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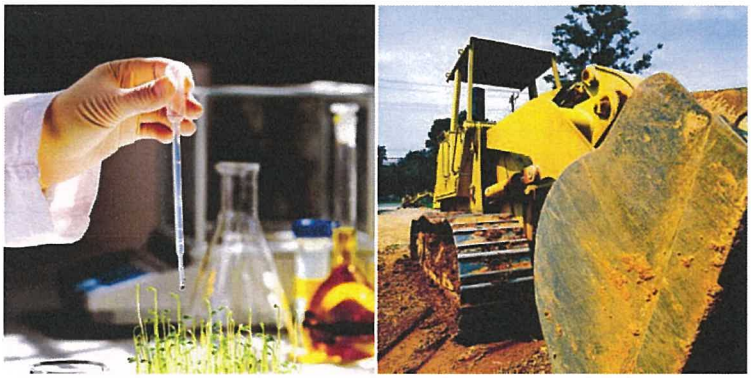
ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

REPORT NO. 210052

ENVIRONMENTAL AUDIT OF THE NORTHERN PORTION OF LOT 1 ON PS419739 AT 1213 – 1217 CENTRE ROAD, OAKLEIGH SOUTH, VICTORIA

EPA CARMS NO: 41385-2

ENVIRONMENTAL EARTH SCIENCES VIC
REPORT TO CITY OF MONASH
APRIL 2011



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AUDIT REPORT EXECUTIVE SUMMARY

This environmental audit report has been prepared in response to a request to issue a Certificate of Environmental Audit (CoEA) for a strip of land along the northern boundary of the property at 1213 – 1217 Centre Road, Oakleigh South, Victoria 3167. This audit was undertaken in accordance with Part IXD of the *Environment Protection Act* (1970). The relevant Certificate of Title for the site is Lot 1 PS419739, Volume 10478 Folio 850. The Environmental Audit covers only part of this allotment as shown on the Title Plan attached in Appendix A. A summary of the environmental audit is presented below.

TABLE 1 SUMMARY OF AUDIT INFORMATION

EPA file reference No	41385-2
Auditor:	Todd Mitchell
Auditor term of appointment:	15 September 2009 to 14 September 2011
Name of person requesting audit:	City of Monash (Frank Bua Giancarro, Manager Property Development at City of Monash acting as representative)
Relationship to premises/location	Site Owner
Date of request	17 June 2010
Date EPA notified of audit	18 June 2010
Completion date of audit	21 April 2011
Reason for audit	Environmental Audit Overlay
Current land use zoning	Residential 1 Zone
EPA region	Southern Metro
Municipality	City of Monash
Dominant – lot on plan	Northern portion of Lot 1 PS419739 – Refer to attached Title Plan
Additional – Lot on plan(s)	-
o **Street/Lot – Lower No.**	1213
o **Street/Lot – Upper No.**	1217
o **Street Name**	Centre
o **Street type**	Road
o **Street suffix (North, South etc)**	Not applicable
o **Suburb**	Oakleigh South
o **Postcode**	3167
GIS coordinate of site centroid **Longitude/Northing (GDA94)** **Latitude/Easting (GDA94)**	 145.060565 37.5534121
Site area (hectares)	0.223 Ha (approx.)
Members and categories of support team utilised	None
Outcome of audit	Certificate
Further work or requirements	None identified
Nature and extent of continuing risk	None known

TABLE 2 PHYSICAL SITE INFORMATION

Site aquifer formation	Groundwater in Brighton Group
Average depth to groundwater	Groundwater expected at 20 mBGL. Possibly areas of perched groundwater at 5-10 mBGL.
Groundwater segment	Segment B
Groundwater flow direction	Assumed to be in a south west direction
Past use / site history	1884 – mid 1920s: Agricultural (market gardens) Mid 1920s – mid 1960s: Poultry farm Mid 1960s – 1998: Part of a sand quarry 1998 – present: Recreational space for the Clarinda Centre (aged care facility)
Surrounding land use	West: Residential and Huntingdale Golf Club East: Talbot Park and Residential South-west: Industrial and Business South: Business and Residential South-east: Clarinda Primary School and Residential
Proposed future use	Client to divest site. End use therefore is unknown however, it is assumed to be residential.

This summary must be read in conjunction with the full audit report and the Certificate of Environmental Audit (CoEA) that has been issued for the site. The audit report provides more data and discussions that are not in the above summary table for reasons of space and clarity.

The CoEA is issued based on the site conditions at the time of issue. The Auditor cannot control future activities that may result in contamination of the site.

There are a number of abbreviations and acronyms throughout the report. Refer to Section 18 of the audit report for a list of these abbreviations and acronyms.

Distribution List

Copy No	Distributed to:
1	City of Monash – Frank Bua Giancarro [client and planning authority]
2	Environment Protection Authority – Principal Auditor
3	Environmental Auditor – Todd Mitchell
4	Environmental Earth Sciences VIC (library)

Revision List

Revision No	Description of Revision	Issued Date
0	Final issue	21 April 2011

ENVIRONMENT PROTECTION ACT 1970

CERTIFICATE OF ENVIRONMENTAL AUDIT

I, Todd Mitchell of Environmental Earth Sciences VIC, a person appointed by the Environment Protection Authority ('the Authority') under the Environment Protection Act 1970 ('the Act') as an environmental auditor for the purposes of the Act, having:

1. been requested by the City of Monash to issue a certificate of environmental audit in relation to the site located at 1213 – 1217 Centre Road, Oakleigh South, Victoria. The site specifically incorporates the northern portion of Lot 1 on Plan of Subdivision 419739, Volume 10478 Folio 850 (which is shown on the attached Title Plan) ('the site") owned by the City of Monash,
2. had regard to, among other things,
   (i) guidelines issued by the Authority for the purposes of Part IXD of the Act,
   (ii) the beneficial uses that may be made of the site, and
   (iii) relevant State environment protection policies/industrial waste management policies, namely

- State Environment Protection Policy (Prevention and Management of Contamination of Land);
- State Environment Protection Policy (Groundwaters of Victoria);
- State Environment Protection Policy (Waters of Victoria); and
- Environment Protection (Industrial Waste Resource) Regulations.

in making a total assessment of the nature and extent of any harm or detriment caused to, or the risk of any possible harm or detriment which may be caused to, any beneficial use made of the site by any industrial processes or activity, waste or substance (including any chemical substance), and

3. completed an environmental audit report in accordance with section 53X of the Act, a copy of which has been sent to the Authority and the relevant planning and responsible authority.

HEREBY CERTIFY that I am of the opinion that the condition of the site is neither detrimental nor potentially detrimental to any beneficial use of the site.

Other related information: Groundwater bores were not installed as part of this audit. Groundwater must be tested to confirm its suitability prior to any beneficial use of this resource. Furthermore, any disposal or importation of soil or fill as part of any future development is to be undertaken in line with EPA Victoria requirements.

This Certificate forms part of environmental audit report (Environmental Earth Sciences VIC, 1213 – 1217 Centre Road, Oakleigh South, Victoria, 21 April 2011). Further details regarding the condition of the site may be found in the environmental audit report.

DATED 21.04.2011

Signed _____
Todd Mitchell
ENVIRONMENTAL AUDITOR

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1 INTRODUCTION

Mr Frank Bua Giancarro of the City of Monash commissioned Todd Mitchell on 17 June 2010 to act as the Environmental Auditor for the site located at 1213 – 1217 Centre Road, Oakleigh South, Victoria. The relevant Certificate of Title for the site is Lot 1 on Plan of Subdivision 419739, Volume 10478 Folio 850. The Environmental Audit covers only part of this allotment (northern 15m strip) as shown on the Title Plan attached in Appendix A.

The size of the property is approximately 2,228 m^2 (0.223 hectares (Ha)). The site is zoned Residential 1 Zone (R1Z) and is subject to an Environmental Audit Overlay (EAO), as per the City of Monash Planning Scheme.

The Environmental Audit was conducted in accordance with Part IXD of the Victorian *Environment Protection Act* 1970 and EPA '*Environmental Auditor (Contaminated Land) Guidelines for Issue of Certificates of Environmental Audit*' (Publication 759.1). The Auditor has exercised professional judgement, had regard, and given due weight to the relevant State Environment Protection Policies (SEPP) and Environment Protection (Industrial waste management) Regulations.

2 PURPOSE OF AUDIT

The purpose of this Audit is to evaluate whether the site is suitable for issue of a Certificate of Environmental Audit (CoEA), thereby indicating that the site is suitable for any beneficial use, and if not, whether it is suitable for the likely residential sensitive use. Such determination would result in the issue of a Statement of Environmental Audit (SoEA).

The Environmental Audit has been requested by the City of Monash.

3 AUDIT SCOPE AND METHODOLOGY

3.1 Audit scope

The audit scope relates to the assessment of the environmental condition of the site in relation to contamination by previous land uses and its suitability for its proposed use. This includes an assessment of potentially contaminating activities, and the potential for contamination at the site to adversely affect beneficial uses on and offsite.

3.2 Audit methodology

In conducting this Environmental Audit, the Auditor and/or his representative has:

- reviewed and provided comment on a work plan proposed by GHD Pty Ltd (the assessor) during the course of the investigation and prior to implementation;
- reviewed, evaluated and commented (if required) on the reports and other information outlined in Section 5 to gain an understanding of the environmental condition of the site

(and surrounds), and the completeness/adequacy of the investigation (including QA/QC);

- regularly liaised with the assessor;
- inspected the site on 26 August and 3 December 2010 to review site assessment works in progress and collect Auditor verification samples in order to verify the environmental condition of the site;
- inspected the site on 25 November 2010 to examine the site condition and surrounding land uses;
- identified the beneficial use(s) to be protected;
- assessed the harm, detriment or risk posed by the condition of the site to the beneficial use(s) to be protected;
- concluded as to the suitability of the site in its final condition;
- prepared and issued an environmental audit report in accordance with EPA requirements; and
- prepared and issued a Certificate of Environmental Audit.

4 AUDIT REQUIREMENTS

An Environmental Audit is a total assessment of the nature and extent of any harm caused to, or the risk of any possible harm or detriment which may be caused to, any beneficial use made of any segment of the environment by any industrial process or activity, waste, substance (including any chemical substance) or noise. Note that Section 3 of the Auditor Guidelines states that *"noise is not a relevant consideration when conducting an environmental audit (contaminated land) but is a factor which can impact on a beneficial use"*.

On 27 September 2001, the Minister for Planning, under the *Planning and Environment Act* 1987, Section 12 (2) (a) substituted his Direction No. 1 (dated October 1989, amended 1992) and issued a revision to Councils to direct them that they must satisfy themselves that potentially contaminated land, which is proposed to be allowed under an amendment to a planning scheme, is suitable for more sensitive uses such as residential use, a child care centre, a pre-school centre or a primary school.

Councils must satisfy themselves by obtaining either a CoEA or SoEA by an Environmental Auditor appointed pursuant to Part IXD of the Victorian *Environment Protection Act 1970* and its amendments for the nominated land-use(s).

A CoEA certifies that the site is suitable for all beneficial uses. A SoEA is a conditional certification with some restriction on the use of the site.

An Auditor must have regard to the requirements of relevant State Environment Protection Policies (SEPPs), Industrial Waste Management Regulations or Policies, guidelines issued by EPA Victoria for the purpose of the Act, and any National Environment Protection Measure (NEPM) publication. In addition, the Auditor should also refer to published guidelines and standards relevant to the assessment and auditing of sites.

This Audit has been undertaken using the guidance contained in the EPA Victoria guidelines, in particular the *Environmental Auditor (Contaminated Land) Guidelines for Issue of Certificates and Statements of Environmental Audit* (Publication 759.1, September 2007).

5 DOCUMENTS REVIEWED BY THE AUDITOR

In undertaking this Environmental Audit, the Auditor has reviewed the documents listed below, and the attached appendices:

- GHD (25 June 2010), GHD Reference: 31/26398/183732, 'Clarinda Centre', 1213 – 1217 Oakleigh South ESA – Work Plan for Auditor Approval;
- GHD (12 July 2010), GHD Reference: 31/26398/184231, 'Clarinda Centre', 1213 – 1217 Centre Rd, Oakleigh South ESA, Response to Auditors Comments on GHD Work plan;
- GHD (9 August 2010), GHD Reference: 31/26398/185435, City of Monash, Clarinda Centre, Phase 1 and 2 Environmental Site Assessment Phase 1 Summary Letter;
- GHD Pty Ltd (October 2010), GHD Reference: 31/26398/183955, Draft (B), City of Monash, Report to Clarinda Centre, Phase 1 and Phase 2 Environmental Site Assessment;
- GHD Pty Ltd (January 2011), GHD Reference: 31/26398/183955, Draft (C), City of Monash, Report to Clarinda Centre, Phase 1 and Phase 2 Environmental Site Assessment;
- GHD Pty Ltd (7 February 2011), GHD Reference: 31/26398/190098, City of Monash, Clarinda Centre, Phase 1 and 2 ESA, Response to Auditors Comments; and
- GHD Pty Ltd (March 2011), GHD Reference: 31/26398/183955, City of Monash, Report to Clarinda Centre, Phase 1 and Phase 2 Environmental Site Assessment; and
- Rock Solid (December 1997), Council's Clarinda Hostel and Development Site, Centre Road, Clayton.

A copy of the final GHD assessment report and appendices (Reference: 31/26398/183955 dated March 2011) is provided in Appendix B. The Auditor notes that the City of Monash appointed the assessor (GHD Pty Ltd), who hold a professional membership with the Australian Contaminated Land Consultants Association Inc (ACLCA).

The Auditor has also examined previous environmental audit reports conducted for sites within a 2 km radius of the site (refer to Section 6.8 for further information).

6 SITE DETAILS AND CHARACTERISTICS

6.1 Site identification, zoning and municipality

The address of the site is 1213 – 1217 Centre Road, Oakleigh South, Victoria. The relevant Certificate of Title for the site is Lot 1 on Plan of Subdivision 419739, Volume 10478 Folio 850. The Environmental Audit covers only the northern 15m strip of this allotment as shown on the Title Plan attached in Appendix A and as shown on Figure 3.

The site is zoned Residential 1 Zone (R1Z), is subject to an EAO as per the City of Monash Planning Scheme and is approximately 0.223 hectares in area. A site location plan is provided as Figure 1.

6.2 Site location and current conditions

The site is located at the rear of the (now disused) Clarinda Centre, 1213 – 1217 Centre Road, Oakleigh South, Victoria. It comprises of a 15m strip of land along the northern boundary of the Clarinda Centre and occupies an area of 0.223 hectares (Please refer to Title Plan [Appendix A] and Figure 3). The area surrounding the site includes a disused former sand quarry to the north, residential properties to the east, a primary school, 7-Eleven (service station) and residential properties to the south, and a golf course (Huntingdale) and Bunnings store to the west and southwest of the site respectively.

At the time of the Auditor (or Auditor representative) inspections on 26 August, 25 November and 3 December 2010, the following was noted:

- Clarinda Centre (a City of Monash aged care facility) is now disused;
- subject land remains well maintained with low-cut grass (lawn) coverage over a large area of the site (>75%);
- paved and concreted footpaths exist as shown on Figure 3;
- some garden/flower beds are noted;
- healthy mature trees, shrubs and bushes observed;
- groundwater monitoring bore located within a few metres of the northern boundary fence as shown on Figure 3;
- Huntingdale Golf Club pump shed located to the north of the site (understood to be used for extraction of water for golf course watering);
- Subject land is relatively flat except for the western and eastern ends which rise between 1 and 2 metres above the level of the body of the site;
- there did not appear to be any evidence of potentially contaminating activities on the subject land. No evidence of fuel storage (ie. underground storage tanks) was observed;
- a breather pipe was observed from the northern wall of the former Clarinda Centre building. Further enquires with Council confirmed that this was not from a fuel tank, but from the former centre macerator; and
- healthy vegetation was observed between the northern site boundary and the former quarry pit escarpment.

6.3 Proposed use

The City of Monash plans to sell both the subject site and the Clarinda Centre property. An EAO exists across the northern strip of site and as such, an Audit is required to indicate that the environmental condition of the land is suitable for any beneficial use. At present, there are no development plans for the site.

6.4 Adjacent uses

Based on the Auditor's site inspection, the site is situated in an area containing a mixture of land uses. Please refer to Figure 2 for details. The following land uses were observed in the surrounding area:

- North: Disused, former sand quarry;
- South: Clarinda Primary School, 7 Eleven (service station) and residential properties;
- West: Bunnings store (south west) and Huntingdale Golf Club (immediately west);
- East: Residential properties.

The surrounding land uses that have potential to impact on the environmental status of the site include the former quarry located immediately north of the site, any filling activities used during construction of the above properties and the service station.

