause site contamination;
- Appraisal of hydrogeology, geology and soil chemistry at the site as recommended by the EPA;
- Laboratory analysis of soil samples for potential contaminants;
- Assessment of analytical data and quality assurance/quality control;
- Evaluation of contaminant characteristics, fate and transport, potential harm to human health and the environment, off-site impacts and exposure pathways;
- Determination of the potential for groundwater at the site to be contaminated;
- Appraisal of the magnitude and extent of soil contamination identified at the site based on the results of the assessment;
- Hazardous substances assessment (excluding an asbestos and other hazardous building materials survey) including inspection of the property for waste chemicals, sludges and dangerous goods;
- Recommendations for the site in accordance with guidelines for the assessment and management of site contamination and EPA requirements; and
- Preparation of a confidential report on the results of the investigation for submission to HM.

2. INTRODUCTION

On 8 August 2004, HM engaged Peter J Ramsay & Associates to perform a preliminary site investigation of a 27 hectare parcel of land at Pigdon Street, Portarlington, Victoria (the site). The investigation was performed in accordance with the Victorian EPA and National guidelines for the assessment and management of site contamination.

The objective of the investigation was to provide advice on the potential for environmental exposures at the site. HM requested the investigation as part of their rezoning application for the property.

The site is approximately 27 hectares and slopes moderately to the north-west. The site comprises five parcels of land. Two of the parcels are used for residential purposes, two are used for agricultural purposes and one parcel is vacant. The site has been used for farming and agricultural purposes since at least 1950. Eleven buildings are present on the site. Facilities identified on the site include three large above ground storage tanks (AGSTs) used to store water and three in-use underground septic tank systems. The location of the site is shown in Figure 1.

The preliminary site investigation involved a review of the site history of the land and information provided by HM, an inspection of the property, a soil vapour survey and an initial soil sampling and analytical program. The sampling program was designed to screen the site for potential organic and inorganic chemical contamination. Our conclusions are presented in Section 15 of this report.

3. SITE DESCRIPTION

The land subject to this investigation is located in the rural district of Portarlington on the Bellarine Peninsula, Victoria. Key features of the site and adjacent land uses are presented in Figure 2 and are described in the sections below.

3.1 Property Details

Address:	27 hectare parcel of land bounded by Tower Road, Allens Road, Batman Road, and Geelong-Portarlington Road, Victoria.
Current Use:	The site comprises five parcels of land. Parcels 1 and 2 are used for residential purposes. Parcels 3 and 5 are used for agricultural purposes. This comprised a vineyard (Parcel 3) and olive groves (Parcel 5). Parcel 4 is vacant.
Occupants:	Occupants of the five parcels are as follows: 1. B & R Mitchell 2. B & D Robbins 3. D & L Hughes 4. Unoccupied 5. J & M Bulla
Owner:	Owners of the five parcels are as follows: 1. B & R Mitchell 2. B & D Robbins 3. D & L Hughes 4. L Bevilacqua 5. J & M Bulla
Area:	Approximately 27 hectares
Certificate of Title:	The site is described as Crown Allotment 4 in Title Plan 787101P, derived from Volume 8986, Folio 330, Crown Allotment 5 in Title Plan 307954P derived from Volume 9022, Folio 937; Lot 1 on Title Plan 113231N derived from Volume 9566, Folio 327; Lot 1 on Title Plan 838988H derived from Volume 9022, Folio 939; and Crown Allotment 8 in Title Plan 307956K derived from Volume 9022, Folio 940, Parish of Bellarine, County of Grant. Copies of the Certificates of Title are provided in Appendix A.
Local Government Administration:	Greater Geelong City Council
Zoning:	RUZ – Rural Zone
Adjacent Land Uses:	North: Medium Density Residential

South:	Farmland
East:	Farmland
West:	Low Density Residential and Farmland

3.2 Site Features

Peter J Ramsay & Associates inspected the site on 18 August 2004 and 9 September 2004 for the preliminary site investigation. Photographs of the site taken during the site inspection of 18 August 2004 are presented in Appendix B. The findings of the inspection and information obtained in relation to the land are:

Topography: The site slopes moderately to the north-west. The regional topography is undulating with a moderate to gentle slope to the north-west. The morphology of the site indicates that minor cutting and filling to a maximum depth of approximately 1.5 m is likely to have occurred for levelling purposes around the buildings in the south-east portion of Parcels 3 and 5.

Buildings: There are 11 buildings located on the site. These are labelled in Figure 2. The locations of the buildings within each parcel are as follows:

Parcel 1: A house and a shed are located in the centre-eastern portion of Parcel 1.

Parcel 2: There are three buildings located on this parcel. These include:

- a house located in the north-eastern portion of Parcel 2;
- a domestic shed located in the centre-eastern portion of Parcel 2; and
- an art gallery located in the south-eastern corner of Parcel 2.

Parcel 3: A house and a large workshed are located in the south-eastern portion of Parcel 3.

Parcel 4: There are no buildings located on this parcel.

Parcel 5: There are four buildings located on Parcel 5. These are:

- a house and domestic shed located in the south-eastern portion of Parcel 5; and
- two sheds located in the south-western corner of Parcel 5.

The houses on the site are built primarily of brick, timber concrete and tiling, whilst the sheds are constructed primarily of timber and corrugated iron.

Surface Conditions:	The building footprints occupy less than 5% of the site. The remainder of the site is unsealed and mostly grassed.
Surface Drainage:	Surface drainage was observed to be satisfactory at the time of the investigation. All runoff at the site is expected to drain to the north-west toward Port Phillip Bay.
Storage Areas:	Parcel 1: Some debris was located between the house and shed in the eastern portion of the parcel. The debris included a small stockpile of gravel, a small quantity of bricks, old car tyres, corrugated iron sheeting, old kitchen appliances, wooden and metal chairs, plastic bags full of rubbish, and a disused car and caravan. Parcel 2: Some debris was located along the eastern boundary of this parcel. This included two large empty gas bottles formerly used to store propane, small piles of bricks, wooden planks, several old empty 205 L drums and some 10 L paint cans. Parcel 3: The work shed contains several 205 L drums of glyphosate (herbicide) and several bags of gypsum and fertiliser. Small 5 L drums of oil are also stored in the workshed. Parcel 4: There are no storage areas as the site is unoccupied. Parcel 5: Two gas bottles and a 5 L drum of herbicide (Roundup) were stored on this parcel.
Vegetation:	Parcels 1, 2 and 4 have a variety of native trees scattered over them in varying density. Parcels 3 and 5 comprised vineyard rows and olive groves respectively. The vegetation was observed during the investigation to be in a healthy condition.
Above Ground Storage Tanks:	Three AGSTs were observed on the site during the investigation. AGSTs are discussed further in Section 3.3.
Underground Petroleum Storage Systems:	No underground petroleum storage systems (UPSSs) were identified on the site during the investigation (refer to Section 3.4).
Other Underground Facilities:	Three in-use underground septic tanks are located on the site. Two are located on Parcel 2 adjacent to the north-western corners of the art gallery and domestic shed. An additional septic tank is also located near the house and workshed on Parcel 3.
Other Installations:	A holding pen for cattle and horses is located in Parcel 1, immediately west of the shed.

3.3 Above Ground Storage Tanks

Three AGSTs were observed during our inspection of the site. These are located in the south-western corner of Parcel 5, adjacent the workshed in Parcel 3, and adjacent to the domestic shed in Parcel 2 (refer to Figure 2). Each AGST has a capacity of approximately 10,000 L, and is used to store water.

3.4 Underground Petroleum Storage Systems

During our inspection we found no evidence of UPSSs, or former UPSSs, at the site. This is consistent with our site history enquiries.

3.5 Geology and Hydrogeology

The Geological Survey of Victoria 1:63,360 Portarlington Map indicates that the site is located at a geological contact between two different geological formations. The trace of this contact traverses diagonally across the site from the north-east to the south-west. Mesozoic Age Barrabool Sandstones underlie the north-western portion of the site and is comprised of arkose, sandstone, shale, and mudstone with plant remains. Tertiary Age Older Volcanics underlie the south-eastern portion of the site and is comprised of basalt, tuff and agglomerate.

The Department of Minerals and Energy 1:1,000,000 Groundwater Resources Victoria Map shows the groundwater at the site has a salinity of between 1 000 and 7 000 mg/L. Groundwater with this salinity is classified as Segment A2 (501-1 000 mg/L) Segment B (1 001-3 500 mg/L) and Segment C (3 501-13,000 mg/L) water under the Statement Environment Protection Policy (SEPP) (Groundwaters of Victoria). Segment A2, Segment B and Segment C groundwater have a number of beneficial uses to be protected, including acceptable potable water supply, agricultural use (irrigation and stock watering), industrial water use, primary contact recreation, maintenance of ecosystems and the protection of buildings and structures.

