

LAND CONTAMINATION SITE INVESTIGATION AND GENERIC RISK ASSESSMENT

Former Bedhampton Arts Centre
29 Bedhampton Road
Havant
Hampshire
PO9 3EY



May 2014

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Contact information

Site address

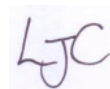
Bedhampton Arts Centre	Contact:	Graham Parrett
Bedhampton Road	Telephone:	07748 715 530
Havant		
Portsmouth	E-mail:	grahamparrett@hotmail.com
Hampshire		
PO9 3EY		

Report co-ordinator

Apple Environmental Limited	Contact:	Laura Charman
Unit 3 Estevan Farm	Telephone:	01420 563377
Stoney Lane		
Medstead	E-mail:	info@appleenvironmental.co.uk
Alton		
Hampshire		
GU34 5EL		

Report checking

Author: Laura Charman



Final check by: Adrian Whittle



Company information



Unit 3 Estevan Farm, Stoney Lane, Medstead. Alton, GU34 5EL

Telephone: 01420 563377
e.mail: info@appleenvironmental.co.uk

www.appleenvironmental.co.uk

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1 Introduction and scope of works

Apple Environmental has been appointed to undertake an intrusive investigation of land at 29 Bedhampton Road, Bedhampton. The report has been prepared in support of the development of the site for residential use; planning reference number APP/14/00008.

An environmental desk study and preliminary risk assessment which had been previously undertaken by Apple Environmental, (Report reference No: CL/1572/GP) identified the former existence of a former plating works adjoining the eastern boundary of the site, such that contamination could potentially be present on site. The premises saw subsequent use as a warehouse and a depot.

Due to the presence of these potentially significant historical activities, a conceptual model was put forward within the desk study that suggested a need for intrusive investigation, to assess the extent of residual ground contamination that may be present at the site.

The principal aims of this work therefore have been to devise and implement an appropriate strategy such that it has been possible to:

- determine the nature of the upper surface soil material on-site;
- determine the presence of chemical contamination at specified locations, its nature and extent;
- assess the degree to which the site itself could be contributing to the contamination of environmental media off-site;
- observe or presume contaminant-pathway-receptor relationships on site; and
- assess the risk to future users of the site, as well as building structures and services.

This type of assessment therefore relies upon visual examination of the area and sub-surface material, and the laboratory analysis of material samples.

As such, the specific objectives are:

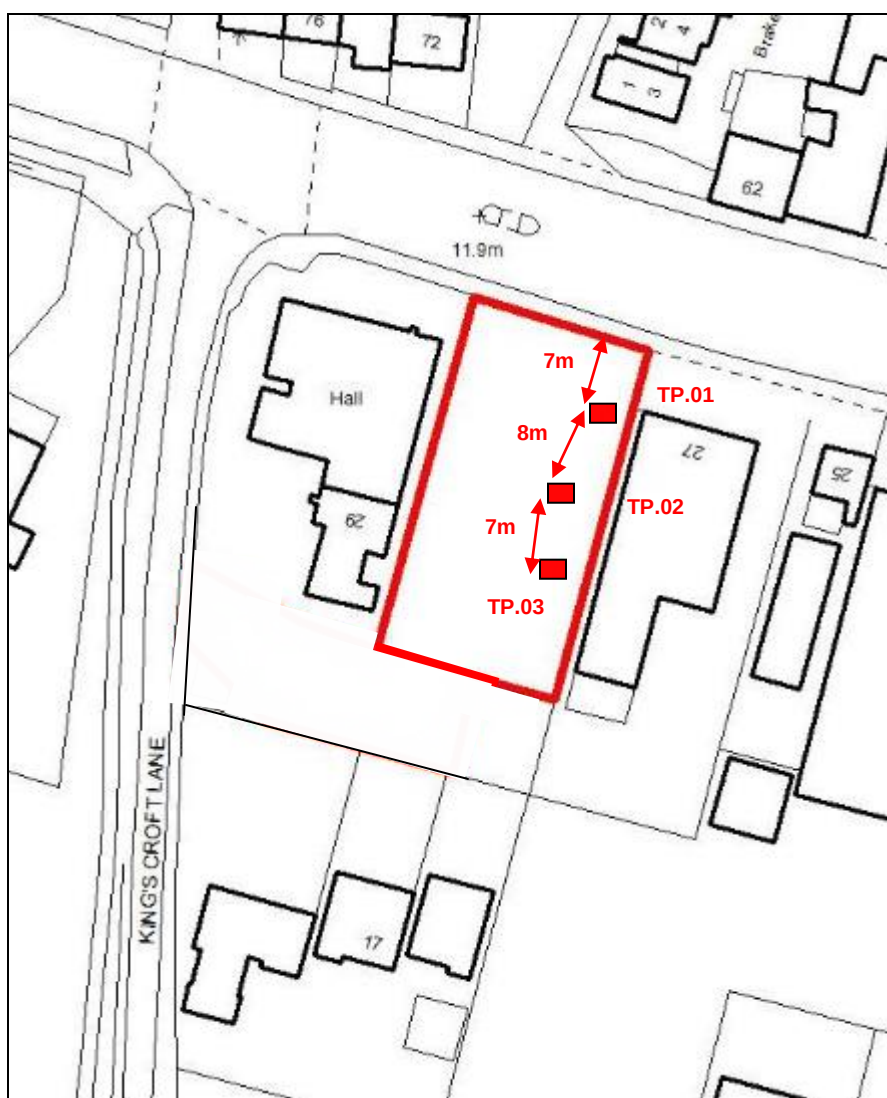
- to excavate trial pits at three locations along the eastern boundary of the site to a maximum depth of 1000mm;
- to characterise the nature of the sub-surface material at each location;
- to collect a single soil sample from each borehole for laboratory analysis representing the upper sub-surface horizon (100-600mm);
- to analyse the samples for a wide range of contamination indicators;
- to ascertain the significance of all chemical or physical data obtained;
- to determine the risk to future users of the site based upon residential usage; and
- to make appropriate recommendations in order to reduce and/or eliminate any risks, as identified.