6.5 Topography, drainage and vegetation

The natural topography of the site is relatively flat with a surface height of approximately 50 - 60 metres Australian Height Datum (mAHD), while the surrounding area gently slopes towards to the south/south-west.

The closest surface water body to the site is the man-made lake in the pit of the former quarry, located immediately north of the site. The nearest down gradient water body is approximately 750 m south-west of the site and appears to be another man-made lake/reservoir. There are a number of similar water bodies within this area ie. between 750 m and 2 kilometres (km) south-west of the site, which are commonly related to sand mining activity.

Of note is the Clayton and Mordiallic drain, which is located south/south-east of the site. It starts approximately 1.5 km south-east of the site and runs for approximately 8.3 km south until it discharges into Mordiallic Creek. However, it is reasonable to conclude that the nearest, significant, down-gradient, natural water body is Port Phillip Bay, approximately 8 km south west of the site.

6.6 Geology

According to the Geological Map Series 1:250 000 geological map (1997), the surface geological formation at the site is part of the Brighton Group Sands of the Upper Tertiary period (5 – 1.8 million years ago). The Brighton Group in this area is comprised of the Red Bluff Sands formation and the Black Rock Sandstone formation. The Red Bluff Sands are characterised by fine to coarse sands, with minor poorly sorted gravels. The Black Rock Sandstone contains silty and shelly sands with local development of ironstone bands.

Underlying the Brighton Group units is the Fyansford Formation which is comprised of glauconitic and carbonaceous silts and clays and shelly sands. This formation is then

underlain by Silurian aged sediments of the Dargile Formation, which consists of massive siltstones and shales. Occasionally there are collections of massive laminated and current bedded greywackes, conglomerates and clast beds. The Silurian sediments are generally present at depths greater than 30-40 mBGL within the area of the site.

6.7 Pertinent hydrogeology

The Department of Natural Resources and Environment (DNRE) South Eastern Victoria Regional Aquifer Systems (1995) defines groundwater in the Upper Tertiary Aquifer System at the site as Segment B. It generally has a Total Dissolved Solids (TDS) (measure of salinity) range of 1,001 – 3,500 mg/L. According to the SEPP Groundwaters of Victoria (1997) this requires the protection of the following beneficial uses:

- agriculture, parks and gardens;
- potable mineral water;
- maintenance of ecosystems;
- stock watering;
- industrial water use;
- primary contact recreation; and
- buildings and structures.

Yields within bores situated in the unconfined to semi-confined Brighton Group sediments of this area can be moderate however, they are generally relatively low and less than 2.5 L/sec (Leonard, 1992). Regional groundwater flow is expected to be in a south/south-westerly direction however, local shallow groundwater flow would likely be north toward the man-made lake/reservoir within the former quarry pit, which is likely due to the drawn down by the adjacent golf club pump (Refer to Plate 8).

The depth to groundwater within the Brighton Group is expected to be approximately 20 mBGL however, locally perched shallow groundwater may be present at depths ranging between 5 and 10 mBGL. It is also possible that this perched water discharges locally into utility trenches, creeks, drains and low points throughout the region.

The Victorian Water Resources Data Warehouse, the DPI spatial database and the DSE groundwater database were used to identify nearby groundwater bores. From this, the assessor identified 34 groundwater bores within approximately 1 km of the site, a summary of which is presented below:

- 14 bores were registered for groundwater investigation purposes;
- 5 bores were registered for State Observation Network purposes;
- 3 bores were registered for both State Observation and Investigation purposes;
- 3 bores were registered for domestic and stock purposes;
- 2 bores were registered for irrigation purposes;
- 1 bore was registered for domestic purposes only; and
- 6 bores were registered for unknown purposes.

The assessor has provided a copy of the results of their search of the State Groundwater Database (SGDB), which is presented in Appendix C of their final report (Appendix B).

According to the assessors report, groundwater in the above bores was found to range between 2.13 and 21.03 mBGL. It was further noted that two nearby bores were reported as having a standing water level (SWL) of 4 and 14 mBGL, at 0.67 and 0.48 km from the site respectively.

The Auditors representative also dipped the groundwater bore located immediately north of the northern boundary (See Figure 3). The SWL was recorded as 11.54 mBGL. This groundwater bore appears to be part of a larger bore network on the former quarry site however, there is no assessment or audit report publicly available for this site.

6.8 Previous Environmental Audits

A search of the list of completed Environmental Audits (undertaken by both GHD and the Auditor) has revealed that there are three sites within a 2 km radius of the site that have undergone an Environmental Audit. The Auditor has examined the Environmental Audit reports for these three sites. Please refer to Figure 2 for the location of these audits. A summary of the relevant findings are presented below.

6.8.1 1213 Centre Road, Oakleigh South, Victoria

Environmental Audit undertaken by:	Mr James Mantle
Date completed:	14 March 2000
CARMS No:	41385-1
Approximate location from site:	Immediately east of the site
Outcome:	Certificate of Environmental Audit

As the Clarinda site was being re-zoned from *Extractive Industrial Zone* and *Residential C* to *Mixed Use Zone,* the City of Monash engaged ESP Laboratories (ESP) to undertake a 'validation audit'. Dr James Mantle of PPK Environment & Infrastructure Pty Ltd was appointed the Environmental Auditor for the site.

Both the geology and hydrogeology descriptions within the assessment report concur with the findings of the current Audit. At the time of the assessment on the above mentioned property, the Auditor noted that the water in the former quarry pit (to the north) was approximately 6 m deep. For reference, the assessor's final assessment report for the current Audit notes that the water level in the former quarry pit is approximately 8 m BGL (not 8 m deep).

The report issued by ESP notes that the former sand quarry to the north of the site was used by Consolidated Quarries Ltd for the '*excavation of sands, internal transportation, washing, separation and external transport of sands*'. It further states that, '*both the past and present (1998) quarrying operations have not involved the use of chemicals*.'

A total of nine (9) near surface soil samples were collected from nine (9) grid locations across the site in October 1998 and analysed for the following chemicals of potential concern (CoPC):

- heavy metals;
- organochlorine pesticides (OCP);
- chlorinated hydrocarbons (CHC);
- monocyclic aromatic hydrocarbons (MAHs);

- polycyclic aromatic hydrocarbons (PAHs); and
- total recoverable hydrocarbons (TRHs).

All laboratory results were found to comply with both the ecological and health-based investigation levels applied at the time of the assessment. Groundwater was not investigated as part of the Audit however, the Auditor notes in his report that '*the Auditor considered it is unlikely that groundwater would have been impacted or that current site conditions would present any risk to beneficial uses of groundwater at the site*'.

6.8.2 8 Coonil Street, Oakleigh South, Victoria

Environmental Audit undertaken by:	Dr Fouad Abo
Date completed:	4 November 1998
CARMS No:	36710-1
Approximate location from site:	350 m east of the site
Outcome:	Certificate of Environmental Audit

Douglas Partners Pty Ltd (Douglas Partners) was engaged by Ms Vivian Lieu to undertake the ESA at this property in September 1998. As the site was to be redeveloped for standard residential use, the property underwent and Environmental Audit by Dr Fouad Abo of Hyder Consulting Pty Ltd (Hyder).

The ESA report indicates that the property was previously used as a part of a nursery and a number of sheds/warehouse type structures were identified during the historical aerial photographic search (between 1945 and 1988). The main CoPC were identified as heavy metals, PAH and OCP/OPP however, a broader analysis was also conducted as the site historical information was somewhat limited. Note that, both the geology and hydrogeology descriptions within the assessment report concur with the findings of the current Audit.

Douglas Partners undertook soil sampling at six (6) borehole locations to a maximum depth of 1 mBGL. They identified fill material between 0.3 and 0.7 mBGL in the form of silty sand with rubble. The underlying natural material was found to be fine to medium grained silty sand.

All laboratory results were reported to comply with the applicable human health guidelines (NEPM 'A' HIL) with the exception of one dieldrin result. This location slightly exceeded the ANZECC B ecological screening guideline of 0.2 mg/kg by 1 mg/kg. This location was however in compliance with the human health guidelines.

The Auditor determined that a groundwater investigation was not necessary and stated the following. "*The groundwater is fairly deep with no groundwater wells or waterways adjacent to the site... Moreover, given both the clean nature of the surface soil, it is therefore unlikely that any risk to surface or groundwater quality could occur.*"

The Auditor concluded that "*the site is suitable for any beneficial uses. As such the site is considered suitable for a Certificate of Environmental Audit.*"

6.8.3 Former Oakleigh Council Depot, Corner of Coombs and Scotsburn Avenues, Victoria

Environmental Audit undertaken by:	Mr James Mantle
Date completed:	29 March 2000
CARMS No:	30572-3
Approximate location from site:	800 m north-east of the site
Outcome:	Certificate of Environmental Audit

The purpose of this Audit was to determine the suitability of the site for any potential sensitive uses in line with the re-zoning of the site from *Local Government-Proposed Public Purposes* to *Residential 1 Zone* (R1Z).

As per the other two nearby Audits, the geology and hydrogeology descriptions within the assessment report concur with the findings of the current Audit. At the time of the assessment on the above mentioned property, the Auditor noted that groundwater was located at approximately 6 mBGL, '*possibly indicating that locally perched water tables are present above the relatively impervious clay layers*'. He further notes that fill material was found to cover '*an extensive area of the site*' to a maximum depth of 1.5 mBGL.

GeoPollution Management Pty Ltd (GeoPollution) first conducted an ESA at this property in September 1995. In September 1998, the City of Monash engaged ESP to conduct remediation (including the removal of three underground storage tanks (USTs)) and validation work. The Audit report indicates that the three USTs were previously installed at the vehicle refuelling area of the former depot which once existed at the property.

The remediation and validation works undertaken by ESP included the following:

- excavation and stockpiling of soil from underneath an overhead bitumen tank, the USTs, hydraulic hoist pits, truck wash pits and vehicle inspection pits;
- validation of the excavated areas;
- onsite land farming of soil contaminated with TPH (approximately 350 m^3);
- reinstatement of excavated areas with soil that was validated by ESP; and
- surface levelling in the centre of the site with remediated soil.

Validation soil samples were analysed for the following broad suite of CoPC:

- heavy metals, pH, OCP, CHC, MAH, PAH and TRH.

In contrast to the assessor's final report for the current Audit, the Auditor did refer to some soil concentrations in excess of applicable ecological guidelines following remediation works. These included soil samples with slightly elevated arsenic (As) and chromium (Cr). However, the arsenic was noted to be localised and associated with fill material, while the Cr was further assessed by the Auditor and found to comply with ANZECC B guidelines.

Due to the significant volume of hydrocarbon impacted soil at the site (prior to remediation), the Auditor considered it necessary to investigate the groundwater prior to issue of a CoEA. The groundwater investigation observed SWL to be 5.7 mBGL within the one bore installed onsite. Concentrations of toluene and xylenes in groundwater were detected however, they were reported to be within the applicable guidelines. The Auditor subsequently concluded that there was no risk to the beneficial uses of groundwater at the site.

7 SITE HISTORY

The City of Monash commissioned GHD to undertake an ESA to determine the contamination status of the site soil and potential for groundwater contamination. A desktop historical investigation was undertaken as part of the ESA and included the review of the following:

- review of site history and the surrounding land uses;
- review of the Certificate of Title documentation;
- review of historical aerial photographs;
- review of geological and hydrogeological survey maps;
- examination of EPA Priority Sites Register;
- a review of the Royal Historical Society of Victoria records;
- a search for Cathodic Protection Systems;
- a review of the State Groundwater Database; and
- review of the one previous Environmental Site Assessment undertaken at the site [Rock Solid, *Geotechnical and Environmental Investigation* (1997)].

7.1 Historical overview

The City of Monash commissioned Todd Mitchell on 17 June 2010 to act as the Auditor for the site. The Auditor understands that the City of Monash acquired the site from the former sand quarry (located immediately north of the site) to provide additional recreational space for the aged care facility, the 'Clarinda Centre' (located immediately south of the site). The Clarinda Centre has now closed.

A summary of the history of the site is provided below based on the assessor's final report (dated March 2011):

- the following historical aerial photographs were reviewed: 1945, 1956, 1968, 1975, 1988, 1991 and 2006, and the key findings are as follows:
    - the site appears to have been undeveloped in 1945 and thought to be a market garden (note that the registered proprietors in 1921, 1922 and 1923 included a farmer, market gardener, grazier and Clarinda Poultry Farm);
    - based on the aerial photographs, the Auditor considers that there was an area of disturbance in the western corner of the site in 1945;
        - the assessor's final report suggests that this may be associated with installation of below ground services (mains water and drainage), and/or car parking for the former quarry office;
        - whilst the assessor's formal response (dated 7 February 2011) to the Auditors comments (dated 1 February 2011) refers to car parking (only) in this area, the Auditor notes that either reason is plausible;
    - the surrounding land use in the 1945 photograph is predominantly market gardens and agricultural, including possible poultry farming north of the site;
    - residential properties increase in the surrounding area between 1945 and 1968, while the disturbance in the western corner of the site is evident throughout this

time. Further, a number of buildings immediately south of the site appear in the 1968 photograph (ie. future Clarinda Centre), and a water filled quarry is evident to the east;

- by 1975, a water filled quarry was evident north of the site however, the likely poultry farm buildings and crops in this area still remain;
- by 1988, the site was completely part of the quarry operation and filled with water. Agricultural operations had ceased in this area and additional buildings are evident to the immediate south of the site (ie. the Clarinda Centre);
- no significant changes were observed between 1988 and 1991, with the exception of the quarry property (to the east), which had been rehabilitated and grassed (now known as Talbot Park);
- the 2006 aerial photograph shows that the site itself had been reinstated and landscaped. No other significant changes had occurred over the years with the exception of a general increase in housing and commercial land use in the surrounding areas;

- the title search generally concurs with the findings of the aerial photographic search as follows:
  - the site was originally owned by graziers, agriculturalists and poultry farmers until 1965;
  - the site was purchased as part of the quarry in 1965, which remained in operation until 1992;
    - note that with the exception of the north east portion described above, the aerial photographs indicate that the site remained the same following purchase;
  - the City of Monash purchased the site in 1998 as recreational space for the Clarinda Centre;
- the RHSV records detailed in the assessor's final report are generally consistent with the above findings however, they suggest that the site became a quarry 'sometime around 1950'. This slight discrepancy is not discussed within the assessor's final report, though the Auditor considers that the exact timing will not affect the outcome of the Audit;
- no registered cathodic protection system and thus no underground storage tanks (USTs) were identified during the search of the cathodic protection systems;
- the site was not listed on the EPA Priority Sites Registered, nor is it in the vicinity of sites that are;
- the surrounding Audit reports were found to generally agree with the geological and hydrogeolocal information provided within the assessor's final report;
- of the three Audit reports issued within 2 km of the site, only one property required a groundwater investigation post soil hydrocarbon remediation works;
  - concentrations of toluene and xylenes were detected in groundwater however, they were reported to be within the applicable guidelines;
  - this property is located 800 m north east (up-gradient) of the site;
  - note that all three Audited properties were issued with a CoEA; and
- according to the City of Monash website, the Clarinda Centre was a 45 bed low care facility, which closed in February 2010.

The Auditor considers that the site history information provided by the assessor provides an adequate indication of previous activities undertaken at the site, with only minor discrepancies noted surrounding dates and possible causes of historical ground disturbance (discussed above).

8 POTENTIAL SOURCE OF AND NATURE OF CHEMICALS OF CONCERN

In summary, the potential sources of contamination at the site are as follows:

- historical ground disturbance in the north western corner of the site from 1945, with the exact cause unknown (thought to be associated with service installation or car parking);
- historical ground disturbance in the north eastern corner of the site, known to be part of the former quarry extent;
- activities associated with previous agricultural/market garden use up until 1965, when the quarry purchased the site;
- activities associated with the former sand quarry operations between 1965 and 1992;
- the use of imported fill materials to reinstate the north eastern portion of the site between 1995 and 1996 (as detailed within Rock Solids report (1997)).

Based on the above summary and surrounding Audit reports, the main CoPC that have the potential to cause impact onsite include the following:

- organochlorine and organophosphate pesticides (OCP/OPP) associated with agricultural uses;
- polycyclic aromatic hydrocarbons (PAH), total petroleum hydrocarbons (TPH), benzene, toluene, ethylbenzene and xylene (BTEX) associated with fill material and/or fuels from farming or quarry machinery possibly historically used onsite;
- heavy metals associated with the importation of fill material and potentially associated with mining activities;
- polychlorinated biphenyls (PCBs) possibly associated with any electrical equipment with may have been used onsite; and
- volatile organic compounds (VOCs).

9 ENVIRONMENTAL QUALITY CRITERIA AND BENEFICIAL USES

The Audit process requires site contamination to be assessed in the context of beneficial uses that need to be protected in relation to the relevant sections of the environment including soil, groundwater, surface water and air.