A search of the DSE's Groundwater Database was performed to identify wells in the vicinity of the site. The search results identified 10 registered wells located within approximately 3.0 km of the site. Data extracted from the database in relation to the 10 wells are provided in Table 1. The results of the database search indicate that two wells were installed for domestic/stock use, two wells were installed for domestic use only, and two wells were installed for unknown purposes. The remaining four wells were installed for irrigation, stock, non-groundwater and miscellaneous purposes. The total depth of the 10 wells varies between 1.5 m and 457.56 m below the ground surface. Standing water levels were provided for six of the wells and vary between 2 m and 29 m below the ground surface. The wells were installed between 1956 and 1990.

Table 1 Groundwater Database Information

Well ID	Approximate Distance from Site (km)	Direction from Site	Total Depth (m)	Aquifer Interval (m)	Aquifer Lithology	Use	SWL (m)
48875	2.4	South-west	2.74	NS	NS	NK	NS
48850	1.4	North-north-west	1.5	NS	NS	IR	NS
48853	0.6	West-south-west	38.1	19.8 - 27.4	CLAY	DM	3.7
48877	1.5	West-south-west	46	3 - 3.5	MARL	DMST	2
132607	0.4	East-north-east	48	42 - 48	MUST	ST	29
301701	2.0	East-north-east	457.56	NS	NS	NG	NS
87827	2.7	East-north-east	24.68	NS	NS	NK	NS
87854	2.8	East	23	18.3-22.9	SAND	MI	7.3
87862	2.9	East	36.88	20.5-36.9	CONG	DMST	10
87873	2.8	East	9.1	7.5-8.4	CLAY	DM	5.9

Note: SWL = Standing Water Level
NS = Not Stated in DSE's Groundwater Database
NK = Not Known
IR = Irrigation
DMST = Domestic/Stock
MUST = Mudstone
ST = Stock
NG = Non-Groundwater
MI = Miscellaneous
DM = Domestic
CONG = Conglomerate

Based on the database information and our hydrogeological experience in the local area, the depth to the regional groundwater at the site is expected to be between approximately 3 m and 30 m below ground level. The direction of regional groundwater flow is expected to be to the north to north-west, toward Port Phillip Bay.

3.6 Acid Sulfate Soil Potential

The EPA Publication 655 *Acid Sulfate Soil and Rock* (August 1999) describes that "Acid sulfate soils generally occur in soil formations that:

- Contain elevated concentrations of metal sulfides;
- Were originally deposited in marine or estuarine settings, often as soft, dark grey to dark greenish-grey muds; and
- Are below or above high tide level, but generally not more than 5 metres above high tide level."

The Publication advises that most acid sulfate soils were deposited during the last 10,000 years (Holocene geological age) but may be as old as a million years ago (Tertiary age). Examples are the Coode Island Silt and the Brighton Group formations respectively. Acid sulfate properties may also exist in present day estuarine and marine sediments. Concentrations of metal sulfides in rocks also pose an environmental risk, and in Victoria these are usually associated with gold-bearing sediments and most coal deposits (other than those in the Latrobe valley). Sulfides have also been noted in siltstones (Silurian age), which underlie the Melbourne-Ringwood-Kilmore area.

The site is not located in a geomorphic environment conducive to the formation of acid sulphate soils. In addition, the geology beneath the site does not consist of sulfidic ores. Field indicators for potential acid sulfate conditions as described in EPA Information Bulletin Publication 655 *Acid Sulfate Soil and Rock* (August 1999) were not encountered during the assessment for the assessment. Therefore, the potential for acid sulphate soils to be present on the site is low.

4. SITE HISTORY

4.1 Information Sources

The site history of the land subject to the investigation was reviewed in order to identify the potential for contaminated soil to be present on the site resulting from historical activities including landfilling.

The site history has been compiled from information obtained from the following sources:

- Documentation provided by HM;
- Aerial photographs of the site and surrounds held by the DSE Land and Survey Information;
- Royal Historical Society of Victoria (RHSV);
- The Office of the Chief Electrical Inspector (OCEI);
- City of Greater Geelong Council;
- EPA;
- Discussions held with four of the five site owners; and
- Discussions held with Mr Gerard Howell of HM, Managing Agents for the site.

4.2 EPA Verification

The site is not listed in the following EPA records relating to contaminated sites or other sites known to the EPA:

- The current version of the EPA Priority Sites Register database; and
- The EPA List of Issued Certificates and Statements of Environmental Audit, 17 September 2004.

A copy of the verification provided by ANSTAT (dated 10 August 2004) for the Priority Sites Register is provided in Appendix C.

However one property, located approximately 950 m north-west of the site, is listed on the EPA List of Issued Certificates and Statements of Environmental Audit. This site is located at 44-46 Geelong-Portarlington Road, Portarlington, downgradient of the site subject to this investigation.

4.3 Previous Land Use

The previous land use has been determined from aerial photographs and site history information which were reviewed by Peter J Ramsay & Associates.

4.3.1 Aerial Photographs

Aerial photographs of the site taken in 1950, 1962, 1978 and 1990 held by the DSE were examined by Peter J Ramsay & Associates to identify previous land uses, as well as any potential landfilling activities on the site, that may have involved contaminated soil or wastes. Copies of the 1950, 1962, 1978 and 1990 aerial photographs of the site and surrounds are shown in Appendix D.

In the 1950 aerial photograph, the site is entirely grassed and is used for farming purposes. A small row of trees trending north-south are evident in the central-western portion of the site. Four small areas of bare ground are also visible. Two of these areas are located directly south of the intersections of Tower Road and Geelong-Portarlington Road, and Pigdon Street and Geelong-Portarlington Road. The third area is adjacent the western boundary between Pigdon Street and Batman Road. The fourth area is adjacent to the row of trees in the centre of the site. Land to the north, south, east and west is used for farming purposes.

The four small areas of bare ground are revegetated with grass in the 1962 aerial photograph. Apart from this, the site has not changed. North of the site, a residential development is in its initial stages of construction. Farmland is evident to the south, east and west.

In the 1978 aerial photograph, several ornamental trees are present directly north-east of the intersection between Pigdon Street and Geelong-Portarlington Road. The south-western portion of the site is used for cropping activities. The residential development to the north of the site has been completed whilst farmland is present to the south, east and west of the site.

In the 1990 aerial photograph, there are three buildings located in the northern portion of the site between Tower Road and Pigdon Street. The southern portion of the site, below Pigdon Street, and the surrounding land uses have not changed from the 1978 aerial photograph.

4.3.2 Site History Review

We were advised by Greater Geelong City Council that there had been several planning permits issued for the site. These include:

Parcel 2:
- Construction of a dwelling and art gallery (June 1989);
- Construction of a café (July 1995);

Parcel 3:
- Construction of a dwelling (1998); and

Parcel 5:
- Construction of a single-storey dwelling and use of the land for agricultural purposes (April 1994).

We were also advised that the owners of Parcel 3 purchased the land in April 2000.

During the site inspection for this investigation the owners of Parcels 1, 2 and 3 advised us that their respective properties were originally used for agricultural purposes to grow potatoes and peas. This is consistent with our review of aerial photographs. The owner of Parcel 5 was not available within the timeframe for this investigation.

The OCEI maintains a register of cathodic protection systems (CPSs), which are installed to protect UPSSs. The OCEI found no record of a CPS installed or having been present at the site.

5. PREVIOUS ASSESSMENTS OF THE SITE

During the site inspection we were informed that several geotechnical investigations had been undertaken for the construction of buildings in Parcels 1, 2 and 3. There were no records of any other previous environmental investigations having been conducted at the site. The results of these investigations were not available for our review.

6. ASSESSMENT FOR POTENTIAL CONTAMINATION

A number of indicators can be used to determine the potential for soil contamination to have occurred at a site and therefore provide the rationale for the sampling program adopted at a site. These indicators include:

- Current or historical activities which may have caused soil contamination;
- The presence of above ground and underground facilities;
- Unexplained disturbed areas or lack of vegetation;
- Presence of accumulations of solid or liquid wastes;
- Discoloured or oily soil or staining; and
- Odorous soil.

Based on our evaluation of historical information and our site observations, we identified the following issues that may indicate the presence of potential contamination:

- **Historical Activities:** Potential pesticide and herbicide contamination of the near surface soils due to farming and other agricultural uses.

6.1 Potential Contamination from Off-Site Sources

No surface evidence of potential contamination resulting from leachates or wastes entering the site from adjacent properties was observed during the site inspection.

