



**Proposed Residential
Development, Woodcroft
Farm, Waterlooville,
Hampshire**

**Geoenvironmental and Geotechnical
Ground Investigation Report**

Project Ref: 21834/030

Doc Ref: R02/rev01

July 2013

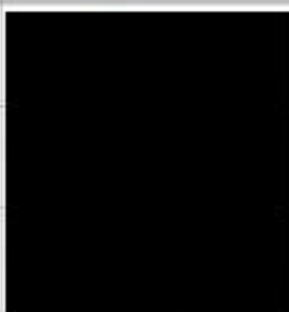
Peter Brett Associates LLP
Caversham Bridge House
Waterman Place
Reading
Berkshire
RG1 8DN
T: 0118 9500761
F: 0118 9597498
E: reading@peterbrett.com



This page is intentionally blank

Document Control Sheet

Project Name: Proposed Residential Development, Woodcroft Farm, Waterlooville, Hampshire
Project Ref: 21834/030
Report Title: Geoenvironmental and Geotechnical Ground Investigation Report
Doc Ref: R02/rev01
Date: November 2011

	Name	Position	Signature	Date
Prepared by:	Arie Zamler	Engineer		4/07/2013
Reviewed by:	Asmi Desai	Senior Engineer		4/07/2013
Approved by:	Richard Thomas	LLP Director		4/07/2013
For and on behalf of Peter Brett Associates LLP				

Revision	Date	Description	Prepared	Reviewed	Approved
Rev00	Nov 2011	Draft for Comments	AZ	AD	RHT
Rev01	July 2013	Final for Issue	AZ	AD	RHT

Peter Brett Associates LLP disclaims any responsibility to the Client and others in respect of any matters outside the scope of this report. This report has been prepared with reasonable skill, care and diligence within the terms of the Contract with the Client and generally in accordance with the appropriate ACE Agreement and taking account of the manpower, resources, investigations and testing devoted to it by agreement with the Client. This report is confidential to the Client and Peter Brett Associates LLP accepts no responsibility of whatsoever nature to third parties to whom this report or any part thereof is made known. Any such party relies upon the report at their own risk.

© Peter Brett Associates LLP 2013

This page is intentionally blank

Contents

Summary	1
1 Introduction	4
2 Site Description	5
2.1 Site Location, History and Current Use	5
2.2 Published Geology	5
2.3 Historical Borehole Records	6
2.4 Geological Hazards	6
2.5 Hydrogeology	7
2.6 Hydrology	8
3 Ground Investigations	9
3.1 Aim of the Investigation	9
3.2 Fieldwork	9
3.3 Laboratory Testing	10
3.4 Monitoring	10
3.5 Limitations	10
4 Ground Conditions	11
4.1 Introduction	11
4.2 Sinkholes and Sinkhole Infill	11
4.3 Made Ground	12
4.4 Head Deposits	13
4.5 Lambeth Group	14
4.6 Upper Chalk	15
4.7 Groundwater	15
5 Geoenvironmental Conditions	16
5.1 Contamination	16
5.2 Aggressiveness of the Ground	17
5.3 Ground Gases	18
6 Tier 2 Geoenvironmental Risk Assessment	19
6.1 Introduction	19
6.2 Hazard Identification	19
6.3 Hazard Assessment	19
6.4 Risk Estimation	20
6.5 Risk Evaluation	20
6.6 Conclusions	20
6.7 Confidence and Uncertainty	21
7 Geotechnical Assessment	22
7.1 Proposed Development	22
7.2 Known Sinkholes and Subsidence Risk	22
7.3 Foundations – Areas A, B and D	22
7.4 Foundations in Area C (Infilled Ground)	23
7.5 Potential for Volumetric Change	23
7.6 Pavement Design	24
7.7 Earthworks	24
7.8 Slope Stability	24
7.9 Infiltration Drainage	24
8 Outline Remediation Strategy	26
8.1 Introduction	26
8.2 Area C	26
8.3 Area D	27

Proposed Residential Development, Woodcroft Farm, Waterlooville, Hampshire
Geoenvironmental and Geotechnical Ground Investigation Report

8.4	Areas C and D	27
8.5	Future Ground Investigation	27
9	References	28
10	Essential Guidance for Report Readers	30

Tables

1	Summary of Chemical Analysis of Soil Samples
2	Summary of Chemical Analysis of Soil Eluate Samples
3	Pollutant Linkages and Risk Estimation

Figures

1	Site Location Plan
2	Site Layout Plan
3	Schematic Sections
4	Standard Penetration Tests
5	Atterberg Limits
6	Undrained Shear Strength
7	Ground Conditions and Potential Constraints
8	Proposed Development of Natural Cavities in Chalk

Appendices

1	Historic Borehole Records
2	Window Sampling Borehole Records
3	Geoenvironmental Testing Results
4	Monitoring Records
5	Rationale for the Selection of Generic Assessment Criteria
6	Methodology and Criteria used to Assess Geoenvironmental Risk

Summary

This report presents an interpretation of the findings of the geotechnical and geoenvironmental investigation carried out to determine the ground conditions at the site of Woodcroft Farm, Waterlooville. The investigation has been carried out to determine the ground conditions on the site to support the planning application for the proposed development.

The site is located adjacent to the western part of Horndean, near Waterlooville. The site is situated on ground sloping to the southeast with a small valley feature located along the western boundary. Historically the site has been used as a farm with open fields although a chalk pit was infilled with inert waste during the 1970s. Currently the site is occupied by a farm and fields used for grazing horses and a small yard occupied by a vehicle dismantling and repair workshop. There are a number of sinkholes as a result of karstic weathering of the Chalk recorded within the site and the near area.

The investigation revealed that ground conditions in the northwest part of the site comprise Pleistocene Head Deposits overlying Chalk Bedrock. On the south and east parts of the site Lambeth Group clay is present overlying the Chalk, with occasional pockets of superficial Head Deposits present overlying the Lambeth Group. Made Ground was encountered overlying the natural soils in the infilled pit and within the farmyard. Sinkholes associated with karstic weathering of the Chalk and solution feature cavity infills were encountered at a number of locations at the site. Details of the strata are summarised in the following table.

Stratum		Depth to base (m bgl)	Typical Description
Sinkhole and Solution Features Infill		2.5 to 7.5	Variable in composition and comprised clay with variable proportions of sand and gravel and silty sand with some chalk and flint gravel.
Made Ground	Infilled Pit	0.6 to 5.8	Variable in composition and comprised clay with changing proportions of sand, gravel and some timber and organic matter. Locally layers of sandy gravel with cobbles and boulders of concrete and brick up 1.2 m long were found.
	Dismantling Yard	0.5 to 0.6	Variable in composition and comprised clayey gravel and sandy gravelly clay.
Head Deposits		1.4 to 4.2	Typically comprises clay with variable proportions of silt, sand and gravel with pockets and beds of sand and/or gravel with some clay.
Lambeth Group		2.4 to 12.7	Multicoloured clay with some silt and sand partings and locally silt and sand. The clay locally contains red and black round and subrounded flint gravel
Upper Chalk		>15.0 base not proven	White with black specks with occasional orange staining recovered as gravelly sandy chalk silt and a silty chalk gravel and cobbles. Locally the Chalk contained seams <5 mm thick of soft brown clay.

Groundwater level in the Chalk as measured in an existing water well was at about 30 m depth. Perched groundwater table was encountered within the Lambeth Group with groundwater levels measured between 4.1 and 6.5 m below ground level.

As confirmed by the ground investigation there are no site wide plausible pollutant linkages because there are no pollutant sources on most of the site. The exceptions are the infilled pit and the vehicle repair/dismantling areas where locally elevated concentrations of a limited number of heavy metals, PAH and asbestos were identified when screened against assessment criteria for a residential with plant uptake land use.

The concentrations of potential contaminants in the eluate from soils on site are below the Environmental Quality Standards values for surface waters and the UK drinking water quality standards. Hence the risks to groundwater are considered to be negligible and not taken forward.

The presence of slightly impacted soils associated with the Made Ground in the infilled pit and the vehicle dismantling area, will require some form of mitigation / remediation if used for residential purposes. There a number of options with regards to the mitigation measures / remediation. The preferred option should be chosen on the balance between economics, sustainability and a reduction in the level of risk as it currently exists. Alternatively, land use other than residential with gardens can be considered for these areas.

Measured concentrations of ground gases indicate elevated methane and carbon dioxide in the infilled pit and the vehicle dismantling yard. Gas protection measures are required for any proposed structures in these areas.

Given the disturbed nature of the soils within and immediately adjacent to the sinkholes a buffer zone of 10m from the known edge of any untreated sinkhole is recommended for any development including buildings, services or roads. Alternatively, the sinkholes can be stabilised to allow future development.

Undiscovered solution features that can lead to sinkhole formation are a site wide subsidence hazard. Furthermore, the Head Deposits may present a risk of excessive total and/or differential settlement if conventional shallow foundations are adopted, even when solution features or sinkholes are absent. It is recommended that the proposed buildings are founded on re-inforced conventional spread or strip foundations, using a combination of probing at close centres and the design of foundations and/or ground beams to span a potential void are adopted to reduce the risk of structural damage due to subsidence or settlement to an acceptable level. Alternatively, re-inforced concrete raft foundations designed to span a 3 m diameter void can be used. Piled foundations are unlikely to be suitable because of the deep penetrative weathering present in places at the site and the possible presence of deep unconsolidated and variable solution feature infill.

The Made Ground in the infilled pit is unsuitable as a founding medium due to its weak and compressible characteristics. It could remain as public open space, however, if needed for development, the most suitable foundation solution for this area is to excavate and remove the upper 2.0 m of the Made Ground and replacement it with an engineered fill. After backfilling the ground can be used to support a grillage of ground beams or a reinforced raft foundation that can accommodate long term settlement of the infill material below. Alternatively, ground improvement using dynamic compaction may be a suitable technique to provide a base to support structures.

The natural soils on site are likely to be suitable for reuse as engineered fill. The materials are likely to be classified as Class 2A and 2C in accordance with the Series 600 of the Highway Agency Specification for Highway Works. The natural moisture content of the near surface materials is relatively high compared to the optimum moisture content, as such, the near surface materials are likely to require some moisture conditioning prior to compaction.

Surface water drainage using infiltration (soakaways) is not likely to provide a suitable site wide drainage solution to accommodate surface runoff from the development because clay soils predominated at shallow depth over much of the site. Also any soakaways will need to be sited at least 20 m from any structures in case the concentrations of water inflow mobilise solution feature movement. Deep bored soakaways may be suitable however locations should be checked for any evidence of karst features and positions adjusted where possible to avoid solution features.

Proposed Residential Development, Woodcroft Farm, Waterlooville, Hampshire
Geoenvironmental and Geotechnical Ground Investigation Report

Additional ground investigation is not likely to be required to support the planning application for redevelopment of the site at this stage. However, additional ground investigations may be required prior to the redevelopment of the site and as part of the detailed design process to confirm the findings of the ground investigation and design any remediation and/or mitigation measures should these would be required with regards to its geoenvironmental conditions, and to deal with the risks associated with subsidence hazard associated with solution features.

The summary contains an overview of the key findings and conclusions. However no reliance should be placed on any part of the summary until the whole of the report has been read

1 Introduction

Peter Brett Associates LLP, PBA, have been retained by Grainger plc, the Client, to carry out a Geotechnical and Geoenvironmental Ground Investigation at the site of Woodcroft Farm, Waterlooville, Hampshire.

Previously a desk study review of readily available published information was carried out to assess the ground conditions on the site and the potential for contamination to be present associated with previous and present uses of the site and the surrounding areas. The report included a qualitative assessment of the geotechnical and geoenvironmental constraints for development. In particular the report identified that a small part of the site had been landfilled with waste parting the past, and that there was a ground stability solution feature hazard at the site. The report was used to inform the design of the ground investigation. The findings of the desk study are presented in a separate report prepared by Peter Brett Associates LLP (PBA, 2010).

The investigation has been carried out to determine the ground conditions on the site to support the planning application for the proposed development. The primary aims of the investigation were to meet the requirements of PPS23: Planning and Pollution Control, Annex 2, Development on Land Affected by Contamination, and PPG14: Development on Unstable Land.

The fieldwork and geotechnical laboratory testing were carried out by Risk Management Ltd acting under instruction of Peter Brett Associates LLP. The factual results of the investigation are presented in a separate report prepared by Risk Management (RML, 2011), with the exception of the Window Sample logging records and the contamination testing certificates, both items of work that were undertaken by PBA.

This report contains the remainder of the factual data, an interpretation of all of the factual information and comments on the ground conditions in relation to the design and construction of the proposed development, together with an assessment of the risk associated with existing contamination in the ground.

Unless stated otherwise, information from previous studies and investigations has not been included in this report and, where referenced, the reports presenting this information should be read in conjunction with this report.

Attention is drawn to the Essential Guidance for Report Readers in **Section 9**, which provides guidance on the context of the report.

2 Site Description

2.1 Site Location, History and Current Use

The site comprises an area of land that forms part of Woodcroft Farm, located adjacent to the western fringes of Horndean, near Waterlooville. This site is located approximately 2 km to the west of Junction 2 the A3(M) Motorway. The site is located at National Grid Reference SU 682 120. The location of the site is shown on a Site Location Plan presented as **Figure 1**.

The site is irregular in shape with overall plan dimensions of about 650 m along the southern boundary by up to 300 m along the western boundary and occupies an area of some 10 hectares. The ground level falls from the highest point located in the northeast part of the site at about 72.5 m OD to a minor valley feature at the southwest part of the site at about 55.5 m OD along the western site boundary. The site is bounded by a recreation ground and a school to the southeast. Residential housing bounds the southern and eastern boundaries of the site. Agricultural farmland, horse paddocks and woodlands bound the site to the north and west.

Available information indicates that from around the 1870s the site and the immediate surrounding area were predominantly undeveloped consisting mainly of agricultural farmland and woodlands. The site comprises six fields and several farm buildings (including a well) named as Woodcroft Farm which are located within the southwestern part of the site. Four chalk pits and a possible pond are marked on the historical maps within the west part of the site, one of the pits is later labelled as a pond. By the 1930s residential development had taken place approximately 200 m to the east of the site. By the 1960s further residential development had taken place adjacent to the eastern site boundary. By the 1970s the chalk pit labelled in Field 2 had been backfilled. According to the Environment Agency records the pit was filled with 'Deposited waste including industrial waste' (LIG, 2010). Anecdotal information from the farm tenant, Mrs Jenny Manson indicates that the pit was backfilled with inert and construction demolition materials. The farm tenant also stated that the area of the infilled pit continued to settle over the years. Cowplain Meadowlands Junior and Infant School was developed adjacent to the southeastern site boundary, with residential premises to the south of the school.

At the time of the investigation the site comprised predominantly a farmyard and 6 fields used as agricultural pastureland for the grazing of horses. Woodcroft Farm farmyard is located within the central western part of the site. The farm comprised 9 sheds, the majority of which were used as stables and for hay and tack storage. Woodcroft Farm farmhouse is located immediately to the south of the farmyard, with gardens extending 15 m to the north of the house and 20 m to the west. A water well was located about 2 m to the north of the house. A small (~1000 litre) disused fuel storage tank (observed to be empty) was located approximately 20 m to the west of the house. A number of outbuildings are located around the house, and are seemingly used as garages/storage. The stables and outbuildings were observed to be of stone blockwork or metal cladding construction with either metal or possible asbestos cement sheet roofs. A yard used for dismantling and repair of cars and other vehicles is located immediately adjacent to a second yard used to store racing cars is located about 20 m northwest of the farmyard.

Further details of the history and present layout of the site are given in the desk study report (PBA, 2010). The layout of the site is shown on a Site Layout Plan presented as **Figure 2**.

2.2 Published Geology

The 1:50 000 scale geological map of the area (BGS, 1998) indicates the solid geology in the vicinity of the site comprises the Lambeth Group (formerly the Woolwich and Reading Beds), which is described as mottled locally sandy clay and overlying the Upper Cretaceous Chalk at depth. The solid geology is shown to overlain by Head Deposits along a small valley located in the central-western part of the site. According to the geological map the Head Deposits comprise sandy silty clay, locally gravelly, chalk and flint. It is possible that due to the topography at the site, Head Deposits derived

from reworking of the Lambeth Group and the Chalk by natural processes may be present in other parts of the site.

The 1:10 000 scale geological map of the area (BGS, 1980) confirms the geology presented on the 1:50 000 scale map. The map also identifies four sinkholes labelled as 'Solution Hollows' located within the western half of the site. A number of other sinkholes are marked beyond the northern and western site boundaries.

2.3 Historical Borehole Records

The British Geological Survey archives contain records of a number of borehole and water wells previously completed in the vicinity of the site. Copies of a number of borehole and well records have been obtained from the archives, these comprise:

- a) The record of six boreholes sunk approximately 100 m southeast of the site (BGS, 1975).
- b) The record of a water well SU61SE114 sunk on site, approximately 2 m north of the farmhouse (BGS, 1966).

The borehole records indicate that the geology 100 m to the southeast of the site comprise the Lambeth Group underlain by Chalk. A summary of the ground conditions in the historic borehole records is presented in the table below.

Strata	Depth (m)	Description
Lambeth Group	1.8 - 10.5	Multicoloured clay locally sandy with some flint gravel pockets and/or thin layers (<0.8 m thick) of sand.
Chalk	> 11.0 (base not proven)	Recovered as gravel fragments with remoulded matrix and flint nodules. Locally a layer (<1.0 m thick) of hard chalk was encountered at the top.

Groundwater within the Lambeth Group was recorded at a number of boreholes locations between 0.2 and 5.1 m below ground level. This groundwater body is considered to be perched.

The water level in the historic well records indicates that the water level in 1968 within the Chalk varies between 27 m and 42 m depth, typically being around 34 m below ground level.

Copies of these records have been reproduced in **Appendix 1** and the location of the well is shown on the Site Layout Plan, **Figure 2**.

2.4 Geological Hazards

The geological hazards presented in the Envirocheck Report (LIG, 2010) which have been assembled from data provided by the British Geological Survey and the National Geoscience Information Service.