This investigation has been undertaken through reference to British Standard guidelines and procedure within BS10175:2011.

2 Methodology

The aim of this investigation is to assess the upper sub-surface of the site in order to determine any risk that may be present. The investigation proposal involved excavating three exploratory trial pits close to the eastern site boundary. In the absence of any identifiable hot spots within this area, the three pits were selected at arbitrary (accessible) points as shown below in Figure 1.

Figure 1 Plan showing the location of trial pits



■ Trial pit locations

The trial pits were excavated by means of a small hydraulic excavator to an approximate depth of 1000mm. The soil profile for each pit has been logged within Section 4 below, along with photographs showing the material cores extracted.

A single soil sample was collected from each bore, representing a depth of 100 - 600mm. All samples were placed immediately into sterilised containers and transferred into a refrigerated cold-box until removed for analyses.

Chemical analysis was undertaken for the following determinand suite:

- arsenic, boron, cadmium, chromium, copper, lead, mercury, nickel, selenium, zinc;
- sulphate, sulphide, cyanide, asbestos;
- benzene, toluene, ethylbenzene, xylene (all isomers), phenols; and
- polycyclic aromatic hydrocarbons (speciated), petroleum hydrocarbons (banded TPHCWG)..

All analyses were undertaken by a UKAS accredited laboratory. The laboratory certified results have been appended to this report.

3 On-site observations

The ground surface at the site consists of both hard and soft surfacing. The hard surfaced area has an asphalt covering marked out for parking. The soft surfacing forms the rear section of the site and is partly turfed and partly exposed soil. There is some broken hardcore within the soil surface. Much of the site area has building materials or soil stockpiled on it.

Visual inspection of the surface vegetation and exposed soil in each instance showed evidence of hardcore and made-ground but no obvious signs of contamination associated with the neighbouring industry.

The sub-surface material strata profiles have been reproduced below in Tables 1, 2 and 3, along with their detailed observations. Photographs showing the trial pits and removed material have been appended to each strata log (Photographs 1, 2 and 3).

According to British Geology Survey mapping the area is characterised by the London Clay Formation, which appears to have been confirmed through this investigation.

There were no superficial deposits expected to be overlying the bedrock in this area which was similarly confirmed through observation.

In general the extracted soil profiles were characterised by topsoil overlying made-ground, and a clayey loam sub soil, overlying what was mostly a sandy clayey material. Groundwater was not present in any of the pits, although due to heavy overnight rain water collected in TP.02 and TP.03 and was retained by the clay bedrock.

Table 1 Strata log - **TP.01**

Borehole	Depth (mm)	Notes
TP.01	0 - 50	Asphalt covering.
	50 - 150	Supporting stone and hardcore base.
	150 - 480	Made-ground and subsoil. Some hardcore present predominantly brick, mortar and flint.
	480 - 1000	Light brown, green and grey mottled sandy clay, becoming more orange at 700mm.
Groundwater	-	Groundwater was not detected.