6.2 Potential for Off-Site Migration of Contamination

No off-site migration of contamination (such as wastes or contaminated stormwater) was observed during our site inspection. However, should the soils on the site be contaminated and have impacted upon the groundwater then there is some potential for off-site migration of contamination to have occurred via the groundwater.

6.3 Risk of Groundwater Contamination

There is the potential for groundwater contamination to have occurred should the soil on the site be contaminated as a result of historical activities.

6.4 Risk of Off-Site Impacts

Based on the results of our site inspection, it is considered that there is a very low potential for off-site migration of contamination to have occurred via surface water or dust. However, as stated in Section 6.3, should the groundwater be contaminated, there would be the potential for contaminated groundwater to migrate off-site.

7. DATA QUALITY OBJECTIVES

Data quality objectives (DQOs) for all aspects of the preliminary site investigation were established. The DQOs are presented in Table 2 below.

Table 2 Data Quality Objectives

Investigation Aspect	DQOs
Documentation	Complete site inspection proforma, soil profile logs and chain of custody documentation.
Sampling	Sampling in accordance with EPA and National Environment Protection Council (NEPM) guidelines, and *Quality Assurance Plan* (QAP) (Appendix E). The soil profile was adequately detailed on logs.
Analytical Program	Screen site for all potential contaminants, as indicated by the site history, site inspection, and EPA guidelines.
Field Quality Assurance / Quality Control (QA/QC) Program	In accordance with QAP, EPA and NEPM guidelines. Collection of a split of a minimum of 10% of the samples as field duplicate samples (5% QA (split samples to a secondary laboratory) and 5% QC (blind samples to the primary laboratory)) as well as blanks. Comparison of duplicate results with acceptable NEPM criteria and rectification of discrepancies where necessary (refer to Sections 12.3).
Laboratory QA/QC Program	NATA registered laboratories (primary and secondary) and methods, appropriate detection limits and sufficient and acceptable internal QA/QC program (see Section 12.2).
Human Health and Environmental Impact Analysis	Determination of the potential risk posed by the site to human health and/or the environment. Assessment of the suitability for proposed use in accordance with EPA and NEPM guidelines and determine remediation necessary to achieve suitability.
Reporting	Reporting in accordance with EPA, and NEPM guidelines.

8. SITE ASSESSMENT

The field activities for the preliminary site investigation were undertaken by Peter J Ramsay & Associates on 18 August and 9 September 2004. The assessment was performed according to:

- EPA guidelines;
- Guidelines issued under Schedule B of the National Environment Protection (Assessment of Site Contamination) Measure (NEPM), December 1999; and
- Australian and New Zealand Environment and Conservation Council (ANZECC) guidelines published by the Australian and New Zealand Environment and Conservation Council/National Health and Medical Research Council, January 1992.

The site assessment activities followed the procedures described in the QAP presented in Appendix E. The preliminary soil sampling program was a systematic sampling program to assess the general areas of the site.

The sampling program was designed to provide a preliminary assessment of the land for potential soil contamination. This is in accordance with EPA guidelines and specifically the NEPM. The program was appropriate to assess for environmental exposures for a low density residential land use.

Field activities comprised:

- A visual assessment for indicators of potential contamination;
- Soil vapour survey for volatile organic compounds; and
- Sampling of near surface and subsurface soil for analysis for potential contaminants.

Sample locations were investigated by visual inspection. Indicators used to determine the presence of potential contamination included:

- Ionisable vapour detected by a Photoionisation Detector (PID);
- Odour;
- Discolouration or oily soil;
- Free product or oily sheen; and
- Industrial wastes in fill.

8.1 Soil Vapour Survey

During the sampling program the concentrations of total ionisable compounds released from the matrix of soil samples were measured. Total ionisable compounds were measured by taking headspace readings of the soil samples. This provides an initial qualitative screening of the degree of contamination of the soil with volatile organic compounds (VOCs). The methodology for the headspace soil vapour survey is presented in the QAP.

The concentration of ionisable vapours was determined by a 10.6 eV Mini Rae 2000 calibrated to read "isobutylene equivalent v/v (ppm)". The PID readings obtained during the soil vapour survey are presented on the Soil Profile Logs in Appendix F.

The concentration of ionisable vapours measured in the headspace above soil samples ranged from 0.0 ppm to 1.8 ppm (v/v isobutylene equivalent). The maximum level of 1.8 ppm was measured in a sample of natural soil retrieved from the near surface in a borehole drilled in the south-western portion of the site.

8.2 Soil Sampling

Locations for soil sampling were identified based on the results of the site history, the site inspection and assessment of the geology of the site. Sample locations were referenced to existing ground features and positioned subject to on-site services, subsurface conditions and other constraints, which were encountered during fieldwork activities.

Soil samples were recovered from ten boreholes drilled across the site (numbered 1 to 10). The sample locations are shown on the site plan in Figure 3.

Qualified and experienced environmental engineers and hydrogeologists from Peter J Ramsay & Associates performed the on-site activities. This involved logging of sample locations and retrieval of soil samples. Boreholes were backfilled following soil sample activities. Logs of soil condition, sample depth details and the soil profile in the ten boreholes were recorded in the field on standard Soil Profile Log sheets (Appendix F).

Soil samples of approximately 250 grams were retrieved from two depths (0 m – 0.5 m) at each sample location. Disturbed samples were retrieved directly from the auger, where it was impractical to use split spoon sampling equipment (for example in gravelly or sandy soil) to collect undisturbed samples or where there was no indication of odorous soil or high levels of volatile compounds in the soil. For each soil sample, one 250 mL glass jar sealed with a Teflon lined lid was used. The jars were entirely filled with soil so that no headspace was present in each jar above the soil sample. This method of sampling ensures that the loss of volatiles during sample storage is minimised.

Each sample container was labelled with the following information:

- A sample number (which consists of the site identifier, sample location number and sample depth); and
- Date of sample collection.

A labelling system identifies the origin of each soil sample collected, e.g. 4041/1A. The number 4041 identifies the site, the number 1 refers to the sample location number and the letter A refers to the depth at which the sample was taken. The letters used to indicate sample depths are:

- A Near surface sample (0.1 m – 0.3 m). Nominal ~ 0.2 m.
- B Subsurface sample (0.4 m – 0.6 m). Nominal ~ 0.5 m.

Please note that the above sample numbering convention is not followed where it is necessary to conceal the identity of duplicate samples (see Section 12.1). In such cases, a fictitious sample location number is used. Identification of the soil samples together with soil sample depths are given on the Chain of Custody (COC) documentation in Appendix G and in the Tables of Results.

Fifteen primary soil samples were analysed individually. Also, on the basis of field observations one composite soil sample was formed. Three samples retrieved from the same depth and/or same soil strata were combined to form the composite soil sample to provide the maximum amount of information while minimising analytical requirements. Analysis for volatile contaminants is not performed on composited samples due to the potential for the loss of volatiles during the compositing process. The composite sample formed was labelled 4041/C1.

Identification of the individual soil samples together with the sample depth of each individual sample that made up the composite soil sample are given on the COC documentation in Appendix G and in the Tables of Results.

Sampling equipment in contact with samples was decontaminated prior to sampling in accordance with the QAP. Samples were stored in chilled and insulated containers whilst on-site, prior to delivery to the laboratories. COC documentation detailing the required analyses and detection limits (where non-standard) accompanied the samples to the laboratory. The environmental engineer signed the appropriate section of the COC form before providing the samples to the laboratories.

8.3 Analytical Program

The analytical program involved sending the primary soil samples to a laboratory designated as the primary laboratory. In addition, a blind replicate sample and blank samples were also dispatched to the primary laboratory. A field duplicate (split) sample was sent to a second laboratory for quality assurance purposes.

The selection of analytes was based on our review of the site history, our observations during the site inspection and EPA site assessment guidelines. The analytes for the soil samples comprised:

Inorganic species:
- Heavy metals (antimony, arsenic, barium, beryllium, cadmium, chromium (total), cobalt, copper, lead, manganese, mercury, nickel, tin, vanadium and zinc);
- pH;
- Fluoride;
- Cyanide; and
- Asbestos.

Organic species:
- Polycyclic Aromatic Hydrocarbons (PAHs);
- Organochlorine Pesticides (OCPs);
- Organophosphorous Pesticides (OPPs);
- Total Petroleum Hydrocarbons (TPHs);
- Monocyclic Aromatic Hydrocarbons (MAHs);
- Volatile Chlorinated Hydrocarbons (VCHs);
- Polychlorinated Biphenyls (PCBs); and
- Total phenols.

The analytical program for the soil samples is outlined in the COC documentation. The samples were selected for analysis based on the results of the assessment for indicators of potential contamination, the soil vapour survey and the project objectives.

