

CONTAMINATED LAND INTRUSIVE INVESTIGATION

19 South Street
Havant
Hampshire
PO9 1BU



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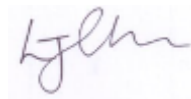
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1 Introduction and scope of work

Apple Environmental has been appointed to undertake an intrusive soil contamination investigation at 19 South Street, Havant, Hampshire, in support of a prior approval for a change of use of a building and associated land from commercial to residential use.

An environmental desk study and preliminary risk assessment previously undertaken by Apple Environmental for the site (Report Ref. CL/3344/SS) had identified a potential land contamination concern, due principally to off-site features of potential concern including the former presence of garages to the north and south of the site.

Due to the proposal to change the building for residential use, the conceptual model within the aforementioned desk study had highlighted a perceived risk from the above sources, with potentially significant pathway linkages enabling contamination to reach receptors.

In considering this, the contaminants deemed to be potentially present included general inorganics, hydrocarbons (both petroleum and poly-aromatic), SVOCs, asbestos and possibly ground gases.

An intrusive investigation was subsequently recommended in order to determine the presence and extent of any such contamination, and to assess the overall risk more fully.

The 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 sub-surface material on-site;
- determine the presence of unacceptable ground contamination in specified areas, along with 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 relies upon visual examination of the area and sub-surface material, as well as the laboratory analysis of material samples.

As such, the specific objectives are:

- to hand-drill three boreholes to a minimum depth of 1000mm;
- to characterise the nature of the sub-surface material at each of these locations;
- to collect at least two soil samples from each of the bores for laboratory analysis representing the direct contact zone and the indirect contact zone;
- to collect additional soil samples from where there may be any other specific or noticeable contamination concern;
- to analyse the soil samples for a range of contamination indicators;
- to ascertain the significance of all chemical or physical data obtained;
- to determine the risk to future users based upon residential usage; and
- to make appropriate recommendations in order to reduce and/or eliminate any risks, as identified.

2 Methodology

As stated above, the overall aim of this investigation is to assess the sub-surface of the site in order to determine any risk that may be present as a result of ground contamination.

For this purpose, three boreholes were hand-augered across the rear garden area to a maximum depth of 1100mm, at the locations shown below in Figure 1.

Figure 1 Plan showing the approximate sampling locations



● Borehole sampling locations

The soil profile from each investigated location has been logged within Section 3 below, along with photographs showing the material excavated.

As stated, soil samples were collected from each of the highlighted locations representing depths of 100 - 200mm and 500 - 600mm.

All of the samples were placed immediately into a sterilised container and transferred into refrigerated cold-boxes until removed for analysis.

Chemical analysis was undertaken for the following determinands:

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

* Photo-ionisation detection was undertaken in-situ on the removed soil in order to detect vapours originating from any VOC residue (fuels/solvents etc.) that may be present in each excavated area. This was performed by means of an externally calibrated Phocheck Tiger PID. Calibration certification has been appended to this report.

** Speciated SVOC analysis has been undertaken on the soil samples obtained from a depth of between 500-600mm in all three of the specified locations.

All chemical analyses were undertaken by a UKAS accredited laboratory. Laboratory certification has been appended to this report.

3 On-site observations

The site has been used as a residential dwelling for at least 100 years.

The ground surface comprised concrete cover beneath the existing dwelling and side pathway, along with a soft landscaped garden area to the rear of the property.

It is understood that the bedrock beneath the site is characterised by the Lewes Nodular, Newhaven, Culver and Seaford Chalk Formations, with overlying river terrace deposits. The bedrock was not noted during the investigation; however the river terrace deposits were evident in all boreholes.

The sub-surface material strata logs have been reproduced below in Tables 1 to 3 along with any detailed observations.

Photographs showing the removed material have been appended to each strata log (Photographs 1 to 3).

Table 1 Strata log - Location **BH.01**

Location ID	Depth (mm)	Notes
BH.01	0 - 10	Grass.
	10 - 50	Dark-brown topsoil.
	10 - 550	Dark-brown clayey, sandy, silty matrix comprising made-ground (brick and angular flints).
	550 - 770	Dark-brown sandy, silty clay.
	770 - 1020	Light brown/orange, sandy, silty clay.
Groundwater	-	Groundwater was not reached.

Photograph 1 Removed soil material - Location BH.01



Left to right 0 - 1020mm

Table 2 Strata log - Location **BH.02**

Location ID	Depth (mm)	Notes
BH.02	0 - 10	Grass.
	10 - 50	Dark-brown topsoil.
	50 - 150	Angular gravels and flints (5-100mm diameter).
	150 - 480	Dark-brown clayey, sandy, silty matrix comprising made-ground (brick and angular flints).
	480 - 1000	Dark-brown silty, sandy soft clay with rounded gravels (5-10mm diameter).
Groundwater	-	Groundwater was not reached.

Photograph 2 Removed soil material - Location BH.02



Left to right 0 - 1000mm

Table 3 Strata log - Location **BH.03**

Location ID	Depth (mm)	Notes
BH.03	0 – 10	Grass.
	10 - 50	Topsoil.
	50 - 490	Dark-brown clayey, sandy, silty matrix comprising made-ground (brick and gravels).
	490 - 1100	Dark-brown, very soft, silty, sandy clay.
Groundwater	-	Groundwater was not reached.

Photograph 3 Removed soil material - Location BH.02



Left to right 0 - 1100mm

4 Results from soil analyses

The results from the soil analyses are displayed in Tables 4 to 10 below. Any determinand detected has been highlighted in **bold** type.

Table 4 Results for specified inorganics in soil - metals

Determinand (mg/kg)	BH.01		BH.02		BH.03	
	Depth 100-200mm	Depth 500-600mm	Depth 100-200mm	Depth 500-600mm	Depth 100-200mm	Depth 500-600mm
Arsenic	6	15	8	29	6	15
Boron	< 1	1.5	< 1	< 1	< 1	<1
Cadmium	0.3	0.4	0.4	0.4	0.3	0.4
Chromium	8	18	12	17	11	15
Hexavalent chromium	< 2	< 2	< 2	< 2	< 2	<2
Copper	26	73	29	73	37	106
Lead	133	239	83	277	278	390
Mercury (total)	< 1	1.5	< 1	1	< 1	1.1
Nickel	8	17	6	14	6	15
Selenium	< 3	< 3	< 3	< 3	< 3	>3
Zinc	84	151	76	168	139	218

Table 5 Results for specified inorganics in soil - non-metals

Determinand (mg/kg)	BH.01		BH.02	
	Depth 100-200mm	Depth 500-600mm	Depth 100-200mm	Depth 500-600mm
Cyanide (total)	< 2	< 2	< 2	< 2
Sulphate (total)	469	581	240	577
Sulphide	< 5	< 5	< 5	< 5
Chloride	9	20	13	17
Asbestos	None detected	None detected	None detected	None detected
	BH.03			
	Depth 100-200mm	Depth 500-600mm		
Cyanide (total)	< 2	< 2		
Sulphate (total)	713	779		
Sulphide	< 5	< 5		
Chloride	41	21		
Asbestos	None detected	None detected		

Table 6 Results for specified hydrocarbons in soil

Determinand (mg/kg)	BH.01		BH.02		BH.03	
	Depth 100-200mm	Depth 500-600mm	Depth 100-200mm	Depth 500-600mm	Depth 100-200mm	Depth 500-600mm
Benzene	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Toluene	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Ethylbenzene	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
p & m-Xylene	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
o-Xylene	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
MTBE	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Phenols	<2	<2	<2	<2	<2	<2