Photograph 1 Soil profile and removed material - **TP.01**

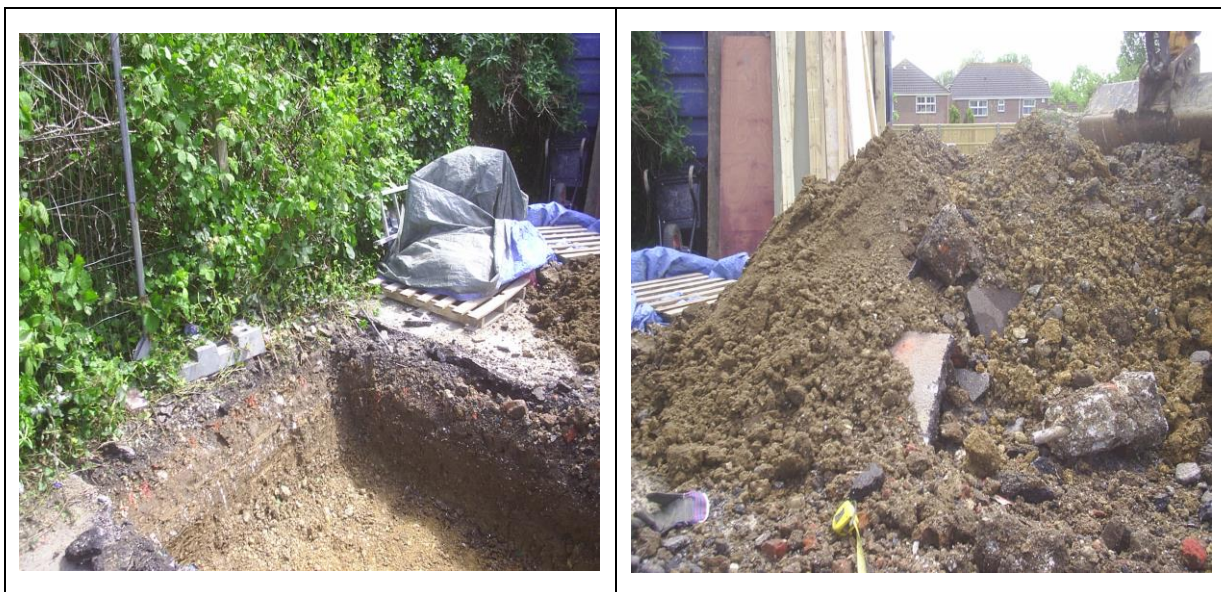


Table 2 Strata log - **TP.02**

Borehole	Depth (mm)	Notes
TP.02	0 - 50	Asphalt covering.
	50 - 100	Supporting stone and hardcore base.
	100 - 520	Made-ground and subsoil. Some hardcore present predominantly brick, mortar and flint to 360mm.
	520 - 1000	Light brown and grey mottled sandy clay, with gravels (10 - 50mm) becoming more orange at 750mm.
Groundwater	-	Groundwater was not detected.

Photograph 2 Soil profile and removed material - **TP.02**



Table 3 Strata log - **TP.03**

Borehole	Depth (mm)	Notes
TP.03	0 - 70	Grass covering overlying sandy loam topsoil.
	70 - 260	Made-ground. Very small fragments of hardcore present predominantly brick, mortar and flint.
	260 - 520	Sandy, clayey subsoil with gravels (10 - 50mm).
	520 - 1000	Light brown and grey mottled sandy clay, with gravels (10 - 50mm) becoming more orange at 650mm.
Groundwater	-	Groundwater was not detected.

Photograph 3 Soil profile and removed material - **TP.03**



4 Results from soil analyses

The results from the soil samples taken are summarised in Tables 4 to 7 below. Any substance detected has been highlighted in bold

Table 4 Results for specified inorganics

Determinand (mg/kg)	TP.01	TP.02	TP.03
	100 - 600	100 - 600	100 - 600
Arsenic	3	6	4
Boron	< 1	< 1	1.1
Cadmium	< 0.5	< 0.5	< 0.5
Chromium	16	38	21
Copper	7	11	27
Lead	12	12	44
Mercury (total)	< 1	< 1	< 1
Nickel	7	11	10
Selenium	< 3	< 3	< 3
Zinc	28	33	51
Cyanide (total)	< 2	< 2	< 2
Sulphate (total)	207	< 200	345
Sulphide	< 5	< 5	< 5
Asbestos screen	Not detected	Not detected	Not detected

Table 5 Results for specified organics

Determinand (mg/kg)	TP.01	TP.02	TP.03
	100 - 600	100 - 600	100 - 600
Benzene	< 0.002	< 0.002	< 0.002
Toluene	< 0.005	< 0.005	< 0.005
Ethylbenzene	<0.01	<0.01	<0.01
p & m-Xylene	<0.01	<0.01	<0.01
o-Xylene	<0.01	<0.01	<0.01
Phenols (total-mono)	<2	<2	2.2

Table 6 Results for poly-aromatic hydrocarbons

Determinand (mg/kg)	TP.01	TP.02	TP.03
	100 - 600	100 - 600	100 - 600
Naphthalene	< 0.1	< 0.1	< 0.1
Acenaphthylene	< 0.1	< 0.1	< 0.1
Acenaphthene	< 0.1	< 0.1	< 0.1
Fluorene	< 0.1	< 0.1	< 0.1
Phenanthrene	0.21	0.12	< 0.1
Anthracene	< 0.1	< 0.1	< 0.1
Fluoranthene	0.81	0.36	< 0.1
Pyrene	0.69	0.32	< 0.1
Benzo(a)anthracene	0.38	0.17	< 0.1
Chrysene	0.36	0.16	< 0.1
Benzo(b)fluoranthene	0.39	0.18	< 0.1
Benzo(k)fluoranthene	0.15	< 0.1	< 0.1
Benzo(a)pyrene	0.27	0.16	< 0.1
Indeno(123-cd)pyrene	0.17	< 0.1	< 0.1
Dibenzo(ah)anthracene	< 0.1	< 0.1	< 0.1
Benzo(ghi)perylene	0.11	< 0.1	< 0.1
Total PAHs	3.5	< 1.6	< 1.6

Table 7 Results for petroleum hydrocarbons

Determinand (mg/kg)	TP.01	TP.02	TP.03
	100 - 600	100 - 600	100 - 600
Aliphatic C5 - C6	< 0.01	< 0.01	< 0.01
Aliphatic C6 - C8	< 0.05	< 0.05	< 0.05
Aliphatic C8 - C10	< 1	< 1	< 1
Aliphatic C10 - C12	< 1	< 1	< 1
Aliphatic C12 - C16	< 1	< 1	< 1
Aliphatic C16 - C21	< 1	< 1	< 1
Aliphatic C21 - C34	< 6	< 6	< 6
Total Aliphatic (C5 - 34)	< 12	< 12	< 12
Aromatic C5 - C7	< 0.01	< 0.01	< 0.01
Aromatic C7 - C8	< 0.05	< 0.05	< 0.05
Aromatic C8 - C10	< 1	< 1	< 1
Aromatic C10 - C12	< 1	< 1	< 1
Aromatic C12 - C16	< 1	< 1	< 1
Aromatic C16 - C21	< 1	< 1	< 1
Aromatic C21 - C35	< 6	< 6	< 6
Total Aromatic (C5 - 35)	< 12	< 12	< 12
Total (C5 - 35)	< 24	< 24	< 24

5 Interpretation

Tables 8 to 11 below show the soil guideline target concentrations used as part of this assessment.