As the City of Monash plan to divest the property, it is unknown what future use will be. The Auditor is determining whether the site is suitable for any beneficial use, and if not, whether it is suitable for the likely residential use. The applicable section of the environment in relation

to the site was considered to be soil and groundwater, which are discussed in more detail below.

9.1 Soil

The SEPP (2002) — *Prevention and Management of Contamination of Land* provides the framework for the protection of land and associated beneficial uses throughout Victoria. The policy allows for a consistent approach to the prevention of contamination of land and clean up of pollution of land in Victoria, and sets environmental quality indicators and objectives for each beneficial use. The SEPP defines certain land use categories and associated beneficial uses of land to be protected.

The beneficial uses of land to be protected are dependent on the proposed land use and are shown in Table 3. A protected beneficial use may not apply at a site where background concentrations of a substance are greater than the relevant guideline. Therefore, it is important to determine the concentrations of substances which occur naturally in a region of the site.

TABLE 3 SEPP PREVENTION AND MANAGEMENT OF CONTAMINATION OF LAND – PROTECTED BENEFICIAL USES OF LAND

Beneficial use	Land use						
	Parks and reserves	Agricultural	Sensitive use		Recreation / Open space	Commercial	Industrial
			High density	Other			
Maintenance of ecosystems							
Natural ecosystems	✓						
Modified ecosystems	✓	✓		✓	✓		
Highly modified ecosystems		✓	✓	✓	✓	✓	✓
Human health	✓	✓	✓	✓	✓	✓	✓
Buildings and structures	✓	✓	✓	✓	✓	✓	✓
Aesthetics	✓		✓	✓	✓	✓	
Production of food, flora and fibre	✓	✓		✓			

9.1.1 NEPM interim urban ecological investigation levels (EILs)

Schedule B (1) of the National Environment Protection (*Assessment of Site Contamination)* Measure (NEPM 1999) sets out ecological-based investigation levels for soil. An investigation level is defined as "*the concentration of a contaminant above which further appropriate investigation and evaluation will be required*" (ANZECC 1992). Ecologically-based soil investigation levels (EILs) for urban settings have been set for contaminants listed

in Table 5 on the basis of phytotoxicity or soil survey data. The NEPM defers to the ANZECC/NHMRC Guidelines (1992) – *Assessment and Management of Contaminated Sites* EILs for all other contaminants.

In general, the NEPM EILs are considered to protect most sensitive receptors and are known to be very conservative without any or very little scientific support. Where the levels of chemicals in soils are below the NEPM EILs, the condition of the land is considered to satisfy the requirements for protection of all beneficial uses (excepting groundwater quality). These guidelines provide the basis for further investigation of contamination for a range of chemicals and, where exceeded, a risk based review of the potential impact from environmental exposure for the proposed residential land use is considered appropriate.

The NEPM EILs are used as the basis for assessment where further investigation of the land may be necessary. Where investigation guidelines are not nominated in the NEPM or ANZECC Guidelines, reference is made to the Dutch intervention level guidelines (1994). The Dutch 2000 guidelines essentially replaces the Dutch 1994 guidelines and will be referenced where necessary as part of this Audit. The NSW DECC 2008 criteria are used where there are no specified levels in the NEPM, ANZECC or Dutch guidelines.

9.1.2 NEPM human health based soil investigation level guidelines (HILs)

A review of health-based soil investigation or guidance levels has been undertaken by Langley *et al*. (1995), as part of the "Third National Workshop on the Health Risk Assessment and Management of Contaminated Sites". This provided a range of health-based soil investigation levels considered to be safe for a range of generic land-uses for Australia, including sensitive uses. Exceeding these guidelines does not mean the land is not safe, it simply means further investigation or explanation is required.

These guidelines have been published as Health Based Soil Investigation Levels (*National Environmental Health Forum Monographs Soil Series No. 1, 1996*). HILs which have been derived from the National Environmental Health Forum (1996) guidelines are included in Schedule B (1) of the NEPM. The NEPM HILs for selected chemicals are presented in Table 6 for a range of land-uses.

The HIL guidance should only be applied statistically and therefore where adequate characterisation of soil contamination has been completed. This requires that firstly data quality is acceptable and secondly, that representative sample data is provided. The data should also be interpreted in terms of background and natural variances in assumptions in the standard scenarios. The NEPM guidance requires the mean concentration of a contaminant be used as a basis for assessment.

The review by Langley *et al.* added that the level of any chemical at a discrete location should not exceed the guidance value by more than 250%, and that the standard deviation of any chemical across the site should be less than 50% of the guidance value. These statistical requirements for reviewing data against the guidelines have been adopted in the NEPM Schedule B(7a) *Guideline on health based investigation levels*.

Where 250% exceedances occur and the proposed development allows for no soil access, and a risk evaluation has taken place, the Auditor considers assessing the results against the 95% UCL more appropriate.

As NEPM guidelines do not include criteria for MAH and TPH, threshold concentrations for sensitive land-use were from the NSW DECC guideline *Service station sites: assessment and remediation* (2008).

9.1.3 Adopted soil investigation criteria

As the issuing of a CoEA requires consideration of all beneficial uses of land, for the assessment of soil at this site Column A (*'Standard' residential with garden/accessible soil – HIL A*) and the *Interim Urban Ecological Investigation Levels (EILs)* of Table 5-A Schedule B(1) of the National Environment Protection Council (1999) — *National Environment Protection (Assessment of Site Contamination) Measure* have been used.

Under the SEPP (2002) *Prevention and Management of Contamination of Land,* the proposed development is classified as Sensitive Use (Other). Therefore, the relevant beneficial uses to be protected for this use include:

- modified ecosystem;
- highly modified ecosystems;
- human health;
- buildings and structures;
- aesthetics; and
- production of food, flora and fibre.

Additional beneficial uses to be considered for the issue of a CoEA include:

- natural ecosystems.

In the Auditor's opinion, the relevant soil investigation criteria for low density use on this site are considered to be:

- NEPM guidelines for ecological investigation levels (EILs)/ANZECC Guidelines/EPA Victoria/Dutch guidelines (2000) or NSW DECC guidelines; and
- health-based soil investigation levels (HILs) – (Column A) as presented in Schedule B(1) of the NEPM.

9.2 Groundwater

The SEPP (1997) *Groundwaters of Victoria* provides the framework for the protection of groundwater and associated beneficial uses throughout Victoria. The policy allows for a consistent approach to the prevention of contamination of groundwater and clean-up of pollution of groundwater throughout Victoria and sets environmental quality indicators and objectives for each beneficial use. The SEPP defines certain aquifer categories based on salinity reported as total dissolved salts (TDS) and associated beneficial uses to be protected. The beneficial uses of groundwater to be protected are dependent on the proposed land-use and are shown in Table 4.

TABLE 4 SEPP GROUNDWATERS OF VICTORIA BENEFICIAL USES BASED ON TDS

Beneficial Uses	Segments (mg/L TDS)				
	A1 (0-500)	A2 (501-1000)	B (1001-3500)	C (3501-13000)	D (>13000)
1. Maintenance of ecosystems	✓	✓	✓	✓	✓
2. Potable Water supply:					
Desirable	✓				
Acceptable		✓			
3. Potable mineral water supply	✓	✓	✓		
4. Agriculture, parks & gardens	✓	✓	✓		
5. Stock watering	✓	✓	✓	✓	
6. Industrial water use	✓	✓	✓	✓	✓
7. Primary contact recreation (eg. bathing, swimming)	✓	✓	✓	✓	
8. Buildings and structures	✓	✓	✓	✓	✓

There are no laboratory measured TDS concentrations from this site, as no groundwater investigation was undertaken. As such, the Department of Natural Resources and Environment (DNRE) South Eastern Victoria Regional Aquifer Systems (1995) defines groundwater in the Upper Tertiary Aquifer System at the site as Segment B. It generally has a Total Dissolved Solids (TDS) (measure of salinity) range of 1,001 – 3,500 mg/L. According to the SEPP (1997) *Groundwaters of Victoria* this requires the protection of the following beneficial uses:

- maintenance of ecosystems;
- potable mineral water supply;
- agriculture, parks and gardens;
- stock watering;
- industrial water use;
- primary contact recreation; and
- buildings and structures.

The EPA may determine that these beneficial uses do not apply to groundwater when:

- there is insufficient yield;
- the background level of a water quality indicator/s other than TDS precludes a beneficial use;
- the soil characteristics preclude a beneficial use; and
- a groundwater quality restricted use zone (GQRUZ) has been declared by the EPA.

In addition, any assessment with the likelihood of the particular beneficial uses of groundwater being realised should be based on an evaluation of whether an owner/occupier of the site, or in the vicinity of the site, may reasonably expect to use or be able to use groundwater for the above purposes, having regard to existing and future land-use.

For this site, the most sensitive beneficial use to be protected is the fresh water ecosystem, in particular, the man-made freshwater lake in the pit of the former quarry located immediately north (and up-gradient – assuming there is no significant draw-down by water pumping by the golf course) of the site. There are a number of similar water bodies within this area ie. between 750 m and 2 kilometres (km) south-west of the site. The Auditor notes that Port Phillip Bay (a marine environment) is also located approximately 8 km south west (down gradient) of the site.

Where the SEPP *Groundwaters of Victoria* (GoV) does not specify contaminant limits, the ANZECC/ ARMCANZ (2000) *Australian and New Zealand guidelines for fresh and marine water quality* and NEPM (1999) *Groundwater investigation levels* (GILs) are consulted. In Victoria, the NEPM levels are generally used in preference to ANZECC/ ARMCANZ criteria for all beneficial uses other than ecological receptors. The reason for this is that the ecological receptor for an aquifer is the nearest surface receiving water or discharge zone for that aquifer, which is controlled under the SEPP *Waters of Victoria* (WoV). The SEPP WoV refers to ANZECC/ ARMCANZ 2000. The NEPM GIL's presented within Schedule B(1) Table 5-B are essentially based on the ANZECC 1992 *Australian water quality guidelines for fresh and marine waters*.

The SEPP *GoV* states that in order to protect the beneficial uses associated with Segment B (relevant to this site) the following should be referred to:

- Maintenance of ecosystems – criteria specified for protection of freshwater water ecosystems in ANZECC/ARMCANZ 2000;
- Stock watering – those specified for livestock in NEPM Schedule B(1) Table 5-B;
- Industrial Water Use – those specified for industrial use in the ANZECC 1992 guidelines;
- Primary Contact Recreation – those specified for primary contact recreation in the ANZECC 1992 guidelines; and
- Buildings and Structures – introduced contaminants shall not cause groundwater to become corrosive to structures or building materials.

A protected beneficial use may not apply at a site where background concentrations of a substance are greater than the relevant guideline. Therefore, if contamination is expected, it is important to determine the concentrations of substances which occur naturally in groundwater in the region of the site.

10 ASSESSMENT OF SITE CONDITIONS

10.1 GHD – Site investigation (August 2010)

On 26 August 2010, GHD undertook a soil sampling investigation across the site. A total of eight (8) test pit locations were placed across the site to comply with Australian Standard AS4482.1 (2005). Seven of these were grid locations, and one was a targeted sampling

location to investigate the known presence of fill material within the north east portion of the site.

A total of 26 primary soil samples were collected and of these, 18 samples were selected for laboratory analysis (in August 2010). The test pits were excavated to depths ranging between 0.7 and 1.9 mBGL. Note that the deepest test pit was excavated in the north eastern portion of the site and did not encounter natural material. Based on the assessors test pit logs, the soil sampling program identified fill at depths ranging between 0.35 and 1.9 mBGL.

The final ESA report is unclear with respect to how fill and natural material was determined. The test pit logs divide the various layers of sand into both fill and natural material, with no clear reason why. For example, TP03 describes natural material as '*SAND – Light brown grey, with limited orange mottling, fine to medium grained*' whilst TP04 describes fill material as '*Brown/grey, fine to course grained SAND*' and natural material as '*CLAY – Grey with orange red mottling, moderate to high plasticity, trace fine sand*'. The Auditor notes that natural material can consist of both sands and/or clays however, some of the layers referred to as fill material within the test pit logs may be natural or re-worked natural, as there are no foreign inclusions. No groundwater was intercepted in any test pits excavated at the site.

All soil samples were screened in the field for the presence of volatile organic compounds (VOCs) using a photo-ionisation detector (PID). Calibration certificates are provided in Appendix N of the Assessors report.

All soil samples were sent to MGT Environmental Consulting Pty Ltd (MGT) for primary laboratory analysis, while the duplicate sample was couriered via MGT to Australian Laboratory Services (ALS). Samples were analysed for a selection of TRH, MAH, PAH, OCP, CHC, PCB, phenols, halogenated volatile organics and heavy metals.

The laboratory results indicated that all analysed parameters were below the laboratory limit of reporting (LOR) or below NEPM 'A' HIL and NEPM EIL, with the exception of locations TP02, TP04 and TP05 (Refer to Table 7 for a summary of results). The following exceedences were reported during this stage of the investigation:

- location TP02_0.1: benzo(a)pyrene (BaP) and total poycyclic aromatic hydrocarbons (PAHs) were reported in excess of NEPM 'A' HIL guidelines, with concentrations of 4.5 and 36 mg/kg respectively;
    - the NEPM 'A' HIL guidelines for BaP and total PAH are 1 and 20 mg/kg respectively; and
- locations TP04_1.0 and TP05_1.0 (ie. natural material): arsenic (As) concentrations were found to exceed the NEPM EIL in these two locations, with concentrations of 47 and 49 mg/kg respectively.

Please refer to Appendix C of this Audit report for a copy of laboratory transcripts relating to the Auditors verification samples. All other laboratory transcripts can be found in the assessors report (Appendix B of this report).

10.2 GHD – Additional soil sampling (October 2010)

An additional soil sampling program was conducted on 1 October 2010 to further investigate the fill material at locations TP02 and TP08, as well as the north western portion of the site (area of historical disturbance).

Location TP02 underwent further assessment due to the elevated PAH and BaP concentrations, while TP08 was investigated because the Auditors verification sample at this location reported detectable PAH concentrations (Refer to Section 10.4 for details). The purpose of this work was to determine if the initial reported concentrations were repeatable and representative of soil in these areas. A discussion regarding the slightly elevated arsenic concentrations at TP04 and TP05 is provided in Section 10.4.3.

The Auditor approved the following scope of works:

- step out sampling and analysis of near surface soil (0.1 mBGL) in the area around TP02, with samples of soil/fill material collected at 5 locations (one immediately adjacent to TP02 and four approximately 1 m from TP02 [north, east, south and west of TP02]);
    - samples were labelled TP02-R1 to R5;
- sampling and analysis of near surface soil (0.1 mBGL) immediately adjacent to TP08, including collection of a new sample and analysis of the original sample that was placed on hold (TP08_0.6); and
- sampling and analysis of representative samples from soil/fill (0.1 mBGL) and natural material (at approximately 0.4 mBGL) at an additional location in the north western portion of the site (ie. area of historical disturbance).

A total of eight (8) soil samples were collected at the above locations using a hand auger, and subsequently analysed at MGT and ALS (along with sample TP08_0.6). All soil samples were screened in the field for the presence of volatile organic compounds (VOCs) using a photo-ionisation detector (PID).

The PAH concentrations reported during the additional sampling programme (Sample ID's: TP02-R1 to R5) contained concentrations of chemicals below all applicable guidelines. As such, the assessor concluded that the initial BaP and PAH concentrations were deemed not repeatable, or representative of soil conditions in this area.

Please note that location TP08_0.1R reported an arsenic concentration slightly in excess of NEPM EIL guidelines. A discussion regarding the slightly elevated arsenic concentrations at TP08 is provided in Section 10.2.3, along with those initially reported at TP04 and TP05.

10.3 Auditor site inspections

The Auditor's representative undertook a site inspection on 26 August and 3 December 2010. The Auditor undertook a site inspection on 25 November 2010.

On 26 August 2010, the Auditor's representative observed the excavation of test pit TP08 and TP07 while onsite. A photo ionisation detector (PID) was used to test for VOC at the site during both test pits. The PID reading at TP07 was 0.0 throughout the test pit profile, while the PID reading at TP08 ranged between 0.1 and 1.1 ppm. These results concur with no detectable volatile chemicals within the analysed samples. A calibration record for the PID is contained in the assessor's final report. During this site visit, the Auditors representative also observed the presence of minor coke and ash in fill material at location TP08 (Refer to Plate 6, Appendix D for a photograph). According to the assessor's final report, the assessor did not make this observation.

The Auditors inspection on 25 November 2010 included a site walk over and field observations. The Auditor observed a breather pipe on the Clarinda Centre property

however, it was later found to be an exhaust from a macerator. No other visible or olfactory evidence of potential contamination was identified however, there was no subsurface work conducted during this inspection.