The potential risks from the majority of geological hazards at the site are negligible or very low with the exception of ground dissolution stability hazards and hazards arising from shrinking or swelling clays which are both classed as Moderate risk. The risk for ground subsidence over karstic weathering hazards is estimated by PBA as High (PBA, 2010).

Ground subsidence over karstic weathering formed by dissolution of chalk is a consequence of a continuing natural process. The surface depressions created are generally referred to as sinkholes. Across the Chalk outcrop sinkholes are associated with the presence of cover deposits, especially those of Tertiary age, such as the Lambeth Group (Edmonds, 2008), and also where Pleistocene Head Deposits are present. A schematic diagram illustrating the proposed development of natural cavities in Chalk is given in **Figure 8**.

Four subsidence features are located within the fields and farmyard to the north of the farmhouse. These features are likely to be associated with karstic weathering of the Chalk. One of the features is located in Field 3 where ground level is about 2 to 3 m lower than that of the surrounding land. This feature is surrounded by mature trees. A second depression feature is located in the centre of Field 4 where the ground is about 1 m below the surrounding land. This feature is surrounded by mature trees. The third feature is located in the north part of Field 4 and here the feature is about 2 to 3 m lower than the surrounding ground. The fourth is located within the farmyard to the east of the stables. This feature is shown in the topographical survey as a pond; at the time of the investigation the feature was dry. This feature is about 2 m lower than the surrounding ground. A ditch connected to the feature is located at the southeast end and a pipe possibly used to discharge storm water into the feature is located within the western end. A small retaining structure along the western face of the feature was noted to show signs of distress.

It is likely that the chalk pit located in Field 1 that was backfilled with waste in 1970s is a man made feature rather than a sinkhole due to its large size and geometry. However, there may have been a smaller sinkhole at this location that provided easy access to the Chalk bedrock for quarrying and at this stage the presence of a sinkhole at this location cannot be ruled out completely.

A search of the PBA Natural Cavities Database indicated that there are five recorded natural cavity features within or adjacent to the site area. This information strongly suggests that the underlying ground is particularly susceptible to karstic weathering in this area, and as such the hazard arising from this type of ground stability feature is likely to be **High**. In addition, to these records, there are over twenty further potential cavity recorded within 250 metres radius of the site boundaries (PBA, 2010).

2.5 Hydrogeology

The published groundwater vulnerability map of the area (NRA, 1995) indicates the Head Deposits are classified as a 'Secondary (undifferentiated)' aquifer. A 'Secondary (undifferentiated)' aquifer has been assigned in cases where the stratum in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.

The Lambeth Group is classified as a 'Secondary A' aquifer. These strata are capable of supporting water supplies at a local rather than regional scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.

The Chalk is classified as a 'Principal Aquifer'. These are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer.

Groundwater vulnerability mapping (NRA, 1995) shows that the soils on the majority of the site are have low leaching potential, where as the soils at the northwest corner of the site are shown to have Intermediate Leaching Potential (I1) (NRA, 1995). Intermediate leaching potential soils have some ability to attenuate diffuse source pollutants and in which non-absorbed diffuse source pollutants and liquid discharges have the potential to move rapidly to underlying strata or to shallow groundwater.

The EA has defined Source Protection Zones (SPZs) for valuable water resources such as wells, boreholes and springs used for public drinking water supply. According to the EA website (2011) the entire site is located within an Inner Source Protection Zone (Zone 1). SPZ1 is defined as the 50 day travel time from any point below the water table to the source.

According to the Envirocheck Report (LIG, 2010) there are two recorded groundwater abstractions located within a 2 km radius of the site from the Chalk. The closest abstraction license is registered to Portsmouth Water Ltd located approximately 1.1 km to the north of the site and is used for potable water supply. It is understood that the Inner SPZ (Zone 1) that underlies the site is in-place to safeguard this abstraction borehole.

The groundwater information available (see **Section 2.3**) suggests it is plausible there are two groundwater bodies beneath the site; one a perched water table within the Lambeth Group at around 5 m below ground level, with the main regional water table being within the Upper Chalk at around 30 m below ground level.

The 1:100 000 scale hydrogeological map of the area (BGS, 1974) indicates that the groundwater levels in the Chalk during October 1973 were at about 30 m below existing ground level. The groundwater is shown to flow to the south and southeast.

2.6 Hydrology

The closest surface water feature to the site an un-named drain located approximately 550 m to the southeast of the site, an un-named pond is located approximately 600 m to the north of the site boundary.

At the time of the investigation, no on-site surface water features were observed including the pond as labelled in the topographical survey and the ditch.

According to the Envirocheck Report (LIG, 2010), there are no licensed surface water abstractions within a 2 km radius of the site boundary.

3 Ground Investigations

3.1 Aim of the Investigation

The aim of the investigation was to confirm the findings of the previous study and provide additional detailed information on the ground conditions within the area of site such that informed decisions on the proposed development of the site can be made. The principal aims of the investigations were to determine:

- The geotechnical characteristics of the ground to provide information for the design of foundations and other engineering works.
- The nature and extent of potential sinkholes present on the site to assess the potential impacts on ground stability.
- The potential contamination of the ground and groundwater to assess the potential impact of any such contaminants on the proposed development, with particular focus on the nature and extent of the infilled pit and the vehicle dismantling area.
- The hydrogeological characteristics of the ground to assess the potential for migration of potential contaminants in the area.
- The nature and extent of ground gases present on the site to assess the potential impact of any such gases on the proposed development.

The ground investigation works carried out are summarised in the following sections. The description of the fieldworks, borehole records, trial pit records, dynamic probing records and geotechnical laboratory testing results are presented in a separate report prepared by Risk Management Limited (RML, 2011) and which should be read in conjunction with this report. The window sampling borehole records, geoenvironmental testing and monitoring records are presented within **Appendices 2, 3 and 4** of this report respectively.

3.2 Fieldwork

The fieldwork for the investigation was carried in accordance with BS5930 (2010). The work was carried out between 22 and 30 August 2011 and comprised the following:

- The sinking of 4 boreholes, designated BH 01 to 04 to provide information on the ground conditions;
- The sinking of 11 window sampling boreholes, designated WS01 to WS11;
- The installation of monitoring wells in selected boreholes to allow monitoring of ground gas concentrations, flows and groundwater levels.
- The sinking of 10 dynamic probing holes, designated P1 to P1; and
- The excavation of 15 trial pits, designated TP 01 to 04, 9 to 11, 13, 14, 17 to 22.

The boreholes were sunk using light cable percussion techniques to between 5.0 and 15.0 m below existing ground level to provide information on ground conditions and to recover samples of the materials encountered for visual examination and laboratory testing. All open derive samples were taken with a thin walled drive sampling system in order to obtain a Class 1 sample of the cohesive soils present for laboratory strength tests in accordance with the requirements of BS EN ISO 22475-1 (2006).

The window sampling boreholes were sunk using a hand held window sampler to between 2.5 and 8.0 m below existing ground level to provide information on the ground conditions and to recover samples of the materials encountered for visual examination and laboratory testing.

On completion a shallow groundwater and ground gas monitoring well was constructed in each of the boreholes and in selected window sampling boreholes. The monitoring wells were constructed with 50 mm diameter in the boreholes and 19 mm in the window sampling boreholes. Well casing and well screen were installed to between 1.0 and 7.0 m below existing ground level to allow monitoring of groundwater levels and ground gas concentrations in the near-surface soils.

The dynamic probes were sunk using a dynamic probing heavy (DPH) rig to between 2.9 and 10.0 m below existing ground levels to provide information on the ground strength profile within the sinkholes.

The trial pits were excavated using a wheeled excavator with 180 degrees backhoe to depths between 2.0 and 4.0 m below existing ground level to provide information on the near surface soils.

The location of each exploratory position was established by RML using a taped distance from known features shown on the site plan. The exploratory hole coordinates were determined by RML by using a taped distance from known features shown on the site plan. The elevation of the exploratory holes was estimated by PBA using the existing topographic survey. The approximate locations of the exploratory positions are shown on **Figure 2**.

3.3 Laboratory Testing

On completion of the fieldwork, a programme of laboratory soils testing was carried out to verify the visual identification and classification, and to determine the physical properties of selected samples of the materials encountered. Samples of soil for laboratory testing were taken from the exploratory holes and selected to be representative of the materials encountered.

In addition, a programme of laboratory chemical tests was carried out on samples of soil to determine the concentrations of a number of potential contaminant.

3.4 Monitoring

Each of the monitoring wells installed in the boreholes as part of the investigation have been monitored to determine the water level and the concentrations of methane, carbon dioxide and oxygen together with gas flow rates and atmospheric pressure. Four monitoring rounds on a weekly basis were carried out between 8 and 28 September 2011.

3.5 Limitations

The locations of the exploratory holes have been selected to provide information on the geotechnical and geoenvironmental conditions on the site and thus to provide information for the design of the foundations and below ground elements of the proposed development and to enable a qualitative assessment to be made of the hazards posed by the existing site conditions to the environment.

Borehole BH01 was scheduled to be drilled to a minimum of 20.0 m below ground level. The borehole was terminated at 5.0 m due to a hard band of chalk immediately below the Lambeth Group Deposits. An additional borehole (BH04) was scheduled to 20.0 m depth, however, due to hard chalk band this borehole terminated at 7.3 m depth.

It should be noted that there may be conditions pertaining to the site which were not disclosed by the investigation and which therefore could not be taken into account in the interpretation of the factual data to determine the ground conditions on the site and the assessment of the geoenvironmental and geotechnical conditions on the site presented in the following **Sections 4.0 to 7.0** of this report.

4 Ground Conditions

4.1 Introduction

The ground conditions, as revealed by the historical borehole records and ground investigation, are in partial agreement with the published geological information and known history of the site. The Head Deposits appear more extensive and thicker in the central and southwest parts of the site than anticipated based on the geological map. In many places the Head Deposits directly overlie the Chalk, while the Lambeth Group is absent. It is likely that periglacial weathering has resulted in removal of the Lambeth Group deposits along the valley feature footprint and resulted in the accumulation of the Head Deposits. Made Ground was locally encountered overlying the natural soils in the infilled pit and within the farmyard.

Details of the soils encountered are given in the following sections and are illustrated on Schematic Geological Sections included as **Figure 3** of this report. The line of the sections is shown on the Site Layout Plan, **Figure 2**. The details of the strata encountered have been determined from the findings of the investigation.

Based on the ground conditions encountered and the historic and current land use the site can be divided into four main Areas (Areas A to D).

- **Area A** – Head Deposits underlain by Chalk.
- **Area B** – Lambeth Group underlain by Chalk and locally overlain by Head Deposits.
- **Area C** – Infilled Pit comprising Made Ground underlain by Chalk and locally by Head Deposits.
- **Area D** – Dismantling and repair car yard comprising a veneer of Made Ground underlain by Head Deposits and Lambeth Group over Chalk.

The four main areas are marked in **Figure 7**. The boundaries shown on the figure for each area are approximate and conjectural.

Where derived values of parameters or characteristic values are suggested in the discussion on ground conditions and geotechnical parameters are given below, reference should be made to the terminology and definitions given in BS EN 1997-1 (2004) and BS EN 1997-2 (2007), as appropriate. The characteristic values of the geotechnical parameters suggested in this report are appropriate for the limit state or limit states likely to be used for the geotechnical design, based on the information available on the structures proposed at the time of writing this report. The actual characteristic values of geotechnical properties for use in design should be determined by the Geotechnical Designer after a further review and taking into consideration the limit states and design methods being used. The process by which final design values are selected should be documented by the Geotechnical Designer in his Geotechnical Design Report. Further guidance on selection of design parameters is given in BS EN 1997-1 (2004) Section 2.4.

4.2 Sinkholes and Sinkhole Infill

Ground subsidence over karstic weathering formed by dissolution of chalk is a consequence of a continuing natural process. The surface depressions created are generally referred to as sinkholes. There are four potential sinkholes that caused by solution features within the Chalk present at the site. For ease of reference from this point in the report the sinkholes at the site are referred to as Sinkhole 1 to Sinkhole 4. The sinkholes are shown and labelled accordingly in **Figure 2**.

Elsewhere on site the geological setting is typically favourable solution feature development and the presence of loose compressible solution feature infill even though there might not be an actual

sinkhole depression at the surface. Such conditions are present in Borehole BH02 where solution feature infill is present within the Chalk between 3.15 and 4.30 m depth. The infill materials comprised silty sand with occasional fragments of chalk. The SPT N values for this borehole ranged from 1 to 13 between ground level and about 10 m depth with values of 1 and 3 within the solution feature infill, these correspond to a very loose relative density insitu. From 10 m depth the SPT N values increased to between 21 and over 50 blows. The profile of Borehole BH2 illustrates the combined effects of periglacial and dissolution weathering to a depth of 10 m below existing ground level. While a sinkhole does not appear at this location, the ground conditions illustrated by this borehole do indicate favourable conditions for sinkhole development.

Sinkholes 1 and 2

It is likely that Sinkhole 1 and Sinkhole 2 are associated with sinkhole development within the Head Deposits in a paleo-valley feature. It is likely that periglacial weathering (including the release of cold meltwater from frozen ground conditions) has removed the Lambeth Group and interacted with the former karst zone beneath the former Lambeth Group/Chalk interface and underlying subvertical joints in the Chalk to form sinkholes within the irregular Head Deposits/Chalk interface. Deeply penetrating weathering of the Chalk is apparent to at least 10m depth as recorded in BH02.

The dynamic probe blow count in Sinkholes 1 and 2 exhibit very weak deeply penetrating profiles. In Sinkhole 1 the sinkhole infill/Chalk interface is irregular and is between 2.5 and 3.5 m below ground level. In Sinkhole 2, the sinkhole infill/Chalk interface is irregular and is between 4.5 and 7.5 m below ground level. The sinkhole infill is of variable strength and the blow count in the Chalk is indicative of structureless and weak chalk. The sinkhole infill within Sinkholes 1 and 2 comprises of clay with variable proportions of sand and gravel with occasional cobbles. Occasional beds and pockets of sand are also present with changing proportions of clay and gravel and rare cobbles. The gravel and cobbles fractions comprised flint and chalk.

There is no specific evidence of an underlying large scale solution pipe and therefore it is more likely that the hollows have developed as a sinkhole centred over solution widened and infilled subvertical joints that extend to depth in the Chalk and may radially inter-link with other solution cavities associated with bedding planes in the Chalk. Such cavities may be both infilled with low strength sands/clays/gravels or even maybe open and air-filled.

Sinkhole 3

The ground profile in Sinkhole 3 contained Lambeth Group at the surface. Here the sinkhole is likely have developed over a weathering feature associated with a karst horizon in the Chalk that has migrated up to the surface through the Lambeth Group.

Sinkhole 4

At the time of the investigation the possible sinkhole labelled as Sinkhole 4 in the former pond could not be investigated due to limited access.

4.3 Made Ground

4.3.1 Area C – Former Landfill

Made Ground was encountered at all the locations investigated at the infilled pit where landfill materials were placed during the 1970s. The Made Ground (Landfill) was found to be variable in composition and comprised brown grey and black clay with variable proportions of sand and gravel. Locally layers of sandy gravel with some clay were found. The gravel size fraction was typically composed of flint, chalk, brick, concrete, and other rare man-made materials such as metal, glass and plastic. Some timber and organic matter were encountered within the Made Ground. Some of the clay materials within the landfill were noted to have organic odour. The Made Ground within the infilled pit locally contained fragments of concrete and brick sections up to 1.2 m long and 0.2 m thick. The Made

Ground was encountered to between 0.6 m (TP04) to a maximum depth of 5.8 m below ground level (WS02) in the infilled pit.

Visual examination of the clay fraction within the Made Ground indicates the clay is variable in consistency ranging from soft to stiff.

In general, olfactory and visual signs of anthropogenic contamination were not noted in the Made Ground (Landfill). The exception includes a fragment of cement bound tile suspected to contain asbestos that was detected in TP02 within the infilled pit.

4.3.2 Area D – Vehicle Dismantling

Made Ground was encountered at both locations investigated at the dismantling and repair yard. The Made Ground was found to be variable in composition and comprised brown and black clayey gravel and brown sandy gravelly clay. The gravel size fractions were typically composed of flint, brick, and concrete. A layer about 0.1 m thick of off white chalk fragments was encountered at the base of the Made Ground in WS03. The Made Ground was between 0.5 and 0.6 m thick.

The surface at the dismantling and repair yard that was noted to be stained by oils and possibly other hydrocarbons. Slight hydrocarbon odour and grey staining was noted within the Made Ground in WS03.

4.4 Head Deposits

The Head Deposits typically comprise brown, orange and yellow clay with variable proportions of silt, sand and gravel. Locally pockets of sand and/or gravel were present with some clay. The gravel fraction was found to be angular to rounded and composed of flint and chalk.

Where present, the Head Deposits were encountered from the ground level to between 1.2 and 4.2 m depth, predominately on the part of the site shown as Area A on **Figure 7**.

It should be noted that the base of the Head Deposits, when underlain by the Lambeth Group, could not be identified positively as the materials comprised reworked natural deposits similar to and derived from the Lambeth Group materials. As such, the depths to the base of the Head Deposits given above should be used with caution.

Classification Results of classification testing are presented on a Casagrande Chart on **Figure 5**. The results indicate the clay is generally of variable plasticity with measured values of liquid and plastic limit between 25 % and 104%, and 13 % and 27%, respectively, which correspond to plasticity indices between 12 % (low plasticity) and 80 % (extremely high plasticity). Measured values of moisture content are between 11 % and 44 %.

Results of particle size distribution analyses for the Head Deposits indicate the fines content (<63 µm) is between 32 % and 84 % by weight. The samples tested were found to contain sand fraction between 10 % and 25 % and gravel size fraction between 6 % and 44 %. The laboratory results indicate that the Head Deposits tested are cohesive (clay or silt) with variable proportions of sand and gravel fractions.

Compaction Results of moisture content and dry density relationship determined by 2.5 kg rammer laboratory compaction test were carried out on two samples. The results for the tests have optimum moisture content are 10 % and 18 % with corresponding maximum dry density of 2.01 and 1.68 Mg/m³.