The Environment Agency has created the CLEA model to derive assessment criteria to ascertain long term risk to human receptors. Using this model the EA has published generic assessment criteria as Soil Guideline Values (SGVs) for a number of contaminants for a range of land uses.

Where the latest SGVs are currently not available, soil guideline concentrations derived using previous software packages and other published guidelines have been consulted. In all instances guideline values for residential end-use have been used.

For the purposes of this assessment, the following hierarchical approach has therefore been adopted for soil screening values:

- Environmental Agency Soil Guideline Values;
- CIEH (LQM) GAC 2nd edition (residential end-use);
- GAC CLEA generated value for residential end-use with plant uptake; and
- Other (as specified).

Note that for some guideline values a choice of soil organic matter (SOM) concentration is provided whereby different guideline concentrations exist for SOM values of 1%, 2.5% and 6%.

In this instance the soil organic matter has been shown to range from 0.5% to 1.2%, with a mean value of 0.8%, hence the more stringent 1% value has been used for this assessment.

Table 8 Soil guideline concentrations referred to for this assessment

Determinand	Soil guidance concentration (mg/kg)	Origin
Arsenic	32	SGV Residential CLEA 1.06
Boron	291	LQM/CIEH GAC (CLEA 1.04) (Residential)
Cadmium	10	SGV Residential CLEA 1.06
Chromium	130	SGV Residential CLEA 1.03
Copper	2300	LQM/CIEH GAC (CLEA 1.04) (Residential)
Lead	450*	SGV Residential (CLEA 1.03 Beta)
Mercury (elemental)	1.0	SGV Residential CLEA 1.06
Mercury (inorganic Hg ²⁺)	170	SGV Residential CLEA 1.06
Nickel	130	SGV Residential CLEA 1.06
Selenium	350	SGV Residential CLEA 1.06
Zinc	3750	LQM/CIEH GAC (CLEA 1.04) (Residential)
Cyanide	398	GAC CLEA 1.04 generated (Residential)
Sulphate	10000	ICRCL Action Value domestic gardens
Sulphide	1000	ICRCL Action Value all uses
Phenols (SOM 1%)	210	LQM/CIEH GAC (CLEA 1.04) (Residential)
Benzene (SOM 6%)	0.33	SGV Residential CLEA 1.06
Toluene (SOM 6%)	610	SGV Residential CLEA 1.06
Ethylbenzene (SOM 6%)	350	SGV Residential CLEA 1.06
o-Xylene (SOM 6%)	250	SGV Residential CLEA 1.06
m-Xylene (SOM 6%)	240	SGV Residential CLEA 1.06
p-Xylene (SOM 6%)	230	SGV Residential CLEA 1.06

* Note that the SGV for lead has been withdrawn as it used to be based on blood lead concentrations. It is proposed by the EA that the SGV will be calculated using an index dose in the future, however the required information is not available at the time of compiling this report.

In view of this, and in the absence of any other UK approved guidance, the screening values for the recorded soil lead concentrations at this location have been calculated using the CLEA model and reproduced below.

In doing so this has produced three values based upon the age range of the receiver. These are as shown in Table 8 below.

Table 9 Site specific CLEA guideline level for lead

Age group	Oral HCV (mg/kg)	Inhaled HCV (mg/kg)	Combined (mg/kg)
1-6	388	220	338
6-12	440	346	391
12-18	No result	No result	No result

As shown in Table 8 it would appear that the 'at risk' group are those of 12 years and younger.

It is therefore suggested that as this is going to be a garden where children may be exposed to the soil, the soil lead guideline concentration should be 220mg/kg in all instances.