On 3 December 2010, the Auditors representative undertook a short visit to the site to dip the groundwater bore located immediately north of the northern boundary (See Plate 7 and 8 in Appendix D [in the vicinity of TP02]). The total monitoring bore depth was found to be 12.1 mBGL, with a SWL of 11.54 mBGL.

10.4 Verification sampling by the Auditor

During the site visit on 26 August 2010, the Auditor's representative collected soil verification samples from the following locations and depths:

- Location TP07: AVS3 from 0.3 - 0.4 mBGL, and AVS4 from 0.6 - 0.7 mBGL; and
- Location TP08: AVS1 from 0.5 - 0.6 mBGL, and AVS2 from 1.0 - 1.1 mBGL.

Refer to Figure 3 for the locations of the above samples. The objectives of the verification sampling by the Auditor were to:

- ensure the material to remain onsite was within adopted soil guidelines for the site (residential use);
- independently verify the soil quality as indicated by the data provided by the assessor;
- correlate the Auditor's observations of the fill/natural soil with independent analytical results;
- to satisfy the Auditor that the data presented by the site assessor is sufficiently reliable in order to issue a CoEA or SoEA.

Samples were sent to ALS for the analysis of some or all of the CoPC including, heavy metals (As, Be, Cd, Co, Cr, Hg, Mn, Ni, Pb, Sb, Se, Sn and Zn), TPH, PAH, phenols, BTEX, VOC and cyanide. A copy of the laboratory transcript and chain of custody documentation is presented in Appendix C.

Soil verification samples were collected as grab samples directly from the bucket of the excavator. A clean pair of nitrile gloves were used to collect samples before placing them into laboratory prepared glass jars, labelling appropriately and storing in a cool esky for transport to the laboratory.

The results of the Auditor verification sampling recorded concentrations of CoPC below NEPM 'A' HIL and NEPM EIL guidelines. However, sample AVS1(0.5-0.6) did report detections of PAH compounds. Total PAH and BaP were reported as 7.1 and 0.7 mg/kg respectively. Sample AVS7 was collected from TP08 between 0.5 and 0.6 mBGL.

These detections are consistent with the field observations made by the Auditors representative, which indicate that this material is associated with either ash or coke (ie. immobile). Please refer to Sections 10.4.1 and 10.4.2 for further discussion surrounding PAH compounds and availability.

10.4.1 Statistical analysis of BaP and total PAH

The assessor's final report is lacking in detail with respect to justification for the elevated concentrations of both BaP and PAH in location TP02_0.1. The Auditor has therefore

undertaken statistical analysis of the PAH data, using both the assessor's and the Auditors laboratory results.

As the reported concentrations do not comply with applicable guidelines, it is appropriate to use the mean (and 95% upper confidence level (UCL) of the mean) for comparison against the nominated guidelines. The statistical compliance requirements stated within the NEPM are as follows:

- the standard deviation (SD) of the result must be less than 50% of the validation criterion; and
- no result can be greater than 250% of the validation criterion.

The results of the Auditors statistical appraisal are presented in Tables 8 and 9.

Concentrations of BaP range between <0.1 and 4.5. Note that 16 of the 32 BaP results were reported below the laboratory LOR, and only one of these results was in excess of NEPM 'A' HIL guidelines. The Auditor is of the opinion that this one sample is an outlier and does not represent the population considered. Thus, while the population distribution for BaP concentrations is log-normally distributed, this outlier skews the data-set such that the calculated standard deviation value is 2.40 mg/kg. Based on the field observations discussed in Section 10.3, the outlier is possibly due to an ash fleck (or similar). The statistical appraisal detailed in Table 8 shows that the mean and 95% UCL for BaP comply with NEPM guidelines. The statistical appraisal for PAH (Table 9) complies with NEPM guidelines and therefore requires no further discussion.

10.4.2 PAH fingerprint analysis

Polycyclic aromatic hydrocarbons (PAHs) are derived from various processes. Mulvey and McKay (2006) have developed a PAH fingerprinting technique that allows the delineation of PAH sources by ranking the degree of fit with known PAH sources. Using two statistical methods, the relationship between PAH and other hydrocarbons can be compared, as well as the proportions of individual hydrocarbons.

The soil samples within this investigation that reported elevated PAH compounds are boreholes AVS1(0.5-0.6) [taken at location TP08 at 0.5-0.6 mBGL] and TP02_0.1. As indicated in Section 10.3, the Auditors representative observed the presence of minor coke and ash in fill material at location TP08. Please note that both ash and charcoal contain PAH formed *insitu* during the heating process of their formation, and these substances are generally considered inert with respect to mobility of PAH in the environment.

The NSW EPA has recognised PAH immobility in their *General approvals of immobilisation of contaminants in waste (1999),* Number 1999/05 and state that "Residual PAH and benzo(a)pyrene present in ash generated at these temperatures (700 to 1,500 degrees Celcius) are immobilised within a vitreous carbonaceous and siliceous matrix."

Based on the statistical procedure described by Mulvey and McKay (2006), the PAH concentrations revealed in fill material at TP02 and TP08 is present as ash (from black and brown coal) and coke. These substances, in the absence of other hydrocarbons or odours are considered immobile in the environment. It is expected that these CoPC are therefore not likely to preclude the protected beneficial uses of the site, particularly human health or the environment.

10.4.3 Arsenic

Of the additional samples analysed for arsenic, one reported a concentration in excess of NEPM EIL guidelines. This was sample TP08_0.1R, with an arsenic concentration of 44 mg/kg. Therefore, across both sampling events, a total of three locations were reported to exceed NEPM EIL guidelines for arsenic, with elevated concentrations ranging between 44 and 49 mg/kg.

Naturally occurring arsenic:
The assessors report notes the following:

- arsenic is in surface fill material at TP08, and natural material at TP04 and TP05;
- the arsenic levels are likely to be representative of naturally elevated arsenic within the heterogenous material of the Brighton Group;
- the elevated arsenic concentrations (< 49 mg/kg) fall within the background levels for Australian soils, as detailed in Table 5A of NEPC 1999 (background As range = 1 to 50 mg/kg).

The report further states that, *"a review of the published literature relating to the Brighton Group failed to locate any reference to the geochemical properties of the unit. Based on previous experience, GHD notes that arsenic is commonly elevated in Brighton Group units and that elevated arsenic concentrations is common for this type of depositional environment."*

Whilst experience is important, the Auditor considers that insufficient information has been supplied within the assessor's final report to definitively state that the arsenic is endemic to the geological setting. The Auditor has therefore included further discussion around the presence of naturally occurring arsenic within Brighton Group or weathered Silurian aged sediments.

Diomedes (2005) indicates that the relative abundance of arsenic in Silurian formations is high. His paper goes on to describe how arsenic can be 'locked up' in the ferruginised strata of these sediments, and strongly bound by iron oxides, which are insoluble by nature. The same paper also notes that arsenic has been shown to be a common metalloid that is present in various natural ecosystems, including the terrestrial soil environment.

Hence, as the underlying geology includes the Brighton Group and Silurian aged sediments, there is evidence to suggest that arsenic identified at this site is a natural occurrence.

ASLP analysis:
To further support the presence of the arsenic levels onsite, the assessor undertook elutriation testing on one sample (TP08_0.1R) using the Australian Standard Leaching Procedure (ASLP) method to analyse for available arsenic. The laboratory report for this work was received post receipt of the final assessment report (Refer to Appendix C for a copy). The result was favourable and reported an arsenic ASLP concentration of <0.02 mg/L. The Auditor has included additional discussion below around this result.

The ASLP method is a bottle leaching procedure using deionised water which emulates rainfall infiltration. This procedure provides a useful indication of the leachate potential to groundwater. The ASLP leach test result can also be used to estimate the bioavailability factor (BF) for each chemical being considered (arsenic in this case). It is important to observe that the NEPM criteria are based on a BF of 1.0 (ie. NEPM derived values assumes that 100% of the arsenic concentration is available).

Although there is only one ASLP result for arsenic, the Auditor calculated the BF to assess the ecological protection of groundwater beneficial uses and receptors from fill and natural material at the site. Applying the total arsenic concentration of 44 mg/kg, and using 100% of the laboratory LOR for the non-detectable ASLP result of <0.02 mg/L, the BF was found to be 0.909 %. Hence, the NEPM criteria can be considered to be highly conservative, as it assumes a BF of 100 %. The BF result indicates that both plant root zones and downward percolation of water will not be able to dissolve arsenic from the soil, as it is strongly adsorbed.

10.4.4 Statistical analysis of arsenic

The Auditor statistically assessed arsenic across the site, as it was not detailed in the assessor's report. Based on the statistical appraisal for arsenic detailed in Table 10, the mean, 95% UCL and standard deviation for arsenic complies with NEPM A HIL and EIL guidelines.

11 CONCEPTUAL SITE MODEL (CSM)

The CSM is a three dimensional understanding of the potential contaminant sources, pathways, receptors and inferred groundwater/surface water flow characteristics. In general, the assessor's report does capture some elements of a CSM however, a number of key areas are missing or have not been completely developed. The Auditor has therefore compiled a CSM as part of this Audit and is discussed below and presented as Figure 4.

The following geological and hydrogeological information is contained elsewhere in the Audit report however, it is also outlined below as it is pertinent to the CSM:

- the site surface geological formation is the Brighton Group comprising of the Red Bluff Sands and the Black Rock Sandstone;
- regional groundwater flow is expected to be in a south/south-westerly direction however, local shallow groundwater flow would likely be north toward the man-made lake/reservoir within the former quarry pit;
    - the closest surface water body receptor to the site is this man-made lake, located immediately north (and up-gradient) of the site;
- the nearest down gradient water body is approximately 750 m south-west of the site and appears to be another man-made lake/reservoir;
- of note is the Clayton and Mordiallic drain, which is located south/south-east of the site;
    - it starts approximately 1.5 km south-east of the site and runs for approximately 8.3 km south until it discharges into Mordiallic Creek;
- it is reasonable to conclude that the nearest, significant, down-gradient, natural water body receptor is Port Phillip Bay, approximately 8 km south west of the site;
- the Audit report conducted at the Clarinda Centre (immediately east of the site) in 2000, notes that the water in the former quarry pit was approximately 6 m deep;
    - the assessor's final report for the current Audit notes that the water level in the former quarry pit is approximately 8 m BGL (ie. not 8 m deep);
- on 3 December 2010, the Auditors representative dipped the groundwater bore located immediately north of the sites northern boundary (Refer to Figure 3);

  - the SWL was recorded as 11.54 mBGL;
- according to Leonard (1992), the depth to groundwater within the Brighton Group is expected to be approximately 20 mBGL however, locally perched shallow groundwater may be present at depths ranging between 5 and 10 mBGL;
- of the 34 groundwater bores identified within a 1km radius of the site, the SWL was found to range between 2.13 and 21.03 mBGL;
- the assessor's report notes that two nearby bores were reported as having a SWL of 4 and 14 mBGL, (0.67 and 0.48 km from the site respectively);
- the groundwater investigation conducted during the Audit at the Former Oakleigh Council Depot in 2000 observed SWL at 5.7 mBGL within the one bore on that site; and
- it is possible that perched water creates a pathway and discharges locally into utility trenches, creeks, drains and low points throughout the region.

There are no groundwater bore construction logs available to confirm the above information. Further, the SWL recorded within the above mentioned bores does not indicate the depth at which groundwater was actually encountered. Based on the depths above, it would be appropriate to assume that some of the above bores are encountered within the perched water zone, and some in the Brighton Group aquifer. Assuming that the man-made lake (former quarry pit) is approximately 6 m deep, and the water level is approximately 8 mBGL, the bottom of the lake should sit approximately between 8 and 14 mBGL (ie. it is potentially hydraulically connected with the expected perched water in the area and therefore creates a pathway for any CoPC that may exist in the man-made lake).

Based on the assessors test pit logs, the soil sampling program identified fill material onsite at depths ranging between 0.35 and 1.9 mBGL. Location TP08 did not encounter natural material at all. This test pit was terminated at 1.9 mBGL, as the excavator could not reach deeper into the profile. Test pit TP08 is located in the north east portion of the site. This area is understood to have been filled between 1995 and 1996 (Rock Solid 1997). The closest test pits (TP06 and TP07) are located approximately 15 – 30 m east/south east of TP08, and encountered natural soil between 0.4 and 0.5 mBGL. According to the assessor's report, the City of Monash provided anecdotal evidence to suggest that fill material (a potential source of contamination) may be as deep as 3 – 4 mBGL in the vicinity of TP08.

In consideration of the above information (ie. fill is 4 m deep in the vicinity of TP08), it is possible that up to 1,000 m^3 of fill material exists within the north east portion of the site (worst case scenario). However, based on historical information and field observations (minor inclusions of crushed rock, brick fragments, ash and coke), there is no evidence to suggest that a significant contamination source exists in this area.

Furthermore, and in consideration of the field observations and laboratory results, it is unlikely that the fill material in the north east portion of the site will impact on the nearest significant water body receptor (Port Phillip Bay – approximately 8 km south west of the site). Please also refer to Section 10.4.2, detailing a discussion on the immobility of ash and coke.

Based on the data obtained, the Auditor can conclude that there is a potential pathway between the fill material onsite and the man-made lake located immediately north of the site. This would likely occur within the perched water zone.

The sources of potential contamination onsite include the historical disturbance in the north-west and north-east corners of the site, previous agricultural/market garden activities, former

sand quarry operations and imported fill material. However, as indicated above, the potential migration pathway to the nearest significant down gradient water body receptor is approximately 8 km of the site, and the observed fill materials have been shown to be immobile (or more accurately, of very low mobility).

12 RISK EVALUATION AND MITIGATION

12.1 Data collection

The previous sections of this document have outlined the data collection process of the investigations undertaken at the site. In brief, this has included:

1. setting appropriate site criteria and associated data quality objectives for issuing a CoEA, and default values for site use in case the conditions for a CoEA cannot be met, which have for the most part been based on NEPM (A) HIL investigation criteria levels and EIL guidelines;
2. undertaking a detailed review of site history to establish the major past activities of potential concern at the site (and surrounds);
3. detailing the likely proposed use of the site, which is low density residential;
4. undertaking a detailed sampling program for soil across the site, to establish levels of chemicals of potential concern (CoPC) in fill and natural soil at the site;
5. observation of the SWL in a groundwater monitoring bore adjacent to the site;
6. extensive analysis to establish levels of CoPC across the site; and
7. statistical and other presentation of the data-set.

12.2 Site specific risk evaluation

Essentially, the data collection phase of works at the site has determined that no CoPC requires further consideration in terms of human health or ecological risk in the soil.

Excluding As in three samples, and BaP/PAH in one sample, all detectable CoPC total concentrations were reported below the laboratory LOR or NEPM 'A' HIL and NEPM EIL. The affected borehole locations were TP02, TP04, TP05 and TP08. Surface material at TP02 was found to have a total BaP and PAH concentration in excess of NEPM 'A' HIL guidelines, while TP04, TP05 and TP08 reported total As concentrations in excess of NEPM EIL guidelines (only).

Based on these results, the assessor undertook further sampling at TP02 and TP08, as well as additional leachability testing for 'As'. To support the findings of this work, the Auditor then conducted the following additional work:

- a short bioavailability assessment of As and it's occurrence in the natural environment;
- statistical and fingerprint analysis of PAH; and
- research into the mobility of ash and coke (PAH) in the environment.

Refer to Sections 10.4.1 – 10.4.3 for details surrounding this additional work.

13 EVALUATION OF QUALITY AND COMPLETENESS

In order to be satisfied with the environmental condition of a site, an Auditor must be satisfied with the extent and quality of the site assessment data. The following outlines the areas of GHD assessments which require critical appraisal:

- appropriateness and completeness of the assessment with respect to the potential contamination on the site;
- validity of the assessment area with respect to data quality; and
- appropriate and correct interpretation of the data and justification for the assessment conclusions.

The quality of the site assessment data collected and reported by GHD is assessed in the following sections.

13.1 Sample density and site coverage

The size of the site is approximately 2,228 m^2 (0.223 hectares (Ha)). The methodology for developing the sampling strategy was in accordance with that specified by the Australian Standard AS4482.1 (2005). A total of nine locations (eight test pit and one hand-auger) were placed across the site.

Follow-up (or step-out) sampling included the collection of soil samples from four new sampling locations and one repeat sampling location (all at or about TP02).

The sampling density is considered appropriate to identify any contamination present across the site, based on a radius of hot-spot detection of approximately 9 metres.