Table 7 Results for poly-aromatic hydrocarbons in soil

Determinand (mg/kg)	BH.01		BH.02		BH.03	
	Depth 100-200mm	Depth 500-600mm	Depth 100-200mm	Depth 500-600mm	Depth 100-200mm	Depth 500-600mm
Naphthalene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthylene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Fluorene	< 0.1	0.13	< 0.1	< 0.1	< 0.1	< 0.1
Phenanthrene	< 0.1	1.50	< 0.1	0.15	0.25	< 0.1
Anthracene	< 0.1	0.51	< 0.1	< 0.1	< 0.1	< 0.1
Fluoranthene	0.31	3.82	0.11	0.46	0.75	0.24
Pyrene	0.29	3.26	< 0.1	0.41	0.62	0.21
Benzo(a)anthracene	0.26	2.38	< 0.1	0.35	0.59	0.19
Chrysene	0.24	2.04	< 0.1	0.32	0.59	0.17
Benzo(b)fluoranthene	0.27	1.99	< 0.1	0.34	0.70	0.16
Benzo(k)fluoranthene	< 0.1	0.80	< 0.1	0.14	0.24	< 0.1
Benzo(a)pyrene	0.24	1.87	< 0.1	0.30	0.56	0.13
Indeno(123-cd)pyrene	0.16	0.89	< 0.1	0.15	0.34	< 0.1
Dibenzo(ah)anthracene	< 0.1	0.26	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(ghi)perylene	0.11	0.67	< 0.1	0.13	0.29	< 0.1
Coronene	< 0.1	0.15	< 0.1	< 0.1	< 0.1	< 0.1
Total PAHs	1.9	20.1	<1.6	2.7	4.9	<1.6

Table 8 Results for petroleum hydrocarbons in soil

Determinand (mg/kg)	BH.01		BH.02		BH.03	
	Depth 100-200mm	Depth 500-600mm	Depth 100-200mm	Depth 500-600mm	Depth 100-200mm	Depth 500-600mm
Aliphatic C5 - C6	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aliphatic C6 - C8	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Aliphatic C8 - C10	< 2	< 2	< 2	< 2	< 2	< 2
Aliphatic C10 - C12	< 2	< 2	< 2	< 2	< 2	< 2
Aliphatic C12 - C16	< 3	< 3	< 3	< 3	< 3	< 3
Aliphatic C16 - C21	< 3	< 3	< 3	< 3	< 3	< 3
Aliphatic C21 - C34	< 10	< 10	< 10	< 10	< 10	< 10
Aliphatic C35 - C40	<10	<10	<10	<10	<10	<10
Total Aliphatic (C5 - 34)	<21	<21	<21	<21	<21	<21
Aromatic C5 - C7	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatic C7 - C8	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Aromatic C8 - C10	< 2	< 2	< 2	< 2	< 2	< 2
Aromatic C10 - C12	< 2	< 2	< 2	< 2	< 2	< 2
Aromatic C12 - C16	< 2	2	< 2	< 2	< 2	< 2
Aromatic C16 - C21	< 3	22	< 3	4	5	< 3
Aromatic C21 - C35	< 10	43	< 10	31	< 10	< 10
Aromatic C35 - C40	<10	<10	<10	<10	<10	<10
Total Aromatic (C5 - 35)	<21	67	<21	35	<21	<21
Total (C6 - 40)	<42	67	<42	<42	<42	<42

Table 9 Non-specified VOCs - measured by means of photo-ionisation detection in-situ

BH.01		BH.02		BH.03	
Depth 100-200mm	Depth 500-600mm	Depth 100-200mm	Depth 500-600mm	Depth 100-200mm	Depth 500-600mm
<0.1 ppm	<0.1 ppm	<0.1 ppm	<0.1 ppm	<0.1 ppm	<0.1 ppm

Table 10 Results for speciated volatile organic compounds

Determinand (mg/kg)	BH.01/02	Determinand (mg/kg)	BH.01/02	Determinand (mg/kg)	BH.01/02
	Depth 500-600mm		Depth 500-600mm		Depth 500-600mm
Phenol	< 0.1	p-Cresol	< 0.15	4-Nitroaniline	< 0.1
1,2,4-Trichlorobenzene	< 0.1	2,4,6-Trichlorophenol	< 0.1	4-Bromophenyl phenyl ether	< 0.1
2-Nitrophenol	< 0.1	2,4,5-Trichlorophenol	< 0.15	Hexachlorobenzene	< 0.1
Nitrobenzene	< 0.1	2-Nitroaniline	< 0.1	2,4-Dinitrotoluene	< 0.1
0-Cresol	< 0.1	4-Chloro-3-methylphenol	< 0.1	Diethyl phthalate	< 0.1
bis(2-chloroethoxy) methane	< 0.1	2-Methylnaphthalene	< 0.1	Dibenzofuran	< 0.1
bis(2-chloroethyl)ether	< 0.1	Hexachloro cyclopentadiene	< 0.1	Azobenzene	< 0.1
2,4-Dichlorophenol	< 0.1	Hexachlorobutadiene	< 0.1	Dibutyl phthalate	< 0.1
2-Chlorophenol	< 0.1	2,6-Dinitrotoluene	< 0.1	Carbazole	< 0.1
1,3-Dichlorobenzene	< 0.1	Dimethyl phthalate	< 0.1	bis(2-ethylhexyl) phthalate	< 0.15
1,4-Dichlorobenzene	< 0.1	2-Chloronaphthalene	< 0.1	Benzyl butyl phthalate	< 0.1
1,2-Dichlorobenzene	< 0.1	4-Chloroaniline	< 0.15	Di-n-octyl phthalate	< 0.1
2,4-Dimethylphenol	< 0.15	4-Nitrophenol	< 0.1		
Isophorone	< 0.1	4-Chlorophenyl phenyl ether	< 0.1		
Hexachloroethane	< 0.1	3-Nitroaniline	< 0.1		

Table 10 (Cont.) Results for speciated volatile organic compounds

Determinand (mg/kg)	BH.02/02	Determinand (mg/kg)	BH.02/02	Determinand (mg/kg)	BH.02/02
	Depth 500-600mm		Depth 500-600mm		Depth 500-600mm
Phenol	< 0.1	p-Cresol	< 0.15	4-Nitroaniline	< 0.1
1,2,4-Trichlorobenzene	< 0.1	2,4,6-Trichlorophenol	< 0.1	4-Bromophenyl phenyl ether	< 0.1
2-Nitrophenol	< 0.1	2,4,5-Trichlorophenol	< 0.15	Hexachlorobenzene	< 0.1
Nitrobenzene	< 0.1	2-Nitroaniline	< 0.1	2,4-Dinitrotoluene	< 0.1
O-Cresol	< 0.1	4-Chloro-3-methylphenol	< 0.1	Diethyl phthalate	< 0.1
bis(2-chloroethoxy) methane	< 0.1	2-Methylnaphthalene	< 0.1	Dibenzofuran	< 0.1
bis(2-chloroethyl)ether	< 0.1	Hexachloro cyclopentadiene	< 0.1	Azobenzene	< 0.1
2,4-Dichlorophenol	< 0.1	Hexachlorobutadiene	< 0.1	Dibutyl phthalate	< 0.1
2-Chlorophenol	< 0.1	2,6-Dinitrotoluene	< 0.1	Carbazole	< 0.1
1,3-Dichlorobenzene	< 0.1	Dimethyl phthalate	< 0.1	bis(2-ethylhexyl) phthalate	< 0.15
1,4-Dichlorobenzene	< 0.1	2-Chloronaphthalene	< 0.1	Benzyl butyl phthalate	< 0.1
1,2-Dichlorobenzene	< 0.1	4-Chloroaniline	< 0.15	Di-n-octyl phthalate	< 0.1
2,4-Dimethylphenol	< 0.15	4-Nitrophenol	< 0.1		
Isophorone	< 0.1	4-Chlorophenyl phenyl ether	< 0.1		
Hexachloroethane	< 0.1	3-Nitroaniline	< 0.1		

Table 10 (Cont.) Results for speciated volatile organic compounds

Determinand (mg/kg)	BH.03/02	Determinand (mg/kg)	BH.03/02	Determinand (mg/kg)	BH.03/02
	Depth 500-600mm		Depth 500-600mm		Depth 500-600mm
Phenol	< 0.1	p-Cresol	< 0.15	4-Nitroaniline	< 0.1
1,2,4-Trichlorobenzene	< 0.1	2,4,6-Trichlorophenol	< 0.1	4-Bromophenyl phenyl ether	< 0.1
2-Nitrophenol	< 0.1	2,4,5-Trichlorophenol	< 0.15	Hexachlorobenzene	< 0.1
Nitrobenzene	< 0.1	2-Nitroaniline	< 0.1	2,4-Dinitrotoluene	< 0.1
0-Cresol	< 0.1	4-Chloro-3-methylphenol	< 0.1	Diethyl phthalate	< 0.1
bis(2-chloroethoxy) methane	< 0.1	2-Methylnaphthalene	< 0.1	Dibenzofuran	< 0.1
bis(2-chloroethyl)ether	< 0.1	Hexachloro cyclopentadiene	< 0.1	Azobenzene	< 0.1
2,4-Dichlorophenol	< 0.1	Hexachlorobutadiene	< 0.1	Dibutyl phthalate	< 0.1
2-Chlorophenol	< 0.1	2,6-Dinitrotoluene	< 0.1	Carbazole	< 0.1
1,3-Dichlorobenzene	< 0.1	Dimethyl phthalate	< 0.1	bis(2-ethylhexyl) phthalate	< 0.15
1,4-Dichlorobenzene	< 0.1	2-Chloronaphthalene	< 0.1	Benzyl butyl phthalate	< 0.1
1,2-Dichlorobenzene	< 0.1	4-Chloroaniline	< 0.15	Di-n-octyl phthalate	< 0.1
2,4-Dimethylphenol	< 0.15	4-Nitrophenol	< 0.1		
Isophorone	< 0.1	4-Chlorophenyl phenyl ether	< 0.1		
Hexachloroethane	< 0.1	3-Nitroaniline	< 0.1		

5 Interpretation

Tables 11 to 13 below show the soil guideline concentrations used as part of this assessment.