Table 10 Soil guideline concentrations for PAHs referred to for this assessment

Determinand	Soil guidance concentration (mg/kg)			Origin
	1% SOM	2.5% SOM	6% SOM	
Naphthalene	1.5	3.7	8.7	LQM/CIEH GAC (CLEA 1.04) (Residential)
Acenaphthylene	170	400	850	LQM/CIEH GAC (CLEA 1.04) (Residential)
Acenaphthene	210	480	1000	LQM/CIEH GAC (CLEA 1.04) (Residential)
Fluorene	160	380	780	LQM/CIEH GAC (CLEA 1.04) (Residential)
Phenanthrene	92	200	380	LQM/CIEH GAC (CLEA 1.04) (Residential)
Anthracene	2300	4900	9200	LQM/CIEH GAC (CLEA 1.04) (Residential)
Fluoranthene	260	460	670	LQM/CIEH GAC (CLEA 1.04) (Residential)
Pyrene	560	1000	1600	LQM/CIEH GAC (CLEA 1.04) (Residential)
Benzo(a)anthracene	3.1	4.7	5.9	LQM/CIEH GAC (CLEA 1.04) (Residential)
Chrysene	6.0	8.0	9.3	LQM/CIEH GAC (CLEA 1.04) (Residential)
Benzo(b)fluoranthene	5.6	6.5	7.0	LQM/CIEH GAC (CLEA 1.04) (Residential)
Benzo(k)fluoranthene	8.5	9.6	10	LQM/CIEH GAC (CLEA 1.04) (Residential)
Benzo(a)pyrene	0.83	0.94	1.0	LQM/CIEH GAC (CLEA 1.04) (Residential)
Indeno(123-cd)pyrene	3.2	3.9	4.2	LQM/CIEH GAC (CLEA 1.04) (Residential)
Dibenzo(ah)anthracene	0.76	0.86	0.90	LQM/CIEH GAC (CLEA 1.04) (Residential)
Benzo(ghi)perylene	44	46	47	LQM/CIEH GAC (CLEA 1.04) (Residential)

Table 11 Soil guideline concentrations for petroleum hydrocarbons referred to for this assessment

Determinand	Soil guidance concentration (mg/kg)			Origin
	1% SOM	2.5% SOM	6% SOM	
Aliphatic TPH C5-C6	30	55	110	LQM/CIEH GAC (CLEA 1.04) (Residential)
Aliphatic TPH C6-C8	73	160	370	LQM/CIEH GAC (CLEA 1.04) (Residential)
Aliphatic TPH C8-C10	19	46	110	LQM/CIEH GAC (CLEA 1.04) (Residential)
Aliphatic TPH C10-C12	93	230	540	LQM/CIEH GAC (CLEA 1.04) (Residential)
Aliphatic TPH C12-C16	740	1700	3000	LQM/CIEH GAC (CLEA 1.04) (Residential)
Aliphatic TPH C16-35	45000	64000	76000	LQM/CIEH GAC (CLEA 1.04) (Residential)
Aliphatic TPH C35-C44	45000	64000	76000	LQM/CIEH GAC (CLEA 1.04) (Residential)
Aromatic TPH C5-C7	65	130	280	LQM/CIEH GAC (CLEA 1.04) (Residential)
Aromatic TPH C7-C8	120	270	611	LQM/CIEH GAC (CLEA 1.04) (Residential)
Aromatic TPH C8-C10	27	65	151	LQM/CIEH GAC (CLEA 1.04) (Residential)
Aromatic TPH C10-C12	69	160	346	LQM/CIEH GAC (CLEA 1.04) (Residential)
Aromatic TPH C12-16	140	310	593	LQM/CIEH GAC (CLEA 1.04) (Residential)
Aromatic TPH C16-21	250	480	770	LQM/CIEH GAC (CLEA 1.04) (Residential)
Aromatic TPH C21-C35	890	1100	1230	LQM/CIEH GAC (CLEA 1.04) (Residential)
Aromatic TPH C35-C44	890	1100	1230	LQM/CIEH GAC (CLEA 1.04) (Residential)

6 Summary and recommendations

A Phase II site investigation was required at this site due to the findings of the conceptual model.

In order to address any possible concern, three trial pits were excavated on the site to a maximum depth of 1000mm, from which soil material samples were collected representing the upper horizon from 100 - 600mm.

The soil profile in each instance was characterised by made-ground and subsoil, directly overlying the clay bedrock.

There was nothing observed during the excavation of the boreholes to suggest that there was anything other than the natural geology present beneath the shallow made-ground. There were no signs of unnatural discolouration, odours or staining, nor any evidence to suggest that waste or other imported material had been interred here.

Of the substances detected within the samples analysed there was nothing present at any concentration expected to present a risk to future users of the site; based on the quoted soil guideline values.

Small concentrations of PAHs were however detected in the soil samples collected from Trial Pits TP.01 and TP.02, however this was presumably due to the presence of the tarmac surface where fragments would have found their way into the analysed samples during the breaking of the surface. In all instances the concentration of each detected PAH was well below the corresponding soil guideline value referred to for residential development.

In the absence of any information or belief to the contrary, the presumption is made that these soil samples were representative of the site as a whole.

The findings of this assessment therefore allow the conceptual model to be reviewed in order to address any previous uncertainties. Tables 1 and 2 taken from the desk study have been reproduced below as Tables 12 and 13. In doing so it can be seen that there appears to be no identifiable pollutant pathway linkage present on this site.

In view of these findings there is no subsequent recommendation for any remedial work to be undertaken in order to lower the perceived risk.