Amdel Laboratories (Amdel) was selected as the primary laboratory. Labmark Pty Limited (Labmark) was used as the secondary, or control, laboratory for implementation of Peter J Ramsay & Associates' quality assurance program. The laboratories are approved by the National Association of Testing Authorities (NATA), and the analyses were performed in accordance with the laboratories' NATA registration. Final laboratory reports bear the NATA stamp. Test methods used are recognised United States Environmental Protection Agency (USEPA) and EPA procedures. Analytical detection limits were specified by Peter J Ramsay & Associates.

8.4 Quality Assurance/Quality Control Program

A QA/QC program was implemented by Peter J Ramsay & Associates during the preliminary site investigation of the site, to appraise the accuracy and reproducibility of the analyses. The program is discussed in Section 12.

9. GEOLOGY AND HYDROGEOLOGY ENCOUNTERED DURING THIS INVESTIGATION

Natural soil was encountered in all ten boreholes drilled at the site. The surface soil comprised brown to dark brown clayey silt and silty clay. The thickness of this layer was approximately 0.2 m to 0.4 m. Underlying the surface soil was yellow, orange and brown sandy clay, silty clay or clayey sand.

Groundwater was not encountered in any of the ten boreholes drilled at the site. As indicated in Section 3.5, the depth to groundwater is expected to be between approximately 3.0 m and 30 m below ground level and the regional groundwater flow direction is expected to be to the north to north-west, toward Port Phillip Bay.

10. BASIS FOR INTERPRETATION OF ANALYTICAL RESULTS

The analytical results for the soil samples are compared with the Victorian EPA's soil quality criteria in Section 11. The relevant criteria are discussed below.

10.1 Soil Quality Criteria

The criteria contained in the NEPM are endorsed by the Victorian EPA. The NEPM contains a set of Investigation Levels for soil. These include Australian public health-based investigation levels (HILs), ecological investigation levels (EILs) and background ranges. The HILs and EILs are not cleanup or response levels nor are they desirable soil quality criteria. They are used as a screening guide for the appraisal of site contamination. HILs are provided for a range of land uses including commercial/industrial land use. Generic EILs have been set for urban areas. Individual Australian states and territories will decide on the implementation of the NEPM, whether in whole or in part in their state or territory.

The key aspect of the Victorian EPA's approach to site contamination is the use of the three soil quality criteria as contained in the NEPM. These are comprised of:

- **HILs:** Threshold values which are indicative of the potential for human health risks to occur;
- **EILs:** Threshold generic values which indicate a potential environmental effect to plants and animals within an urban context; and
- **Background Ranges:** Typical 'background' levels, generally indicating no further investigation of a site is needed.

The HILs were developed for frequently occurring toxicologically important parameters using a risk assessment approach based on worst-case exposure scenarios. The HILs were proposed by the National Environmental Health Forum (NEHF), now known as the enHealth Council, and are reported in Langley et al 1996 and 1998 Contaminated Sites Monograph Series: *The Health Risk Assessment and Management of Contaminated Sites*. HILs have been derived for important contaminants for a number of land uses. Where significant contamination is present in soil samples the HILs are used as guideline values which are indicative of the potential for human health risks to occur.

The NEPM was made by the National Environment Protection Council (NEPC) on 10 December 1999. The NEPM contains a set of the most recently reviewed and developed Australian public health-based and ecological investigation levels for soil and groundwater.

A set of national Interim EILs have been developed for some contaminants based on considerations of phytotoxicity, and soil survey data from urban areas. More pertinent regional EILs will be developed by EPA. For many organic contaminants no EILS have been developed, therefore the ANZECC environmental investigation threshold (B) levels and the threshold concentrations for sensitive land uses contained in the NSW EPA's *Guidelines for Assessing Service Station Sites* have been used.

Contaminated sites that may pose a significant risk to human health or the environment will be included by the EPA on the *Priority Sites Register*. These sites are classified as 'risk sites' and would not be suitable for their current or proposed use without remediation. Sites that do not pose a significant risk to public health or the environment whilst their current land use continues (low risk sites) may be placed by the EPA on the *List of Issued Certificates and Statements of Environmental Audit*. This includes sites for which a *Certificate* or *Statement of Environmental Audit* has been issued as a result of a statutory assessment under the *Environment Protection Act 1970*.

Risk assessments may show contamination on a site to be acceptable from a human health viewpoint, however, there may still be a liability in regard to contamination, which remains on a site. This liability is incurred in managing contamination on the site, on redevelopment or changes in land use. In particular, there may be considerable costs incurred to dispose of soil with elevated contaminant levels, and the ongoing management of on-site contamination.

10.2 Assessment and Remediation of Land

Specifically in relation to the assessment and management of site contamination in Victoria the following subordinate legislation applies:

- SEPP (Prevention and Management of Contamination of Land) 2002;
- SEPP (Groundwaters of Victoria) 1997;
- SEPP (Waters of Victoria);
- SEPPs for air;
- Industrial Waste Management Policy (IWMP) (Waste Acid Sulfate Soils) 1999; and
- IWMP (Prescribed Industrial Waste) 2000.

Also, EPA has issued a number of guidelines under these policies.

Further, EPA has endorsed the NEPM. Schedule B of the NEPM provides a detailed standard methodology for site assessments. That is, EPA recommends that assessments should be undertaken in accordance with the approved methods and protocols contained in the NEPM.

SEPP (Prevention and Management of Contamination of Land) 2002

The SEPP for land was declared in June 2002 and is the key legislative instrument regarding the assessment and management of contaminated land in Victoria.

The Policy requires occupiers to implement the principles of best practice environmental management, namely:

- Best practice in prevention of contamination of land. This is through the application of Industry Codes of Practice and Environment Improvement Plans. For example, occupiers with underground storage tanks must comply with Australian Institute of Petroleum (AIP) Code of Practice CP4 for the Design, Installation and Operation of Underground Petroleum Storage Tanks.
- Best Practice in the assessment of land for contamination. This requires assessments to be performed in accordance with the NEPM and EPA guidelines.
- Clean up and management of polluted land must be undertaken to protect beneficial uses of the land and to ensure that the condition of land off-site is not adversely affected. Any clean up should reflect the order of preference set out in the waste hierarchy, i.e. Treatment and re-use on-site is preferred to treatment and reuse off-site (provided that an equivalent environmental outcome is achieved). Long term containment (including disposal) off-site is least preferred. It also requires the occupier to disclose information on land contamination to the new occupier of the land where a notice under the Environment Protection Act 1970 has been served that is still in force or where a Statement of Environmental Audit has been issued.

Specifically, the Policy stipulates five beneficial uses of land that are to be protected:

- Maintenance of natural ecosystems, modified ecosystems and highly modified ecosystems;
- Human health;
- Buildings and structures;
- Aesthetics; and
- Production of food, flora and fibre.

The particular beneficial uses that need to be protected are defined in the Policy for different types of land uses, namely:

- Parks and reserves;
- Agricultural;
- Sensitive use – residential, childcare, preschool or primary school;
- Recreation/open space;
- Commercial; and
- Industrial.

The beneficial uses that need to be protected for each specific land use are shown in Table 1 of the Policy. For example, for an industrial use, the beneficial uses that are protected include highly modified ecosystems, human health and buildings and structures.

The Policy provides guidance in Table 2 on the objective criteria to be used to determine whether the level of contamination at any site poses an unacceptable risk to protected beneficial uses. These criteria are principally the NEPM human health investigation criteria and ecological investigation criteria. Alternatively, clean up to levels derived using a site specific risk assessment in accordance with the NEPM methodology may be undertaken.

Other provisions of the Policy relate to reinforcing the role and independence of Environmental Auditors and the need for auditors to notify EPA of they become aware of an imminent environmental hazard.

SEPP (Groundwaters of Victoria) 1997

The SEPP for groundwater was declared in December 1997 and is the key legislative instrument for the protection of groundwater in Victoria. This Policy was varied in March 2002 and in EPA Publication 840 *The Clean Up and Management of Polluted Groundwater* to include 'Groundwater Quality Restricted Use Zones' (GQRUZ) and principles regarding 'Clean Up to the Extent Practicable' (CUTEP) respectively.

The SEPP (Groundwaters of Victoria) classifies segments of the environment based on groundwater quality as represented by total dissolved solids (salinity).

Each segment of the environment is assigned existing or potential beneficial uses that must be protected. For example, groundwater with a salinity of up to 500 mg/L is classified as Segment A1 waters and has the maximum number of beneficial uses to be protected, including use as a high quality potable (where potable refers to water of drinkable quality) water resource.