Where Environment Agency guideline values are unavailable, soil guideline concentrations derived using CLEA software packages and other published guidelines have been consulted. In all instances guideline values for residential end-use with home-grown produce have been considered.

For the purposes of this assessment therefore, the following guideline criteria have been referred to:

- Environment Agency Category 4 Screening Levels (2014);
- CIEH (LQM) GAC 3rd Edition (residential end-use);
- Atkins ATRISK SSVs (residential end-use with home-grown produce);
- GAC CLEA generated value for residential end-use with home-grown produce; and
- others, as available.

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 between 1% and 6%.

In this instance the more stringent guideline value for 1% SOM was referred to, despite the mean organic content being determined as 3%; which approximates to 5.1% SOM.

Table 11 Soil guideline concentrations for inorganics referred to for this assessment

Determinand (mg/kg)	Guideline concentration for 1% SOM	Origin
Arsenic	37	Atkins ATRISK Category 4 Screening Level
Boron	290	LQM/CIEH S4ULs (CLEA 1.06) for residential with home-grown produce
Cadmium	22.1	Atkins ATRISK Category 4 Screening Level
Chromium	14300	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Chromium VI	20.5	Atkins ATRISK Category 4 Screening Level
Copper	4730	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Lead	200	Category 4 Screening Level ^(a)
Mercury (elemental)	0.0863	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Mercury (inorganic Hg ²⁺)	180	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Nickel	136	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Selenium	375	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Zinc	20000	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Free Cyanide	34	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Sulphate	10000	ICRCL Action Value domestic gardens ^(b)
Sulphide	1000	ICRCL Action Value all uses ^(b)
Phenols (SOM 1%)	267	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Benzene (SOM 1%)	0.137	Atkins ATRISK (C4SL) for residential with home-grown produce
Toluene (SOM 1%)	113	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Ethylbenzene (SOM 1%)	50.7	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
o-Xylene (SOM 1%)	26.4	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
m-Xylene (SOM 1%)	25	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
p-Xylene (SOM 1%)	24	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce

(a) Quoted for residential land-use 0-7 year-old child taking into account bioavailability, with exposure parameters as detailed in report SR3.

(b) This 'withdrawn' value has been quoted in the absence of any other available published guideline.

Table 12 Soil guideline concentrations for PAHs referred to for this assessment

Determinand (mg/kg)	Guideline concentration for 1% SOM	Origin
Naphthalene	2.3	LQM/CIEH S4ULs (CLEA 1.06) for residential with home-grown produce
Acenaphthylene	608	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Acenaphthene	210	LQM/CIEH S4ULs (CLEA 1.06) for residential with home-grown produce
Fluorene	735	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Phenanthrene	95	LQM/CIEH S4ULs (CLEA 1.06) for residential with home-grown produce
Anthracene	10200	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Fluoranthene	983	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Pyrene	668	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Benzo(a)anthracene	7.2	LQM/CIEH S4ULs (CLEA 1.06) for residential with home-grown produce
Chrysene	15	LQM/CIEH S4ULs (CLEA 1.06) for residential with home-grown produce
Benzo(b)fluoranthene	2.6	LQM/CIEH S4ULs (CLEA 1.06) for residential with home-grown produce
Benzo(k)fluoranthene	77	LQM/CIEH S4ULs (CLEA 1.06) for residential with home-grown produce
Benzo(a)pyrene	2.2	LQM/CIEH S4ULs (CLEA 1.06) for residential with home-grown produce
Indeno(123-cd)pyrene	27	LQM/CIEH S4ULs (CLEA 1.06) for residential with home-grown produce
Dibenzo(ah)anthracene	0.24	LQM/CIEH S4ULs (CLEA 1.06) for residential with home-grown produce
Benzo(ghi)perylene	320	LQM/CIEH S4ULs (CLEA 1.06) for residential with home-grown produce

Table 13 Soil guideline concentrations for TPHs referred to for this assessment

Determinand (mg/kg)	Guideline concentration for 1% SOM	Origin
Aliphatic TPH C5-C6	42.7	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Aliphatic TPH C6-C8	99.3	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Aliphatic TPH C8-C10	13.9	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Aliphatic TPH C10-C12	81.7	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Aliphatic TPH C12-C16	385	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Aliphatic TPH C16-C35	210000	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Aliphatic TPH C35-C44	65000	LQM/CIEH S4ULs (CLEA 1.06) for residential with home-grown produce
Aromatic TPH C5-C7	0.137	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Aromatic TPH C7-C8	113	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Aromatic TPH C8-C10	20.5	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Aromatic TPH C10-C12	70	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Aromatic TPH C12-C16	165	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Aromatic TPH C16-C21	319	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Aromatic TPH C21-C35	1120	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Aromatic TPH C5-C35	1100	LQM/CIEH S4ULs (CLEA 1.06) for residential with home-grown produce

6 Results evaluation

As detailed above, three boreholes were hand-augered on the site to a maximum depth of 1100mm; from each of which two soil samples were collected for laboratory analysis, representing depths of between 100 and 200mm, and 500 to 600mm.

In doing so, the results reproduced in Tables 4 to 10 above have shown that there were a number of substances detected, of which the only identified substances of particular concern for residential development were reportedly lead and dibenzo(ah)anthracene.

More specifically, lead was detected at concentrations of 239mg/kg, 277mg/kg and 390mg/kg in the lower sample (500-600mm (bgl)) obtained at each of the three locations respectively, and at a concentration of 278mg/kg in the upper sample (100-200mm (bgl)) obtained from borehole BH.03 only. The corresponding generic guideline concentration for residential development is 200mg/kg.

Furthermore it is noted that there was some minor PAH and other hydrocarbon residue present also; once again generally associated with the deeper material only. The only PAH to exceed residential criteria was dibenzo(ah)anthracene, where the reported concentration of 0.26mg/kg marginally exceeds the corresponding generic guideline concentration for residential development of 0.24mg/kg.

Lead and PAHs are commonly detected soil contaminants, and are presumably associated with either the previous use of the adjacent site as a car park with cars awaiting repair (through small-scale leaks of fuel and oil), or possibly introduced through the shallow deposition of made-ground that was noted across the site to a general depth of around 500mm.

7 Review of conceptual model and risk assessment

Using the sampling results and observations made, the conceptual site model (CSM) from the Phase 1 desk study can now be reviewed and updated. In doing so any uncertainties highlighted within that report can now be readdressed and the corresponding risk reassessed.

In reviewing this conceptual model, Table 14 below highlights any perceived pollutant pathway linkages that may be present.

It should be noted that the following re-assessment of risk, has been made on the basis that the existing soft landscaped recreational area associated will be retained.

The risk matrix used for this purpose is reproduced below in Figure 2.