Table 12 Pathways linking possible contamination at the site to a receptor during the construction phase

Source(s) identified	Possible pathways	Pathway potentially present	Receptor linkage identified with source
None	Ingestion of soil	No	No
	Ingestion of soil dust within the buildings	No	No
	Consumption of home-grown vegetables	No	No
	Ingestion of soil attached to vegetables	No	No
	Dermal contact with soil	Yes	No
	Dermal contact with household soil dust	No	No
	Inhalation of soil dust	Yes	No
	Inhalation of soil dust within the buildings	No	No
	Inhalation of gases/vapours indoors	No	No
	Ignition of gases or vapours indoors	No	No
	Inhalation of gases/vapours outdoors	No	No
	Ignition of gases or vapours outdoors	No	No
	Ingestion of surface or groundwater	No	No
	Dermal contact with surface or groundwater	No	No
	Contact with mains services	Yes	No
	Contact with building fabric below ground	Yes	No
	Contact with building fabric above ground	No	No
	Contact with features of the surrounding ecosystem	No	No

Table 13 Pathways linking possible contamination at the site to a receptor during the occupied phase

Source(s) identified	Possible pathways	Pathway potentially present	Receptor linkage identified with source
None	Ingestion of soil	Yes	No
	Ingestion of soil dust within the buildings	Yes	No
	Consumption of home-grown vegetables	Yes	No
	Ingestion of soil attached to vegetables	Yes	No
	Dermal contact with soil	Yes	No
	Dermal contact with household soil dust	Yes	No
	Inhalation of soil dust	Yes	No
	Inhalation of soil dust within the buildings	Yes	No
	Inhalation of gases/vapours indoors	No	No
	Ignition of gases or vapours indoors	No	No
	Inhalation of gases/vapours outdoors	No	No
	Ignition of gases or vapours outdoors	No	No
	Ingestion of surface or groundwater	No	No
	Dermal contact with surface or ground water	No	No
	Contact with mains services	Yes	No
	Contact with building fabric below ground	Yes	No
	Contact with building fabric above ground	No	No
	Contact with features of the surrounding ecosystem	No	No

7 Limitations

Apple Environmental Limited has prepared this report for Mr Graham Parrett who in this instance is the 'client'. The work has been undertaken in accordance with Apple Environmental Limited's standard terms and conditions.

The findings represent the professional opinion of the report author. All work carried out is based upon Apple Environmental Limited's current professional knowledge and understanding. It is therefore stated that the conclusions of this report have been based upon information gathered from third party sources and it can only be assumed that this information provided was accurate and correct.

Intrusive investigation undertaken as part of this work has been restricted to a level of detail required to achieve the stated objectives of this work. The results of any measurements taken may vary spatially or with time, and further confirmatory measurements may wish to be considered.

It is also pointed out that soil sampling by its very nature may only provide a general indication of contamination present. There is always the possibility that other undetected contaminants exist, or, that detected contaminants may exist at a greater concentration than that specified in areas of the site that have not been intrusively investigated.

APPENDIX

Laboratory data



Adrian Whittle
Apple Environmental Ltd
Unit 3 Estevan Farm
Stoney Lane
Medstead
Hampshire
GU34 5EL

QTS Environmental Ltd
Unit 1
Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Kent
ME17 2JN
t: 01622 850410
russell.jarvis@qtsenvironmental.com

QTS Environmental Report No: 14-21918

Site Reference: None Supplied

Project / Job Ref: CL/1585/GP

Order No: None Supplied

Sample Receipt Date: 29/05/2014

Sample Scheduled Date: 29/05/2014

Report Issue Number: 1

Reporting Date: 04/06/2014

Authorised by:

Russell Jarvis
Director

On behalf of QTS Environmental Ltd

Authorised by:

Kevin Old
Director

On behalf of QTS Environmental Ltd

QTS Environmental Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410



Soil Analysis Certificate						
QTS Environmental Report No: 14-21918	Date Sampled	27/05/14	27/05/14	27/05/14		
Apple Environmental Ltd	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: None Supplied	TP / BH No	TP.01	TP.02	TP.03		
Project / Job Ref: CL/1585/GP	Additional Refs	1585	1585	1585		
Order No: None Supplied	Depth (m)	None Supplied	None Supplied	None Supplied		
Reporting Date: 04/06/2014	QTSE Sample No	105755	105756	105757		

Determinand	Unit	RL	Accreditation					
Asbestos Screen	N/a	N/a	ISO17025	Not Detected	Not Detected	Not Detected		
pH	pH Units	N/a	MCERTS	7.4	7.2	7.4		
Total Cyanide	mg/kg	< 2	NONE	< 2	< 2	< 2		
Total Sulphate as SO ₄	mg/kg	< 200	NONE	207	< 200	345		
Sulphide	mg/kg	< 5	NONE	< 5	< 5	< 5		
Total Organic Carbon (TOC)	%	< 0.1	NONE	0.5	0.6	1.2		
Arsenic (As)	mg/kg	< 2	MCERTS	3	6	4		
W/S Boron	mg/kg	< 1	NONE	< 1	< 1	1.1		
Cadmium (Cd)	mg/kg	< 0.5	MCERTS	< 0.5	< 0.5	< 0.5		
Chromium (Cr)	mg/kg	< 2	MCERTS	16	38	21		
Copper (Cu)	mg/kg	< 4	MCERTS	7	11	27		
Lead (Pb)	mg/kg	< 3	MCERTS	12	12	44		
Mercury (Hg) ^(S)	mg/kg	< 1	ISO17025	< 1	< 1	< 1		
Nickel (Ni)	mg/kg	< 3	MCERTS	7	11	10		
Selenium (Se)	mg/kg	< 3	NONE	< 3	< 3	< 3		
Zinc (Zn)	mg/kg	< 3	MCERTS	28	33	51		
Total Phenols (monohydric)	mg/kg	< 2	NONE	< 2	< 2	2.2		

Analytical results are expressed on a dry weight basis where samples are dried at less than 30°C

Analysis carried out on the dried sample is corrected for the stone content

The samples have been examined to identify the presence of asbestiform minerals by polarising light microscopy and dispersion staining technique to In-House Procedures QTSE600 Determination of Asbestos in Bulk Materials; Asbestos in Soils/Sediments (fibre screening and identification)

This report refers to samples as received, and QTS Environmental Ltd, takes no responsibility for the accuracy or competence of sampling by others.