The SEPP (Groundwaters of Victoria) refers to water quality objectives for each particular beneficial use. The water quality criteria required to meet the relevant objectives for each beneficial use are specified in other publications or sections of publications, such as:

- Australian Water Quality Guidelines for Fresh and Marine Waters, ANZECC 1992 (AWQG);
- Recommended Water Quality Criteria, EPA 1983 (RWQC);
- Australian Food Standards Code (1987) – Standard 08 Mineral Water; and
- SEPPs for surface waters of receiving water bodies.

The criteria contained in the AWQG are based on a review by ANZECC of the most recent overseas criteria (e.g. USEPA, Canadian and World Health Organisation publications), a review of Australian information and a detailed public review of the draft AWQG document.

11. ANALYTICAL RESULTS AND INTERPRETATION

The analytical results for the soil samples from the preliminary site investigation of land are presented in the NATA endorsed laboratory results included in Appendix H and are summarised in the Tables of Results. These data are presented according to their location in numerical order of sample numbers.

11.1 Results

The analytical results for the soil samples are summarised in Table R1 (individual soil samples) and Table R2 (composite soil sample) of this report. The organic and inorganic contaminant concentrations in the soil samples have been compared with background ranges, NEPM EILs, and the HILs for a low density residential land use. Also, the ANZECC environmental investigation (B) levels and the threshold concentrations for sensitive land use contained in the NSW EPA *Guidelines for Assessing Service Station Sites* (NSW EPA's threshold concentrations) are used where no EIL exists. The results exceeding the criteria are highlighted in the tables accordingly. The detection limits for the analytes were set below background levels for Australian soil.

It should be noted that equivalent criteria for the composite sample have been derived by dividing the relevant criteria by the number of primary samples used to form the composite sample. This allows comparison of the analytical results with the relevant criteria. The results exceeding the criteria are highlighted in the tables accordingly.

11.2 Interpretation

The analytical results for the soil samples retrieved from the site show that the **concentrations of the organic and inorganic species** analysed for are well below the HILs for a standard residential land use. The detection limits for the species analysed for were set below background ranges in Australian soil.

Individual Soil Samples

An elevated concentration of **manganese** (850 mg/kg) was measured in one near surface sample retrieved from natural soil in the southern portion of the site. This concentration exceeds the EIL criterion of 500 mg/kg for manganese. However, it is well below the HIL criterion of 1 500 mg/kg for a standard residential land use, and does not exceed the background concentration for typical Australian soils. Therefore, the elevated manganese concentration is considered to be consistent with natural background concentrations and is not significant for a low density residential land use.

The **pH** of the individual soil samples retrieved from the site range from 5.1 to 7.4. At several sample locations the pH was marginally outside the range of 6 to 8 for typical Australian soils. Similarly, these are not considered significant for a low density residential land use.

The concentrations of all other analytes were measured to be below their respective EILs and well below their HILs for a standard residential land use. Also, no **asbestos** fibres were detected in the individual near surface sample analysed for asbestos.

Composite Soil Sample

The analytical results for composite soil sample 4041/C1, which was formed from three near surface samples from across the central and southern portions of the site, are presented in Table R2.

The results show that a **manganese** concentration of 620 mg/kg exceeds the equivalent HIL criterion of 500 mg/kg for manganese in a three-way composite sample for a standard residential land use. In addition, elevated **barium** (110 mg/kg), **nickel** (25 mg/kg) and **vanadium** (56 mg/kg) were measured in the composite sample to be in excess of the equivalent EIL criteria for these analytes. However, as all these analyte concentrations (apart from manganese) are well below the equivalent HIL criteria, and they are within the typical background ranges in Australian soil, these concentrations are not considered to be significant for a low density residential land use.

Following our review of the initial results, the three individual samples (4041/4A, 4041/5A and 4041/9A) that comprised composite sample 4041/C1 were analysed individually for manganese. These additional analyses showed that the manganese concentrations in the three individual samples making up the composite were all below the HIL criterion of 1 500 mg/kg for manganese. In addition, they are consistent with natural background concentrations and are not significant for a low density residential land use.

The concentrations for all other analytes were measured to be below their respective equivalent EILs and HILs for a three-way composite sample or within the background range for typical Australian soils. Further, the concentrations of contaminants in the composite soil sample are consistent with the concentrations measured in the individual soil samples retrieved from across the site. In addition, no asbestos fibres were detected in the composite soil sample.

11.3 Quality Assurance/Quality Control Program

A QA/QC program was implemented during the investigation, to appraise the accuracy and reproducibility of the analyses. The results of the program are discussed in Section 12.

12. QUALITY ASSURANCE/QUALITY CONTROL PROGRAM

Inaccuracies in sampling and analytical programs can result from many causes, including collection of unrepresentative samples, cross contamination between samples, unanticipated interferences between elements during laboratory analyses, equipment malfunctions and operator error (USEPA 1986). Inappropriate sampling, preservation, handling, storage and analytical techniques can also reduce the precision and accuracy of results.

The NEPM has documented procedures for QA/QC for sampling and analysis to ensure that the required degree of accuracy and precision is obtained. The NEPM and the EPA recommend the use of two laboratories for the implementation of a quality assurance program for the analyses in addition to the quality control procedures followed by the primary laboratory.

Peter J Ramsay & Associates initiated a QA/QC program to appraise the accuracy and reproducibility of the analyses. The accuracy of an analysis is a measure of the variation between the concentration of an analyte obtained by the method and the true concentration in the sample. This is determined by comparing the analytical results from field duplicate samples analysed at two laboratories, and by the laboratory's internal QC programs. The precision of a result is a measure of the reproducibility of the result. This is, in effect, a measure of the natural spread of data about the mean result.

According to the NEPM a split of a minimum of 10% of the samples as field duplicate samples (5% QA and 5% QC) as well as blanks is required. Where less than 20 samples are to be analysed, a minimum of two field duplicate samples (one QA and one QC) and a blank is considered sufficient.

In this investigation, one QA duplicate sample (split sample) was taken and analysed. Also, one QC duplicate sample (blind replicate sample) was taken and analysed. In addition, a rinsate blank and a trip blank were also taken. The rinsate blank was analysed by the primary laboratory. That is, at least 10% of the samples were field QA/QC samples as well as two blank samples. The laboratories also performed internal QC programs in accordance with their NATA registration.

12.1 Peter J Ramsay & Associates QA/QC Program

The QA/QC program for this assessment is in accordance with the recommendations of the EPA and the NEPM. The results of the QA/QC program are discussed in Section 12.3. Soil samples were retrieved and analysed in accordance with the NEPM recommendations for the use of containers, preservation techniques and holding times.

Field QA Duplicate Samples (Split Samples)

Field QA duplicate samples are used as a check on the accuracy of the field sampling and the analytical procedures. One soil sample was selected at random and was split in the field to form a primary sample and a QA duplicate (split) sample. The split sample was sent to the secondary laboratory and was analysed. The results of the analyses for the QA duplicate sample (analysed by the secondary laboratory) was compared with the results from the primary laboratory to determine the accuracy of the sampling and analytical procedures.

Field QC Duplicate Samples (Blind Replicate Samples)

Field QC duplicate samples are used to determine the precision of the field sampling procedures and laboratory analyses. One soil sample was selected at random and split in the field to form a primary sample and a QC duplicate (blind replicate) sample. The QC duplicate sample was labelled with a sample identification number different to its primary sample number in order to conceal its identity. The duplicate soil sample was analysed by the primary laboratory. The results of the analysis of the blind replicate sample are used to determine the precision of the sampling and analytical procedures.

Field QC Blank Samples (Rinsate Blank and Trip Blank)

Up to 5% of the total number of primary samples are blanks collected in the field. Blanks are comprised of trip blanks and rinsate blanks. A trip blank is a sample of deionised water prepared prior to sampling. The trip blank is carried through the sampling program, transported with the samples to the laboratory and stored with the samples. They are used to identify laboratory errors or to identify sources of contamination due to sample storage and handling.

Rinsate blanks are samples of deionised water collected from the field equipment after decontamination. They are used to determine the effectiveness of the decontamination procedures. One rinsate blank was collected in the field during the sampling program and was analysed by the primary laboratory. One trip blank was collected and was retained by the primary laboratory for analysis if required.

12.2 Laboratory QC Program

The laboratories perform internal QA/QC programs in accordance with their NATA registration to ensure that the analytical procedures are followed correctly and with the required degree of accuracy. This involves the laboratories preparing and analysing their own duplicate samples, blanks and analytical standards.

The results from the laboratories internal duplicate samples are compared with the results from the primary (field) samples, in order to determine the precision of the analyses. The duplicate samples are subjected to the same preparation and analytical procedures as the primary samples.

Reagent blank analyses and instrument calibrations using chemical standards are routinely conducted by the laboratories.