CBR Value of the California Bearing Ratio as determined by a single sample tested on remoulded soaked sample as determined by laboratory for the Head Deposits is about 3%. From empirical correlation using an average plasticity index value of 50, for average construction conditions and high

or low water table a CBR a value of 2.0% (thin pavement) or 2.5% (thick pavement) is recommended for pavement design (TRRL, 1984).

Undrained Shear Strength Visual examination of the material indicates the clay is typically soft and firm in consistency. Measured values of undrained shear strength, as determined by hand shear vane are variable in the range of 30 to 100 kPa of which the higher values were recorded where sand particles were abundantly present.

Measured values of undrained shear strength, as determined by laboratory triaxial testing of 100 mm diameter specimens taken by thin walled driven sampling, are presented as a plot against depth on **Figure 6**. The measured values for two samples are 19 and 73 kPa.

Derived values of undrained shear strength determined using the empirical correlation with SPT N values (Stroud, 1989) are also presented on **Figure 6**. The derived values were determined from the correlation with measured SPT N values using a factor N_c of 4.5 for average plasticity index value of 50 range from 18 to 68 kPa and, have no apparent correlation between strength and increasing depth.

4.5 Lambeth Group

The Lambeth Group was encountered in the exploratory holes located at the southern and eastern parts of the site at the surface or below a veneer of Head Deposits.

The Lambeth Group was found to comprise multicoloured clay with some silt and sand partings and locally lenses of silt and sand. The clay locally also contained red and black round and subrounded flint gravel.

Where encountered, the Lambeth Group was between 0.7 and 12.4 m in thickness and the base was encountered to between 2.4 and 12.7 m below ground level.

Classification Results of classification testing are presented on a Casagrande Chart on **Figure 5**. The results indicate the Lambeth Group clays are generally of variable plasticity with measured values of liquid and plastic limit between 43 % and 108%, and 15 % and 24%, respectively which correspond to plasticity index between 34 % (intermediate plasticity) and 84 % (extremely high plasticity). Measured values of moisture content are between 19 % and 43 %.

Results of particle size distribution analyses for the Lambeth Group indicate the fines content (<63 μm) is between 87 % and 98 % by weight. The samples tested were found to contain a sand fraction between 2 % and 13 %.

Compaction Results of moisture content and dry density relationship determined by 2.5 kg rammer laboratory compaction test on two samples indicate that the optimum moisture content is 17 and 27 % with corresponding maximum dry density of 1.77 and 1.41 Mg/m^3 .

CBR Value of the California Bearing Ratio as determined by a single sample tested on remoulded soaked sample as determined by laboratory for the Lambeth Group is about 5 %. From empirical correlation using average plasticity index value of 52, for average construction conditions and high or low water table a CBR value of 2% (thin pavement) or 2.5% (thick pavement) is recommended for pavement design (TRRL, 1984).

Undrained Shear Strength Visual examination indicates that the consistency of the clay is typically firm to stiff and very stiff with depth. Locally the clay was observed to be soft to firm at the near surface. Measured values of undrained shear strength, as determined by hand shear vane are typically in the range of 30 to 100 kPa with a general trend of increasing strength with increasing depth.

Measured values of undrained shear strength, as determined by laboratory triaxial testing of 100 mm diameter specimens taken by a thin walled sampling, are presented as a plot against reduced level on **Figure 6**. The measured values are in the range of 96 to 275 kPa.

Derived values of undrained shear strength determined using the empirical correlation with SPT N values (Stroud, 1989) are also presented on **Figure 6**. The derived values determined from the correlation with measured SPT N values using a factor N_c of 4.5 for average plasticity value of 52, and give a range from 54 kPa at 3.2 m depth to 113 kPa at 11.2 m depth indicating a general trend of increasing strength with increasing depth.

4.6 Upper Chalk

The Upper Chalk was encountered at a number locations across the site. The Chalk was generally white with occasional black specks and orange staining and was recovered as gravelly sandy chalk silt and silty chalk gravel and cobbles. Locally the Chalk contained seams <5 mm thick of soft brown clay. Visual examination of the chalk fragments recovered was variable between extremely weak to strong.

In borehole BH2, the Chalk appeared to be impacted by weathering to about 10 m below ground level. A sand infill was encountered between 3.15 m and 4.30 m depth within the Chalk. This is likely to be an infilled solution cavity.

Values of penetration resistance determined by standard penetration testing are presented as a plot against reduced level on **Figure 4**. The measured values were variable between different locations on site. In Borehole 02, the SPT N values ranged from 3 to 13 between ground level and about 10 m depth, from 10 m depth the SPT N values increased to between 21 and over 50 blows. The low blow count up to 10 m depth is likely to represent karstic weathering profile. The high blow count (>50) is likely to represent a large nodule or a band of flint. The SPT N value within the chalk that was encountered below the Lambeth Group in the other boreholes (Boreholes 01, 03 and 04) was over 50. The high blow count is likely to represent a band of hard chalk not impacted by deep weathering which occurs immediately below the Lambeth Group deposits in this area, as recorded also in a number of historic borehole records.

The base of the Upper Chalk was not proven in any of the exploratory holes during the investigation and the chalk was penetrated during the investigation to a maximum thickness of about 10.7 m corresponding to a depth of 15.0 m and reduced level of about 45.8 m OD.

4.7 Groundwater

During the fieldwork, groundwater entries were not detected at any of the exploratory holes across the site.

The water level in the historic well records indicates that the water level in 1968 within the Chalk varies between 27m and 42m OD, typically being about 34 m below ground level, which is equivalent to about 31 m OD. The water levels in the well were measured during and after the fieldworks and were between 30.1 and 30.2 m below ground level, corresponding to reduced level of about between 29.9 and 29.8 m OD.

On completion of the fieldwork for the investigation, all the monitoring holes were dry with the exception of Borehole BH03 where groundwater levels were recorded between about 4.1 and 6.5 m below ground level, corresponding to reduced levels between about 65.4 and 67.0 m OD. These groundwater levels are considered to be representative of perched groundwater body within the Lambeth Group.

5 Geoenvironmental Conditions

This section of the report discusses the concentrations of potential contaminants and ground gases measured as part of the ground investigation.

5.1 Contamination

5.1.1 Chemical Analysis

Chemical analyses for a range of contaminants including metals, inorganic and organic contaminants that may exist within the site due to its historic and current land use were carried out on a total of 26 samples of soil selected from the Made Ground the natural soils. Chemical analysis was also carried out on 3 soil samples to determine the potential presence of pesticides and herbicides due to the potential use of these chemicals in a working farm. In addition, four soil samples were sent for asbestos screen to establish the potential presence of asbestos within the Made Ground in the infilled pit.

Three soil samples were tested for eluate testing to assess the potential for contaminants to leach out of the soil and impact groundwater. The laboratory terminated the test for one of the samples submitted, due to health and safety procedures because asbestos was detected in the sample tested.

A copy of the testing certificates is reproduced in **Appendix 3**. The results of the soil analyses carried out is summarised on **Table 1** presented after the text of the report.

Given the potential variability of the Made Ground it is possible that localised and unidentified contamination is present on the site.

5.1.2 Contamination Assessment Regime

Soils For initial screening, the results of the geochemical testing on the soils samples have been compared to CLEA SGVs for residential with plant uptake end-use (EA, 2009) as appropriate for the proposed use of the site. Where a CLEA SGV is not available the concentrations were compared against the Land Quality Management Ltd (LQM) Generic Assessment Criteria (GACs) for a residential with plant uptake end-use (CIEH, 2009). Full details of the assessment criteria are given in **Appendix 5**.

5.1.3 Soil Eluate Quality

There are no published soil assessment criteria for protection of Controlled Waters. As such, the results of the geochemical testing on soil eluate samples were compared to Environmental Quality Standards for fresh waters (EA, 2004) and where not available to the more stringent UK Drinking Water Standards (DETR, 2000).

5.1.4 Assessment of Soil Contamination to Impact Human Health

For the samples analysed, the measured concentrations of potential contaminants, as summarised on **Table 1**, are typically below the assessment values appropriate for a land use as residential with plant uptake or a comparable land use.

The exceptions include slightly elevated concentrations of metals (vanadium and zinc), and two samples with elevated concentrations of polycyclic aromatic hydrocarbons (PAH) which were detected in the Made Ground in the infilled pit and in the vehicle dismantling and repair yard.

Vanadium - A total of thirteen soil samples were tested for vanadium, five from the natural soils and eight from the Made Ground. The measured concentrations of vanadium in the natural soil were between 48.2 and 77.3 mg/kg and in the Made Ground between 30.8 and 94.8 mg/kg. The screening

assessment criterion for residential end use for vanadium is 75 mg/kg. Of the two concentrations above the assessment criterion one was recorded in natural soil (BH01 at 0.3 to 0.8 m depth) and one in the Made Ground (WS01 between 0.5 and 1.0 m depth). The sample in the natural soil recorded a slightly elevated concentration (77 mg/kg) and is considered to be a background concentration, as such, vanadium in the natural soil is not taken forward as a potential hazard. The elevated vanadium concentration in the Made Ground statistically is considered to be an outlier of the vanadium population, as such, this is considered to be a 'hot spot' and is carried forward as a potential hazard in Area C.

Zinc - The sample with elevated concentration of the zinc (6120 mg/kg) was sampled in the dismantling and repair yard (WS06 between 0.1 and 0.5 m depth). It is expected that the elevated concentrations of zinc is associated with the man-made materials noted within the Made Ground. As such, the potential for heavy metal to be present in the Made Ground is taken forward as a potential hazard in Area D.

Asbestos - The laboratory identified material containing white asbestos (Chrysotile), in the cement bound tile sample in TP02. In addition, asbestos fibres were identified in a single sample for the soils sent for asbestos screen in TP01. As such, asbestos in Area C is carried forward as a potential hazard.

PAH - Two samples with slightly elevated speciated polycyclic aromatic hydrocarbons (PAH) were detected in the Made Ground. Benzon(a)pyrene was detected at slightly elevated concentration within the Made Ground at the vehicle dismantling and repair yard (WS03 between 0.1 and 0.4 m depth) and indeno(123)pyrene and benzo(ghi)perlyne were detected at slightly elevated concentrations within the Made Ground in the infilled pit (TP02 at 2.0 m depth). As such, PAH is taken forward as a potential hazard in Areas C and D.

5.1.5 Assessment of Soil Eluate Quality

For the samples analysed, the measured concentrations of potential soil eluate contaminants, as summarised on **Table 2**, are within the Environmental Quality Standards none of the tested samples exceeded the relevant assessment criterion. In addition, all the soil eluate samples were within the drinking water standards.

5.2 Aggressiveness of the Ground

5.2.1 Design of Buried Concrete

The measured pH values and concentrations of water soluble sulphate are summarised on the following table.

Strata	pH Value	Water Soluble Sulphate (g/l)
Made Ground	7.6 – 8.5	0.003 - 0.202
Head Deposits	7.2 – 7.8	0.011 - 0.018
Lambeth Group	6.2 - 7.9	0.005 - 0.038
Chalk	8.1 – 8.2	0.022 - 0.033

Based on the results and the procedures outlined in BRE Special Digest 1, 3rd Edition, (BRE, 2005) and assuming static groundwater conditions, the Design Sulphate and Aggressive Chemical Environment for Concrete (ACEC) Classes for the site are DS-1 and AC-1s respectively.

5.2.2 Design of Water Supply Pipes

The concentrations of potential contaminants measured as part of the ground investigations indicate potential contaminants are locally present in Areas C and D at concentrations above background concentrations. Adopting a precautionary approach, it is possible that contamination of the water supply may occur and hence suitable precautions may need to be made in the design and construction of the water supply pipes.

Under the Water Supply (Water Fittings) Regulations (DETR, 1999), the Water Supplier has a statutory duty to ensure that the design and material selection for water supply pipes are suitable and their advice and recommendations should be sought with regard to the water supply pipes for the proposed development. It should be noted that the Water Supplier may require additional testing to be carried out.

5.3 Ground Gases

The concentrations of methane, carbon dioxide and oxygen have been measured on four occasions the gas monitoring wells installed in the boreholes sunk as part of the ground investigation. The measured gas concentrations and steady gas flows are presented in the report in **Appendix 4** and are summarised on the following table.

Gas	Concentration	
	Areas C and D	Areas A and B
Methane (%v/v)	0.0 – 42.5	ND
Carbon Dioxide (%v/v)	3.9 – 17.0	0.8 – 5.4
Oxygen (%v/v)	0.0 – 7.6	6.9 – 21.0
Gas Flow (l/hr)	0.0 – 0.3	0.0 - 0.1
ND denotes below the instrumental detection limit		

Methane was not recorded and carbon dioxide concentrations were typically below 5% in Areas A and B. The measured concentrations of ground gases indicate elevated concentrations of carbon dioxide and methane in Areas C and D.

Using the procedure for classifying gassing sites proposed by BS 8485 (2007), Areas A and B would be classified as Characteristic Situation 1 assuming the measured concentrations of ground gases are representative of the long term equilibrium values. This Situation is representative of ground with a very low potential for gas generation. For Characteristic Situation 1, BS 8485 (2007) advises that gas protection measures are not required.

For Areas C and D the gas data would be classified as Characteristic Situation 3. This situation is characteristic of a site with old landfill or inert waste which produces some methane and/or carbon dioxide gases, however, these are limited in concentrations and/or flows. For Characteristic Situation 3, BS 8485 (2007) advises that gas protection measures are required (see **Section 6.6.1**).

6 Tier 2 Geoenvironmental Risk Assessment

6.1 Introduction

A Tier 1 Preliminary Risk Assessment was carried out as part of the Phase 1 Ground Condition Report (PBA, 2010). The Tier 1 included a conceptual site model (CSM). The CSM describes the types and locations of potential contamination sources, the identification of potential receptors and the identification of potential transport/migration pathways. In addition, a preliminary risk assessment was carried out based on the known historical and current land use at the time. The CSM and the risk assessment can now be updated based on the findings of the ground investigation for the site.

6.2 Hazard Identification

The methodology and criteria used to assess risk adopted by PBA as used within this document is defined within **Appendix 6**.

The risk assessment updates of the Conceptual Site Model and describes the types and locations of identified possible contamination sources. The identification of potential receptors and potential pathways has also been undertaken. For a pollutant linkage to be identified all three elements (i.e. a source, pathway and receptor) must be present.

As confirmed by the ground investigation there are no pollutant sources in Areas A and B and therefore plausible pollutant linkages are not present. As such, there is no identified risk with regards to contamination in these areas. This section assesses the risk associated with contamination only within Areas C and D where a limited and localised contamination hazard has been identified by the ground investigation.

6.2.1 Hazards with the Potential to Impact Human Health

In summary the results of the ground investigations have been assessed using generic criteria and the potential for contaminants to be present on this site as a whole is classed as **Very Low**.

However, the Made Ground associated with the infilled pit and the dismantling and repair yard has been identified as a localised potential hazard in Areas C and D for a residential with plant uptake end use.

The following parameters were taken forward as a potential hazard in the Made Ground:-

- PAH in the Made Ground (Areas C and D);
- Heavy metals in the Made Ground (Zinc in Area D and Vanadium in Area C);
- Asbestos in the Made Ground (Area C); and
- Soil Gas in the Made Ground (Area C and D).

6.2.2 Hazards with the Potential Impact to Controlled Waters

The eluate samples indicated that potential contaminants present within the soil are not likely to leach out and impact controlled waters. Hence the risks to groundwater are considered to be negligible and not taken forward.

6.3 Hazard Assessment

Localised sources of contamination (PAH, heavy metals, asbestos and soil gas) have been identified associated with the infilled pit (Area C) and with the dismantling and repair yard (Area D) and the

pollutant linkages for these areas are presented in a tabular format in **Table 3** presented after the text of this report.

6.4 Risk Estimation

Risk estimation involves predicting the likely consequence (what degree of harm might result) and the probability that the consequences will arise (how likely the outcome is). A table summarising the estimated risks for the identified pollutant linkages in Areas C and D is presented in **Table 3**.

Based on the information available, there are a number of plausible pollutant linkages, the estimated risks for residential with plant uptake use have been classed as follows:

- Human Health (On-site Current) – **Low**
- Human Health (On-site Future) – **Moderate/Low**
- Human Health (Off site) – **Moderate/Low**
- Human Health (On-site construction) – **Moderate/Low**
- Buildings (On-site future) – **Low** and **Moderate/Low**
- Property (horses current) – **Low**

6.5 Risk Evaluation

Plausible pollutant linkages are determined using professional judgement. If a linkage is considered possible, it is considered that this represents a potentially 'unacceptable risk' and therefore requires further consideration. This may be through remediation or mitigation or through further tiers of investigation and assessment.

Plausible pollutant linkages have been identified for human health, buildings and property. In this instance plausible pollutant linkages have been identified for the PAH, heavy metals, asbestos and ground gas within the Made Ground in Areas C and D. The risk associated with any one linkage is at worse assessed as **Moderate/Low**, using the methodology described in **Appendix 6**.

It is likely that all the linkages can be addressed through mitigation and/or remedial measures. The principles of any remediation are to design a practical scheme which will reduce the risks associated with the ground conditions. In particular measures should be taken to mitigate against potential effects on the proposed redevelopment, site users and construction workers. The remediation works should be designed to achieve an appropriate balance between economics, sustainability and a reduction in the level of risk as it currently exists.

6.6 Conclusions

The results of this Tier 2 Geoenvironmental Risk Assessment confirm that the site soils are unlikely to be impacted by contamination with the exception of localised relatively low concentrations of contamination within the Areas C and D. The majority of the site is considered to have **Very Low** potential for ground contamination to be present.

For Areas C and D where contamination has been identified as a potential hazard, potential pollutant linkages have been identified. The risks associated with each linkage range from **Low** to **Moderate/Low**. A moderate/low risk is classified as follows:-

It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that any such harm would be mild/severe, or if any harm were to occur it is more likely that the harm would be relatively mild.

Investigation (if not already undertaken) is normally required to clarify the risk and to determine the potential liability. Some remedial works may be required in the longer-term.

It is likely that all the possible linkages can be addressed through an appropriate choice of end use, mitigation and/or remedial measures. The remediation works should be designed to achieve an appropriate balance between economics, sustainability and a reduction in the level of risk as it currently exists.