The material description shall be regarded as tentative and is not included in our scope of UKAS Accreditation.

Opinions and interpretations expressed herein are outside the scope of UKAS Accreditation.

Asbestos Analyst: Piotr Lipski

RL: Reporting Limit

Pinch Test: Where pinch test is positive it is reported "Loose Fibres - PT" with type(s).

Subcontracted analysis ^(S)



QTS Environmental Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410



Soil Analysis Certificate - Speciated PAHs						
QTS Environmental Report No: 14-21918	Date Sampled	27/05/14	27/05/14	27/05/14		
Apple Environmental Ltd	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: None Supplied	TP / BH No	TP.01	TP.02	TP.03		
Project / Job Ref: CL/1585/GP	Additional Refs	1585	1585	1585		
Order No: None Supplied	Depth (m)	None Supplied	None Supplied	None Supplied		
Reporting Date: 04/06/2014	QTSE Sample No	105755	105756	105757		

Determinand	Unit	RL	Accreditation					
Naphthalene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
Acenaphthylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
Acenaphthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
Fluorene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
Phenanthrene	mg/kg	< 0.1	MCERTS	0.21	0.12	< 0.1		
Anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
Fluoranthene	mg/kg	< 0.1	MCERTS	0.81	0.36	< 0.1		
Pyrene	mg/kg	< 0.1	MCERTS	0.69	0.32	< 0.1		
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	0.38	0.17	< 0.1		
Chrysene	mg/kg	< 0.1	MCERTS	0.36	0.16	< 0.1		
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	0.39	0.18	< 0.1		
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	0.15	< 0.1	< 0.1		
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	0.27	0.16	< 0.1		
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	0.17	< 0.1	< 0.1		
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	0.11	< 0.1	< 0.1		
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	3.5	< 1.6	< 1.6		

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Soil Analysis Certificate - TPH CWG Banded						
QTS Environmental Report No: 14-21918	Date Sampled	27/05/14	27/05/14	27/05/14		
Apple Environmental Ltd	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: None Supplied	TP / BH No	TP.01	TP.02	TP.03		
Project / Job Ref: CL/1585/GP	Additional Refs	1585	1585	1585		
Order No: None Supplied	Depth (m)	None Supplied	None Supplied	None Supplied		
Reporting Date: 04/06/2014	QTSE Sample No	105755	105756	105757		

Determinand	Unit	RL	Accreditation					
Aliphatic >C5 - C6	mg/kg	< 0.01	NONE	< 0.01	< 0.01	< 0.01		
Aliphatic >C6 - C8	mg/kg	< 0.05	NONE	< 0.05	< 0.05	< 0.05		
Aliphatic >C8 - C10	mg/kg	< 1	NONE	< 1	< 1	< 1		
Aliphatic >C10 - C12	mg/kg	< 1	NONE	< 1	< 1	< 1		
Aliphatic >C12 - C16	mg/kg	< 1	NONE	< 1	< 1	< 1		
Aliphatic >C16 - C21	mg/kg	< 1	NONE	< 1	< 1	< 1		
Aliphatic >C21 - C34	mg/kg	< 6	NONE	< 6	< 6	< 6		
Aliphatic (C5 - C34)	mg/kg	< 12	NONE	< 12	< 12	< 12		
Aromatic >C5 - C7	mg/kg	< 0.01	NONE	< 0.01	< 0.01	< 0.01		
Aromatic >C7 - C8	mg/kg	< 0.05	NONE	< 0.05	< 0.05	< 0.05		
Aromatic >C8 - C10	mg/kg	< 1	NONE	< 1	< 1	< 1		
Aromatic >C10 - C12	mg/kg	< 1	NONE	< 1	< 1	< 1		
Aromatic >C12 - C16	mg/kg	< 1	NONE	< 1	< 1	< 1		
Aromatic >C16 - C21	mg/kg	< 1	NONE	< 1	< 1	< 1		
Aromatic >C21 - C35	mg/kg	< 6	NONE	< 6	< 6	< 6		
Aromatic (C5 - C35)	mg/kg	< 12	NONE	< 12	< 12	< 12		
Total >C5 - C35	mg/kg	< 24	NONE	< 24	< 24	< 24		

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Soil Analysis Certificate - BTEX / MTBE						
QTS Environmental Report No: 14-21918	Date Sampled	27/05/14	27/05/14	27/05/14		
Apple Environmental Ltd	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: None Supplied	TP / BH No	TP.01	TP.02	TP.03		
Project / Job Ref: CL/1585/GP	Additional Refs	1585	1585	1585		
Order No: None Supplied	Depth (m)	None Supplied	None Supplied	None Supplied		
Reporting Date: 04/06/2014	QTSE Sample No	105755	105756	105757		