The laboratories also determine the accuracy of the analytical procedures used as part of their internal quality control procedures. This is determined using either control samples (where the concentration of the species to be determined is known) or matrix spikes.

The laboratories are required to analyse matrix spikes or control samples at a minimum frequency of 5% of the total number of primary samples. This is consistent with the approach recommended by the USEPA.

The results of analyses of method blanks, duplicates and control samples were compared by the laboratory to established quality assurance criteria for precision and accuracy. If the results did not meet the criteria the analyses were repeated. These criteria are:

- Method blanks should not return any positives on analysis;
- Duplicate soil samples should not vary by more than 35% from the mean result; and
- Control samples should generally give a recovery of 75-125%.

12.3 Results of the QA/QC Program

The analytical results of the QA and QC duplicate analyses have been compared using the Relative Percent Difference (RPD). The RPD is a measure of the difference between the results of the duplicate analyses. The RPD is calculated by:

$$RPD = \frac{Sample(A) - Sample(B)}{Mean\ of\ Samples(A) + (B)} x100$$

According to the USEPA methodology (USEPA 1986), the criteria for valid results for laboratory duplicates are that the RPDs are required to be <20% for waters and <35% for soil. Where the duplicate results are lower than five times the detection limit, the USEPA methodology indicates that the results are valid if the difference between the results for the duplicate soil sample is equal to or less than twice the detection limit.

For samples split in the field, the NEPM refers to Australian Standard AS4482.1-1997, which provides a guide to the validity of the data obtained from duplicate samples. According to the Australian Standard an RPD of up to 50% is the acceptance criteria. RPDs of up to 50% are considered to demonstrate good correlation between duplicate analytical results. The Australian Standard also states that the variation can be expected to be higher for organic analytes than for inorganics, and for low concentrations of analytes. Based on Peter J Ramsay & Associates' experience, RPDs up to 70% are considered to be acceptable for organic species. RPDs of 100% or more generally considered to demonstrate poor correlation.

12.3.1 Field QA Duplicate Sample (Split Sample)

The results of the QA duplicate analyses by the secondary laboratory are presented in Table R3 with the corresponding primary laboratory's results and the RPDs.

The results show a high correlation for the analyses as all but one of the RPDs for the heavy metal analyses are less than the acceptance criterion of 50%. The RPD exceedance of 67% for copper in sample 4041/3A does not affect the outcome of the investigation as the results in the duplicate samples are very low and well below the HIL for this analyte for a low density residential land use. Therefore the results indicate that a high level of prevision was achieved during the sampling and analytical program.

12.3.2 Field QC Duplicate Sample (Blind Replicate Sample)

The results for the QC duplicate soil sample are also presented in Table R3 with the corresponding laboratory's results and the RPDs.

The results show an excellent correlation for the analyses as all of the RPD's for the heavy metal analyses are less than the acceptance criterion of 50%. Therefore, the results indicate that an excellent level of accuracy was achieved in the sampling and analytical program.

12.3.3 Field QC Blank Sample

One rinsate blank was analysed for QC purposes. The rinsate blank was analysed for heavy metals. The analytical results for the blank are presented in Table R4.

The results of the blank analysis indicate that some minor cross contamination between samples and sample locations may have occurred as zinc was detected in the rinsate blank. However, as the concentrations of zinc in the soil at the site are well below its EIL this result would not affect the outcome of this investigation.

12.3.4 Laboratory QA/QC

The QA/QC programs of all laboratories used for this investigation have been reviewed to ensure that the sample data is reliable and complete. Chain of custody documentation and/or sample receipts were signed and dated by the laboratories to confirm that samples were received in good condition within acceptable time limits. The analytical methods used for the laboratories' internal QA/QC program are NATA accredited and details of the methods are provided in the laboratory reports in Appendix H. The laboratories QA/QC programs include analysis of internal duplicate samples, spike recoveries, surrogate standards and laboratory blanks.

A review of the results of the internal QA/QC has shown that the majority of these were within the laboratories' recommended range for acceptable reproducibility. Therefore, Peter J Ramsay & Associates considers the laboratory data obtained in this investigation to be of acceptable precision, accuracy and reliability and therefore representative of the site conditions encountered.

12.4 QA/QC Data Evaluation

The data quality objectives were met during the investigation, as demonstrated throughout the report. Documentation was maintained and complete, the site was assessed in accordance with National and EPA requirements, the data has been shown to be comparable and representative of the site, while precision and accuracy has been demonstrated in the field and laboratory QA/QC programs.

13. HUMAN HEALTH AND ENVIRONMENTAL IMPACT ANALYSIS

13.1 Exposure Pathways and Risk Characterisation

The analyte concentrations in the soil samples retrieved from the site are generally low and are well below the HILs for a low density residential land use. Manganese above the NEPM EIL criterion for manganese was measured at a discrete area in the south of the site. However, this does not exceed the background manganese concentration for typical Australian soils.

In view of the low analyte concentrations across the site, it is considered that there is a negligible potential for human health risks or environmental impacts on this site to occur for a low density residential land use.

13.2 Risk of Groundwater Contamination

As the analyte concentrations in the soil on the site are within background levels, the expected depth to groundwater is likely to be between 3.0 m and 30 m below ground level and that the natural soil underlying the site is of a clayey nature, there is negligible risk of groundwater contamination to have occurred at the site.

13.3 Risk of Off-Site Impacts

It is considered that there is negligible potential for off-site human health and environmental risks to occur. No evidence of potential off-site impacts was identified.

14. HAZARDOUS SUBSTANCES ASSESSMENT

Peter J Ramsay & Associates inspected the site on 18 August and 9 September 2004 for the presence of hazardous substances such as waste chemicals, sludges, dangerous goods and the potential for stormwater contamination. A hazardous materials survey for asbestos and other hazardous buildings materials was not conducted as part of the investigation.

14.1 Hazardous Substances and Waste Disposal

Peter J Ramsay & Associates' inspection of the site identified some debris on Parcels 1 and 2 including a gravel stockpile, bricks, old car tyres, corrugated iron sheeting, old kitchen appliances, wooden and metal chairs, plastic bags full of rubbish, a disused caravan, two empty propane gas canisters and wooden planks. These solid wastes are inert, recyclable and are not sources of significant site contamination.

Stored in the work shed on Parcel 3 are small drums of glyphosate (herbicide), several bags of gypsum and fertiliser, and 5 L drums of oil. In addition, along the eastern boundary of Parcel 2 are stored some debris including several old empty 205 L drums and some 10 L paint cans. Some small drums of herbicide (Roundup) were also stored in a shed on Parcel 5. As the farm chemicals are stored inside sheds on concrete floors there is a low potential for soil or stormwater contamination to occur.

Peter J Ramsay & Associates' inspection of the site showed that there are no other significant quantities of hazardous substances, dangerous goods, or wastes presently stored on the site which could present a risk of soil or storm water contamination.

15. CONCLUSIONS

Based on the results of the preliminary site investigation of land at Pigdon Street, Portarlington, Victoria, the following conclusions are made:

Conclusions

- The site is approximately 27 hectares and slopes moderately to the north-west. The site is divided into five parcels, two of which are used for residential purposes, two for agricultural purposes and one is vacant. Apart from the building footprints, the site is unsealed.

- Aerial photographs and historical records indicate that the site has been used for farming and agricultural purposes since at least the 1950s.

- The site is not registered with the Victoria EPA as contaminated land.

- Eleven buildings are present on the site including four houses, six sheds and an art gallery. Minor quantities of debris and farm chemicals are present in several areas on the site. Three AGSTs used to store water, and three in-use underground septic tanks were also identified on the site. There is no evidence of UPSSs or former UPSSs on the site.

- Minor volumes of fill are present in the south-east of Parcels 3 and 5 to a maximum depth of 1.5 m. It is likely that the fill has been sourced from on-site levelling works.

- Soil was sampled at ten locations on the site for this preliminary investigation. The analytical results for the soil samples are below guidelines values considered acceptable for a low density residential land use.

- Slightly elevated levels of barium, manganese, nickel and vanadium were identified in the southern and central portions of the site. However, these concentrations are considered to be consistent with natural background concentrations and are not significant for a low density residential land use.

- The site is considered to be suitable for a low density residential land use.