Figure 2 Risk assessment algorithm

Potential severity	Risk rating						Severity of hazard	Probability of hazard	Overall risk
	5	5	10	15	20	25	5 = Fatality	1 = Improbable	1 - 6 Low
	4	4	8	12	16	20	4 = Major	2 = Remote	8 - 12 Medium
	3	3	6	9	12	15	3 = Minor	3 = Possible	15 - 25 High
	2	2	4	6	8	10	2 = Negligible	4 = Probable	
	1	1	2	3	4	5	1 = None	5 = Certainty	
		1	2	3	4	5			
	Probability						Severity of hazard x probability = risk rating		

Table 14 Perceived risk to receptors

Source(s) identified	Identified pathways	Overall risk	Comments
Lead and dibenzo(ah)anthracene	Direct ingestion of soil and soil-dust	10	The likelihood of ingesting soil during recreation is low. Ingestion is most likely to be limited to trace quantities through unwashed hands or ingesting airborne dusts etc. However as an elevated concentration lead has been identified close to the surface in one part of the garden, the corresponding risk in that area is deemed to be moderate. In all other instances, the identified elevated concentrations of lead and dibenzo(ah)anthracene were noted at depth, and therefore less likely to be ingested.
	Dermal contact with soil and soil-dust	10	The potential for touching soil during recreation is high. It is also possible that the identified dibenzo(ah)anthracene could exert a biological effect from absorption through the epidermis, or alternatively be transferred to the mouth. Once again, most of the contamination concerns were at depth and therefore less likely to be an issue regarding contact; however with an elevated concentration of lead nearer to the surface in one identified area, the risk in that area must at least be considered moderate.
	Inhalation of soil and soil-dust	6	The potential for inhaling soil or airborne soil-derived dust during construction work may be high, but the actual uptake of a significant amount of lead or dibenzo(ah)anthracene via this route is expected to be low. As such the corresponding risk is considered to be low.

Table 14 (Cont.)

Reviewed comments relating to perceived risk

Contaminants identified	Potential pathways	Perceived level of risk	Comments and reasoning
Lead and dibenzo(ah)anthracene	Ingestion of vegetables	8	Lead is unlikely to be taken up during the growing of fruit or vegetables, whereas PAHs could potentially be. Despite this, the uptake concentration is expected to be low, and therefore the corresponding risk overall is deemed to be low-moderate at worst.
	Inhalation and/or ignition of gases and/or vapours	5	Despite the general low-concentration presence of hydrocarbon residue, and with dibenzo(ah)anthracene marginally exceeding guideline criteria, it is not expected for this to be great enough to generate significant vapours. Similarly the general organic carbon content of the soil is not deemed to be high enough to produce significant quantities of methane or carbon dioxide. The corresponding risk from each is therefore expected to be low.
	Direct contact with buildings and services	3	Despite the general low-concentration presence of hydrocarbon residue, and with dibenzo(ah)anthracene marginally exceeding guideline criteria, it is not expected for this to be great enough to impact underground building fabric or services. The corresponding risk is therefore considered to be low.

8 Summary and recommendations

8.1 Summary

This report has been prepared in support of the prior approval for a change of use of the existing building and associated garden from commercial to residential use, with soil sampling focussing on the garden area only.

In doing so it has noted that the soil within all three locations assessed has a lead concentration that exceeds the corresponding residential guideline criteria. Furthermore, there was a general low-concentration presence of PAHs, of which dibenzo(ah)anthracene was seen to exceed its corresponding residential guideline criteria in one location.

More specifically, the majority of these exceedences were noted within the deeper samples obtained from between 500-600mm below the surface, other than which one of the lead exceedences was additionally detected in an upper soil sample.

This contamination is presumed to be present due to either the made-ground material in these locations, although it is possible also that the lead and PAH contamination could be associated with historic vehicle activity on the adjacent properties to both the north and south of the site.

Based on the findings of this investigation therefore, the revised conceptual site model has concluded that in its current state the site presents an unacceptable degree of risk to future receptors on the basis of the proposed residential use.

8.2 Recommendations

In view of this conclusion it would be necessary to undertake a programme of remediation in order to bring the risk down to an acceptable level.

Considering the fact that the site is going to return to its previous use as a dwelling with an associated garden area, remediation should focus on areas where pathway linkages are expected to be present; which in this instance is the recreational soft landscaping of the garden.

On the basis of these reported findings, it is suggested that the entire garden area should be excavated to a depth of at least 600mm below the existing ground level, and removed off-site for appropriate disposal or treatment.

Once this has been undertaken, it is suggested that soil samples are obtained from the base and sides of the excavated garden area, and analysed for the presence of lead and PAHs.

If either of these contaminants are still present above guideline criteria at this depth then the excavated area would need to be lined with an appropriate geotextile membrane to the base and sides, and protected with at least 100mm of 'clean' crushed concrete, followed by backfilling with 'clean' soil.

If soil analysis indicates that the lead and PAH concentrations are acceptable for residential use then there should be no need for installing a protective membrane. Instead the excavation can be backfilled directly with 'clean' soil.

Note that any soil brought onto the site for the purposes of backfilling the excavated area (or for general landscaping) should arrive 'fit for purpose', and comply with the British Standard BS3882:2015; although this will still need to undergo independent confirmatory laboratory analyses to show that it is free from contamination.

Photographic evidence of all remedial work undertaken should be collated and presented to the planning authority in the form of a post-remediation validation report, along with any waste transfer documentation relating to the off-site disposal of soil, and any receipts or other documentation relating to the importation of soil.

Finally, an informal observation strategy must be put in place during all ground-works that may take place as part of this redevelopment, whereupon care should be taken during the working of the site to investigate any soils, which are suspected by sight, odour or suspicion, to be contaminated, but not previously identified.

In the event of such a discovery, the location, type and quantity should be recorded, and the contaminated land officer at Havant Borough Council notified immediately. Approval should be sought prior to continuing groundworks or implementing any mitigation

9 Limitations

This 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 a number of 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, as necessary.

It is also pointed out that soil sampling, 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.

10 References and specific sources of information

1. Investigation of potentially contaminated sites - code of practice (BSI 10175:2011+A2:2017)
2. Land Contamination Risk Management (LCRM) - Environment Agency (April 2021)
3. Using Soil Guideline Values - Environment Agency Science Report SC050021/SGV (March 2009)
4. The LQM/CIEH Generic Assessment Criteria for Human Health Risk Assessment CIEH 3rd Ed. - Land Quality Management Ltd. (2015)
5. Atkins ATRISK SSCs (July 2017)
6. CLEA Software (Version 1.05) Handbook - Environment Agency Science Report SC050021/SR4 (January 2014)
7. ICRCCL 59/83 Trigger Concentrations - Department of the Environment (1983)
8. Land Affected by Contamination - Planning Practice Guidance - The Department for Communities and Local Government (June 2014)
9. The National Planning Policy Framework (Revised) - July 2021
10. Model procedures for the management of contaminated land (CLR-11) - Environment Agency (September 2004)
11. Contaminated Land Risk Assessment: A Guide to Good Practice (C552) - CIRIA (2001)
12. SP1010 - Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination - CL:AIRE (September 2014)
13. British Geological Survey. Geology of Britain:
<http://mapapps.bgs.ac.uk/geologyofbritain/home.html?>

APPENDICES

- i Laboratory data
- ii Calibration certification



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DETS Report No: 22-06926

Site Reference: None Supplied

Project / Job Ref: CL/3361/SS

Order No: None Supplied

Sample Receipt Date: 15/08/2022

Sample Scheduled Date: 15/08/2022

Report Issue Number: 1

Reporting Date: 17/08/2022

Authorised by:

Dave Ashworth
Technical Manager

Dates of laboratory activities for each tested analyte are available upon request.

Opinions and interpretations are outside the laboratory's scope of ISO 17025 accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.