6.7 Confidence and Uncertainty

CLR 11 requires appropriate range and level of information to be collected. The information quality criteria given in CLR 11 are:-

- Relevant – to the context of the assessment
- Sufficient – for the required level of confidence
- Reliable – reflect the true or likely conditions
- Transparent – in meaning and origin

Whilst the data used in this assessment is considered robust and suitable for purpose, there is some degree of uncertainty due to the potential for unforeseen ground conditions, however, it is considered that if present these will be localised and relatively small in scale.

7 Geotechnical Assessment

7.1 Proposed Development

It is understood from the Masterplan that it is proposed to redevelop the site for residential use consisting of approximately 300 residential units of two and two and a half storeys high with associated infrastructure and roads.

7.2 Known Sinkholes and Subsidence Risk

Given the disturbed nature of the soils within and immediately adjacent to the sinkholes development in these areas may result in significant settlement and structural damage. It is recommended that a development exclusion buffer zone of 10 m from the known edge of any untreated sinkhole is applied for any structure in the vicinity of any development including buildings, services or roads.

Alternatively, the sinkholes can be remediated for future development. Appropriate remedial works include the removal of the loose soil, compaction grouting of the weathered chalk, and backfilling of the depression with engineered fill. The process will require an engineering specification and validation testing. A preliminary cost estimate for the treatment of a sinkhole of this size that exists at the site is in the order of £250,000 per feature.

7.3 Foundations – Areas A, B and D

7.3.1 Possible Foundation Solutions

There is a risk that hitherto undiscovered solution features that can lead to sinkhole formation might be present anywhere on site, without any tell tale surface expression such as a depression. Consequently, future subsidence and settlement of near surface soils into such features would occur beneath conventional foundation types and lead to a risk of structural damage. Such instability could be triggered by extremes of climate, changes to infiltration and drainage due to development, soakaways or leakages etc.

Furthermore, the Head Deposits found predominantly in Area A may present a risk of excessive total and/or differential settlement if conventional shallow foundations are adopted, even when solution features or sinkholes are absent. The reason for this is because the Head Deposits are predominantly unconsolidated and variable in nature and generally of a soft and firm consistency at this site. They contain pockets and/or layers of granular material that could be prone to inundation settlement or piping erosion caused by loss of fines, especially where triggered by leaking drainage. This is because of their sand content and poor state of compaction. Consequently if the Head Deposits were to be used as a founding medium for conventional shallow foundations then future parcel by parcel or plot by plot ground investigation and assessment would be required, to assess foundation design requirements.

Options to deal with the solution feature hazard and variability of the Head Deposits are as follows.

(a) Re-inforced Conventional Spread or Strip Foundations

This solution involves proving the ground beneath the footprint of proposed foundations using the dynamic probing technique, and then designing either re-inforced strip foundation, or a pad and ground beam system to span the likely size of void that might form as the result of ground loss into a feature. PBA experience of sites in similar geology suggests that a combination of probing at, say, 2 m centres and the design of foundation and/or ground beams to span a nominal 2 m diameter void will reduce the risk to an acceptable level, however, different solutions based on other comprises between probing costs and the cost of re-inforcing the foundations and/or ground beams are possible, and this will need to be assessed on a site specific basis.

(b) Re-inforced Raft Foundations

The use of a re-inforced concrete raft foundation designed to span 3 m diameter void is a suitable foundation solution. This spacing width is based on a statistical assessment of the engineering characteristics of sites with a similar geological setting and solution features hazard rating.

7.3.2 Piled Foundations

Piled foundations are unlikely to be suitable because of the deep penetrative weathering present in places at the site (e.g. at Borehole BH02) and the possible presence of deep unconsolidated and variable solution feature infill. These hazards can lead to a loss of lateral support and shaft friction and/or loss in end bearing support below the pile toe. Furthermore, a single pile design to accommodate the variable ground profile will not be possible and a flexible configuration adjusted for each structure or each individual pile based on the driving resistance during installation, may well prove to be impracticable and far uneconomic to implement.

7.3.3 Disturbed Ground

Disturbed ground or otherwise unsuitable soils may be present at the formation level owing to karstic weathering or due to the presence of Made Ground. It is recommended that all bearing surfaces be inspected by a qualified geotechnical engineer prior to constructing the foundations to ensure that the design criteria are achieved. Any soft or loose soil encountered at foundation level should be removed and replaced with well compacted granular fill or foundation concrete.

7.4 Foundations in Area C (Infilled Ground)

The Made Ground is unsuitable as a founding medium due to its weak and compressible characteristics, which may result in shear failure and/or excessive total and differential settlement deformations. Piling through the Made Ground into the Chalk is not recommended due to the underlying weathering of the Chalk that may result in loss of support below the pile toe. In addition, man made materials may form an obstruction to piling within the infilled pit. Therefore, the most suitable foundation solution is to excavate and remove the upper 2.0 m of the Made Ground and replacement with an engineered fill. Some of the materials present in the removed soils may be suitable for this purpose after screening, crushing and/or conditioning. After compaction in accordance with an engineering specification and validated by testing the engineered fill can then be used to support a grillage of ground beams or a reinforced raft foundation that can accommodate long term settlement of the infill material below.

Alternatively, ground improvement using dynamic compaction may be a suitable technique to provide a base to support structures. The process involves of dropping a heavy weight repeatedly on the ground at regularly spaced intervals. The impact of the free fall weight creates high energy impact that transmits shock waves through the treated ground. This reduces voids between soil particles resulting in enforced settlement, thus reducing long term settlement.

7.5 Potential for Volumetric Change

In accordance with the guidance given in NHBC (2010), the Head Deposits have low to high shrinkability potential and the Lambeth Group have medium and high shrinkability potential. In accordance with the guidance the minimum depth of the foundations has to be 0.9 m below the proposed level, however, the depth may need to be greater due to the potential for volumetric change as trees, hedgerows or shrubs take moisture from the ground and, in cohesive soils such as clay with medium and high shrinkability potential, this can cause significant volume changes resulting in ground movement. This has the potential to affect foundations and damage the supported structure. In order to minimise this risk, foundations should be designed to accommodate the movement or be taken to a depth where the likelihood of damaging movement is low, however, it is possible that the foundation solutions described in **Section 7.3** (above) will also mitigate this risk. An assessment of the potential influence of any proposed planting and existing trees on the foundations for the proposed buildings should be carried out in accordance with the NHBC guidance.

7.6 Pavement Design

A site wide CBR design value of 2.0% for thin pavement and 2.5 % for thick pavement is suggested for the Head Deposits and Lambeth Group.

Given the potential for ground instability due to the potential karstic weathering it would be prudent for the pavement design (roads/driveways) to incorporate reinforcement, using a high tensile strength geogrid, in the road design sub base. This would help to reduce the potential effect and impact on health and safety should any future collapse occur and excessive differential settlement.

The formation level should be inspected and tested to ensure that the insitu materials and the placed compacted fill have achieved the CBR values on which the design is based. The formation level is required to be proof rolled and any loose or soft material is removed and replaced with acceptable fill material.

7.7 Earthworks

The proposed scheme may include the reuse of the near surface soils as an engineered fill where site levels are required to be amended. The materials observed during the ground investigation along with results from the classification and compaction testing at the site, suggests that the majority of material on the site will be suitable for use as engineered fill for any earthworks required for the proposed development.

The classification and compaction testing identified that the majority of the near surface materials are likely to be classified as cohesive materials (Class 2A) in accordance with the Series 600 of the Highway Agency Specification for Highway Works (HA, 2009). Where higher gravel content exists within the Head Deposits the materials may be classified as stony cohesive (Class 2C). The natural moisture content of the near surface materials is relatively high compared to the optimum moisture content. As such, the near surface materials are likely to require some moisture conditioning prior to compaction. The earthworks should be carried out in accordance with an Engineering Specification. It is unlikely that chalk will be used for earthworks, however if used, chalk can degrade and become unsuitable as engineered fill due to wet conditions, disturbance, handling and trafficking.

The proposed scheme may include the reuse of the topsoil at the site as top cover. It is likely that the topsoil will be suitable for reuse providing no evidence of visual and/or olfactory signs of contamination is detected during the works. The topsoil should be carefully removed prior to commencement of any excavation work and stockpiled separately for later reuse on or off site. The requirements for handling topsoil are specified in BS 3882 (2007).

7.8 Slope Stability

The proposed scheme may include the reuse of the near surface soils as an engineered fill where site levels are required to be amended. This may result in a number of cut and filled slopes. It is recommended that the long term stability of such slopes will be assessed over the design life of proposed structures. This will be carried out after the integrated earthworks strategy for the site is finalised.

7.9 Infiltration Drainage

Surface water drainage using shallow infiltration (soakaways) is unlikely to provide a complete drainage solution to accommodate surface runoff from the development due to the low permeability nature of the near surface soils over large areas of the site.

In addition, it is not recommended that shallow soakaways are adopted for surface water drainage in areas identified to be sinkholes as shown in **Figure 7**. If shallow soakaways are to be used on site then the soakaway should be a minimum of 20 m distant from a property (CIRIA C574, 2002). Alternatively deep bored soakaways should be considered. However, due to the deep weathering of

Proposed Residential Development, Woodcroft Farm, Waterlooville, Hampshire
Geoenvironmental and Geotechnical Ground Investigation Report

the chalk the soakaway bore should be checked for any evidence of karst features by validation investigation such as dynamic probing and positions adjusted where possible to avoid karst features to mitigate ground instability.

8 Outline Remediation Strategy

8.1 Introduction

This report has identified the presence of a localised area with slightly impacted soil associated with the infilled pit and the vehicle dismantling and repair yard, which although considered localised will require some form of mitigation / remediation for residential with plant uptake end use. An outline Remediation Strategy is described for each of the identified Areas in accordance with the recommended mitigation measures and/remediation required. A full options appraisal and detailed remediation strategy is not part of the scope of this report, but will be undertaken in the future if the site comes forward for development.

The specific mitigation measures required related to:

- The risks to site workers associated with ingestion, inhalation or prolonged skin contact of contaminated material.
- The risks to future site users associated with ingestion, inhalation or prolonged skin contact of contaminated material.
- The risks to future site users in buildings associated with inhalation of hazardous ground gasses.
- The risks to buildings associated with hazardous ground gases build up to concentrations giving rise to a potential risk of explosion.

8.2 Area C

For the infilled pit there are a number of mitigation measures and/remediation options that can be considered as part of the redevelopment of the site for a residential with gardens (plant uptake) end use and these are discussed below. Alternatively, the infilled pit area can be used for a less sensitive end use such as managed housing, commercial/industrial or public open space, although further risk assessment based on site specific assessment criteria generated for these end uses will be required. The preferred option should be chosen on the balance between economics, sustainability and a reduction in the level of risk as it currently exists.

Source Removal – Excavation of the Made Ground and disposal of the material off site in a suitable facility. It is envisaged that some of the excavated materials are likely to be suitable for reuse on site as engineered fill after segregation, treatment and processing. The remaining void can be backfilled with clean engineered site won materials from foundation and services excavations elsewhere on site. It is estimated that the volume of the Made Ground in the worst case scenario in the infilled pit is about 20 000 m³, it should be noted that this figure is a preliminary estimate only based on the ground investigation findings using a surface dimensions of 80 m x 85 m and average thickness of 3 m.

Capping – The Made Ground can be separated from future site users by a physical barrier such as a suitable capping thickness of clean soil. It should be noted that the Made Ground (waste) in the infilled pit is not a suitable founding medium for buildings and roads (see [Section 7.4](#)). As such, ground treatment (dynamic compaction) or excavation of the top 1 to 2 m and replacement with clean engineered fill from other parts of the site may be considered as an appropriate foundation solution. If the later option of excavation and replacement by engineered fill is chosen then the engineered fill is likely to be a suitable capping system to segregate the site users from the Made Ground.

Gas Protection Measures - To mitigate the risk to future users associated with inhalation of hazardous gas and the risk to the proposed buildings of explosion from hazardous gas, gas protection measures are recommended to be adopted in any proposed buildings in Area C. Guidance on typical gas protection measures for a development are detailed by BS 8485 (2007). For a residential

development in soil gas Characteristic Situation 3 (see **Section 5.3**) the BS recommends gas protection measures are installed in buildings. The gas protection measures are required to achieve a specific grade in accordance with the soil gas characteristics and the proposed end use of the building. For private residential properties the BS recommends that gas protection measures are required to score an equivalent of grade 4 to achieve an appropriate gas solution. A combination of the installation of passive sub floor ventilation, floor slabs and the installation of gas protection membrane is recommended for the proposed structures to achieve gas solution grade 4. In addition, appropriate procedures should be adopted to ensure any confined areas are not accessible to the future site users unless they are checked for hazardous gases prior to man-entry. Active ground gas protection measures as part of the development are not deemed to be necessary.

8.3 Area D

Source Removal - The most likely remedial option for the dismantling and repair yard is deemed to be shallow source removal. The primary source (the cars and car parts) will be removed once the site is decommissioned. Any secondary sources are likely to comprise hot spots within the shallow (<0.5 m) thickness of superficial Made Ground present. This can be dealt with by future investigation before any contaminated materials are removed using shallow scrape and visual inspection (confidence scrape) ensuring any potential contaminated soils have been removed. Validation testing should be carried out on the remaining clean materials at the base of the excavation. It is estimated that the volume of impacted soils is relatively small and limited to the near surface Made Ground with an approximate area of 10 m x 30 m and 0.5 m deep.

8.4 Areas C and D

Protection of Site Workers – It is recommended that appropriate health and safety and welfare provisions are in place to protect both the site workers and general public/neighbours. This should include the adoption of relevant procedures in accordance with the current health and safety guidance including those given in 'Protection of workers and the general public during the development of contaminated land' HS(GS)66 (HMSO, 1991).

A protocol for the identification and assessment of any unforeseen ground conditions will be required combined with a briefing of the ground work contractors.

8.5 Future Ground Investigation

Additional investigation is not likely to be required to support the planning application for redevelopment of the site at this stage. However, an additional ground investigation may be required prior to the redevelopment of the site and as part of the detailed design process to confirm the findings of the current investigation and design any remediation and/or mitigation measures should these be required with regards to its geoenvironmental conditions and to deal with the risks associated with subsidence hazard. In addition, the ground investigation may be required for the detailed design of the proposed earthworks, foundations and stability assessment for the proposed development.

9 References

- BGS (1966) Record of well at Woodcroft Farm. Record SU316/237, British Geological Survey (formerly Geological Survey and Museum), Keyworth, Notts.
- BGS (1975) Record of boreholes at Lovedean (HMS Mercury). Record SU61SE/12A, British Geological Survey (formerly Geological Survey and Museum), Keyworth, Notts.
- BGS (1979) Hydrogeological Map of Hampshire and the Isle of Wight, 1 to 100 000 scale. British Geological Survey (Former Institute of Geological Sciences, Keyworth, Notts.
- BGS (1980) Geological Map Sheet SU 61SE Solid and Drift Edition, 1 to 10 000 scale. British Geological Survey, Keyworth, Notts.
- BGS (1998) Fareham, England and Wales Sheet 315, Bedrock and Superficial Deposits, 1 to 50 000 scale. British Geological Survey, Keyworth, Notts.
- BRE (2005) Concrete in aggressive ground, Special Digest 1. Building Research Establishment, Garston, Herts.
- BS 3882 (2007) Specification for topsoil and requirements for use. British Standards Institution, London.
- BS 5930 (2010) Code of practice for site investigations, Amendment No. 2. British Standards Institution, London.
- BS 8485 (2007) Code of practice for the characterization and remediation from ground gas in affected developments. British Standards Institution, London.
- BS EN 1997-2 (2007) Eurocode 7 - Geotechnical design -Part 2: Ground investigation and testing. British Standards Institution, London.
- BS EN 1997-1 (2004) Eurocode 7: Geotechnical design — Part 1: General rules. British Standards Institute, London.
- BS EN ISO 22475-1 (2006) Geotechnical investigation and testing - Sampling methods and groundwater measurements, Part 1: Technical principles for execution. British Standards Institute, London.
- CIEH (2009) The LQM/CIEH Generic Assessment Criteria for Human Health Risk Assessment (2nd Edition). ISBN 0-9547474-7-X. The Chartered Institute of Environmental Health, Nottingham.
- CIRIA (2002). Engineering in chalk. Report C574. Construction Industry Research and Information Association, London.
- CIRIA (2004) Engineering in the Lambeth Group. Report C583 Construction Industry Research and Information Association, London.
- DETR (1999) The Water Supply (Water Fittings) Regulations 1999. Statutory Instrument 1999 No 1148. Department of the Environment, Food and Rural Affairs, (formerly Department of the Environment, Transport and the Regions), London.
- DETR (2000) The Water Supply (Water Quality) Regulations, 2000. Statutory Instrument 2000 No. 3184. Department of the Environment, Food and Rural Affairs (formerly Department of the Environment, Transport and Regions), London.