16. REFERENCES

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appendix

Tables

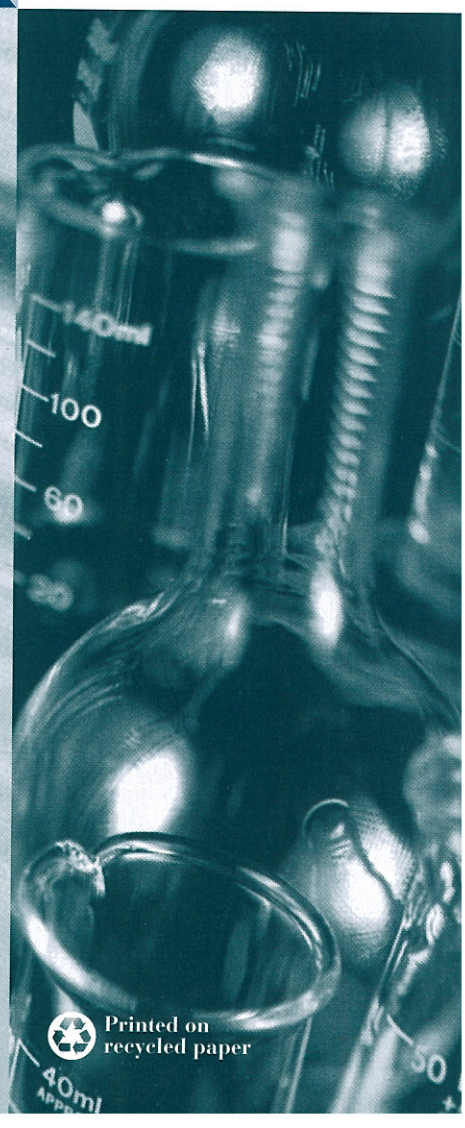

Table R1 Summary of Analytical Results for Individual Soil Samples

Analyte	Sample Number 4041/ 1A	2A	2B	3A	4A	4B	5A	5B	6A	7A	8A	9A	9B	10A	10B	Background Ranges	Ecological Investigation Level (EIL)	Health Investigation Level (HIL) (Low Density Residential)
Metals																		
Arsenic	2.8		<2.0	4.3		2.1		8.9	4.4	4.4	4.4		3.0		3.8	1-50	20	100
Cadmium	<2.0		<2.0	<2.0		<2.0		<2.0	<2.0	<2.0	<2.0		<2.0		<2.0	1	3	20
Chromium	11		20	21		26		21	22	28	18		28		26	5-1000	400 (c)	12% (c)
Copper	5.3		17	15		14		35	18	8.7	11		12		14	2-100	100	1000
Lead	7.0		17	11		7.1		16	15	11	14		8.1		8.0	2-200	600	300
Manganese					310		470					850				850	500	1500
Mercury	0.03		0.06	0.05		0.04		0.04	0.04	0.05	0.04		0.03		0.06	0.001-0.1	1 (d)	15 (d)
Nickel	5.6		23	16		30		32	18	20	12		37		41	5-500	60	600
Zinc	11		48	32		15		69	37	29	34		30		29	10-300	200	7000
Monocyclic Aromatic Hydrocarbons (MAHs)																		
Total MAH above detection limits					ND													
Total Petroleum Hydrocarbons (TPHs)																		
Total C_6 -C_{36} above detection limits					ND													
Polycyclic Aromatic Hydrocarbons (PAHs)																	1000 (e)	5600 (f)
Total PAH		<2								<2						0.95-5 (a)	20 (e)	20
Organochlorine Pesticides (OCPs)																		
Total OCP above detection limits	ND	ND		ND				ND	ND	ND	ND			ND				
Organophosphorus Pesticides (OPPs)																		
Total OPP above detection limits	ND	ND		ND				ND	ND	ND	ND			ND				
Polychlorinated Biphenyls (PCBs)																		
Total PCBs																		
Volatile Chlorinated Hydrocarbons (VCHs)																		
Total VCH above detection limits					ND													
pH (units)	5.1		6.2			7.4		6.2	5.4				6.4	5.6		6-8 (a)		
Asbestos	NA																	

Note : Results expressed as mg/kg dry weight unless indicated otherwise.
ND = No individual species was detected above the laboratory detection limits.
NA = No asbestos detected.
Results that have been shaded in green exceed the EILs for soil.
Results that have been shaded in red exceed the HILs for soil for a low density residenital land use.

(a) ANZECC background ranges (used where no NEPM ranges available).
(b) ANZECC B level criteria (used where no EIL available).
(c) Criterion for chromium (III).
(d) Criterion for inorganic mercury.
(e) NSW EPA (1994) threshold concentration (used where no EIL available).
(f) NEPM criterion for TPH (C_{16}-C_{35}) aliphatics.

Table R2 Summary of Analytical Results for Composite Soil Sample

Analyte	Composite Sample Number 4041/ C1	Equivalent EIL for 3 way composite sample	Equivalent HIL (Low Density Residential) for a 3 way composite sample
Metals			
Antimony	<2.0	6.7 (a)	
Arsenic	4.6	6.7	33
Barium	110	100	
Beryllium	<2.0		6.7
Cadmium	<2.0	1	6.7
Chromium	30	133 (b)	4% (b)
Cobalt	17		33
Copper	13	33	333
Lead	9.5	200	100
Manganese	620	167	500
Mercury	0.04	0.3 (c)	5 (c)
Nickel	25	20	200
Tin	<2.0	17 (a)	
Vanadium	56	17	
Zinc	23	67	2333
Polycyclic Aromatic Hydrocarbons (PAHs)			
Total PAH	<2	6.7 (d)	6.7
Organochlorine Pesticides (OCPs)			
Total OCP above detection limits	ND		
Organophosphorus Pesticides (OPPs)			
Total OPP above detection limits	ND		
Phenols			
Total Phenols	<0.1		2833
Polychlorinated Biphenyls (PCBs)			
Total PCBs	<0.1	0.3 (a)	3.3
Total Cyanide	1.0		167 (e)
Fluoride	<2.0		
pH (units)	5.3		
Asbestos	NA		

Note : Results expressed as mg/kg dry weight unless indicated otherwise.
ND = No individual species was detected above the laboratory detection limits.
NA = No asbestos detected.
4041/C1 is a composite soil sample of samples 4041/4A, 5A & 9A.
Results that have been shaded in green exceed the equivalent EILs for soil.
Results that have been shaded in red exceed the equivalent HILs for a low density

(a) ANZECC B level criteria (used where no EIL available).
(b) Criterion for chromium (III).
(c) Criterion for inorganic mercury.
(d) NSW EPA (1994) threshold concentration (used where no EIL available).
(e) Criterion for cyanide (complexed).

Table R3 Results of Quality Assurance and Quality Control - Duplicate Samples

Analyte	Sample Number 4041/3A					
	Primary Sample	Split Sample*	RPD (%)	Primary Sample	Blind Sample#	RPD (%)
Metals						
Arsenic	4.3	4	7	4.3	4.3	0
Cadmium	<2.0	0.3	<50	<2.0	<2.0	<50
Chromium	21	16	27	21	23	9
Copper	15	30	**67**	15	16	6
Lead	11	11	0	11	11	0
Mercury	0.05	0.06	18	0.05	0.04	22
Nickel	16	13	21	16	17	6
Zinc	32	36	12	32	37	14

Note: Results expressed as mg/kg dry weight.

* Sample labelled in the field identically to the primary sample and subsequently analysed by the secondary laboratory.

Labelled 4041/50A in the field and subsequently analysed by the primary laboratory.

RPDs that have been shaded exceed the acceptance criteria.

Table R4 Results of Quality Control - Blank Sample

Analyte	Sample Number 4041/ RB1
Metals	
Arsenic	<0.005
Cadmium	<0.005
Chromium	<0.005
Copper	<0.005
Lead	<0.005
Mercury	<0.001
Nickel	<0.005
Zinc	**0.009**

Note: Results expressed as mg/L.
RB = Rinsate Blank
Results that have been shaded exceed the acceptance criteria.