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Soil Analysis Certificate - Semi Volatile Organic Compounds (SVOC)						
DETS Report No: 22-06926	Date Sampled	11/08/22	11/08/22	11/08/22		
Apple Environmental Ltd	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: None Supplied	TP / BH No	BH.01/02/3361	BH.02/02/3361	BH.03/02/3361		
Project / Job Ref: CL/3361/SS	Additional Refs	None Supplied	None Supplied	None Supplied		
Order No: None Supplied	Depth (m)	None Supplied	None Supplied	None Supplied		
Reporting Date: 17/08/2022	DETS Sample No	609151	609152	609153		

Determinand	Unit	RL	Accreditation					
Phenol	mg/kg	< 0.1	NONE	< 0.1	< 0.1	< 0.1		
1,2,4-Trichlorobenzene	mg/kg	< 0.1	ISO17025	< 0.1	< 0.1	< 0.1		
2-Nitrophenol	mg/kg	< 0.1	NONE	< 0.1	< 0.1	< 0.1		
Nitrobenzene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
0-Cresol	mg/kg	< 0.1	NONE	< 0.1	< 0.1	< 0.1		
bis(2-chloroethoxy)methane	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
bis(2-chloroethyl)ether	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
2,4-Dichlorophenol	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
2-Chlorophenol	mg/kg	< 0.1	ISO17025	< 0.1	< 0.1	< 0.1		
1,3-Dichlorobenzene	mg/kg	< 0.1	ISO17025	< 0.1	< 0.1	< 0.1		
1,4-Dichlorobenzene	mg/kg	< 0.1	ISO17025	< 0.1	< 0.1	< 0.1		
1,2-Dichlorobenzene	mg/kg	< 0.1	ISO17025	< 0.1	< 0.1	< 0.1		
2,4-Dimethylphenol	mg/kg	< 0.15	ISO17025	< 0.15	< 0.15	< 0.15		
Isophorone	mg/kg	< 0.1	NONE	< 0.1	< 0.1	< 0.1		
Hexachloroethane	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
p-Cresol	mg/kg	< 0.15	MCERTS	< 0.15	< 0.15	< 0.15		
2,4,6-Trichlorophenol	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
2,4,5-Trichlorophenol	mg/kg	< 0.15	MCERTS	< 0.15	< 0.15	< 0.15		
2-Nitroaniline	mg/kg	< 0.1	NONE	< 0.1	< 0.1	< 0.1		
4-Chloro-3-methylphenol	mg/kg	< 0.1	NONE	< 0.1	< 0.1	< 0.1		
2-Methylnaphthalene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
Hexachlorocyclopentadiene	mg/kg	< 0.1	NONE	< 0.1	< 0.1	< 0.1		
Hexachlorobutadiene	mg/kg	< 0.1	ISO17025	< 0.1	< 0.1	< 0.1		
2,6-Dinitrotoluene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
Dimethyl phthalate	mg/kg	< 0.1	NONE	< 0.1	< 0.1	< 0.1		
2-Chloronaphthalene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
4-Chloroaniline	mg/kg	< 0.15	NONE	< 0.15	< 0.15	< 0.15		
4-Nitrophenol	mg/kg	< 0.1	NONE	< 0.1	< 0.1	< 0.1		
4-Chlorophenyl phenyl ether	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
3-Nitroaniline	mg/kg	< 0.1	NONE	< 0.1	< 0.1	< 0.1		
4-Nitroaniline	mg/kg	< 0.1	NONE	< 0.1	< 0.1	< 0.1		
4-Bromophenyl phenyl ether	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
Hexachlorobenzene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
2,4-Dinitrotoluene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
Diethyl phthalate	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
Dibenzofuran	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
Azobenzene	mg/kg	< 0.1	NONE	< 0.1	< 0.1	< 0.1		
Dibutyl phthalate	mg/kg	< 0.1	ISO17025	< 0.1	< 0.1	< 0.1		
Carbazole	mg/kg	< 0.1	ISO17025	< 0.1	< 0.1	< 0.1		
bis(2-ethylhexyl)phthalate	mg/kg	< 0.15	ISO17025	< 0.15	< 0.15	< 0.15		
Benzyl butyl phthalate	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
Di-n-octyl phthalate	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		



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Soil Analysis Certificate - Sample Descriptions

DETS Report No: 22-06926	
Apple Environmental Ltd	
Site Reference: None Supplied	
Project / Job Ref: CL/3361/SS	
Order No: None Supplied	
Reporting Date: 17/08/2022	

DETS Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
609151	BH.01/02/3361	None Supplied	None Supplied	16.8	Black sandy clay with stones and brick
609152	BH.02/02/3361	None Supplied	None Supplied	14.3	Brown gravelly sand with stones and concrete
609153	BH.03/02/3361	None Supplied	None Supplied	15.9	Brown sandy clay with stones and concrete

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

Insufficient Sample ^{1/5}

Unsuitable Sample ^{4/5}



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Soil Analysis Certificate - Methodology & Miscellaneous Information

DETS Report No: 22-06926

Apple Environmental Ltd

Site Reference: None Supplied

Project / Job Ref: CL/3361/SS

Order No: None Supplied

Reporting Date: 17/08/2022

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 (C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID for C8 to C40. C6 to C8 by headspace GC-MS	E004
Soil	D	Fluoride - Water Soluble	Determination of Fluoride by extraction with water & analysed by ion chromatography	E009
Soil	D	Fraction Organic Carbon (FOC)	Determination of TOC by combustion analyser.	E027
Soil	D	Organic Matter (SOM)	Determination of TOC by combustion analyser.	E027
Soil	D	TOC (Total Organic Carbon)	Determination of TOC by combustion analyser.	E027
Soil	AR	Exchangeable Ammonium	Determination of ammonium by discrete analyser.	E029
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 (ali: C5- C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C34, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C35. C5 to C8 by headspace GC-MS	E004
Soil	AR	TPH LQM (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C35, C35-C44, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35, C35-C44)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C44. C5 to C8 by headspace GC-MS	E004
Soil	AR	VOCs	Determination of volatile organic compounds by headspace GC-MS	E001
Soil	AR	VPH (C6-C8 & C8-C10)	Determination of hydrocarbons C6-C8 by headspace GC-MS & C8-C10 by GC-FID	E001

D Dried
AR As Received



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List of HWOL Acronyms and Operators

DETS Report No: 22-06926

Apple Environmental Ltd

Site Reference: None Supplied

Project / Job Ref: CL/3361/SS

Order No: None Supplied

Reporting Date: 17/08/2022

Acronym	Description
HS	Headspace analysis
EH	Extractable Hydrocarbons - i.e. everything extracted by the solvent
CU	Clean-up - e.g. by florisil, silica gel
1D	GC - Single coil gas chromatography
2D	GC-GC - Double coil gas chromatography
Total	Aliphatics & Aromatics
AL	Aliphatics only
AR	Aromatics only
#1	EH_2D_Total but with humics mathematically subtracted
#2	EH_2D_Total but with fatty acids mathematically subtracted
	Operator - underscore to separate acronyms (exception for +)
+	Operator to indicate cumulative eg. EH+HS_Total or EH_CU+HS_Total

Det - Acronym



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Unit 1
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DETS Report No: 22-06889

Site Reference: None Supplied

Project / Job Ref: CL/3361/SS

Order No: None Supplied

Sample Receipt Date: 12/08/2022

Sample Scheduled Date: 12/08/2022

Report Issue Number: 2

Reporting Date: 19/08/2022

Authorised by:

Dates of laboratory activities for each tested analyte are available upon request.

Dates of laboratory activities for each tested analyte are available upon request.

This report supersedes 22-06889, issue no.1.
Opinions and interpretations are outside the laboratory's scope of ISO 17025 accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.



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Soil Analysis Certificate						
DETS Report No: 22-06889	Date Sampled	11/08/22	11/08/22	11/08/22	11/08/22	11/08/22
Apple Environmental Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: None Supplied	TP / BH No	BH.01/01/3361	BH.01/02/3361	BH.02/01/3361	BH.02/02/3361	BH.03/01/3361
Project / Job Ref: CL/3361/SS	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: None Supplied	Depth (m)	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Reporting Date: 19/08/2022	DETS Sample No	608968	608969	608970	608971	608972