13.2 Analytical schedule and completeness

The soil sampling program undertaken at the site involved the collection of 34 primary soil samples. Of these, 28 primary samples underwent laboratory analysis, as well as 2 blind duplicates (FD01 and FD03), 2 split duplicates (FS02 and FS04), 2 trip blanks (TB01 and TB02) and 1 rinsate blank (RB01). The analytical schedule for these samples covers a wide range of potential contaminants including some unlikely contaminants to allow for any uncertainties. In the Auditor's opinion the analytical program for soil was adequate to characterise the contamination status of the site.

13.3 Data quality objectives

A review of the quality of data from the soil sampling was undertaken based on the following:

- review of the sampling methodology in accordance with all current guidelines;
- review the analytical results against field observations;
- analysis of at least 5% blind duplicates, 5% split duplicates and compliance with relative percentage differences (RPDs);
- analysis of rinsate samples to ensure correct decontamination is observed;
- analysis of a trip blanks to ensure contamination from VOC was not occurring;

- review of data quality based on verification of field QA/QC procedures, correct sample containers and completed chain of custody documentation;
- review of correct sample analysis including the extraction and analysis within appropriate holding times;
- review of the laboratory detection limits; and
- review the internal laboratory QA/QC analysis including reagent blanks, spike recoveries and duplicates.

These requirements are defined in Australian Standard AS4482.1 – 2005, the NEPM and EPA guidelines.

13.4 Sampling methodology

The Auditor considers that the sampling procedures adopted are appropriate and unlikely to introduce significant error and are in accordance with the relevant Australian Standards, NEPM and EPA guidelines for conducting environmental contamination assessments.

The rationale for selection of the roughly grid based sampling pattern, sampling density and sampling depths is discussed in previous sections. These are consistent with the requirements of the Victorian EPA and Australian Standard AS4482.1 (2005).

Soil samples were collected by hand and cross contamination was prevented by the use of disposable gloves and samples were placed into appropriate clean glass sample jars (inorganic and organic analysis) according to Australian Standard AS4482.1 (2005) and AS4482.2 (1999) and Victorian EPA publication IWRG701 (2009). The samples were then placed into an Esky with ice for storage and transport back to the office, where they were stored in a temperature controlled sample fridge until they were transferred again in a cooled and darkened container to the laboratories.

Overall, the Auditor is satisfied that the field protocols by GHD were adequate for characterisation of site conditions.

13.5 Laboratories used by the site assessor

The following laboratories were used by GHD as part of the soil assessment.

Primary laboratory used by site assessor:	MGT Environmental Consulting Pty Ltd
Secondary laboratory used by site assessors:	Australian Laboratory Services (ALS)

The analytical laboratories report that the tests performed by the laboratories were in accordance with the terms of National Association of Testing Authorities (NATA) accreditation.

13.6 Field quality assurance and quality control

The chain of custody forms presented in Appendix I of the assessors report are clear and identify each sample, the name of sampler, nature of the sample, collection date, analyses to be performed and departure date from the site.

Blind and split duplicates were collected according to the method stipulated in AS4482.1.

As observed by the Auditor's representative in the field on 26 August 2010, test pits were excavated using a 1.5 tonne Komatsu excavator under the direction of GHD staff. To collect soil samples, loose soil was removed from the centre of the excavator bucket where the soil was least disturbed. GHD staff members used nitrile gloves to collect these samples directly. The assessor noted within their report that the excavation of test pits can cause significant soil disturbance and potentially oxidise the soil substrate. The assessor was observed in the field to cause minimal disturbance to address this issue.

On 1 October 2010, the assessor collected additional soil samples using a hand auger. As stipulated within the assessors report, the hand auger "*was washed and decontaminated between each location using a clean cloth to wipe down the equipment with mains water and Decon 90 detergent. Once washed, the hand auger was rinsed using deionised water*". This procedure ensured that no cross contamination occurred.

13.7 Laboratory quality assurance and quality control

Chain of custody forms acknowledging the date sent, receipt date and time by the laboratory as well as identity of samples are presented in Appendix I of the assessors report with the original laboratory transcripts.

Primary samples and the blind duplicate samples were analysed by MGT while the split duplicate samples were analysed by ALS. The Auditor confirms that both MGT and ALS laboratories are NATA accredited for the analysis methods used. Details of this accreditation can be viewed at http://www.nata.asn.au/. The laboratory report numbers are as follows:

- 26 August 2010:
  - MGT report 274649 – initial sampling event; and
  - ALS report EM1009397 – initial sampling event.
- 8 September 2010:
  - MGT report 276053 – additional analysis for Cr VI;
- 30 September 2010:
  - MGT report 278259 – analysis of TP08_0.6 (collected on 26 August 2010);
- 1 October 2010:
  - MGT report 278399 – second sampling event; and
  - ALS report EM1010789 – second sampling event.

As part of MGT and ALS internal QA /QC, the following was undertaken:

- sufficient internal duplicate analyses were undertaken with relative percent difference (RPD) calculations reported;
- with the exception of one primary sample (TP08_0.6), samples were analysed within the appropriate holding times;
  - this sample was placed on hold after the initial sampling event on 26 August 2010 and not analysed until 30 September 2010;
  - the following CoPC were analysed outside of the holding times:
    - TRH, MAH, PAH, OCP, CHC, PCB, phenols, % moisture, halogenated volatile compounds (14 day holding time);

- cyanide and pH (7 day holding time);
- sulphur (28 day holding time);

o heavy metals were analysed within the holding time of 6 months;

- samples were analysed within the appropriate detection limits;
- sufficient blank analyses were conducted; and
- sufficient spikes on reagent and the soil matrix were undertaken with percent recoveries reported.

As mentioned above, the analysis of TP08_0.6 was outside of the holding period for a number of CoPC. This sample was eventually analysed because the Auditors verification sample at this location reported detectable PAH concentrations. These holding times are not considered to affect the data quality or the outcome of the audit, as the Auditors verification sample at this location is within holding times.

The internal duplicates, spikes and blanks are presented in the laboratory transcripts of Appendix I of the assessors report. The RPDs of the internal duplicates were acceptable in all cases. All blanks from the two laboratories were acceptable. In addition, 100% of spike results from MGT and ALS were within the acceptable range.

The MGT and ALS internal laboratory quality assurance and quality control results demonstrate that the laboratory quality assurance program was satisfactory for this soil investigation.

The overall rate of internal laboratory QA/QC performed is considered acceptable to achieve reliability on the results used to reach the conclusions of this audit.

13.8 Blind and split duplicate evaluation

The soil sampling program undertaken at the site involved the collection of 34 primary soil samples. Of these, 28 primary samples underwent laboratory analysis, as well as 2 blind duplicates (FD01 and FD03), 2 split duplicates (FS02 and FS04), 2 trip blanks (TB01 and TB02) and 1 rinsate blank (RB01). Based on this, both the blind and split duplicates met the 5% requirement for density and therefore are in compliance with AS4482.1.

With the exception of TPH (C_{15}-C_{28}), the concentrations of all CoPC in sample RB01 were reported to be below the laboratory LOR. The TPH (C_{15}-C_{28}) result was reported as 100 µg/L, which is equal to the laboratory LOR. As all of the primary samples reported TPH concentrations below the LOR, it is unlikely that cross contamination has occurred. The trip blank samples were not found to contain any detectable CoPC.

The RPD values for the blind and split duplicates have been calculated and are presented in Table 11. According to AS4482.1 "*the acceptable RPD range for blind and split duplicates are 30-50% of the mean concentration of analyte. This variation can be expected to be higher for organic analysis than for inorganics and for low concentrations*". This refers to laboratory split samples. Samples split in the field where adequate splitting devices are not available would be expected to have a greater variability. It also should be noted that RPD values of heterogeneous material between 80% and 150% are not unusual for field duplicates. See Table 11 for a summary of the calculable relative percent differences (RPDs) for blind and split duplicate results.

In summary, two sets of blind (intra laboratory) field duplicates were collected as part of this assessment of which 152 pairs were available to calculate the RPDs. Out of these 152 the following were recorded:

- 125 of these pairs could not have the RPD % calculated as both of the samples were the laboratory LOR;
- 6 of these pairs had an RPD value of 0%;
- 1 of these pairs had a RPD value <10%;
- 11 of these pairs had a RPD value between 10% and 50%; and
- 9 of these pairs exceeded an RPD value of 50%.

The exceedences, which were reported to range between 67 and 93%, can be attributed to the natural heterogeneity of the soil and differences in laboratory subsamples, or comparison of low concentrations. As such, the exceeding RPD values are not considered grounds for rejecting the data as a whole. It should be noted that in all cases the highest RPD results are for concentrations significantly below adopted guidelines. Based on the above the blind duplicate data is considered acceptable.

In summary, two sets of split (inter laboratory) duplicates were collected as part of this assessment of which 129 pairs were available to calculate the RPDs. Out of these 129 the following was recorded:

- 107 of these pairs could not have the RPD % calculated as both of the samples were below detection limits;
- 1 of these pairs had an RPD value of 0%;
- 5 of these pairs had a RPD value <10%;
- 3 of these pairs had an RPD value between 10% and 50%; and
- 13 of these pairs exceeded an RPD value of 50%.

The exceedences, which were reported to range between 86 and 133%, can again be attributed to the natural heterogeneity of the soil and differences in laboratory subsamples, or comparison of low concentrations. As such, the exceeding RPD values are not considered grounds for rejecting the data as a whole. It should be noted that in all cases the highest RPD results are for concentrations significantly below adopted guidelines. Based on the above the split duplicate data is considered acceptable.

13.9 Data set comparability

Olfactory senses were used when sampling to detect odours. The absence of odour at all test pit locations corresponds to the low concentration of volatile chemicals at all test pit locations.

As indicated in Section 10.4, the Auditors representative observed minor ash or coke at test pit location TP08. Whilst the assessor did not make this observation in the field, it does correlate well with the reported PAH concentrations at this location.

Results obtained during the use of a PID in the field (ranging between 0.0 and 1.9 ppm) are supported by the laboratory results.

The Auditor also notes that all results adhered to chemical laws or were not outside logical explanation. Metal and pH levels in natural soil were within the range expected for this region, and in all instances field observations and measurements correlated with laboratory data.

Thus, it is concluded that the data set overall was consistent and the samples are representative of the site. Thus, the data can be seen as precise, accurate and representative of site conditions.

13.10 Auditor conclusions on quality assurance and quality control

In the Auditors opinion:

- the quantity of split and blind duplicate analysis for the audit was considered to be acceptable;
- the field blind and split duplicate sample analyses indicated that all RPD values were within the acceptable range or not outside logical explanation;
- no CoPC were detectable in either of the trip blank samples;
- TPH (C15-C28) was reported to be 100 µg/L within the rinse blank, which is equal to the laboratory LOR;
    - as all of the primary samples reported TPH concentrations below the LOR, it is unlikely that cross contamination has occurred;
- all results adhered to chemical laws or were not outside logical explanation;
- for all soil samples, no concentrations of TPH, VOC (including BTEX), SVOC (including phenols), OCP or PCB exceeded laboratory LOR or site criteria;
- in all instances field observations and measurements correlated with laboratory data;
- the organic and inorganic analysis is consistent with the geology, local region and site history;
- internal laboratory duplicate analyses were within the acceptable RPD values or could be readily explained;
- laboratory spike values were within acceptable recovery percentages; and
- laboratory blanks were all acceptable.

It is concluded that, based on the area of the site, the site history and Australian Standard (AS 4482.1-2005), the locations and frequency of sampling at the site is considered sufficient to identify and characterise the gross contamination status of the soil beneath the site. In addition, the data set is consistent, and the laboratory results can be seen as representative of the site condition. Therefore data can be accepted as being representative of samples taken from the site.

Overall, the sampling and analysis procedures are considered acceptable and the quality control procedures have indicated that the overall data supplied by the laboratories are adequate to arrive at the conclusions in this audit.

14 AUDIT FINDINGS

The audit was undertaken at the northern portion of Lot 1 on PS419739, Volume 10478 Folio 850. The Environmental Audit covers only part of this allotment as shown on the Title Plan attached in Appendix A.

Further, the audit has provided objective information from which an assessment can be made regarding the suitability of the site for all uses and in particular for the likely 'standard' residential land use.

14.1 Nature and extent of contamination

The laboratory results reported by the assessor identified that concentrations of all soil organic and inorganic chemicals were below the adopted health-based criteria for the most sensitive beneficial use (NEPM 'A' HIL) and the ecological based criteria (NEPM EILs), with the exception of the following:

- location TP02_0.1: benzo(a)pyrene (BaP) and total poycyclic aromatic hydrocarbons (PAHs) were reported in excess of NEPM 'A' HIL guidelines, with concentrations of 4.5 and 36 mg/kg respectively;
- locations TP04_1.0, TP05_1.0 and TP08_0.1R: arsenic (As) concentrations were found to exceed the NEPM EILs in these three locations, with concentrations ranging between 44 and 49 mg/kg.

The results of the Auditor verification sampling also recorded concentrations of CoPC below NEPM 'A' HIL and NEPM EIL guidelines. However, sample AVS1(0.5-0.6) did report detections of PAH compounds. Total PAH and BaP were reported as 7.1 and 0.7 mg/kg respectively (note that sample AVS7 was collected from TP08 between 0.5 and 0.6 mBGL).

The above BaP and PAH detections revealed in fill material at TP02 and TP08 are present as ash (from black and brown coal) and coke (Refer to Section 10.4.2). These substances are considered immobile in the environment and are therefore not likely to pose a significant threat to either human health or the environment. This assessment agrees with the field observations made by the Auditors representative, who observed minor ash and coke material in the field. Additionally, the BaP and PAH statistical appraisal conducted by the Auditor complies with NEPM guidelines.

Although, the concentration of arsenic in TP04_1.0, TP05_1.0 and TP08_0.1R exceeds the NEPM EIL, the concentration complies with NEPM 'A' HIL, and the average arsenic concentration is 10.32 mg/kg (just over half the NEPM 'A' HIL of 20 mg/kg). Furthermore, the assessor undertook leachate analysis on TP08_0.1R using the ASLP method. From this, the Auditor calculated the bioavailability factor (BF) to assess the ecological protection of groundwater beneficial uses and receptors from fill and natural material at the site. The BF was found to be 0.909% and as such, the NEPM criteria can be considered to be highly conservative, as it assumes a BF of 100 %. Based on the BF result, both plant root zones and downward percolation of water will not be able to dissolve arsenic from the soil, as it is strongly adsorbed.

Groundwater at the site was not directly investigated as part of the Environmental Audit. Available groundwater information from nearby groundwater bores was reviewed and there is considered to be a moderate potential for regional groundwater contamination from various nearby former industrial sites. However, the potential for exposure of groundwater to onsite

beneficial uses is considered low, and there is not likely to be any local, up-gradient potential sources of groundwater contamination.

From a health and environmental perspective, the soil at the site does not pose a hazard to beneficial site users. Furthermore, no odours or unusual discoloration due to contamination was noted in any of the soil sampling points.

14.2 Imminent environmental hazard

The Auditor is not aware of any imminent environmental hazards that are associated with the site.

14.3 Evaluation of environmental quality and assessment of risk

14.3.1 Soil

The SEPP (2002) *Prevention and Management of Contamination of Land* sets out the protected beneficial uses for various land users. It is likely that the site will be used for residential purposes, however in order to issue the site with a CoEA, the Auditor must be satisfied that the site is suitable for any future land-use. Therefore the condition of the site must be assessed against the criteria for sensitive land-use.

The relevant beneficial uses of land are set out below:

- Maintenance of ecosystems (natural, modified and highly modified);
- Human health;
- Buildings and Structures;
- Aesthetics; and
- Production of Food, Flora and Fibre.

A review of the compliance of the condition of the land with all potential beneficial use objectives is set out below.

Maintenance of ecosystems:
The SEPP (2002) *Prevention and Management of Contamination of Land* states that the beneficial use of maintenance of ecosystems should be assessed against the interim NEPM EIL's or against any regional ecological protection levels developed in accordance with the NEPM.

Modified ecosystems include areas that have been disturbed by human activity but allow an altered ecosystem, usually with a lower diversity, to exist. These can include species associated with domestic gardens, significant native trees and plants which may be important to wildlife, pasture or other species of economic importance for grazing or other agricultural activities.

Highly modified ecosystems are characterised by a high level of anthropogenic intervention, where the environment has been substantially altered. Species diversity is generally low with few valuable plants and animals able to live in this type of environment.

Samples collected across the site indicate that all chemicals of potential concern existed at concentrations below the NEPM interim EIL's with the exception of arsenic. Further leachate

and statistical analysis (described in Section 10.4.3) demonstrated that the arsenic concentrations in excess of the EILs at this site pose no threat to protection of ecosystems.

The Auditor concludes that 'maintenance of ecosystems' is a protected beneficial use.