Proposed Residential Development, Woodcroft Farm, Waterlooville, Hampshire
Geoenvironmental and Geotechnical Ground Investigation Report

- EA (2002) Assessment of risks to human health from land contamination: an overview of the development of soil guideline values and related research. R&D Publication CLR7, Environment Agency, Bristol.
- EA (2004) The EC Dangerous Substances Directive (76/464/EEC and Daughter Directives) controls the release of dangerous substances to water. Environment Agency, Bristol.
- EA (2009) Soil Guideline Value Reports. CLEA website. <http://www.environment-agency.gov.uk/research/planning/33714.aspx> Environment Agency, Bristol.
- Edmond (2001) Predicting Natural Cavities in Chalk. In Griffiths J.S. (ed.) Land Surface Evaluation for Engineering Practice. Geological Society, London, Engineering Geology Special Publication, p. 29-38.
- Edmonds (2008) Karst and mining geohazards with particular reference to the Chalk outcrop, England. Quarterly Journal of Engineering Geology and Hydrogeology 2008; v. 41; p. 261-278.
- HA (2009) Manual of Contract Documents for highway works, Volume 1 Specification for highway work, Series 600 Earthworks. Highway Agency, London.
- HMSO (1991) Protection of workers and the general public during development of contaminated land. HS(GS)66. Her Majesty Stationary Office, London.
- LIG (2010) Envirocheck Report. Report 32110209_1_1, Landmark Information Group, Exeter.
- NHBC (2010) Part 4 Foundations, Standard Chapter 4.2, Building near trees. National House Building Council, Amersham, Buckinghamshire.
- NRA (1995) Groundwater Vulnerability of South Hampshire and the Isle of Wight, Sheet 52, 1 to 100 000 scale groundwater vulnerability map. Environment Agency (formerly National Rivers Authority), Bristol.
- PBA (2010) Phase 1 Ground Condition Report. Land at Woodcroft Farm, Waterlooville, Havant. Peter Brett Associates LLP, Reading, Berks.
- RML (2011) Factual Report on Site Investigation at Woodcroft Farm, Waterlooville. Project No. RML 4750. Risk Management Limited, Bakenham, Kent.
- Stroud M A (1989) The standard penetration test its application and interpretation. ICE Conference on Penetration Testing in the UK, Birmingham, pp 29-50.
- TRL (1984) The Structural Design of Bituminous Roads, TRRL Laboratory Report 1132. Transport and Road Research Laboratory, Crowthorne, Berkshire.

10 Essential Guidance for Report Readers

This report has been prepared within an agreed timeframe and to an agreed budget that will necessarily apply some constraints on its content and usage. The remarks below are presented to assist the reader in understanding the context of this report and any general limitations or constraints. If there are any specific limitations and constraints they are described in the report text.

- 1 The opinions and recommendations expressed in this report are based on statute, guidance, and best practice current at the time of its publication. Peter Brett Associates LLP (PBA) does not accept any liability whatsoever for the consequences of any future legislative changes or the release of subsequent guidance documentation, etc. Such changes may render some of the opinions and advice in this report inappropriate or incorrect and we will be pleased to advise if any report requires revision due to changing circumstances, especially those over one year old. Following delivery of any report PBA has no obligation to advise the Client or any other party of such changes or their repercussions.
- 2 Some of the conclusions in this report may be based on third party data. No guarantee can be given for the accuracy or completeness of any of the third party data used. Historical maps and aerial photographs provide a "snap shot" in time about conditions or activities at the site and cannot be relied upon as indicators of any events or activities that may have taken place at other times.
- 3 The conclusions and recommendations made in this report and the opinions expressed are based on the information reviewed and/or the ground conditions encountered in exploratory holes and the results of any field or laboratory testing undertaken. There may be ground conditions at the site that have not been disclosed by the information reviewed or by the investigative work undertaken. Such undisclosed conditions cannot be taken into account in any analysis and reporting.
- 4 Unless specifically stated to the contrary, this report does not purport to be a "Geotechnical Design Report" as defined in Clause 2.8 of Eurocode 7 (Geotechnical Design BS EN 1997-1:2004). Some of the data contained herein and used to support any geotechnical assessment presented in this report may be historical or for other reasons not fully compliant with the requirements of that code.
- 5 It should be noted that groundwater levels, groundwater chemistry, surface water levels, surface water chemistry, soil gas concentrations and soil gas flow rates can vary due to seasonal, climatic, tidal and man made effects.
- 6 This report has been written for the sole use of the Client stated at the front of the report in relation to a specific development or scheme. The conclusions and recommendations presented herein are only relevant to the scheme or the phase of project under consideration. This report shall not be relied upon or transferred to any other party without the express written authorisation of PBA. Any such party relies upon the report at its own risk.
- 7 The interpretation carried out in this report is based on scientific and engineering appraisal carried out by suitably experienced and qualified technical consultants based on the scope of our engagement. We have not taken into account the perceptions of, for example, banks, insurers, other funders, lay people, etc, unless the report has been prepared specifically for that purpose. Advice from other specialists may be required such as the legal, planning and architecture professions, whether specifically recommended in our report or not.
- 8 Public or legal consultations or enquiries, or consultation with any Regulatory Bodies (such as the Environment Agency, Natural England or Local Authority) have taken place only as part of this work where specifically stated.

WOODCROFT FARM, WATERLOOVILLE
TABLE 1 - SUMMARY OF SOIL CHEMICAL RESULTS
Brightside Soils Using 2011 Assessment Criteria

[illegible]

Assessment Criteria

- A - Soil Guideline Value (SGV) for Allotments
- B - SGV for Residential with Plant Uptake
- C - SGV for Commercial/Industrial
- D - LQM Generic Assessment Criteria (GAC) for Allotments
- E - LQM GAC for Residential with Plant Uptake
- F - LQM GAC for Commercial/Industrial
- G - Contaminated Land Working Group (CLWG) GAC for Allotments
- H - CLWG GAC for Residential with Plant Uptake
- I - CLWG GAC for Commercial/Industrial
- J - PBA Site Specific Screening Value

NOTES

MG - Made Ground
HD - Head Deposits
LG - Lambeth Group
CH - Chalk

*Lead - Soil Guideline Value 2002

WOODCROFT FARM, WATERLOOVILLE
TABLE 1 - SUMMARY OF SOIL CHEMICAL RESULTS
Brightside Soils Using 2011 Assessment Criteria

Analyte	Units	Assessment Criteria										MG	HD	MG	HD	MG	LG	HD
		A	B	C	D	E	F	G	H	I	J	WS 3	WS 3	WS 4	WS 4	WS 5	WS 5	WS 11
												0.10-0.40	0.75-1.00	0.10-0.30	0.70-1.00	0.10-0.50	0.05-1.00	0.20-0.50
Stones BG 2.6/3.0	%																	
Moisture content at 30 C	%																	
Arsenic as As, dry weight	mg/kg	43	32	540								5.22		10.4		21.1		14.4
Beryllium as Be, dry weight	mg/kg				55	51	420					0.754		0.616		0.395		0.904
Boron as B, hot water sol dw	mg/kg				45	291	192000											
Cadmium as Cd, dry weight	mg/kg	1.6	10	230								0.365		0.47		2.79		0.579
Chromium as Cr, dry weight	mg/kg	34600	3000	30400								14.5		28.1		16.6		27.3
Copper as Cu, dry weight	mg/kg				524	2330	71700					65.1		21.6		56.9		7.73
Lead as Pb, dry weight	mg/kg	450*	450*	750*								26.4		72.3		170		17.1
Mercury as Hg, dry weight	mg/kg	80	170	3600								0.14		0.14		0.14		0.14
Nickel as Ni, dry weight	mg/kg	230	130	1800								6.39		15.7		15.1		32.3
Selenium as Se, dry weight	mg/kg	120	350	13000								1		1		1		1.36
Vanadium as Vn, dry weight	mg/kg				18	75	9100					31		39.5		30.6		52.8
Zinc as Zn, dry weight	mg/kg				618	3750	685000					155		124		6120		52.9
Cyanide (Total)	mg/kg																	
Organic matter	%											3.95		4.55		2.36		1.55
Phenol, Total	mg/kg			3200				158	316									
Sulphate (Total) as SO4	%											0.145		0.0031		0.0516		0.0152
pH	pH Units											8.51		8.22		8.35		7.15
Benzene								0.04	0.18	57		0.01		0.01		0.01		
Toluene								60	320	2200		0.002		0.002		0.002		
Ethylbenzene								45	180	1400		0.003		0.003		0.003		
Xylene								80	120	1300		0.009		0.009		0.009		
>C5 to C6 Aliphatic	mg/kg				1700	55	6200					0.0256		0.01		0.01		
>C6 to C8 Aliphatic	mg/kg				5600	160	16000					0.03		0.01		0.01		
>C8 to C10 Aliphatic	mg/kg				770	46	5100					0.01		0.01		0.01		
>C10 to C12 Aliphatic	mg/kg				4400	230	24000					0.0133		0.01		0.01		
>C12 to C16 Aliphatic	mg/kg				13000	1700	83000					12.4		2.12		1.58		
>C16 to C35 Aliphatic	mg/kg				270000	64000	2E+06					641.6		209.06		197.76		
>C35 to C44 Aliphatic	mg/kg				270000	64000	2E+06					260		1.36		31.6		
Total Aliphatic	mg/kg											611		16		232		
>C5 to C7 Aromatic	mg/kg				27	130	49000					0.01		0.01		0.01		
>C7 to C8 Aromatic	mg/kg				51	270	110000					0.01		0.01		0.01		
>C8 to C10 Aromatic	mg/kg				21	65	8600					0.01		0.01		0.01		
>C10 to C12 Aromatic	mg/kg				31	160	29000					0.01		0.01		0.01		
>C12 to C16 Aromatic	mg/kg				57	310	37000					26.1		6.75		2.39		
>C16 to C21 Aromatic	mg/kg				110	480	28000					128		6.21		7.11		
>C21 to C35 Aromatic	mg/kg				820	1100	28000					734		38		59.6		
>C35 to C44 Aromatic	mg/kg				820	1100	28000					734		17		20.2		
Total Aromatic	mg/kg											1620		71.9		84.1		
Total EPH Aliphatic/Aromatic	mg/kg											2230		88		316		
TPH by GC (>C6-C10)	mg/kg																	
TPH by GC (>C10 - C20)	mg/kg																	
TPH by GC (>C20-C40)	mg/kg																	
TPH by GC (>C6 - C40)	mg/kg												42.8		35		420	55.9
TPH (Chromatogram)	TEXT																	
naphthalene	mg/kg				9.9	3.7	480					0.227		0.0275		0.0275		
acenaphthylene	mg/kg				69	400	97000					0.513		0.0313		0.0167		
acenaphthene	mg/kg				85	480	98000					1.8		0.090		0.098		
fluorene	mg/kg				67	380	69000					1.25		0.01		0.01		
phenanthrene	mg/kg				38	200	22000					3.46		0.0782		0.105		
anthracene	mg/kg				950	4900	540000					1.52		0.0636		0.0304		
fluoranthene	mg/kg				130	460	23000					11.3		0.165		0.289		
pyrene	mg/kg				270	1000	54000					11.1		0.158		0.205		
benzo(a)anthracene	mg/kg				5.5	4.7	95					6.16		0.117		0.195		
chrysene	mg/kg				5.8	8	140					5.84		0.106		0.169		
benzo(b)fluoranthene	mg/kg				7.4	6.5	100					9.75		0.206		0.285		
benzo(k)fluoranthene	mg/kg				14	9.6	140					3.39		0.0651		0.1		
benzo(a)pyrene	mg/kg				1.2	0.94	14					6.51		0.112		0.201		
indeno(123cd)pyrene	mg/kg				3.8	3.9	61					4.33		0.105		0.135		
dibenzo(ah)anthracene	mg/kg				1.5	0.86	13					1.36		0.0316		0.0412		
benzo(ghi)perylene	mg/kg				120	46	660					5.91		0.175		0.179		
PAH (Total)	mg/kg											75.2	<10	1.43	<10	2	<10	<10
PCB (as Aroclors)	mg/kg											0						
1,2-dichloroethane	mg/kg				0.0063	0.008	1					0.01				0.005		
1,1,1 Trichloroethane (TCA)	mg/kg				110	13	1400					0.014				0.007		
1,1,1,2 Tetrachloroethane	mg/kg				1.9	2.1	260					0.02				0.01		
1,1,2,2 Tetrachloroethane	mg/kg				0.89	2.9	580					0.02				0.01		
Tetrachloroethene (PCE)	mg/kg				3.7	2.1	290					0						
Tetrachloroethane	mg/kg				0.37	0.039	6.6					0						
Tetrachloroethene (TCE)	mg/kg				0.95	0.22	25					0.01				0.005		
Trichloromethane (Chloroform)	mg/kg				0.7	1.3	190					0						
Vinyl Chloride (Chloroethene)	mg/kg				0.001	0.0006	0.081					0.02				0.01		
Asbestos	TEXT																	
Fluoride	mg/kg																	
Molybdenum	mg/kg																	

Assessment Criteria

A - Soil Guideline Value (SGV) for Allotments
B - SGV for Residential with Plant Uptake
C - SGV for Commercial/Industrial
D - LQM Generic Assessment Criteria (GAC) for Allotments
E - LQM GAC for Residential with Plant Uptake
F - LQM GAC for Commercial/Industrial
G - Contaminated Land Working Group (CLWG) GAC for Allotment
H - CLWG GAC for Residential with Plant Uptake
I - CLWG GAC for Commercial/Industrial
J - PBA Site Specific Screening Value

*Lead - Soil Guideline Value 2002

Potential Contaminant		Measured Values			Critical Concentration	Outlier Test		Assessment Values					
		Number of Tests	Minimum	Maximum		Critical Value	Number Exceeding	EQS Freshwater	Exceeding No	Cc	UK Drinking Water	Exceeding No	Cc
Arsenic	µg/l	2	0.6	3.1	9.6	-	-	50 (1)	0	-	10 (2)	0	-
Cadmium	µg/l	2	0.1	0.1	-	-	-	5 (1)	0	-	5 (2)	0	-
Chromium	µg/l	2	2.3	3.3	6.0	-	-	20 (1)	0	-	50 (2)	0	-
Lead	µg/l	2	0.1	0.7	2.2	-	-	10 (1)	0	-	50 (2)	0	-
Mercury	µg/l	2	0.01	0.01	-	-	-	1 (1)	0	-	1 (2)	0	-
Selenium	µg/l	2	1.1	1.2	1.3	-	-	-	-	-	10 (2)	0	-
Copper	µg/l	2	1.7	2.1	3.3	-	-	10 (1)	0	-	2000 (2)	0	-
Nickel	µg/l	2	0.6	2.8	8.7	-	-	150 (1)	0	-	20 (2)	0	-
Zinc	µg/l	2	0.6	2.4	7.3	-	-	75 (1)	0	-	-	-	-
Sulphate (Water Soluble)	mg/l	2	4	90	321	-	-	-	-	-	250 (2)	0	-
PAH	mg/l	2	0.1	0.1	-	-	-	-	-	-	0.1 (2)	0	-
pH	pH units	2	7.9	8.2	9.0	-	-	9 (1)	0	-	10 (2)	0	-
Total Alkalinity	mg/l	2	271	630	1584	-	-	-	-	-	-	-	-
Electrical conductivity	µS/cm	2	124.0	360.0	987.1	-	-	-	-	-	2500 (2)	0	-

Notes

- (1) Denotes EQS values for freshwater
- (2) Denotes UK Drinking Water Standards
- EPH Denotes Extractable Petroleum Hydrocarbons
- PAH Denoted Polynuclear Aromatic Hydrocarbons
- X Denotes Critical Concentration (Cc) exceeding assessment value

Critical Concentration is the concentration which the actual mean concentration will be below 19 times out of 20

Critical Value is the concentration above which values may be outliers of the data set.
Critical Concentrations are determined including values exceeding Outlier Test