Determinand	Unit	RL	Accreditation					
Asbestos Screen ^(S)	N/a	N/a	ISO17025	Not Detected	Not Detected	Not Detected	Not Detected	Not Detected
pH	pH Units	N/a	MCERTS	7.7	7.6	7.7	7.7	7.7
Total Cyanide	mg/kg	< 2	NONE	< 2	< 2	< 2	< 2	< 2
Total Sulphate as SO ₄	mg/kg	< 200	MCERTS	469	581	240	577	713
Total Sulphate as SO ₄	%	< 0.02	MCERTS	0.05	0.06	0.02	0.06	0.07
W/S Sulphate as SO ₄ (2:1)	mg/l	< 10	MCERTS	55	25	< 10	12	44
W/S Sulphate as SO ₄ (2:1)	g/l	< 0.01	MCERTS	0.06	0.03	< 0.01	0.01	0.04
Sulphide	mg/kg	< 5	NONE	< 5	< 5	< 5	< 5	< 5
TOC (Total Organic Carbon)	%	< 0.1	MCERTS	0.4	5	2.7	2	7.1
W/S Chloride (2:1)	mg/kg	< 1	MCERTS	9	20	13	17	41
W/S Chloride (2:1)	mg/l	< 0.5	MCERTS	4.7	9.8	6.4	8.6	20.5
Arsenic (As)	mg/kg	< 2	MCERTS	6	15	8	29	6
W/S Boron	mg/kg	< 1	NONE	< 1	1.5	< 1	< 1	< 1
Cadmium (Cd)	mg/kg	< 0.2	MCERTS	0.3	0.4	0.4	0.4	0.3
Chromium (Cr)	mg/kg	< 2	MCERTS	8	18	12	17	11
Chromium (hexavalent)	mg/kg	< 2	NONE	< 2	< 2	< 2	< 2	< 2
Copper (Cu)	mg/kg	< 4	MCERTS	26	73	29	73	37
Lead (Pb)	mg/kg	< 3	MCERTS	133	239	83	277	278
Mercury (Hg)	mg/kg	< 1	MCERTS	< 1	1.5	< 1	1	< 1
Nickel (Ni)	mg/kg	< 3	MCERTS	8	17	6	14	6
Selenium (Se)	mg/kg	< 2	MCERTS	< 3	< 3	< 3	< 3	< 3
Zinc (Zn)	mg/kg	< 3	MCERTS	84	151	76	168	139
Total Phenols (monohydric)	mg/kg	< 2	NONE	< 2	< 2	< 2	< 2	< 2
TPH - Aliphatic >C35 - C40 : EH 1D CU AL	mg/kg	< 10	NONE	< 10	< 10	< 10	< 10	< 10
TPH - Aromatic >C35 - C40 : EH 1D CU AR	mg/kg	< 10	NONE	< 10	< 10	< 10	< 10	< 10
TPH - Aliphatic / Aromatic (C6 - C40) - Total : HS 1D MS+EH 1D CU Total	mg/kg	< 42	NONE	< 42	67	< 42	< 42	< 42

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C. The Method Description page describes if the test is performed on the dried or as-received portion
Subcontracted analysis (S)



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Soil Analysis Certificate						
DETS Report No: 22-06889	Date Sampled	11/08/22				
Apple Environmental Ltd	Time Sampled	None Supplied				
Site Reference: None Supplied	TP / BH No	BH.03/02/3361				
Project / Job Ref: CL/3361/SS	Additional Refs	None Supplied				
Order No: None Supplied	Depth (m)	None Supplied				
Reporting Date: 19/08/2022	DETS Sample No	608973				

Determinand	Unit	RL	Accreditation				
Asbestos Screen ^(S)	N/a	N/a	ISO17025	Not Detected			
pH	pH Units	N/a	MCERTS	7.7			
Total Cyanide	mg/kg	< 2	NONE	< 2			
Total Sulphate as SO ₄	mg/kg	< 200	MCERTS	779			
Total Sulphate as SO ₄	%	< 0.02	MCERTS	0.08			
W/S Sulphate as SO ₄ (2:1)	mg/l	< 10	MCERTS	28			
W/S Sulphate as SO ₄ (2:1)	g/l	< 0.01	MCERTS	0.03			
Sulphide	mg/kg	< 5	NONE	< 5			
TOC (Total Organic Carbon)	%	< 0.1	MCERTS	1.2			
W/S Chloride (2:1)	mg/kg	< 1	MCERTS	21			
W/S Chloride (2:1)	mg/l	< 0.5	MCERTS	10.5			
Arsenic (As)	mg/kg	< 2	MCERTS	15			
W/S Boron	mg/kg	< 1	NONE	< 1			
Cadmium (Cd)	mg/kg	< 0.2	MCERTS	0.4			
Chromium (Cr)	mg/kg	< 2	MCERTS	15			
Chromium (hexavalent)	mg/kg	< 2	NONE	< 2			
Copper (Cu)	mg/kg	< 4	MCERTS	106			
Lead (Pb)	mg/kg	< 3	MCERTS	390			
Mercury (Hg)	mg/kg	< 1	MCERTS	1.1			
Nickel (Ni)	mg/kg	< 3	MCERTS	15			
Selenium (Se)	mg/kg	< 2	MCERTS	< 3			
Zinc (Zn)	mg/kg	< 3	MCERTS	218			
Total Phenols (monohydric)	mg/kg	< 2	NONE	< 2			
TPH - Aliphatic >C35 - C40 : EH 1D CU AL	mg/kg	< 10	NONE	< 10			
TPH - Aromatic >C35 - C40 : EH 1D CU AR	mg/kg	< 10	NONE	< 10			
TPH - Aliphatic / Aromatic (C6 - C40) - Total : HS 1D MS+EH 1D CU Total	mg/kg	< 42	NONE	< 42			

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C. The Method Description page describes if the test is performed on the dried or as-received portion
Subcontracted analysis (S)



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Soil Analysis Certificate - Speciated PAHs						
DETS Report No: 22-06889	Date Sampled	11/08/22	11/08/22	11/08/22	11/08/22	11/08/22
Apple Environmental Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: None Supplied	TP / BH No	BH.01/01/3361	BH.01/02/3361	BH.02/01/3361	BH.02/02/3361	BH.03/01/3361
Project / Job Ref: CL/3361/SS	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: None Supplied	Depth (m)	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Reporting Date: 19/08/2022	DETS Sample No	608968	608969	608970	608971	608972

Determinand	Unit	RL	Accreditation					
Naphthalene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Fluorene	mg/kg	< 0.1	MCERTS	< 0.1	0.13	< 0.1	< 0.1	< 0.1
Phenanthrene	mg/kg	< 0.1	MCERTS	< 0.1	1.50	< 0.1	0.15	0.25
Anthracene	mg/kg	< 0.1	MCERTS	< 0.1	0.51	< 0.1	< 0.1	< 0.1
Fluoranthene	mg/kg	< 0.1	MCERTS	0.31	3.82	0.11	0.46	0.75
Pyrene	mg/kg	< 0.1	MCERTS	0.29	3.26	< 0.1	0.41	0.62
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	0.26	2.38	< 0.1	0.35	0.59
Chrysene	mg/kg	< 0.1	MCERTS	0.24	2.04	< 0.1	0.32	0.59
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	0.27	1.99	< 0.1	0.34	0.70
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	0.80	< 0.1	0.14	0.24
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	0.24	1.87	< 0.1	0.30	0.56
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	0.16	0.89	< 0.1	0.15	0.34
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	0.26	< 0.1	< 0.1	< 0.1
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	0.11	0.67	< 0.1	0.13	0.29
Coronene	mg/kg	< 0.1	NONE	< 0.1	0.15	< 0.1	< 0.1	< 0.1
Total Oily Waste PAHs	mg/kg	< 1	MCERTS	1.2	10.2	< 1	1.6	3.0
Total Dutch 10 PAHs	mg/kg	< 1	MCERTS	1.3	14.5	< 1	2	3.6
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	1.9	20.1	< 1.6	2.7	4.9
Total WAC-17 PAHs	mg/kg	< 1.7	NONE	1.9	20.3	< 1.7	2.7	4.9



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Soil Analysis Certificate - Speciated PAHs						
DETS Report No: 22-06889	Date Sampled	11/08/22				
Apple Environmental Ltd	Time Sampled	None Supplied				
Site Reference: None Supplied	TP / BH No	BH.03/02/3361				
Project / Job Ref: CL/3361/SS	Additional Refs	None Supplied				
Order No: None Supplied	Depth (m)	None Supplied				
Reporting Date: 19/08/2022	DETS Sample No	608973				