Human Health:
The SEPP states that the beneficial use of protection of human health should be assessed against the human health investigation levels (HILs), as set out in the NEPM. The Auditor must assess the site against the most sensitive criteria for the issue of a CoEA, hence the most sensitive HILs have been adopted which are the NEPM 'A' HIL (standard residential with garden/accessible soil, including children's day care centres, kindergartens, preschools and primary schools).

Given that it is not known what the future redevelopment of the site will be, the Auditor has assumed it is for low density residential with direct asses to the soil onsite.

The laboratory results reported by the assessor identified that concentrations of all soil organic and inorganic chemicals were below the adopted NEPM 'A' HIL, with the exception of BaP and PAH at one location (TP02_0.1). As detailed in Section 13.1, the BaP and PAH detections at this location are likely to be present as ash (from black and brown coal) and coke (Refer to Section 10.4.2). These substances are considered immobile in the environment and are therefore not likely to pose a threat to either human health or the environment. Additionally, the BaP and PAH statistical appraisal conducted by the Auditor complies with NEPM guidelines. Furthermore, as no vapours were reported or detected by a PID at the site, the inhalation of contamination via vapour is not a concern for this site.

The Auditor therefore concludes that 'human health' is a protected beneficial use.

The chemical condition of the site is considered suitable for use as children's day care centres, kindergartens, pre schools, primary schools, residential, commercial, parks/open space and industrial use.

Buildings and Structures:
The SEPP requires that contamination must not cause the land to be corrosive, or to adversely impact the integrity of structures or building materials. Australian Standard AS3600 – *Concrete Structures* states that permeable soils with a pH of less than 4 or groundwater containing sulfate concentrations higher than 1,000 mg/L is considered aggressive and detrimental to concrete structures. The NEPM 1999 sets a sulfate level in soil of 2,000 mg/kg for protection of buildings and structures.

The SWL was recorded in one groundwater bore during the Audit undertaken at the former Oakleigh Council Depot in 2000 and, Environmental Earth Sciences staff measured the SWL in a groundwater bore immediately north of the site in December 2011. The SWL at the Oakleigh Council Depot was recorded as 5.7 mBGL, and the SWL recorded in the bore immediately north of the site was 11.54. No construction logs are available for either bore and it is therefore unclear as to where groundwater was actually encountered.

The following observations are also made with reference to buildings and structures:

- the pH of the soil beneath the site ranged from 4.6 to 8.1 (slightly acidic to slightly alkaline), and based on this, the pH levels identified at the site are satisfactory in terms of the beneficial use of buildings and structures;
- all soil sulfate concentrations were reported to be below the NEPM 1999 guideline of 2,000 mg/kg; and

- groundwater beneath the site is likely to exist at depths greater than approximately 5.7 mBGL (see above);

Furthermore, the Auditor did not identify any soil contamination which was considered to detrimentally impact buildings and structures.

The Auditor therefore concludes that 'buildings and structures' is a protected beneficial use.

Aesthetics:
The beneficial use of aesthetics requires that contamination must not cause the land to be offensive to the human senses. This is considered to relate to the presence of offensive odour or the presence of stained or visually impacted soil, including and evidence of waste materials.

No odour or discolouration due to contamination was noted in any of the sampling points investigated however, the assessor did observe minor brick fragments and crushed rock in fill material at locations TP03, TP05, TP06 and TP08. The Auditors representative also observed minor ash and coke within fill material at TP08. The estimated volume of fill material that potentially exists in the north east corner of the site is 1,000 m^3.

The presence of minor amounts of inert foreign material in soil is not grounds for refusing to issue a Certificate of Environmental Audit. Therefore, in its current state, the Auditor concludes that 'aesthetics' is a protected beneficial use.

Production of Food, Flora and Fibre:
Even though the production of food, flora and fibre is not a likely beneficial use for this site, it will be discussed briefly in case in the future the site is used for this purpose.

The SEPP - (2002) *Prevention and Management of Contamination of Land* states "contamination of land must not adversely affect produce quality or yield". Specific criteria for the protection of food, flora and fibre, are not provided. However the NEPM EILs are based on phytotoxicity. With the exception of three samples analysed for arsenic and one sample analysed for BaP and PAH, all analytes were below NEPM EIL concentrations (note that NEPM does not state EILs for BaP and PAH).

The arsenic concentrations within soil at the site are considered to be within background ranges. Further, leachate tests indicate that arsenic at this site has a low bioavailability, and when adjusted for this, all arsenic concentrations are found to be below the applicable NEPM EIL.

For the above reasons the Auditor concludes that the 'production of food, flora and fibre' is a protected beneficial use.

14.3.2 Air quality

Any direct effects of soil contamination on the air quality would be through direct exposure to the soil, which (under the right conditions) can form dust and humans can then inhale the fine particles. Such exposure is most likely to only occur in the construction phases of any site redevelopment and potentially during future maintenance works. No odours were detected in any sampling points investigated, and a PID was unable to detect VOC's above 1.9 ppm at any of the locations. Therefore, the exposure to any contaminants in the volatile phase is most unlikely.

No analyte concentration is high enough to present a risk impact on the air quality and hence to human health or the environment, even during construction.

14.3.3 Groundwater and surface water

In accordance with the SEPP (1997) — *Groundwaters of Victoria* and the Auditing Guidelines an Auditor must have regard to the "beneficial uses that may be made of the relevant segment of the environment". An Auditor must take into account that polluted groundwater at a site may affect the ability to issue a Certificate of Environmental Audit. In order to assess the groundwater component of the audit process, three questions need to be answered:

a) is groundwater likely to be polluted?

b) if yes to (a) is groundwater polluted?

c) if yes to (b) are the beneficial uses of the groundwater precluded by the pollution relevant or is the site the source of pollution?

Is groundwater likely to be polluted from previous or current onsite activities?
Given the history, geology and the analytical results from the assessment, the potential for contamination of groundwater by the site is considered low. Evidence to support this includes the following:

- fill material generally consisted of sand, sandy clays and clays with only occasional inclusions of brick fragments, crushed rock and minor ash/coke;
- low permeability, highly plastic clays were observed in a number of bores >1 mBGL;
- there was no significant evidence of surface staining;
- with the exception of BaP and PAH at one location, no chemicals were detected in excess of NEPM (A) HILs;
    - these concentrations are discussed within the body of this Audit report and the source of PAH is likely to be ash/coke (ie. immobile);
- site history indicates past use of industrial chemicals at the site is unlikely; and
- site history indicates that the site was used for agricultural purposes (including poultry) up until approximately 1965, where it was purchased by the adjacent quarry; and
- the site has been used as recreational space for the Clarinda Centre since 1998.

Is groundwater likely to be polluted from previous or current offsite activities?
Based on the results of the review of surrounding Audit sites (Section 6.8) it has been established that it is unlikely that regional groundwater has been impacted from nearby industrial activities. Only one of the three audited sites located within 2 km of the site had a groundwater investigation. Concentrations of toluene and xylenes in groundwater were detected however, they were reported to be within the applicable guidelines. The Auditor of that site subsequently concluded that there was no risk to the beneficial uses of groundwater at the site. The possibility of regional groundwater contamination is therefore likely to be low.

Nevertheless, any groundwater or perched water contamination potentially originating from the quarry (located to the north) would likely impact on the site groundwater, as the two sites are likely to be hydraulically connected. In consideration of the information provided within the Rock Solid (1997) report, the quarry was partially reinstated with quarry overburden, imported demolition material, clay, crushed rock and siltstone. The majority of the quarry void was left exposed and is now filled with water. Hence, based on the likely 'backfill materials' used at the quarry to the north, the potential for groundwater contamination is low.

Based on the above discussion, the answer to question a) (Section 14.3.3) is no.

15 CONCLUSIONS

Based on the a potential future low density residential use, and the Auditor's review of information supplied in the previous sections of this report, this information is considered of sufficient quality and quantity to meet the requirements of an environmental audit.

The sources of information include:

- the site history;
- the geology and hydrogeology of the site;
- the distribution and frequency of sampling locations to obtain a valued judgement of the contamination status of the site;
- the soil sampling procedures suitable to produce accurate results;
- the analytical suite sufficient to identify a broad spectrum of likely contaminants;
- the accuracy and reproducibility of results verified via quality control sampling;
- the discussions with the client;
- the Auditor's site inspection;
- inspections by members of the Auditor's team;
- the results of the assessment;
- the EPA Auditor Guidelines and the relevant EPA policies as referenced in Section 17.0; and
- the NEPM 1999 Guidelines, ANZECC 1992 Guidelines, Australian Standards and EPA Victoria guidelines.

The concentrations of chemicals in soil have been compared to the criteria for the most sensitive beneficial land use, which is a standard residential use with accessible soil. All chemical concentrations detected in soil were either:

- within the statistical compliance levels (as specified in the NEPM);
- within the expected background levels for the area; and/or
- found to be immobile within the environment.

The Auditor concludes that the site is not likely to be a source of groundwater contamination.

The Auditor considers that the chemical condition of the site is suitable for beneficial uses of sensitive use (high density), sensitive use (other), parks & reserves, agricultural, recreation/open space, commercial and industrial.

Additional information that the site owners should be aware of is as follows:

- any fill disposed from or imported to the site for any reason must be classified as "Fill Material" as defined in EPA Victoria *Industrial Waste Resource Guidelines* (IWRG) *Soil Hazard* Categorisation and Management, June 2009 (IWRG621) - or as subsequently amended; and

- no onsite bores were installed into the regional aquifer and the owner must test groundwater to determine the suitability prior to any use of that resource.

16 LIMITATIONS

The site has been investigated as part of the audit by the placement of sampling points on a systematic and targeted basis. Though the Auditor has inspected the site and viewed the reports, the Auditor is not responsible for opinions based on work that is later found to be false or misleading. The audit in no way implies that the site will be free from contamination after development but only that exposure of contamination to the environment or from activities on the site as a whole will not cause adverse impact.

This audit does not conclude that all material remaining on-site, if excavated, will be classified as "Fill Material or Prescribed Waste" for off-site disposal (under EPA Victoria Industrial Waste Resource Guidelines (IWRG621) – *Soil Hazard Categorisation and Management*). As the site has been investigated on a systematic and targeted basis and validated statistically the Auditor cannot guarantee that the locations between the sampling points are not contaminated, but the site statistically, as a whole, is fit for the proposed use.

The Auditor does not conclude that commercially viable yields of food, flora and fibre can be achieved on this site. Prospective buyers who envisage this use should undertake their own investigations.

The Auditor does not make any comment regarding the geotechnical suitability of the site. The Auditor is not responsible for any change in state of the site from the date of the audit report, and for the compliance by site owners of any laws or regulations relating to demolition and waste disposal.

17 REFERENCES, GUIDELINES AND DOCUMENTS

Australian and New Zealand Environment and Conservation Council (ANZECC)/National Health and Medical Research Council (NHMRC) (1992) – *Australian and Nez Zealand Guidelines for the Assessment and Management of Contaminated Sites*.

ANZECC (1992) - *Australian water quality guidelines for fresh and marine waters. National Water Quality Management Strategy.*

ANZECC and Agricultural and Resource Management Council of Australia and New Zealand (ARMCANZ) (2000) – *Australian and New Zealand guidelines for fresh and marine water quality. National Water Quality Management Strategy*.

Australian and New Zealand Environment and Conservation Council (ANZECC) and ARMCANZ (2000) *Australian and New Zealand guidelines for fresh and marine water quality*.

Berkman, D. A. 1989, *Field Geologist's Manual*, 3rd edn. The Australian Institute of Mining and Metallurgy, Carlton, Victoria, Australia.

Dahlaus P. et al. 2004, *Port Phillip and Westernport Groundwater Flow Systems*, Port Phillip and Westernport Catchment Management Authority.

Dutch Ministry of Housing, Spatial Planning and Environment (2000) – *Circular of target Values and Intervention Values for Soil Remediation.*

Environmental Earth Sciences Pty Ltd (2009) *Soil, Gas and Groundwater Sampling Manual.*

Environment Protection Act (1970) and amendments.

EPA Victoria (2007) *Environmental Auditor (contaminated land) guidelines for issue of Certificates and Statements of Environmental Audit.* Publication 759.1.

EPA Victoria (1998) State Environment Protection Policy (Groundwaters of Victoria). Publication 597

EPA Victoria (August 2007) *Environmental auditing of contaminated land.* Publication 860.1.

EPA Victoria (August 2007) *Environmental auditor guidelines for appointment and conduct.* Publication 865.6.

EPA Victoria (April 2003) *Environmental Auditing in Victoria.* Publication 902

EPA Victoria (August 2007) *Environmental auditor guidelines for the preparation of environmental audit reports on risk to the environment.* Publication 952.2.

EPA Victoria (August 2007) *Environmental auditor guidelines for conducting environmental audits.* Publication 953.2.

EPA Victoria (September 2007) *Environmental auditor guidelines – provision of environmental audit reports, certificates and statements.* Publication 1147.

EPA Victoria (2002) *Policy impacts assessment – Prevention and management of contaminated land in Victoria.* Publication 854.

EPA Victoria (2003) EPA *Contaminated Sites Information Systems Priority Sites Register.* Publication 735.1.

EPA Victoria Industrial Waste Resource Guidelines (IWRG) *Sampling and analysis of waters, wastewaters, soils and wastes*, June 2009 (IWRG701).

EPA Victoria Industrial Waste Resource Guidelines (IWRG) *Soil sampling,* June 2009 (IWRG702)

EPA Victoria Industrial Waste Resource Guidelines (IWRG) *Soil sampling,* June 2009 (IWRG702)

Geological Survey of Victoria (1997) — *Melbourne 1:250 000 map sheet*

GHD (25 June 2010), GHD Reference: 31/26398/183732, 'Clarinda Centre', 1213 – 1217 Oakleigh South ESA – Work Plan for Auditor Approval.

GHD (12 July 2010), GHD Reference: 31/26398/184231, 'Clarinda Centre', 1213 – 1217 Centre Rd, Oakleigh South ESA, *Response to Auditors Comments on GHD Work plan.*

GHD (9 August 2010), GHD Reference: 31/26398/185435, City of Monash, Clarinda Centre, *Phase 1 and 2 Environmental Site Assessment Phase 1 Summary Letter.*

GHD Pty Ltd (October 2010), GHD Reference: 31/26398/183955, Draft (B), City of Monash, Report to Clarinda Centre, *Phase 1 and Phase 2 Environmental Site Assessment.*

GHD Pty Ltd (January 2011), GHD Reference: 31/26398/183955, Draft (C), City of Monash, Report to Clarinda Centre, *Phase 1 and Phase 2 Environmental Site Assessment.*

GHD Pty Ltd (7 February 2011), GHD Reference: 31/26398/190098, City of Monash, Clarinda Centre, *Phase 1 and 2 ESA, Response to Auditors Comments.*

Leonard, J, 1992, *Port Phillip Region Groundwater Systems - Future Use and Management.* Department of Water Resources.

National Environment Protection Council (NEPC) (1999) *National Environment Protection (Assessment of Site Contamination) Measure* (NEPM).

NHMRC (2004) *Australian drinking water guidelines.* National Water Quality Management Strategy.

NSW Department of Environment and Climate Change (NSW DECC) (February 2008) *Service station sites: assessment and remediation.*

Standards Australia (2005) Guide to the investigation and sampling of sites with potentially contaminated soil. Part 1: Non-volatile and semi-volatile compounds. AS 4482.1.

Standards Australia (1999) Guide to the sampling and investigation potentially contaminated soil. Part 2: Volatile Substances. AS 4482.2.

Standards Australia (1986) Selection of Containers and Preservation of Water Samples for Chemical and Microbiological Analysis, Part 1 (Chemical) and Part 2 (Microbiological).

Van de Graaff, R and Wootton, C (1996). Landcare Notes Melbourne Soils. Department of Sustainability and Environment.

Victorian Government (2002) State Environment Protection Policy (Prevention and Management of Contamination of Land). Government Printer, Melbourne.

Victoria Government Gazette (1997) State Environment Protection Policy (Groundwaters of Victoria) (SEPP GoV). Victorian Government Printer.

Victoria Government Gazette (1997) Variation of the State environment protection policy (Waters of Victoria) – insertion of Schedule F6. Waters of Port Phillip Bay.