Determinand	Unit	RL	Accreditation					
Benzene	ug/kg	< 2	MCERTS	< 2	< 2	< 2		
Toluene	ug/kg	< 5	MCERTS	< 5	< 5	< 5		
Ethylbenzene	ug/kg	< 10	MCERTS	< 10	< 10	< 10		
p & m-xylene	ug/kg	< 10	MCERTS	< 10	< 10	< 10		
o-xylene	ug/kg	< 10	MCERTS	< 10	< 10	< 10		

Analytical results are expressed on a dry weight basis where samples are dried at less than 30°C



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Soil Analysis Certificate - Sample Descriptions	
QTS Environmental Report No: 14-21918	
Apple Environmental Ltd	
Site Reference: None Supplied	
Project / Job Ref: CL/1585/GP	
Order No: None Supplied	
Reporting Date: 04/06/2014	

QTSE Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
105755	TP.01	1585	None Supplied	9.1	Light brown clay with stones
105756	TP.02	1585	None Supplied	21.5	Light brown clay
105757	TP.03	1585	None Supplied	15.9	Light brown clayey gravel with stones

Moisture content is part of procedure E003 & is not an accredited test

Insufficient Sample ^{1/5}

Unsuitable Sample ^{U/5}



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Soil Analysis Certificate - Methodology & Miscellaneous Information	
QTS Environmental Report No: 14-21918	
Apple Environmental Ltd	
Site Reference: None Supplied	
Project / Job Ref: CL/1585/GP	
Order No: None Supplied	
Reporting Date: 04/06/2014	

Matrix	Analysed On	Determinand	Brief Method Description	Method No
Soil	D	Boron - Water Soluble	Determination of water soluble boron in soil by 2:1 hot water extract followed by ICP-OES	E012
Soil	AR	BTEX	Determination of BTEX by headspace GC-MS	E001
Soil	D	Cations	Determination of cations in soil by aqua-regia digestion followed by ICP-OES	E002
Soil	D	Chloride - Water Soluble (2:1)	Determination of chloride by extraction with water & analysed by ion chromatography	E009
Soil	AR	Chromium - Hexavalent	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry	E016
Soil	AR	Cyanide - Complex	Determination of complex cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Free	Determination of free cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Total	Determination of total cyanide by distillation followed by colorimetry	E015
Soil	D	Cyclohexane Extractable Matter (CEM)	Gravimetrically determined through extraction with cyclohexane	E011
Soil	AR	Diesel Range Organics (C10 - C24)	Determination of hexane/acetone extractable hydrocarbons by GC-FID	E004
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of saturated calcium sulphate followed by electrometric measurement	E022
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of water followed by electrometric measurement	E023
Soil	D	Elemental Sulphur	Determination of elemental sulphur by solvent extraction followed by GC-MS	E020
Soil	AR	EPH (C10 - C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH Product ID	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH TEXAS	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	D	Fluoride - Water Soluble	Determination of Fluoride by extraction with water & analysed by ion chromatography	E009
Soil	D	FOC (Fraction Organic Carbon)	Determination of fraction of organic carbon by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	D	Loss on Ignition @ 450oC	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace	E019
Soil	D	Magnesium - Water Soluble	Determination of water soluble magnesium by extraction with water followed by ICP-OES	E025
Soil	D	Metals	Determination of metals by aqua-regia digestion followed by ICP-OES	E002
Soil	AR	Mineral Oil (C10 - C40)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004
Soil	AR	Moisture Content	Moisture content; determined gravimetrically	E003
Soil	D	Nitrate - Water Soluble (2:1)	Determination of nitrate by extraction with water & analysed by ion chromatography	E009
Soil	D	Organic Matter	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	PAH - Speciated (EPA 16)	Determination of PAH compounds by extraction in acetone and hexane followed by GC-MS with the use of surrogate and internal standards	E005
Soil	AR	PCB - 7 Congeners	Determination of PCB by extraction with acetone and hexane followed by GC-MS	E008
Soil	D	Petroleum Ether Extract (PEE)	Gravimetrically determined through extraction with petroleum ether	E011
Soil	AR	pH	Determination of pH by addition of water followed by electrometric measurement	E007
Soil	AR	Phenols - Total (monohydric)	Determination of phenols by distillation followed by colorimetry	E021
Soil	D	Phosphate - Water Soluble (2:1)	Determination of phosphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Total	Determination of total sulphate by extraction with 10% HCl followed by ICP-OES	E013
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of sulphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of water soluble sulphate by extraction with water followed by ICP-OES	E014
Soil	AR	Sulphide	Determination of sulphide by distillation followed by colorimetry	E018
Soil	D	Sulphur - Total	Determination of total sulphur by extraction with aqua-regia followed by ICP-OES	E024
Soil	AR	SVOC	Determination of semi-volatile organic compounds by extraction in acetone and hexane followed by GC-MS	E006
Soil	AR	Thiocyanate (as SCN)	Determination of thiocyanate by extraction in caustic soda followed by acidification followed by addition of ferric nitrate followed by colorimetry	E017
Soil	D	Toluene Extractable Matter (TEM)	Gravimetrically determined through extraction with toluene	E011
Soil	D	Total Organic Carbon (TOC)	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	TPH CWG	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004
Soil	AR	TPH LQM	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004
Soil	AR	VOCs	Determination of volatile organic compounds by headspace GC-MS	E001
Soil	AR	VPH (C6 - C10)	Determination of hydrocarbons C6-C10 by headspace GC-MS	E001

D Dried
AR As Received