Determinand	Unit	RL	Accreditation				
Naphthalene	mg/kg	< 0.1	MCERTS	< 0.1			
Acenaphthylene	mg/kg	< 0.1	MCERTS	< 0.1			
Acenaphthene	mg/kg	< 0.1	MCERTS	< 0.1			
Fluorene	mg/kg	< 0.1	MCERTS	< 0.1			
Phenanthrene	mg/kg	< 0.1	MCERTS	< 0.1			
Anthracene	mg/kg	< 0.1	MCERTS	< 0.1			
Fluoranthene	mg/kg	< 0.1	MCERTS	0.24			
Pyrene	mg/kg	< 0.1	MCERTS	0.21			
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	0.19			
Chrysene	mg/kg	< 0.1	MCERTS	0.17			
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	0.16			
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1			
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	0.13			
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	< 0.1			
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	< 0.1			
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	< 0.1			
Coronene	mg/kg	< 0.1	NONE	< 0.1			
Total Oily Waste PAHs	mg/kg	< 1	MCERTS	< 1			
Total Dutch 10 PAHs	mg/kg	< 1	MCERTS	< 1			
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	< 1.6			
Total WAC-17 PAHs	mg/kg	< 1.7	NONE	< 1.7			



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Soil Analysis Certificate - TPH CWG Banded

DETS Report No: 22-06889	Date Sampled	11/08/22	11/08/22	11/08/22	11/08/22	11/08/22
Apple Environmental Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: None Supplied	TP / BH No	BH.01/01/3361	BH.01/02/3361	BH.02/01/3361	BH.02/02/3361	BH.03/01/3361
Project / Job Ref: CL/3361/SS	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: None Supplied	Depth (m)	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Reporting Date: 19/08/2022	DETS Sample No	608968	608969	608970	608971	608972

Determinand	Unit	RL	Accreditation					
Aliphatic >C5 - C6 : HS_1D_MS_AL	mg/kg	< 0.01	NONE	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aliphatic >C6 - C8 : HS_1D_MS_AL	mg/kg	< 0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Aliphatic >C8 - C10 : EH_1D_CU_AL	mg/kg	< 2	MCERTS	< 2	< 2	< 2	< 2	< 2
Aliphatic >C10 - C12 : EH_1D_CU_AL	mg/kg	< 2	MCERTS	< 2	< 2	< 2	< 2	< 2
Aliphatic >C12 - C16 : EH_1D_CU_AL	mg/kg	< 3	MCERTS	< 3	< 3	< 3	< 3	< 3
Aliphatic >C16 - C21 : EH_1D_CU_AL	mg/kg	< 3	MCERTS	< 3	< 3	< 3	< 3	< 3
Aliphatic >C21 - C34 : EH_1D_CU_AL	mg/kg	< 10	MCERTS	< 10	< 10	< 10	< 10	< 10
Aliphatic (C5 - C34) : HS_1D_MS+1D_CU_AL	mg/kg	< 21	NONE	< 21	< 21	< 21	< 21	< 21
Aromatic >C5 - C7 : HS_1D_MS_AR	mg/kg	< 0.01	NONE	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatic >C7 - C8 : HS_1D_MS_AR	mg/kg	< 0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Aromatic >C8 - C10 : EH_1D_CU_AR	mg/kg	< 2	MCERTS	< 2	< 2	< 2	< 2	< 2
Aromatic >C10 - C12 : EH_1D_CU_AR	mg/kg	< 2	MCERTS	< 2	< 2	< 2	< 2	< 2
Aromatic >C12 - C16 : EH_1D_CU_AR	mg/kg	< 2	MCERTS	< 2	2	< 2	< 2	< 2
Aromatic >C16 - C21 : EH_1D_CU_AR	mg/kg	< 3	MCERTS	< 3	22	< 3	4	5
Aromatic >C21 - C35 : EH_1D_CU_AR	mg/kg	< 10	MCERTS	< 10	43	< 10	31	< 10
Aromatic (C5 - C35) : HS_1D_MS+EH_1D_CU_AR	mg/kg	< 21	NONE	< 21	67	< 21	35	< 21
Total >C5 - C35 : HS_1D_MS+EH_1D_CU_Tot al	mg/kg	< 42	NONE	< 42	67	< 42	< 42	< 42



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Soil Analysis Certificate - TPH CWG Banded

DETS Report No: 22-06889	Date Sampled	11/08/22				
Apple Environmental Ltd	Time Sampled	None Supplied				
Site Reference: None Supplied	TP / BH No	BH.03/02/3361				
Project / Job Ref: CL/3361/SS	Additional Refs	None Supplied				
Order No: None Supplied	Depth (m)	None Supplied				
Reporting Date: 19/08/2022	DETS Sample No	608973				

Determinand	Unit	RL	Accreditation				
Aliphatic >C5 - C6 : HS 1D MS AL	mg/kg	< 0.01	NONE	< 0.01			
Aliphatic >C6 - C8 : HS 1D MS AL	mg/kg	< 0.05	NONE	< 0.05			
Aliphatic >C8 - C10 : EH 1D CU AL	mg/kg	< 2	MCERTS	< 2			
Aliphatic >C10 - C12 : EH 1D CU AL	mg/kg	< 2	MCERTS	< 2			
Aliphatic >C12 - C16 : EH 1D CU AL	mg/kg	< 3	MCERTS	< 3			
Aliphatic >C16 - C21 : EH 1D CU AL	mg/kg	< 3	MCERTS	< 3			
Aliphatic >C21 - C34 : EH 1D CU AL	mg/kg	< 10	MCERTS	< 10			
Aliphatic (C5 - C34) : HS 1D MS+1D CU AL	mg/kg	< 21	NONE	< 21			
Aromatic >C5 - C7 : HS 1D MS AR	mg/kg	< 0.01	NONE	< 0.01			
Aromatic >C7 - C8 : HS 1D MS AR	mg/kg	< 0.05	NONE	< 0.05			
Aromatic >C8 - C10 : EH 1D CU AR	mg/kg	< 2	MCERTS	< 2			
Aromatic >C10 - C12 : EH 1D CU AR	mg/kg	< 2	MCERTS	< 2			
Aromatic >C12 - C16 : EH 1D CU AR	mg/kg	< 2	MCERTS	< 2			
Aromatic >C16 - C21 : EH 1D CU AR	mg/kg	< 3	MCERTS	< 3			
Aromatic >C21 - C35 : EH 1D CU AR	mg/kg	< 10	MCERTS	< 10			
Aromatic (C5 - C35) : HS_1D_MS+EH_1D_CU_AR	mg/kg	< 21	NONE	< 21			
Total >C5 - C35 : HS_1D_MS+EH_1D_CU_Tot al	mg/kg	< 42	NONE	< 42			



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Soil Analysis Certificate - BTEX / MTBE						
DETS Report No: 22-06889	Date Sampled	11/08/22	11/08/22	11/08/22	11/08/22	11/08/22
Apple Environmental Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: None Supplied	TP / BH No	BH.01/01/3361	BH.01/02/3361	BH.02/01/3361	BH.02/02/3361	BH.03/01/3361
Project / Job Ref: CL/3361/SS	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: None Supplied	Depth (m)	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Reporting Date: 19/08/2022	DETS Sample No	608968	608969	608970	608971	608972

Determinand	Unit	RL	Accreditation					
Benzene : HS_1D_MS	ug/kg	< 2	MCERTS	< 2	< 2	< 2	< 2	< 2
Toluene : HS_1D_MS	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
Ethylbenzene : HS_1D_MS	ug/kg	< 2	MCERTS	< 2	< 2	< 2	< 2	< 2
p & m-xylene : HS_1D_MS	ug/kg	< 2	MCERTS	< 2	< 2	< 2	< 2	< 2
o-xylene : HS_1D_MS	ug/kg	< 2	MCERTS	< 2	< 2	< 2	< 2	< 2
MTBE : HS_1D_MS	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5



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Soil Analysis Certificate - BTEX / MTBE						
DETS Report No: 22-06889	Date Sampled	11/08/22				
Apple Environmental Ltd	Time Sampled	None Supplied				
Site Reference: None Supplied	TP / BH No	BH.03/02/3361				
Project / Job Ref: CL/3361/SS	Additional Refs	None Supplied				
Order No: None Supplied	Depth (m)	None Supplied				
Reporting Date: 19/08/2022	DETS Sample No	608973				

Determinand	Unit	RL	Accreditation				
Benzene : HS_1D_MS	ug/kg	< 2	MCERTS	< 2			
Toluene : HS_1D_MS	ug/kg	< 5	MCERTS	< 5			
Ethylbenzene : HS_1D_MS	ug/kg	< 2	MCERTS	< 2			
p & m-xylene : HS_1D_MS	ug/kg	< 2	MCERTS	< 2			
o-xylene : HS_1D_MS	ug/kg	< 2	MCERTS	< 2			
MTBE : HS_1D_MS	ug/kg	< 5	MCERTS	< 5			