18 ABBREVIATIONS AND ACRONYMS

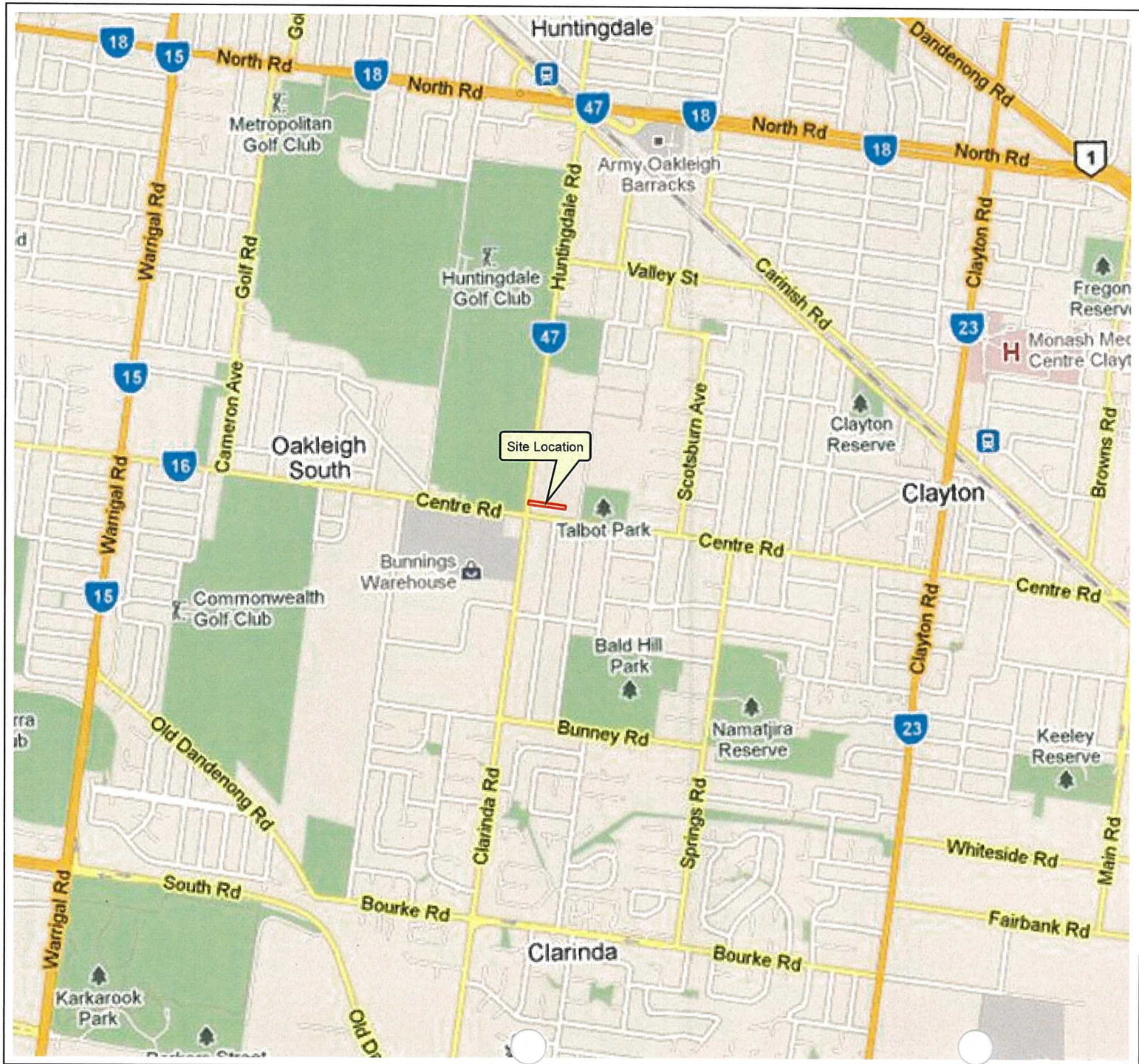
~	approximately
AHD	Australian Height Datum
ANZECC	Australian and New Zealand Environment and Conservation Council
ASLP	Australian Standard Leaching Procedure
BaP	Benzo(a)pyrene
CN	Cyanide
COC	Chain of Custody
CoEA	Certificate of Environmental Audit
CoPC	Chemicals of Potential Concern
DQO	Data Quality Objectives
DNRE	Department of Natural Resources and Environment
DPO	Development Plan Overlay
EAO	Environmental Audit Overlay
EILs	Environmental Investigation Levels
EPA	Environment Protection Authority
GoV	Groundwaters of Victoria (SEPP 1997)
GQRUZ	Groundwater quality restricted use zone
HILs	Health-based soil Investigation Levels
IWRG	Industrial Waste Resource Guidelines
IWMP	Industrial Waste Management Policy
MAHs	Monocyclic Aromatic Hydrocarbons

mBGL	metres below ground level
Myo	Million years old
NATA	National Association of Testing Authorities
NEHF	National Environmental Health Forum
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NHMRC	National Health and Medical Research Council
OCP	Organochlorine (pesticides)
OH&S	Occupational Health and Safety
OPP	Organo phosphorous (pesticides)
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated biphenyls
PID	Photo ionisation detector
QA/QC	Quality Assurance / Quality Control
RPD	Relative Percentage Difference
SEPP	State Environment Protection Policy
SoEA	Statement of Environmental Audit
SEPP	State Environment Protection Policy
TCE	Trichloroethylene/Trichloroethane
TDS	Total Dissolved Salts
TPH	Total Petroleum Hydrocarbon/Total Recoverable Hydrocarbons
UCL	Upper Confidence Limit
USEPA	United States EPA
VOC	Volatile Organic Compounds

Metals

As	Arsenic	Be	Beryllium
Ba	Barium	Mn	Manganese
Mo	Molybdenum	Se	Selenium
Cd	Cadmium	Ni	Nickel
Cr	Chromium	Pb	Lead
Cu	Copper	Co	Cobalt
Sn	Tin	Hg	Mercury
Zn	Zinc	V	Vanadium

FIGURES



Legend

Site Boundary

0 250 500 1,000 Meters

ENVIRONMENTAL EARTH SCIENCES	Title: **Site Location**	
	Location: **1213-1217 Centre Road, Oakleigh Sth**	
Client: **City of Monash**		Job number: **210052**
Drawn by: **PF**	Scale: **As Shown**	51
Proj Man: **AS**	Date: **Apr 2011**	**Figure 1**

Legend

- Site Boundary
- Audit Locations

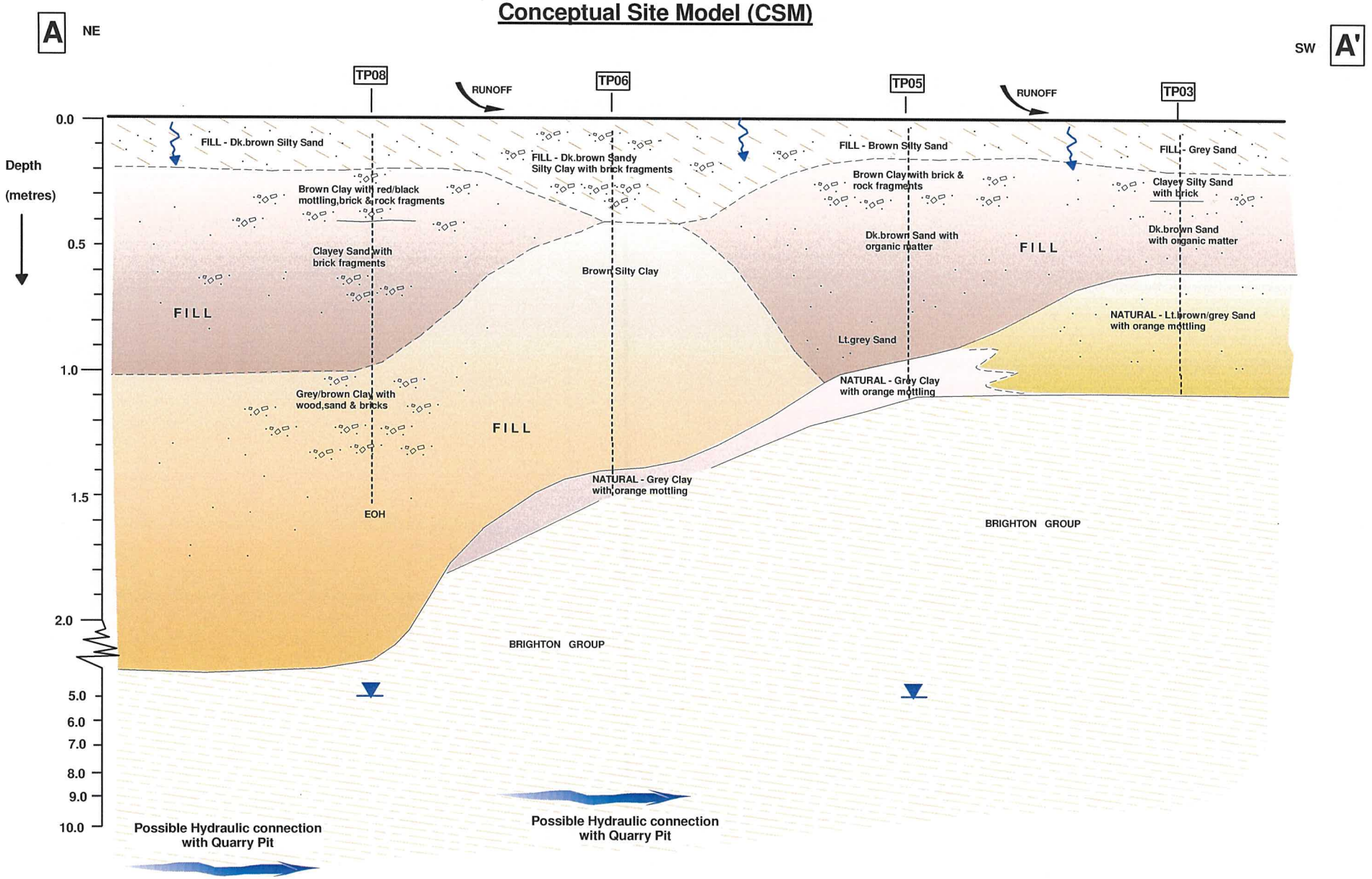
0 125 250 500 Meters

ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

Title: **Surrounding Land Uses**		
Location: **1213-1217 Centre Road, Oakleigh Sth**		
Client: **City of Monash**		Job number: **210052**
Drawn by: **PF**	Scale: **As Shown**	
Proj Man: **AS**	Date: **Apr 2011**	**Figure 2**


Huntingdale Road
Disused, former sand quarry
Pump House
HA01
TP02
TP01
TP04
TP03
TP06
TP05
TP08
TP07
A
A'
Clarinda Centre
AVS1
AVS2
AVS3
AVS4
Centre Road
KEEP CLEAR
TP02_R3
TP02_R2
TP02
TP02_R4
TP02_R1
TP02_R5
0 0.25 0.5 1 Meters
Site Boundary
Centre Boundary
Transect
Groundwater Bore
Hand Auger
Test Pit
Approximate fill extent in N/E corner
0 5 10 20 Meters
ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW
Title: Borehole Locations
Location: 1213-1217 Centre Road, Oakleigh Sth
Client: City of Monash
Job number: 210052
Drawn by: PF
Scale: As Shown
Proj Man: AS
Date: Apr 2011
53
Figure 3

Conceptual Site Model (CSM)



ENVIRONMENTAL EARTH SCIENCES THE KNOW AND THE HOW	Title: Conceptual Site Model (CSM)		
	Location: 1213-1217 Centre Road, Oakleigh South, Vic.		
Client: City of Monash		Job number: 210052	
Drawn by: TRJ	Scale: Exaggerated	Figure 4	
Proj Man: AS	Date: April 2011		

TABLES

TABLE 5 NEPM ECOLOGICAL-BASED SOIL INVESTIGATION LEVELS (EILS) AND NEPM BACKGROUND RANGES

Metals/Metalloids	Ecological Investigation Levels (mg/kg)	Background Ranges (mg/kg)
Arsenic	20	1 - 50
Barium	300	100 - 3,000
Cadmium	3	1
Chromium (III)	400	-
Chromium (VI)	1	-
Chromium (total) *	-	5 - 1,000
Copper	100	2 - 100
Cobalt	-	1 - 40
Lead	600	2 - 200
Manganese	500	850
Mercury (inorganic)	1	0.03
Nickel	60	5 - 500
Vanadium	50	20 - 500
Zinc	200	10 - 300

Note(s):
1. * = valence state not distinguished (expected as Cr (III)); and
2. - = no investigation level or background range available.

TABLE 6 NEPM HEALTH-BASED SOIL INVESTIGATION LEVELS

SUBSTANCE	Health Soil Investigation Levels (mg/kg)					
Exposure Settings	**A**	**B[a]**	**C[a]**	**D**	**E**	**F**
Aldrin + Dieldrin	10			40	20	50
Arsenic (total)	100			400	200	500
Benzo (a) pyrene	1			4	2	5
Beryllium	20			80	40	100
Boron	3 000			12 000	6 000	15 000
Cadmium	20			80	40	100
Chlordane	50			200	100	250
Chromium (III)	12%			48%	24%	60%
Chromium (VI)	100			400	200	500
Cobalt	100			400	200	500
Copper	1 000			4 000	2 000	5 000
Cyanides (complexed)	500			2 000	1 000	2 500
DDT+DDD+DDE	200			800	400	1 000
Heptachlor	10			40	20	50
Lead	300			1 200	600	1 500
Manganese	1 500			6 000	3 000	7 500
Methyl mercury	10			40	20	50
Mercury (inorganic)	15			60	30	75
Nickel	600			2 400	600	3 000
Total PAH	20			80	40	100
PCBs (total)	10			40	20	50
Phenol	8 500			34 000	17 000	42 500
TPH >C_{16}-C_{35} aromatics	90			360	180	450
TPH >C_{16}-C_{35} aliphatics	5 600			22 400	11 200	28 000
TPH >C_{35}	56 000			224 000	112 000	280 000
Zinc	7 000			28 000	14 000	35 000

Exposure Setting(s):

A 'Standard' residential with garden/accessible soil (less than 10% intake of home grown produce; no poultry): this category includes children's day-care, pre-schools etc.
B Residential with substantial vegetable garden (contributing up to 50% of vegetable and fruit intake) and poultry providing all dietary egg intake and 25% poultry meat intake.
C Residential with substantial vegetable garden (contributing up to 50% of vegetable and fruit intake); poultry excluded.
D Residential with minimal opportunities for soil access includes high-rise apartments and flats.
E Parks, recreational open space and playing fields: includes secondary schools.
F Commercial/Industrial: includes premises such as shops and offices as well as factories and industrial sites. (If, however, a commercial site is also used for residential purposes or regular soil access by children if possible then the appropriate 'residential' setting should be used.) It is assumed that thirty years is the duration of exposure.
[a] Site and contaminant specific