Client

grainger

Caversham Bridge House, Waterman Place, Reading, RG1 8DN

Tel 0118 950 0761 Fax 0118 959 7499

SUMMARY OF CHEMICAL ANALYSIS OF WATER SAMPLES ELUATE SAMPLES

WOODCROFT FARM, WATERLOOVILLE

Date November 2011

A4 Scale nts

Drawn az

Checked ad

Table

2

WOODCROFT FARM, WATERLOOVILLE
TABLE 3

Pollutant Linkages, Risk Estimation and Hazard Classification

Receptor	Present (Y/N) & Sensitivity Value	Pathway	Present (Y/N)	EPH & Solvent	PAH	Metals	Inorganic	Biocides	Radioactivity	Ground Gas	Consequence (Hazard Classification x Sensitivity)	Probability	Estimated Risk
Human Health - On-Site Current Users	(Y) 3	Ingestion of fruit or vegetable leaf or roots	Y	X	✓	✓	✓	X	X	X	MILD 9=(3x3)	Low likelihood	Low
		Ingestion of contaminated drinking water	N										
		Ingestion of water / sediments when swimming	N										
		Ingestion of soil/dust indoors	Y	X	✓	✓	✓	X	X	X	MILD 9=(3x3)	Low likelihood	Low
		Ingestion of soil/dust outdoors	Y	X	✓	✓	✓	X	X	X	MILD 9=(3x3)	Low likelihood	Low
		Inhalation of particles (dust / soil) indoor and outdoor	Y	X	✓	✓	✓	X	X	X	MILD 9=(3x3)	Low likelihood	Low
		Inhalation of vapours/gases – outdoor	Y	X	✓	✓	✓	X	X	✓	MILD 9=(3x3)	Low likelihood	Low
		Inhalation of vapours/gases - indoor	Y	X	✓	✓	✓	X	X	✓	MILD 9=(3x3)	Low likelihood	Low
		Dermal absorption via direct contact with soil	Y	X	✓	✓	✓	X	X	X	MILD 9=(3x3)	Low likelihood	Low
		Dermal absorption via waters (swimming / showering)	Y	X	✓	✓	✓	X	X	X	MILD 9=(3x3)	Low likelihood	Low
Human Health - On-Site Future User	(Y) 5	Ingestion of fruit or vegetable leaf or roots	Y	X	✓	✓	✓	X	X	X	MEDIUM 15=(5x3)	Low likelihood	Moderate/Low
		Ingestion of contaminated drinking water	N										
		Ingestion of water / sediments when swimming	N										
		Ingestion of soil/dust indoors	Y	X	✓	✓	✓	X	X	X	MEDIUM 15=(5x3)	Low likelihood	Moderate/Low
		Ingestion of soil/dust outdoors	Y	X	✓	✓	✓	X	X	X	MEDIUM 15=(5x3)	Low likelihood	Moderate/Low
		Inhalation of particles (dust / soil) indoor and outdoor	Y	X	✓	✓	✓	X	X	X	MEDIUM 15=(5x3)	Low likelihood	Moderate/Low
		Inhalation of vapours/gases – outdoor	Y	X	✓	✓	✓	X	X	✓	MEDIUM 15=(5x3)	Low likelihood	Moderate/Low
		Inhalation of vapours/gases - indoor	Y	X	✓	✓	✓	X	X	✓	MEDIUM 15=(5x3)	Low likelihood	Moderate/Low
		Dermal absorption via direct contact with soil	Y	X	✓	✓	✓	X	X	X	MEDIUM 15=(5x3)	Low likelihood	Moderate/Low
		Dermal absorption via waters (swimming / showering)	Y	X	✓	✓	✓	X	X	X	MEDIUM 15=(5x3)	Low likelihood	Moderate/Low
Human Health - Off-Site	(Y) 5	Ingestion of fruit or vegetable leaf or roots	Y	X	✓	✓	✓	X	X	X	MEDIUM 15=(5x3)	Low likelihood	Moderate/Low
		Ingestion of contaminated drinking water	N										
		Ingestion of water / sediments when swimming	N										
		Ingestion of soil/dust indoors	Y	X	✓	✓	✓	X	X	X	MEDIUM 15=(5x3)	Low likelihood	Moderate/Low
		Ingestion of soil/dust outdoors	Y	X	✓	✓	✓	X	X	X	MEDIUM 15=(5x3)	Low likelihood	Moderate/Low
		Inhalation of particles (dust / soil) indoor and outdoor	Y	X	✓	✓	✓	X	X	X	MEDIUM 15=(5x3)	Low likelihood	Moderate/Low
		Inhalation of vapours – outdoor	Y	X	✓	✓	✓	X	X	✓	MEDIUM 15=(5x3)	Low likelihood	Moderate/Low
		Inhalation of vapours - indoor	Y	X	✓	✓	✓	X	X	✓	MEDIUM 15=(5x3)	Low likelihood	Moderate/Low
		Dermal absorption via direct contact with soil	Y	X	✓	✓	✓	X	X	X	MEDIUM 15=(5x3)	Low likelihood	Moderate/Low
		Dermal absorption via waters (swimming / showering)	N	X	✓	✓	✓	X	X	X	MEDIUM 15=(5x3)	Low likelihood	Moderate/Low
Human Health - Construction/ Maintenance Workers*	(Y) 2	Ingestion of soil/dust indoors	Y	X	✓	✓	✓	X	X	X	MILD 6=(2x3)	Likely	Moderate/Low
		Ingestion of soil/dust outdoors	Y	X	✓	✓	✓	X	X	X	MILD 6=(2x3)	Likely	Moderate/Low
		Inhalation of particles (dust / soil) outdoor	Y	X	✓	✓	✓	X	X	X	MILD 6=(2x3)	Likely	Moderate/Low
		Inhalation of vapours – outdoor	Y	X	X	X	✓	X	X	✓	MILD 6=(2x3)	Likely	Moderate/Low
		Inhalation of vapours - indoor	Y	X	X	X	✓	X	X	✓	MILD 6=(2x3)	Likely	Moderate/Low
		Dermal absorption via direct contact with soil	Y	X	✓	✓	✓	X	X	X	MILD 6=(2x3)	Likely	Moderate/Low
Groundwater	(Y) 5	Leaching	Y	X	X	X	X	X	X	X			
		Migration via natural or anthropogenic	Y	X	X	X	X	X	X	X			
Surface Water	N	Direct runoff or discharges from pipes											
		Indirect via recharge from groundwater (hydraulic flow)											
		Deposition of wind blown dust											
Buildings	(Y) 2	Direct contact	Y	X	✓	✓	✓	X	X	X	Minor 6=(2x3)	Low likelihood	Low
		Explosion due to gas migration via natural or anthropogenic	Y	X	X	X	X	X	X	✓	Medium 12=(3x4)	Low likelihood	Moderate/Low
Ecological Systems	N	Direct deposition of particles / dust - wind blown or flood											
		Indirect - through watering											
		Inhalation of gases/vapours or particulates/dust by animals											
		Ingestion of of vegetation / water / soil by animals											
Property	(Y) 2	Direct deposition via wind or flood	Y	X	✓	✓	✓	X	X	X	Minor 6=(2x3)	Low likelihood	Low
		Indirect through watering	Y	X	✓	✓	✓	X	X	X	Minor 6=(2x3)	Low likelihood	Low
		Inhalation of gas / vapour / particulates / dust by animals	Y	X	✓	✓	✓	X	X	✓	Minor 6=(2x3)	Low likelihood	Low
		Ingestion of vegetation / water / soil by animals	Y	X	✓	✓	✓	X	X	X	Minor 6=(2x3)	Low likelihood	Low

NOTES

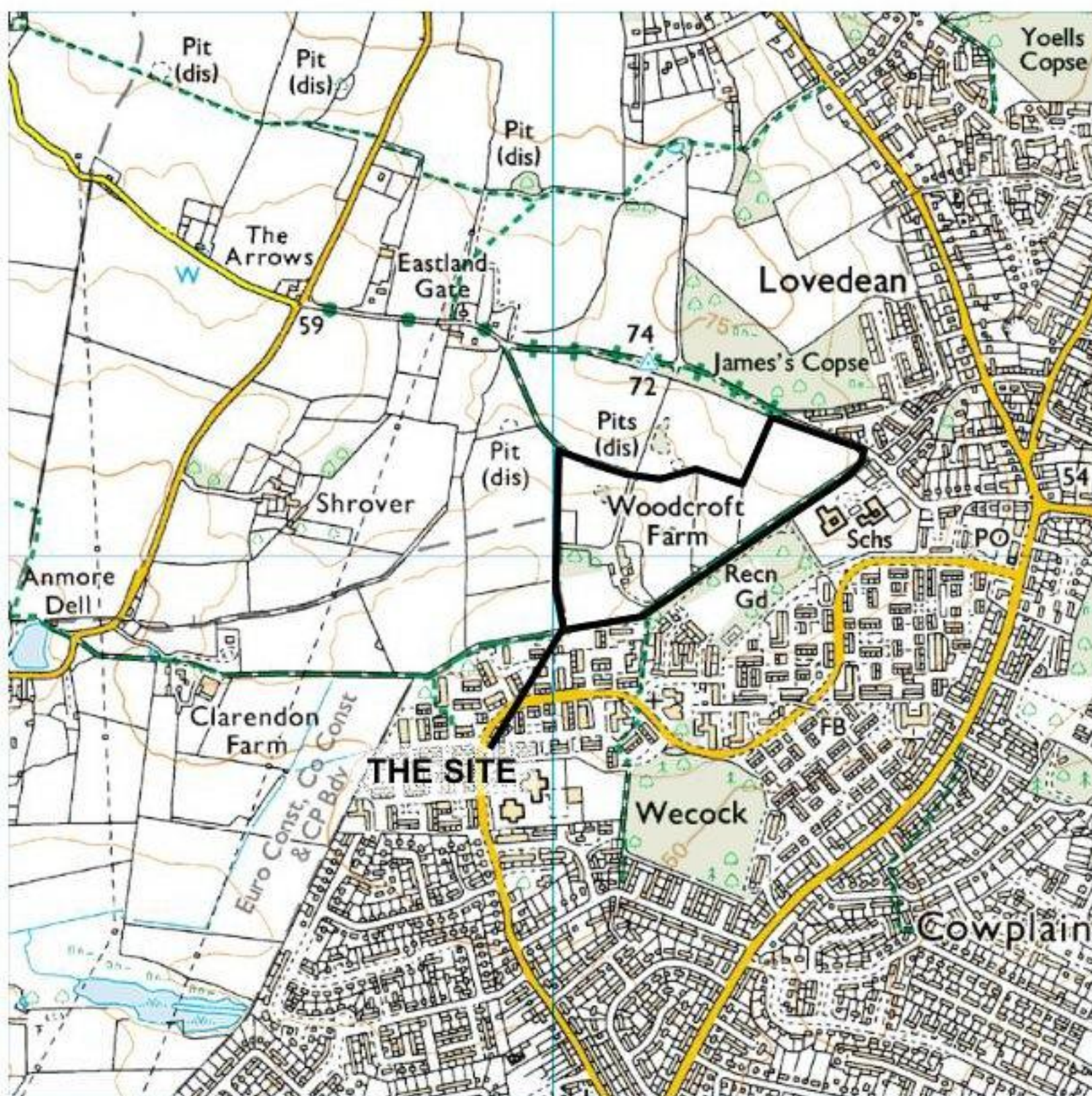
* It is assumed that construction workers will undergo appropriate health and safety training and wear personal protective equipment in conjunction with appropriate hygiene facilities.

Risk estimation establishes the magnitude and probability of the possible consequences (what degree of harm might result and how likely).

The criteria for classifying probability and consequence are set out in Tables 3 and 4 of the PBA methodology.

Green text highlights one or more elements of the Pollutant Linkage are missing and therefore eliminated

The risks estimated in this table are assessed only for the Made Ground in the filled Pit and the breakers yard.



Reproduced from the 1:25,000 map by permission of the Ordnance Survey © on behalf of The Controller of Her Majesty's Stationery Office. All rights reserved. Licence No. 100017583 © Crown Copyright 2011.

National Grid Reference SU 681 119
Coordinates N50:54:12 W1:01:57
Nearest Post Code PO8 9QA

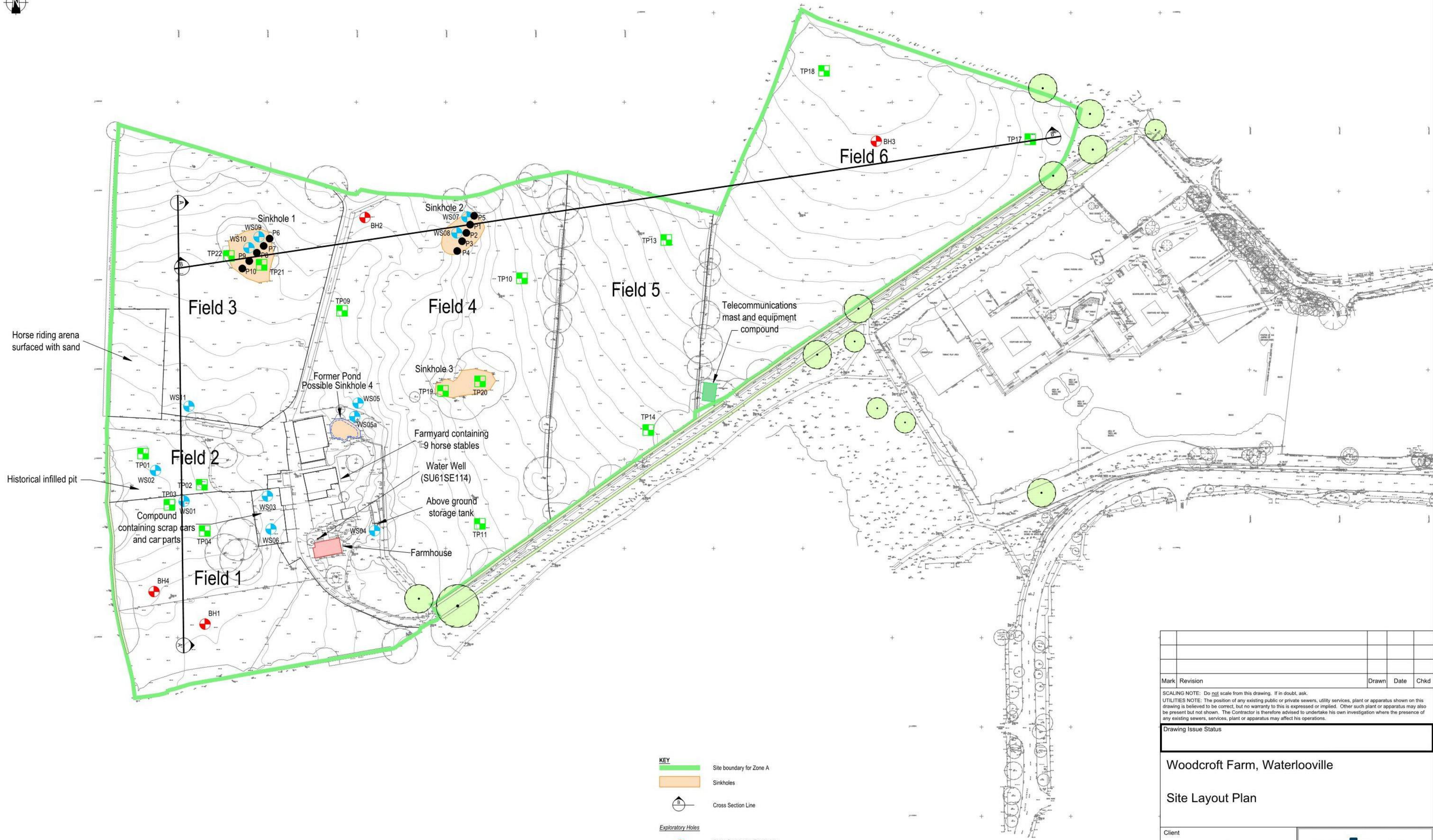
pba
peterbrett

Client
grainger

Caversham Bridge House, Waterman Place, Reading, RG1 8DN
Tel 0118 950 0761 Fax 0118 959 7498

SITE LOCATION PLAN **WOODCROFT FARM,** **WATERLOOVILLE**

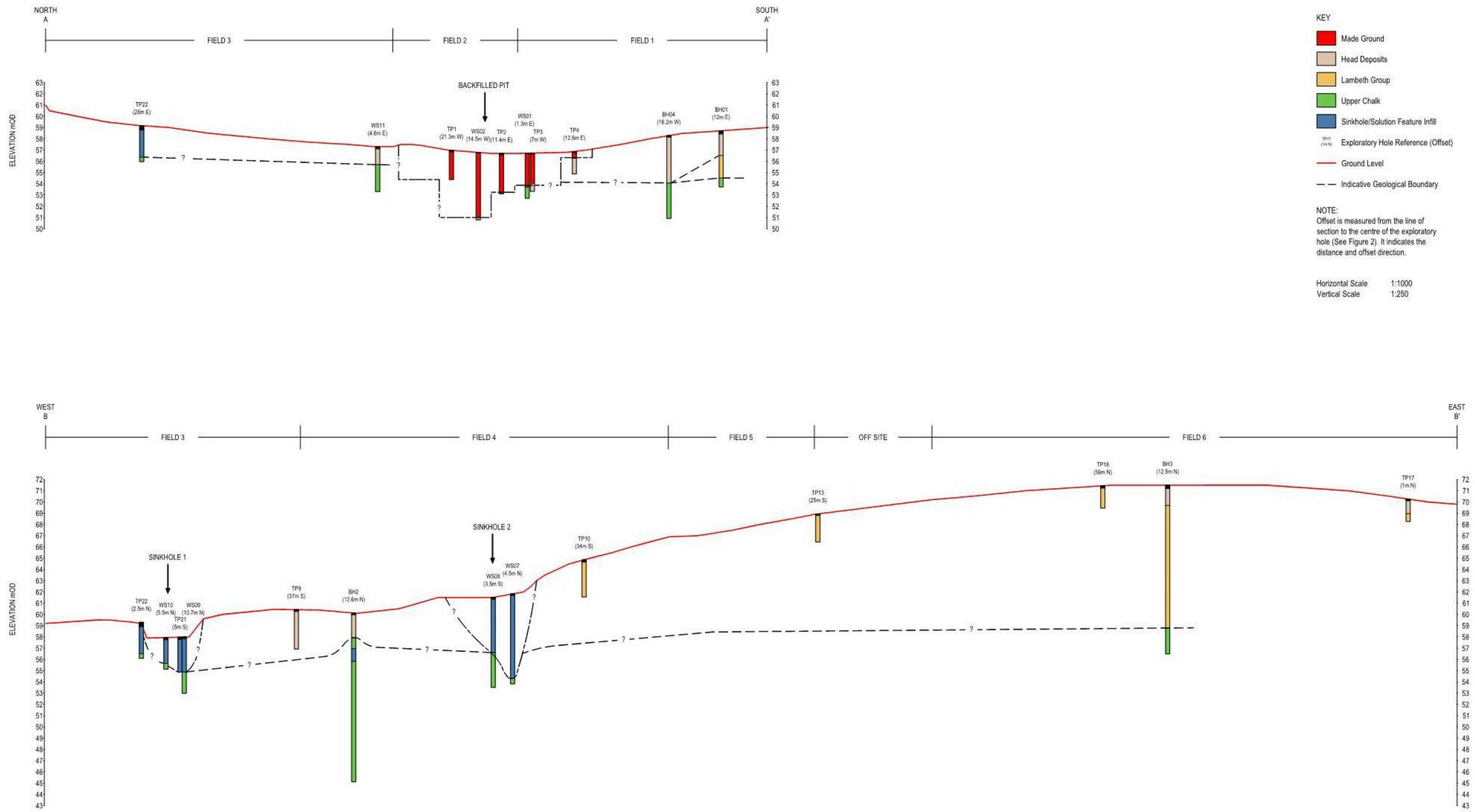
Date	Oct 2011
A4 Scale	1:12 500
Drawn	az
Checked	ad
Figure	1



- KEY**
- Site boundary for Zone A
 - Sinkholes
 - Cross Section Line
- Exploratory Holes**
- Cable Percussion Boreholes
 - Trial Pits
 - Window Sample
 - Dynamic Probe

Mark	Revision	Drawn	Date	Chkd	
SCALING NOTE: Do <u>not</u> scale from this drawing. If in doubt, ask.					
UTILITIES NOTE: The position of any existing public or private sewers, utility services, plant or apparatus shown on this drawing is believed to be correct, but no warranty to this is expressed or implied. Other such plant or apparatus may also be present but not shown. The Contractor is therefore advised to undertake his own investigation where the presence of any existing sewers, services, plant or apparatus may affect his operations.					
Drawing Issue Status					
Woodcroft Farm, Waterlooville					
Site Layout Plan					
Client					
grainger					
Date of 1st Issue		Drawn by			
28.10.2011		DJM			
A1 Scale		Checked by			
1:1000		AZ			
Drawing Number		Revision			
Figure 2		-			