appendix

Figures

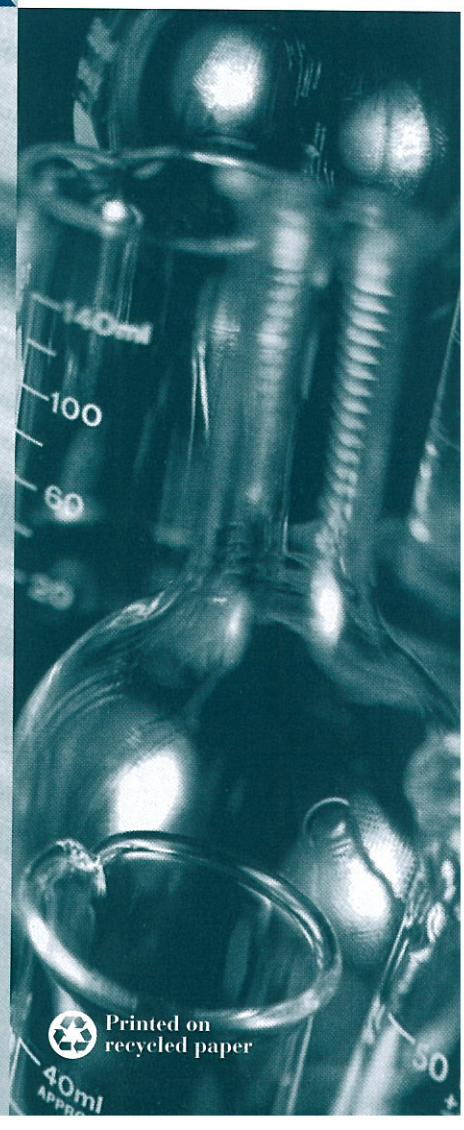

Figure 1 Locality Map

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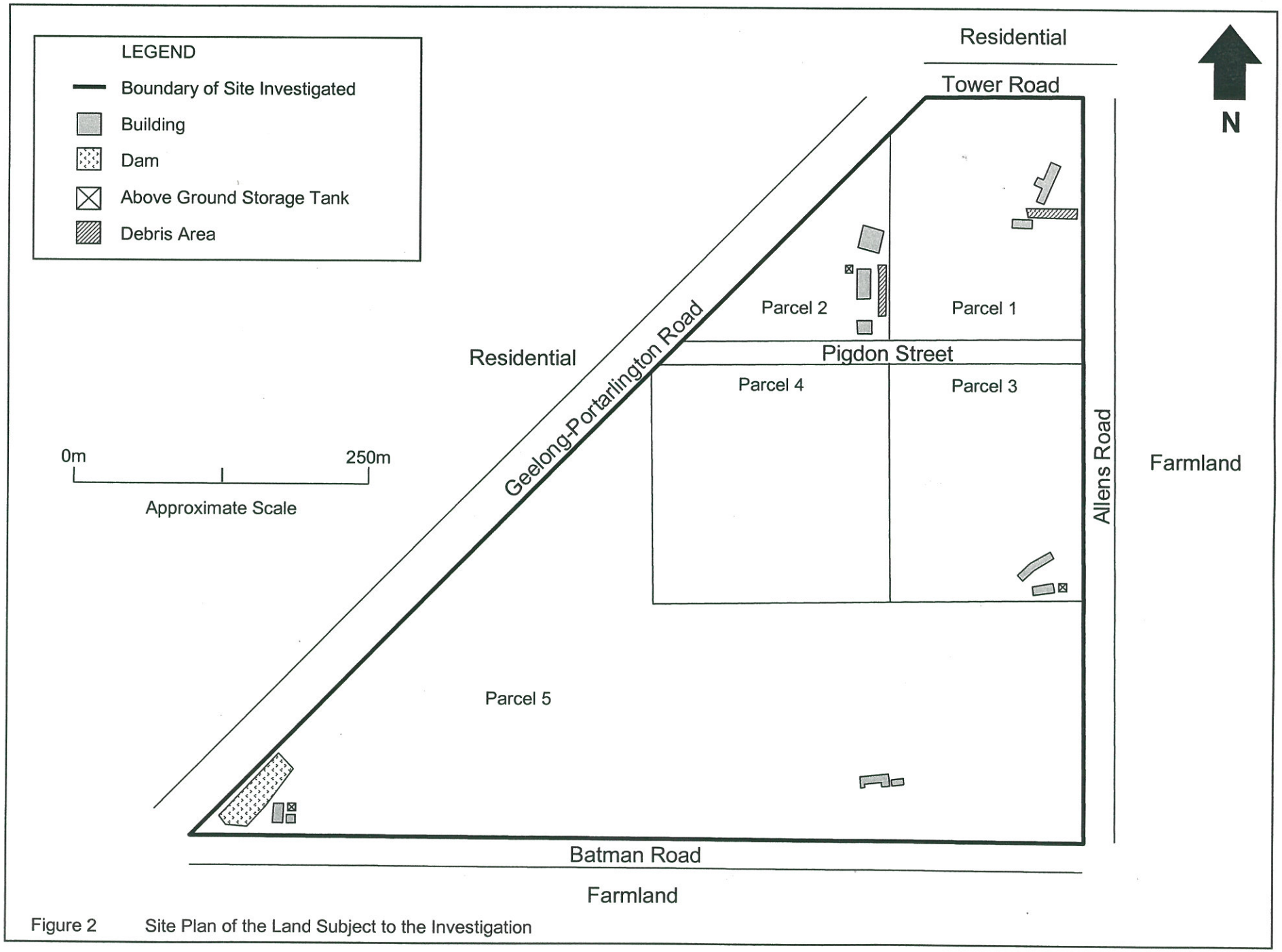

Figure 2 Site Plan of the Land Subject to the Investigation

PETER J RAMSAY & ASSOCIATES

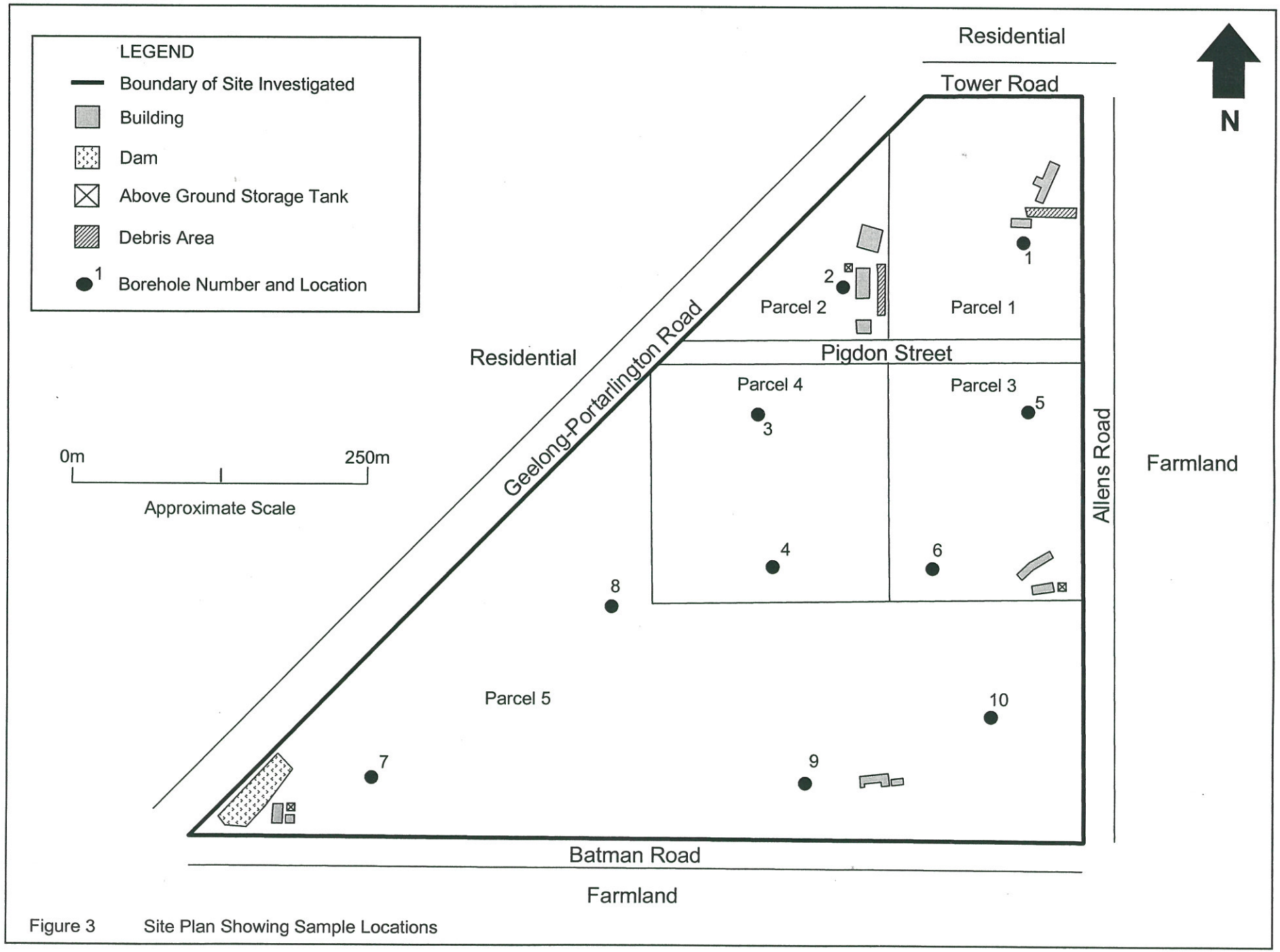

Figure 3 Site Plan Showing Sample Locations

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