TABLE 7 SOIL LABORATORY RESULTS SUMMARY

Analyte	Units	NEPM EIL	NEPM 'A' HIL	HA01_0.1	HA01_0.4	TP01_0.1	TP01_0.3	TP01_0.7	TP01_0.7	TP02_0.1	TP02_0.9	TP02_R1	TP02_R2	TP02_R3	TP02_R4	TP02_R5	TP03_0.1	TP03_0.5	TP03_1.0
Heavy Metals																			
Antimony	mg/kg	20		ND	ND	-	ND	-	-	ND	ND	-	-	-	-	-	-	ND	ND
Arsenic	mg/kg	20	100	4.9	ND	3	ND	ND	-	3.2	ND	-	-	-	-	-	3.3	7.5	ND
Arsenic ASLP	mg/L			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Beryllium	mg/kg		20	ND	ND	-	ND	-	-	ND	ND	-	-	-	-	-	-	ND	ND
Cadmium	mg/kg	3	20	ND	ND	ND	ND	ND	-	ND	ND	-	-	-	-	-	ND	ND	ND
Chromium (III+VI)	mg/kg	401		16	5.1	ND	ND	5.5	-	14	ND	-	-	-	-	-	16	7.1	ND
Cobalt	mg/kg		100	6.4	ND	-	ND	-	-	ND	ND	-	-	-	-	-	-	ND	ND
Copper	mg/kg	100	1000	16	ND	8.6	ND	ND	-	9.9	ND	-	-	-	-	-	13	ND	ND
Lead	mg/kg	600	300	34	ND	43	ND	5.5	-	41	ND	-	-	-	-	-	44	7.6	ND
Manganese	mg/kg																		
Mercury	mg/kg	1	15	ND	ND	ND	ND	ND	-	ND	ND	-	-	-	-	-	ND	ND	ND
Molybdenum	mg/kg			ND	ND	-	ND	-	-	ND	ND	-	-	-	-	-	-	ND	ND
Nickel	mg/kg	60	600	15	ND	ND	ND	ND	-	14	ND	-	-	-	-	-	21	ND	ND
Selenium	mg/kg			ND	ND	-	ND	-	-	ND	ND	-	-	-	-	-	-	ND	ND
Tin	mg/kg			ND	ND	-	ND	-	-	ND	ND	-	-	-	-	-	-	ND	ND
Zinc	mg/kg	200	7000	47	ND	61	9	ND	-	46	ND	-	-	-	-	-	51	17	5.2
Inorganic																			
Chromium VI	mg/kg	1	100	ND	ND	-	-	-	ND	-	-	-	-	-	-	-	ND	-	-
Chromium III	mg/kg	400		16	5.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cyanide Total	mg/kg		500	ND	ND	-	ND	-	-	ND	ND	-	-	-	-	-	-	ND	ND
pH	pH_units			7.9	7.3	-	5.6	-	-	6.7	5.1	-	-	-	-	-	-	4.9	4.6
Sulphate as S	mg/kg			15	24	-	ND	-	-	ND	52	-	-	-	-	-	-	74	61
PAH																			
Naphthalene	mg/kg			ND	ND	ND	ND	ND	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acenaphthylene	mg/kg			ND	ND	ND	ND	ND	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acenaphthene	mg/kg			ND	ND	ND	ND	ND	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluorene	mg/kg			ND	ND	ND	ND	ND	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Phenanthrene	mg/kg			0.3	ND	ND	ND	ND	-	2	ND	ND	0.2	0.1	0.1	ND	0.2	ND	ND
Anthracene	mg/kg			ND	ND	ND	ND	ND	-	0.6	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluoranthene	mg/kg			0.7	ND	0.2	ND	ND	-	5.4	ND	0.2	0.4	0.3	0.4	0.2	0.4	ND	ND
Pyrene	mg/kg			0.7	ND	0.2	ND	ND	-	6.5	ND	0.2	0.4	0.3	0.4	0.2	0.4	ND	ND
Benz(a)anthracene	mg/kg			0.5	ND	0.2	ND	ND	-	3.4	ND	0.2	0.2	0.2	0.2	0.2	0.3	ND	ND
Chrysene	mg/kg			0.4	ND	0.1	ND	ND	-	2.9	ND	0.1	0.2	0.2	0.2	0.1	0.2	ND	ND
Benzo(b)fluoranthene	mg/kg			0.5	ND	0.2	ND	ND	-	4.5	ND	0.1	0.2	0.2	0.2	0.2	0.3	ND	ND
Benzo(k)fluoranthene	mg/kg			0.2	ND	ND	ND	ND	-	2.1	ND	ND	0.1	0.1	0.1	ND	0.2	ND	ND
Benzo(a) pyrene	mg/kg		1	0.4	ND	0.1	ND	ND	-	4.5	ND	0.1	0.2	0.2	0.2	0.2	0.3	ND	ND
Indeno(1,2,3-c,d)pyrene	mg/kg			0.2	ND	ND	ND	ND	-	1.8	ND	ND	0.1	ND	0.1	ND	0.1	ND	ND
Dibenz(a,h)anthracene	mg/kg			ND	ND	ND	ND	ND	-	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(g,h,i)perylene	mg/kg			0.2	ND	ND	ND	ND	-	2.1	ND	ND	0.2	0.1	0.2	0.1	0.2	ND	ND
PAHs (Sum of total)	mg/kg		20	4.1	ND	1	ND	ND	-	36	ND	0.9	2.2	1.7	2.1	1.2	2.6	ND	ND

TABLE 7 SOIL LABORATORY RESULTS SUMMARY (CONTINUED)

Analyte	Units	NEPM EIL	NEPM 'A' HIL	HA01_0.1	HA01_0.4	TP01_0.1	TP01_0.3	TP01_0.7	TP01_0.7	TP02_0.1	TP02_0.9	TP02_R1	TP02_R2	TP02_R3	TP02_R4	TP02_R5	TP03_0.1	TP03_0.5	TP03_1.0
TPH																			
TPH C_6 - C_9	mg/kg	-	-	ND	ND	-	ND	-	-	ND	ND	-	-	-	-	-	-	ND	ND
TPH C_{10} - C_{14}	mg/kg	-	-	ND	ND	-	ND	-	-	ND	ND	-	-	-	-	-	-	ND	ND
TPH C_{15} - C_{28}	mg/kg	-	-	ND	ND	-	ND	-	-	ND	ND	-	-	-	-	-	-	ND	ND
TPH C_{29}-C_{36}	mg/kg	-	-	ND	ND	-	ND	-	-	ND	ND	-	-	-	-	-	-	ND	ND
TPH C_{10} - C_{36}	mg/kg	-	-	ND	ND	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BTEX	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OCP (Total)	mg/kg	-	-	ND	ND	-	ND	-	-	ND	ND	-	-	-	-	-	-	ND	ND
PCB (Total)	mg/kg	-	-	ND	ND	-	ND	-	-	ND	ND	-	-	-	-	-	-	ND	ND
SVOC	mg/kg	-	-	ND	ND	-	ND	-	-	ND	ND	-	-	-	-	-	-	ND	ND
VOC	mg/kg	-	-	ND	ND	-	ND	-	-	ND	ND	-	-	-	-	-	-	ND	ND
MAH	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oxygenated Cmpds	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sulfonated Cmpds	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fumigants	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Halogenated Aliphatic Cmpds	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Halogenated Aromatic Cmpds	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trihalomethanes	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenolic Cmpds	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

TABLE 7 SOIL LABORATORY RESULTS SUMMARY (CONTINUED)

Analyte	Units	NEPM EIL	NEPM 'A' HIL	TP04_0.2	TP04_0.7	TP04_1.0	TP05_0.1	TP05_1.0	TP06_0.1	TP06_0.4	TP06_1.4	TP07_0.1	AVS3 (0.3-0.4)	TP07_0.7	AVS4 (0.6-0.7)	TP08_0.1R	TP08_0.6	AVS1 (0.5-0.6)	AVS2 (1.0-1.1)	TP08_1.8
Heavy Metals																				
Antimony	mg/kg	20		ND	ND	-	-	ND	-	ND	-	ND	ND	-	ND	ND	ND	ND	ND	-
Arsenic	mg/kg	20	100	6.2	19	**47**	4	**49**	4.1	5.6	2.5	ND	ND	2.5	ND	**44**	12	17	12	7.6
Arsenic ASLP	mg/L			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	ND
Beryllium	mg/kg		20	ND	ND	-	-	ND	-	ND	-	ND	ND	-	ND	ND	ND	ND	1	-
Cadmium	mg/kg	3	20	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chromium (III+VI)	mg/kg	401		14	6.3	ND	16	23	16	20	26	ND	ND	6.7	7	32	31	20	38	19
Cobalt	mg/kg		100	5.5	ND	-	-	ND	-	ND	-	ND	ND	-	ND	ND	5.5	4	5	-
Copper	mg/kg	100	1000	9.1	ND	ND	10	ND	12	6.2	ND	ND		ND		ND	11			7.9
Lead	mg/kg	600	300	49	7.2	16	38	23	39	43	16	ND	ND	7.7	6	13	34	36	28	36
Manganese	mg/kg												ND		ND			76	57	
Mercury	mg/kg	1	15	ND	ND	ND	ND	ND	ND	ND	0.3	ND	0.3	ND	ND	ND	ND	ND	ND	ND
Molybdenum	mg/kg			ND	ND	-	-	ND	-	ND	-	ND		-		ND	ND			-
Nickel	mg/kg	60	600	17	ND	<5	24	5.8	15	8.5	7	ND	ND	ND	2	5	18	13	9	10
Selenium	mg/kg			ND	ND	-	-	ND	-	ND	-	ND	ND	-	ND	ND	ND	ND	6	-
Tin	mg/kg			ND	ND	-	-	ND	-	ND	-	ND	ND	-	ND	ND	ND	ND	ND	-
Zinc	mg/kg	200	7000	52	<5	<5	52	7.3	49	33	9.6	ND	ND	ND	ND	22	51	58	11	31
Inorganic (other)																				
Chromium VI	mg/kg	1	100	ND	-	-	-	-	-	-	ND	-	-	-	ND	ND	-	ND	ND	ND
Chromium III	mg/kg	400		-	-	-	-	-	-	-	-	-	-	-	6	32	-	14	39	-
Cyanide Total	mg/kg		500	ND	ND	-	-	ND	-	ND	-	ND	-	-	ND	<5	ND	ND	ND	-
pH	pH_units			6.6	5.3	-	-	4.7	-	7.6	-	7.1	6.2	-	4.7	7.7	8.1	7.3	7.7	-
Sulphate as S	mg/kg			11	97	-	-	140	-	12	-	ND	-	-	-	24	75	-	-	-
PAH																				
Naphthalene	mg/kg			ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acenaphthylene	mg/kg			ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acenaphthene	mg/kg			ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluorene	mg/kg			ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Phenanthrene	mg/kg			ND	ND	ND	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.6	ND	0.2
Anthracene	mg/kg			ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluoranthene	mg/kg			0.2	ND	ND	0.4	ND	0.1	ND	ND	ND	ND	ND	ND	ND	ND	1.4	ND	0.5
Pyrene	mg/kg			0.2	ND	ND	0.4	ND	0.2	ND	ND	ND	ND	ND	ND	ND	ND	1.5	ND	0.5
Benz(a)anthracene	mg/kg			0.2	ND	ND	0.2	ND	0.1	0.1	ND	ND	ND	ND	ND	ND	ND	0.7	ND	0.4
Chrysene	mg/kg			0.1	ND	ND	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.7	ND	0.3
Benzo(b)fluoranthene	mg/kg			0.2	ND	ND	0.2	ND	0.1	ND	ND	ND	ND	ND	ND	ND	ND	0.9	ND	0.4
Benzo(k)fluoranthene	mg/kg			ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.2
Benzo(a) pyrene	mg/kg		1	0.2	ND	ND	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.7	ND	0.4
Indeno(1,2,3-c,d)pyrene	mg/kg			0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.2
Dibenz(a,h)anthracene	mg/kg			ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.1
Benzo(g,h,i)perylene	mg/kg			0.2	ND	ND	0.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.6	ND	0.3
PAHs (Sum of total)	mg/kg		20	1.5	ND	ND	1.9	ND	0.5	0.1	ND	ND	ND	ND	ND	ND	ND	7.1	ND	3.5

TABLE 7 SOIL LABORATORY RESULTS SUMMARY (CONTINUED)

Analyte	Units	NEPM EIL	NEPM 'A' HIL	TP04_0.2	TP04_0.7	TP04_1.0	TP05_0.1	TP05_1.0	TP06_0.1	TP06_0.4	TP06_1.4	TP07_0.1	AVS3 (0.3-0.4)	TP07_0.7	AVS4 (0.6-0.7)	TP08_0.1R	TP08_0.6	AVS1 (0.5-0.6)	AVS2 (1.0-1.1)	TP08_1.8
TPH																				
TPH C_6 - C_9	mg/kg			ND	ND	-	-	ND	-	ND	-	ND	ND	-	ND	ND	ND	ND	ND	-
TPH C_{10} - C_{14}	mg/kg			ND	ND	-	-	ND	-	ND	-	ND	ND	-	ND	ND	ND	ND	ND	-
TPH C_{15} - C_{28}	mg/kg			ND	ND	-	-	ND	-	ND	-	ND	ND	-	ND	ND	ND	ND	ND	-
TPH C_{29}-C_{36}	mg/kg			ND	ND	-	-	ND	-	ND	-	ND	ND	-	ND	ND	ND	ND	ND	-
TPH C_{10} - C_{36}	mg/kg			ND	ND	-	-	ND	-	ND	-	ND	ND	-	ND	ND	ND	ND	ND	-
BTEX	mg/kg			-	-	-	-	-	-	-	-	-	ND	-	-	-	-	ND	-	-
OCP (Total)	mg/kg			ND	ND	-	-	ND	-	ND	-	ND	-	-	-	ND	ND	-	-	-
PCB (Total)	mg/kg			ND	ND	-	-	ND	-	ND	-	ND	-	-	-	ND	ND	-	-	-
SVOC	mg/kg			ND	ND	-	-	ND	-	ND	-	ND	-	-	-	ND	ND	-	-	-
VOC	mg/kg			ND	ND	-	-	ND	-	ND	-	ND	-	-	-	ND	ND	-	-	-
MAH	mg/kg			-	-	-	-	-	-	-	-	-	-	-	ND	-	-	-	ND	-
Oxygenated Cmpds	mg/kg			-	-	-	-	-	-	-	-	-	-	-	ND	-	-	-	ND	-
Sulfonated Cmpds	mg/kg			-	-	-	-	-	-	-	-	-	-	-	ND	-	-	-	ND	-
Fumigants	mg/kg			-	-	-	-	-	-	-	-	-	-	-	ND	-	-	-	ND	-
Halogenated Aliphatic Cmpds	mg/kg			-	-	-	-	-	-	-	-	-	-	-	ND	-	-	-	ND	-
Halogenated Aromatic Cmpds	mg/kg			-	-	-	-	-	-	-	-	-	-	-	ND	-	-	-	ND	-
Trihalomethanes	mg/kg			-	-	-	-	-	-	-	-	-	-	-	ND	-	-	-	ND	-
Phenolic Cmpds	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-	-	ND	-	-	-	ND	-

Note(s):

1. All results are expressed in mg/kg (dry weight);
2. - = not analysed or no guideline available;
3. ND = not detected;
4. Shaded = CoPC in excess of NEPM 'A' HIL
5. **Bold and underlined** = CoPC in excess of NEPM EIL

TABLE 8 BAP STATISTICAL ANALYSIS

Statistics	All Samples (mg/kg)	Guidelines (mg/kg)
Count	32	-
Distribution	Lognormal	-
95% UCL (mg/kg)	0.19	1
Mean (mg/kg)	0.35	1
Standard deviation (mg/kg)	**2.40**	0.5
Maximum value (mg/kg)	**4.50**	2.5

TABLE 9 PAH STATISTICAL ANALYSIS

Statistics	All Samples (mg/kg)	Guidelines (mg/kg)
Count	32	-
Distribution	Lognormal	-
95% UCL (mg/kg)	10.84	20
Mean (mg/kg)	2.88	20
Standard deviation (mg/kg)	6.26	10
Maximum value (mg/kg)	36.00	50

TABLE 10 ARSENIC STATISTICAL ANALYSIS

Statistics	All Samples (mg/kg)	Guidelines NEPM 'A' HIL / NEPM EIL (mg/kg)
Count	23	-
Distribution	Lognormal	-
95% UCL (mg/kg)	16.70	100 / 20
Mean (mg/kg)	10.32	100 / 20
Standard deviation (mg/kg)	2.88	50 / 10
Maximum value (mg/kg)	49.00	250 / 50

TABLE 11 SUMMARY OF CALCULABLE RELATIVE PERCENT DIFFERENCE (RPD)

Analyte	TP04_0.2	FD01	RPD (%)	TP02_R1	FD03	RPD %	TP04_0.2	FS02	RPD %	TP02_R1	FS04	RPD %
Arsenic	6.2	3.6	**53**	-	-	-	6.2	<5.0	21	-	-	-
Chromium (III & VI)	14	18	25	-	-	-	14	14	0	-	-	-
Cobalt	5.5	5.6	2	-	-	-	5.5	6	9	-	-	-
Copper	9.1	7.5	19	-	-	-	9.1	14	42	-	-	-
Lead	49	18	**93**	-	-	-	49	59	19	-	-	-
Nickel	17	13	27	-	-	-	17	16	6	-	-	-
Zinc	52	27	**63**	-	-	-	52	53	2	-	-	-
pH	6.6	7.4	11	-	-	-	6.6	6.7	2	-	-	-
Sulfate as S	11	10	10	-	-	-	11	<50	**128**	-	-	-
Benz(a)anthracene	0.2	0.2	0	0.2	0.2	0	0.2	<0.5	**86**	0.2	<0.5	-
Benzo(a)pyrene	0.2	0.1	**67**	0.1	0.2	**67**	0.2	<0.5	**86**	0.1	<0.5	**133**
Benzo(b)fluroranthene	0.2	0.2	0	0.1	0.2	**67**	-	-	-	0.1	<0.5	**133**
Benzo(g,h,i)perylene	0.2	<0.1	**67**	<0.1	<0.1	-	0.2	<0.5	**86**	<0.1	<0.5	-
Chrysene	0.1	0.1	0	0.1	0.2	**67**	0.1	<0.5	**133**	0.1	<0.5	**133**
Fluranthene	0.2	0.2	0	0.2	0.3	40	0.2	<0.5	**86**	0.2	<0.5	**86**
Pyrene	0.2	0.2	0	0.2	0.3	40	0.2	<0.5	**86**	0.2	<0.5	**86**
Indeno(1,2,3-c,d)pyrene	0.2	<0.1	**67**	<0.1	<0.1	-	0.2	<0.5	**86**	<0.1	<0.5	-
Total PAH	1.5	1	40	0.9	1.4	43	1.5	-	-	0.9	-	-

Note(s):

1. RPD relative percentage difference; 2. - not analysed, or RPD not calculable; 3. all units in mg/kg (dry weight); 4. Acceptance Criteria: no limit applies to <5x MDL; 80-150% for low level (<10x MDL); 50-130% for medium to high level (>10x MDL)