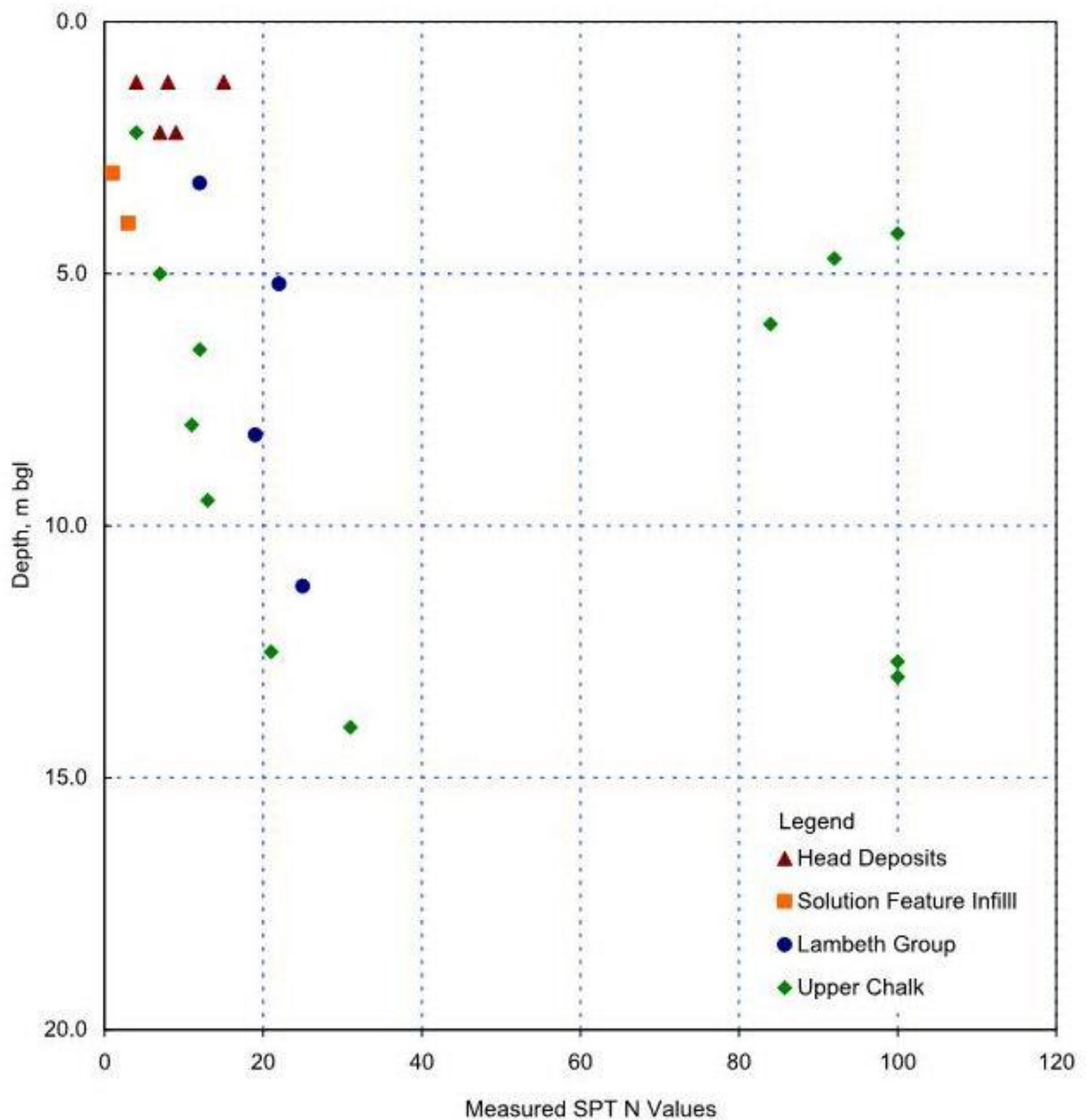
	
Offices throughout the UK, Ireland, continental Europe, Africa, Asia and Australia	
www.pba.co.uk	
© Peter Brett Associates LLP	
READING	
Tel: 0118 950 0761 Fax: 0118 959 7498	



Woodcroft Farm, Waterloooville

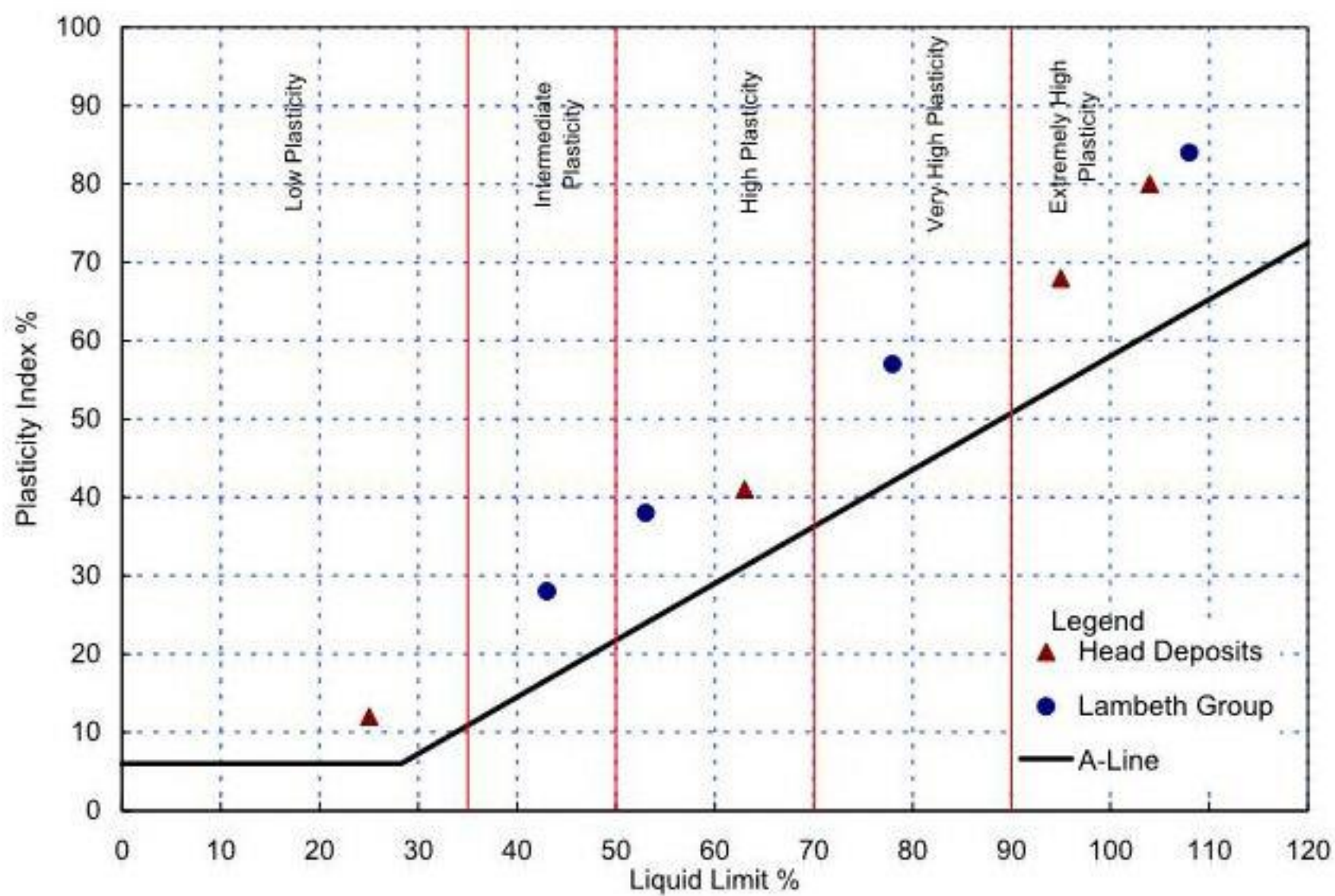
Schematic Sections A-A' & B-B'

Client		 Offices throughout the UK, continental Europe, Africa and Asia www.peterbrett.com © Peter Brett Associates LLP READING Tel: 0118 950 0761 Fax: 0118 959 7498	
Date	28.10.2011	Drawn by	DJM
A2 Scale	H 1:1000 V 1:250	Checked by	AZ
Figure Number	3		



Note: SPT N values have not been corrected for overburden pressure
SPT N values shown over 50 have been extrapolated using the penetration length

	Client 	STANDARD PENETRATION TESTS WOODCROFT FARM, WATERLOOVILLE	Date	November 2011
			A4 Scale	nts
			Drawn	az
			Checked	AD
			Figure	4



Client

grainger

Caversham Bridge House, Waterman Place, Reading, RG1 8DN
Tel 0118 950 0761 Fax 0118 959 7499

ATTERBERG LIMITS

**WOODCROFT FARM,
WATERLOOVILLE**

Date November 2011

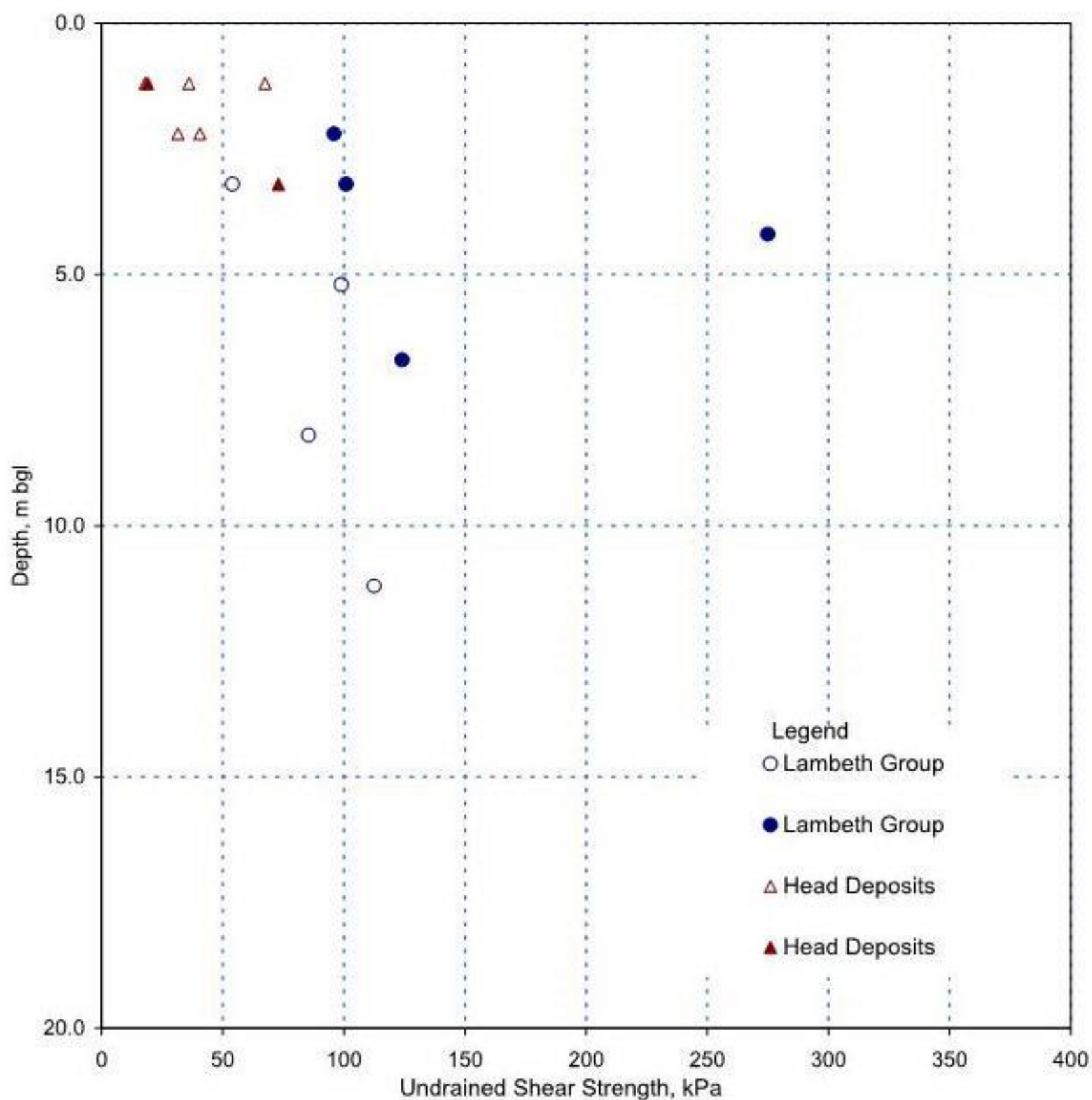
A4 Scale nts

Drawn az

Checked ad

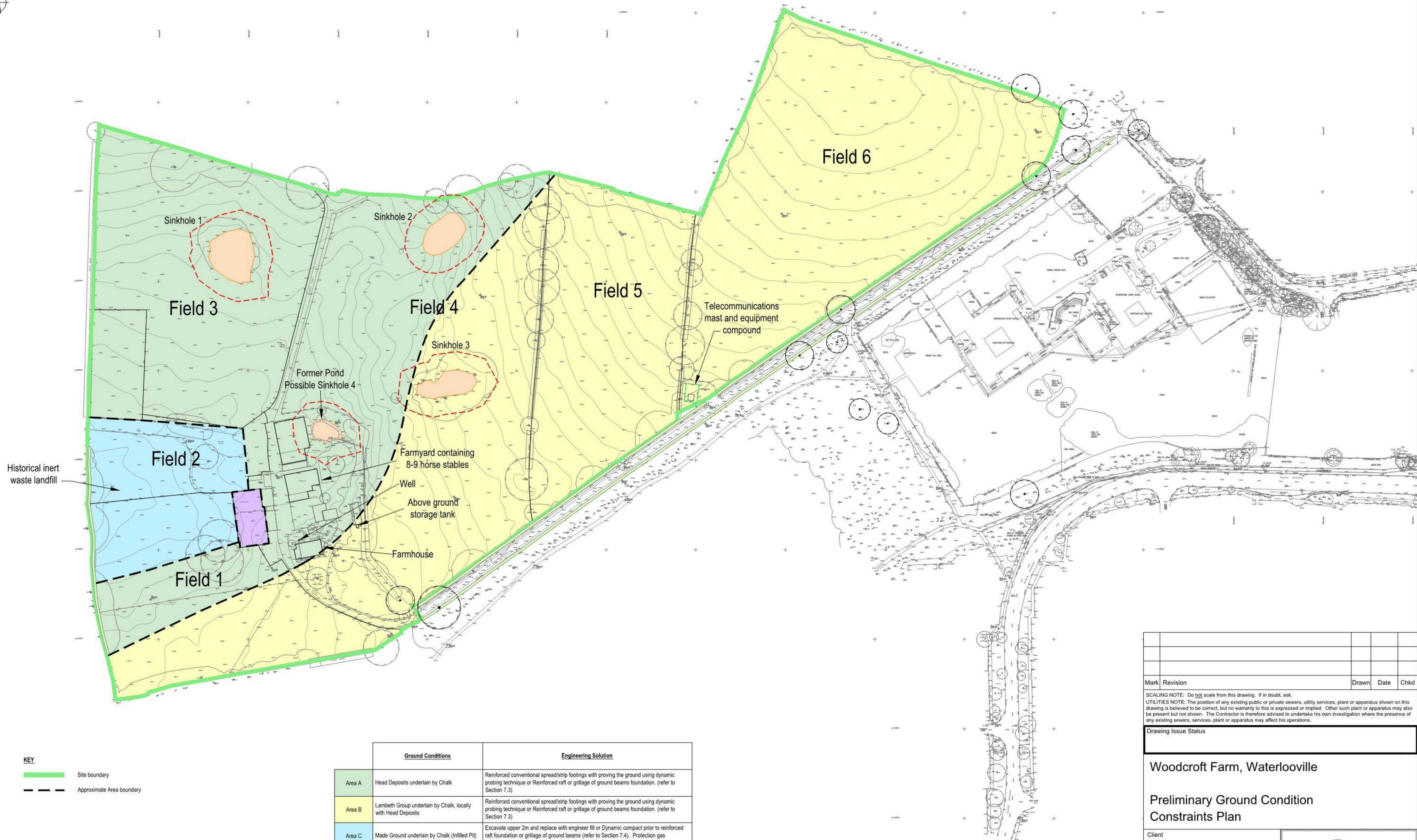
Figure

5



Note: Open symbols denote values of undrained shear strength determined using the empirical correlation with SPT N values (Stroud, 1989) with a factor N_c of 4.5
 Closed symbols denote values of undrained shear strength determined by laboratory triaxial testing of UT100 mm diameter specimens

	Client 	UNDRAINED SHEAR STRENGTH WOODCROFT FARM, WATERLOOVILLE	Date	November 2011
			A4 Scale	nts
			Drawn	az
			Checked	AD
			Figure	
Caversham Bridge House, Wateman Place, Reading, RG1 8DN Tel 0118 950 0761 Fax 0118 959 7499				



KEY

— Site boundary

--- Approximate Area boundary

	Ground Conditions	Engineering Solution
Area A	Head Deposits underlain by Chalk	Reinforced conventional spread/strip footings with proving the ground using dynamic probing technique or Reinforced raft or grillage of ground beams foundation. (refer to Section 7.3)
Area B	Lambeth Group underlain by Chalk, locally with Head Deposits	Reinforced conventional spread/strip footings with proving the ground using dynamic probing technique or Reinforced raft or grillage of ground beams foundation. (refer to Section 7.3)
Area C	Made Ground underlain by Chalk (Infilled Pit)	Excavate upper 2m and replace with engineer fill or Dynamic compact prior to reinforced raft foundation or grillage of ground beams (refer to Section 7.4). Protection gas measures to be incorporated in structures (refer to Section 6.6).
Area D	Made Ground underlain by Head Deposits and Chalk (Vehicle Dismantling Yard)	Remove identified impacted soil and use Reinforced conventional spread/strip footings with proving the ground using dynamic probing technique or Reinforced raft or grillage of ground beams foundation. (refer to Section 7.3)
Sinkhole	Sinkhole Infill	10m Buffer Zone around Sinkhole where development should be avoided, unless remedial treatment is carried out.

Notes:
Reinforcing geogrids to be incorporated into road design.