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Soil Analysis Certificate - Sample Descriptions

DETS Report No: 22-06889	
Apple Environmental Ltd	
Site Reference: None Supplied	
Project / Job Ref: CL/3361/SS	
Order No: None Supplied	
Reporting Date: 19/08/2022	

DETS Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
608968	BH.01/01/3361	None Supplied	None Supplied	9.9	Black loamy sand with stones and vegetation
608969	BH.01/02/3361	None Supplied	None Supplied	17.7	Brown sandy clay with stones
608970	BH.02/01/3361	None Supplied	None Supplied	11.8	Brown loamy sand with stones and vegetation
608971	BH.02/02/3361	None Supplied	None Supplied	14.3	Brown sandy clay with stones and brick
608972	BH.03/01/3361	None Supplied	None Supplied	9.6	Brown sandy clay with stones and concrete
608973	BH.03/02/3361	None Supplied	None Supplied	16.2	Brown sandy clay with brick and concrete

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

Insufficient Sample ^{1/5}

Unsuitable Sample ^{1/5}



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Soil Analysis Certificate - Methodology & Miscellaneous Information

DETS Report No: 22-06889

Apple Environmental Ltd

Site Reference: None Supplied

Project / Job Ref: CL/3361/SS

Order No: None Supplied

Reporting Date: 19/08/2022

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 (C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID for C8 to C40. C6 to C8 by headspace GC-MS	E004
Soil	D	Fluoride - Water Soluble	Determination of Fluoride by extraction with water & analysed by ion chromatography	E009
Soil	D	Fraction Organic Carbon (FOC)	Determination of TOC by combustion analyser.	E027
Soil	D	Organic Matter (SOM)	Determination of TOC by combustion analyser.	E027
Soil	D	TOC (Total Organic Carbon)	Determination of TOC by combustion analyser.	E027
Soil	AR	Exchangeable Ammonium	Determination of ammonium by discrete analyser.	E029
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 (ali: C5- C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C34, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C35. C5 to C8 by headspace GC-MS	E004
Soil	AR	TPH LQM (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C35, C35-C44, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35, C35-C44)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C44. C5 to C8 by headspace GC-MS	E004
Soil	AR	VOCs	Determination of volatile organic compounds by headspace GC-MS	E001
Soil	AR	VPH (C6-C8 & C8-C10)	Determination of hydrocarbons C6-C8 by headspace GC-MS & C8-C10 by GC-FID	E001

D Dried
AR As Received



DETS Ltd
Unit 1, Rose Lane Industrial Estate
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Lenham Heath
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List of HWOL Acronyms and Operators
DETS Report No: 22-06889
Apple Environmental Ltd
Site Reference: None Supplied
Project / Job Ref: CL/3361/SS
Order No: None Supplied
Reporting Date: 19/08/2022

Acronym	Description
HS	Headspace analysis
EH	Extractable Hydrocarbons - i.e. everything extracted by the solvent
CU	Clean-up - e.g. by florisil, silica gel
1D	GC - Single coil gas chromatography
2D	GC-GC - Double coil gas chromatography
Total	Aliphatics & Aromatics
AL	Aliphatics only
AR	Aromatics only
#1	EH_2D_Total but with humics mathematically subtracted
#2	EH_2D_Total but with fatty acids mathematically subtracted
	Operator - underscore to separate acronyms (exception for +)
+	Operator to indicate cumulative eg. EH+HS_Total or EH_CU+HS_Total

Det - Acronym
Benzene - HS_1D_MS
Ethylbenzene - HS_1D_MS
MTBE - HS_1D_MS
TPH CWG - Aliphatic >C10 - C12 - EH_1D_CU_AL
TPH CWG - Aliphatic >C12 - C16 - EH_1D_CU_AL
TPH CWG - Aliphatic >C16 - C21 - EH_1D_CU_AL
TPH CWG - Aliphatic >C21 - C34 - EH_1D_CU_AL
TPH CWG - Aliphatic >C35 - C40 - EH_1D_CU_AL
TPH CWG - Aliphatic >C5 - C6 - HS_1D_MS_AL
TPH CWG - Aliphatic >C6 - C8 - HS_1D_MS_AL
TPH CWG - Aliphatic >C8 - C10 - EH_1D_CU_AL
TPH CWG - Aliphatic C5 - C34 - HS_1D_MS+1D_CU_AL
TPH CWG - Aromatic >C10 - C12 - EH_1D_CU_AR
TPH CWG - Aromatic >C12 - C16 - EH_1D_CU_AR
TPH CWG - Aromatic >C16 - C21 - EH_1D_CU_AR
TPH CWG - Aromatic >C21 - C35 - EH_1D_CU_AR
TPH CWG - Aromatic >C35 - C40 - EH_1D_CU_AR
TPH CWG - Aromatic >C5 - C35 - HS_1D_MS+EH_1D_CU_AR
TPH CWG - Aromatic >C5 - C7 - HS_1D_MS_AR
TPH CWG - Aromatic >C7 - C8 - HS_1D_MS_AR
TPH CWG - Aromatic >C8 - C10 - EH_1D_CU_AR
TPH CWG - Total >C5 - C35 - HS_1D_MS+EH_1D_CU_Total
TPH CWG - Total >C6 - C40 - HS_1D_MS+EH_1D_CU_Total
Toluene - HS_1D_MS
m & p-xylene - HS_1D_MS
o-Xylene - HS_1D_MS



CUSTOMER: Apple Environmental Ltd

FIRMWARE: V8.14
UPGRADED TO: V9.4

TESTS	Pre Service	Post Service
Charger Test		ok
Battery charge Test		ok
Lamp Test		ok
Air Flow Test ≥ 220ml/min	232ml/min	238ml/min
Block Flow Test ≤ 15ml/min		7ml/min
Moisture Sensitivity = 0.0ppm		0.0ppm
Switch Test		ok
Sensor Test		ok
Alarm Test		ok
PC Comms Test		ok
Datalog Test		ok
Display Test		ok
Physical Inspection		ok
PAT Test		ok
Firmware Upgrade		ok
Software Upgrade (usb)		N/A
Function Test		ok
Run time	25:52	

Flow as received:232ml/min.
Run time as received:25:52.
Upgraded firmware from V8.14 to V9.4.
Set real time clock.
Tested comms cable - OK.
Replaced stack, sensor seal, inlet/outlet seals and PTFE filter as per annual scheduled maintenance.
Replaced lamp as per biennial scheduled maintenance.
Flow:238ml/min.
Blocked flow rate:7ml/min.
Moisture sensitivity:0.0ppm
Instrument serviced, calibrated, bump tested and fully charged.



Life-saving solutions

CERTIFICATE OF CALIBRATION

Phocheck Tiger

CALIBRATION CERTIFICATE NO: 74185

ISSUED BY: SHAWCITY LIMITED
DATE: 21-Jul-22

APPROVED SIGNATORY: 

NAME: Freya Whyte

CUSTOMER: Apple Environmental Ltd
INSTRUMENT: PhoCheck Tiger
SERIAL NUMBER: T-113211

CALIBRATION METHOD: CM03
AMBIENT CONDITIONS: 20°C ± 2°C and 50% (± 20%) RH

Prior to calibration the instrument was allowed to stabilise in the laboratory for at least 30 minutes.
The instrument was calibrated by exposing the sensor to known values of gas concentrations.
All gases were sampled through the complete probe and in line filter, where applicable.
The reference value is that generated by the certified source and the indicated value is that measured by the instrument.

CALIBRATION RESULTS

GAS	LOT No	REF. VALUE	INDICATED VALUE
Isobutylene	WO358840-1	100 ppm	100 ppm
Isobutylene	WO3224037-1	1000 ppm	1000 ppm
Benzene	WO358841-1	5ppm	5.1ppm

COMMENTS:

The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor of $k=2$.
This provides a level of confidence of uncertainty of approximately 95%.
The uncertainty of measurement is $\pm 2\%$
The results indicate that the instrument conforms to the applicable parts of the published specification.

HEALTH & SAFETY, OCCUPATIONAL HYGIENE AND ENVIRONMENTAL MONITORING INSTRUMENTS

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