Mark	Revision	Drawn	Date	Chkd

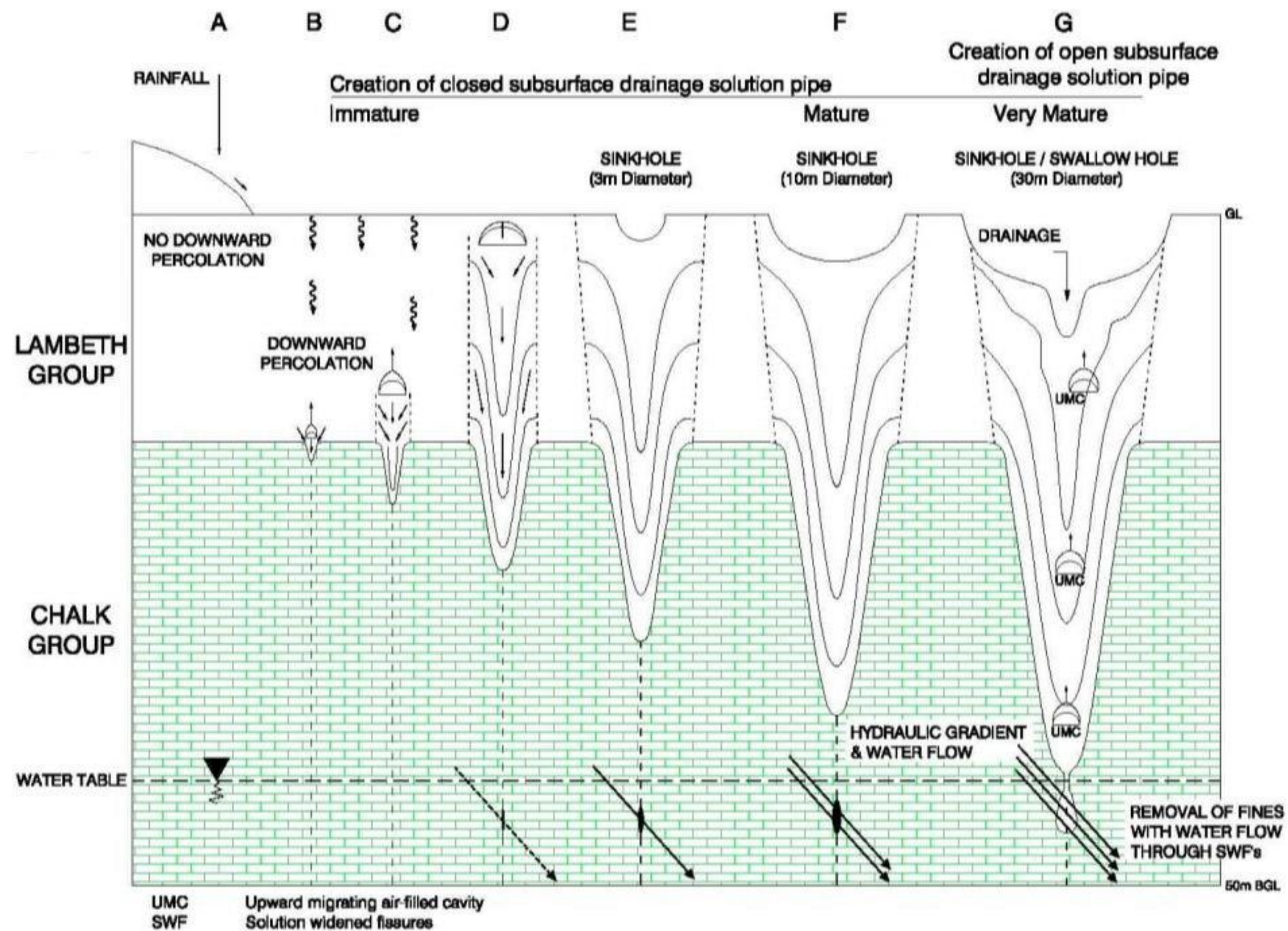
SCALING NOTE: Do not scale from this drawing. If in doubt, ask.
UTILITIES NOTE: The position of any existing public or private sewers, utility services, plant or apparatus shown on this drawing is believed to be correct, but no warranty to this is expressed or implied. Other such plant or apparatus may be present but not shown. The Contractor is therefore advised to undertake his own investigation where the presence of any existing sewers, services, plant or apparatus may affect his operations.

Drawing Issue Status

Woodcroft Farm, Waterlooville

Preliminary Ground Condition
Constraints Plan

Client		grainger		pba peterbrett	
Date of 1st Issue	28.10.2011	Drawn by	DJM	Offices throughout the UK, Ireland, continental Europe, Africa, Asia and Australia www.pba.co.uk © Peter Brett Associates LLP READING Tel: 0118 950 0761 Fax: 0118 959 7498	
A1 Scale	1:1000	Checked by	AZ		
Drawing Number	Figure 7	Revision	-		



Note

The figure is reproduced from the paper 'Karst and mining geohazards with particular reference to the Chalk outcrop, England' By C.D. Edmonds. Published in the Quarterly Journal of Engineering Geology and Hydrogeology 2008; v. 41; p. 261-278.

37 MRQ's

LOVEDEAN
(HMS Mercury)

BOREHOLE LOG SU61SE/12A
N.E.R. 687.120 1":316

Borehole No. 1
Ground Level 61.5 m O.D.
Date 5th - 7th February 1975

Note:-

Standpipe inserted to 6m. Borehole grouted with bentonite/cement mix to depth of 1.0m

Description of Strata	Legend	Sample	Depth (m)	O.D. (m)	Remarks
TOPSOIL: turf and organic CLAY with stones.	T		0 - 0.5	61.5	Water levels in standpipe
CLAY: variegated in light brown and grey, with small stones (READING BEDS - Type C)			0.5 - 0.8	61.0	8/2/75 dry 24/2/75 4.9m
CLAY: variegated in red, brown and grey. Nearly vertical curved slickensided fissure present in UIOO at 2.0 - 2.5m			0.8 - 1.0	60.7	9/2/75 5.5m 25/2/75 4.9m
(READING BEDS - Type C)			1.0 - 1.3 (approx)	60.5	10/2/75 5.4m 26/2/75 5.0m
CLAY/SILT: sandy, variegated in yellow - brown, red and grey. 3.0 - 3.5m sandy SILT with scattered clay patches.			1.3 - 2.0	60.2	11/2/75 5.1m 2/7/75 4.3m
(READING BEDS - Type C)			2.0 - 2.5	59.5	12/2/75 5.3m
			2.5 - 3.0	59.0	13/2/75 3.2m
			3.0 - 3.5	58.5	14/2/75 3.2m
			3.5 - 4.0	58.0	15/2/75 3.1m
			4.0 - 4.5	57.0	16/2/75 3.2m
			4.5 - 5.0	56.5	17/2/75 1.3m
			5.0 - 5.5	56.0	18/2/75 4.8m
			5.5 - 6.0	55.5	19/2/75 4.7m
			6.0 - 6.5	55.0	20/2/75 5.0m
			6.5 - 7.0	54.5	21/2/75 4.9m
			7.0 - 7.5	54.0	22/2/75 5.0m
			7.5 - 8.0	53.5	23/2/75 5.0m
			8.0 - 8.5	53.0	4.3m
			8.5 - 9.0	52.8 (approx)	
			9.0 - 9.5	52.5	
			9.5 - 10.0	52.0	
			10.0 - 10.5	51.8	
			10.5 - 11.0	51.5	

contd.

Department of the Environment		Investigation No.		Appendix A	
CIVIL ENGINEERING LABORATORY Cardington		FGE / 185		Sheet No. 3	
37 MRQ's			LOVEDEAN (HMS Mercury)		
BOREHOLE LOG			SU 61 SE 12 A N.G.R. 687.120 1":316		
Borehole No. 1 contd Ground Level Date			Note:-		
Description of Strata	Legend	Sample	Depth (m)	O.D. (m)	Remarks
CLAY: gravelly (flints), grey-brown, with pockets of orange-brown sand. (READING BEDS - Type CG)		I	10.0	51.5	UPPER CHALK End of borehole
CHALK: remoulded with sand pockets (resembles GRADE V)			10.5	51.0	
CHALK: rubbly. Also pipe containing clay and sand with flints. (resembles GRADE IV)			10.6	50.7	
			11.0	50.5	

Department of the Environment		Investigation No.		Appendix A	
CIVIL ENGINEERING LABORATORY		Cardington		FGE / 185	
37 MRQ's		LOVEDEAN (HMS Mercury)			
BOREHOLE LOG		SU61SE / 12 B N.E.R. 687.120 1" : 316			
Borehole No. 2 Ground Level 60.7 m O.D Date 8th - 10th February 1975			Note:- Standpipe inserted to 6m. Borehole grouted with bentonite / cement mix to depth of 1.0m		
Description of Strata	Legend	Sample	Depth (m)	O.D. (m)	Remarks
Water levels in standpipe					
TOPSOIL: turf and organic CLAY	T		0.5	60.2	11/2/75 5.0m 25/2/75 3.8m
					12/2/75 5.2m 26/2/75 3.9m
CLAY: with stones, grey-green changing to brown and grey variegated at approx. 1.0m (READING BEDS - Type C)	I		0.8	59.9	13/2/75 5.3m 2/7/75 4.1m
					14/2/75 5.4m
CLAY: sandy, mottled brown/yellow (READING BEDS - Type C)	I		1.3	59.4	15/2/75 5.1m
					16/2/75 4.0m
CLAY: variegated in red, brown and grey, becoming dark purple/brown or dark grey/brown between 4.5m and 5.0m. Occasional silt layers and pockets of brown sand are present between 4.5m and 5.0m. Plant remains noted at 5.0m. (READING BEDS - Type C)	I		1.5	59.2	17/2/75 4.0m
					18/2/75 4.1m
	I		2.0	58.7	19/2/75 4.0m
					20/2/75 4.0m
	I		3.0	57.7	21/2/75 4.0m
					22/2/75 3.9m
	I		3.5	57.2	23/2/75 4.0m
					24/2/75 3.3m
					4.1m
			4.6	56.2	
			5.0	55.7	← Water Entry 5.0m
			5.6	55.2	
CLAY: dark grey, possibly slightly organic. Gypsum crystals present at 6.5m. (READING BEDS - Type C)			6.0	54.7	
			6.5	54.2	
CLAY: sandy, orange-brown / grey. (READING BEDS - Type C)			6.9	53.8	
			7.5	53.2	
CLAY: sandy and gravelly (flints), Patches of gypsum crystals and traces of chalk are present. (READING BEDS - Type CG)			8.2	52.5	} chisel employed } no flints in SPT sample
CHALK: hard and indurated, with brown clay.			8.5	52.2	
CHALK: buff, resembling rubblely chalk in matrix of remoulded chalk. Flints present (up to 120mm seen) (resembles GRADE V → GRADE IV)			8.7	52.0	
			9.5	51.2	} flints present in SPT sample
			9.7	51.0	
CHALK: buff, rubblely, with patches of brown clay - possibly a 'pipe'. (resembles GRADE IV)			10.0	50.7	
					End of borehole

37 MRQ's

LOVEDEAN
(HMS Mercury)

BOREHOLE LOG

SU61SE/12c 1:316
N.G.R. 687.120

Borehole No. 3
Ground Level 61.0 m O.D.
Date 11th - 13th February 1975

Note:- Standpipe inserted to 6.0m. Borehole grouted with bentonite/cement mix to depth of 1.0m

Description of Strata	Legend	Sample	Depth (m)	O.D. (m)	Remarks
Water levels in Standpipe					
TOPSOIL: turf and organic sandy CLAY with flints.		I	0.0 - 61.0	61.0	14/2/75 5.6m 2/7/75 4.6m
			0.6 - 60.4 (approx)	60.2	15/2/75 5.1m
CLAY: variegated in brown and grey, with a few small flints. Patches of organic clay with roots etc. between 1.5m and 2.0m. (MADE GROUND)		I	0.8 - 60.2	60.2	16/2/75 4.3m
			1.3 - 59.7	59.7	17/2/75 4.2m
			1.8 - 59.2	59.2	18/2/75 4.0m
			2.0 - 59.0	59.0	19/2/75 3.9m
			2.1 - 58.9	58.9	20/2/75 3.8m
			2.5 - 58.5	58.5	21/2/75 3.9m
CLAY: variegated in yellow, orange-brown and grey. Thin sandy streaks/partings present at 4.0m. Large flint at 4.6 - 4.8m. Limit of made or disturbed ground marked by well-defined inclined surface in U100 sample at 2.1m. (READING BEDS - Type C)		I	2.5 - 58.5	58.5	22/2/75 3.9m
			3.5 - 57.5	57.5	23/2/75 3.8m
			4.0 - 57.0	57.0	24/2/75 3.8m
			4.5 - 56.2	56.2	25/2/75 3.9m
			5.0 - 56.0	56.0	26/2/75 3.9m
			5.3 - 55.7 (approx)	55.7	
CLAY: sandy, brown/grey (READING BEDS - Type CS)		I	5.5 - 55.5	55.5	
CLAY: dark grey-brown, probably slightly organic. Stones and concentration of gypsum present at 5.5 - 6.0m. (READING BEDS - Type C)		I	6.2 - 54.8	54.8	Water entry 6.0m (slow seepage)
CLAY: sandy and slightly chalky, yellow-brown. (READING BEDS - Type CS)		I	6.5 - 54.5	54.5	
CLAY: gravelly (flints), light brown/grey. (READING BEDS - Type CG)		I	7.2 - 53.8	53.8	
CHALK: rubble consisting of hard and indurated chalk with some brown clay matrix.		I	8.0 - 53.0	53.0	chiselling not required
CHALK: buff/brown, remoulded, clayey, with flints and fragments of hard chalk. (resembles GRADE V)		I	8.5 - 52.5	52.5	
CHALK: rubbly, cream to buff. Joints 10mm wide. Patches of brown and grey clay between 9.0m and 9.5m. (resembles GRADE IV)		I	9.0 - 52.0	52.0	
CHALK: hard and rather brittle, blocky, cream, no flints present. (GRADE I)		I	9.5 - 51.5	51.5	
		I	9.7 - 51.3	51.3	
		I	10.0 - 51.0	51.0	End of borehole

(147)

End of borehole

37 MRQ's

LOVEDEAN
(HMS Mercury)

BOREHOLE LOG

SUBISE 12 D 1" 316
N.G.R. 687.120

Borehole No. 4
Ground Level 57.3 m O.D.
Date 18th - 20th February 1975

Note:- Standpipe inserted to depth of 3.0m.
Bottom of borehole grouted up to 3.0m.
Top of borehole grouted from surface
to depth of 1.0m with bentonite / cement
mix.

Description of Strata	Legend	Sample	Depth (m)	O.D. (m)	Remarks
TOPSOIL: turf and organic CLAY with stones.	T		0 - 57.3		
CLAY: gray/brown (READING BEDS - Type C)			0.4 - 56.9		
SAND: light gray, slightly silty/clayey (READING BEDS - Type B)			0.8 - 56.5 1.0 - 56.3 (approx) 1.3 - 56.0		
CLAY: variegated in red, brown, and gray. (READING BEDS - Type C)			2.5 - 54.8 3.0 - 54.3 3.4 - 53.9		
CLAY: gravelly (flints), variegated. (READING BEDS - Type CG)			4.0 - 53.3 4.1 - 53.2		* SPT attempted - no penetration chisel employed
CHALK: hard and indurated, with flints.			4.4 - 52.8 4.5 - 52.8		UPPER CHALK
CHALK: cream, rubbly. Joints quite closely spaced with brown staining. (resembles GRADE IV)			5.0 - 52.3		End of borehole
Inclusions of gray clay occur in the chalk at 5.0m.					
					Water levels in standpipe
					21/2/75 dry 26/2/75 dry
					22/2/75 dry 2/7/75 dry
					23/2/75 dry
					24/2/75 dry
					25/2/75 dry

Department of the Environment		Investigation No.	Appendix A
CIVIL ENGINEERING LABORATORY	Cardington	FGE/185	Sheet No. 7

37 MRQ's	LOVEDEAN (HMS Mercury)
----------	----------------------------------

BOREHOLE LOG		SU61SE/12 E 1":316 N.G.R. 687.120
--------------	--	--------------------------------------

Borehole No. 5 Ground Level 59.1 m O.D. Date 14th - 16th February 1975	Note:- Standpipe inserted to 6m. Borehole grouted with bentonite / cement mix to depth of 1.0m.
---	---

Description of Strata	Legend	Sample	Depth (m)	O.D. (m)	Remarks																																												
CLAY: gravelly, variegated in brown and grey. (READING BEDS? - Type CG)	0-0.1	I	0.1	59.1 59.0	0.5m MADE GROUND? (probably surface water)																																												
CLAY: variegated in brown and grey. (READING BEDS - Type C)	0.1-1.0	4	1.0 1.1	58.1 58.0																																													
CLAY: sandy, variegated in grey, brown and red. Partings of brown/grey clayey sand are present. Flints present between 2.0m and 2.5m. (READING BEDS - Type CG)	1.0-2.0	I	2.0	57.1	<table border="1" style="width:100%; border-collapse: collapse;"> <caption>Water levels in standpipe</caption> <tr><td>17/2/75</td><td>0.2m</td><td></td><td></td></tr> <tr><td>18/2/75</td><td>0.2m</td><td></td><td></td></tr> <tr><td>19/2/75</td><td>0.2m</td><td></td><td></td></tr> <tr><td>20/2/75</td><td>0.2m</td><td></td><td></td></tr> <tr><td>21/2/75</td><td>0.2m</td><td></td><td></td></tr> <tr><td>22/2/75</td><td>0.2m</td><td></td><td></td></tr> <tr><td>23/2/75</td><td>0.2m</td><td></td><td></td></tr> <tr><td>24/2/75</td><td>0.2m</td><td></td><td></td></tr> <tr><td>25/2/75</td><td>0.2m</td><td></td><td></td></tr> <tr><td>26/2/75</td><td>0.2m</td><td></td><td></td></tr> <tr><td>2/7/75</td><td>0.5m</td><td></td><td></td></tr> </table>	17/2/75	0.2m			18/2/75	0.2m			19/2/75	0.2m			20/2/75	0.2m			21/2/75	0.2m			22/2/75	0.2m			23/2/75	0.2m			24/2/75	0.2m			25/2/75	0.2m			26/2/75	0.2m			2/7/75	0.5m		
17/2/75	0.2m																																																
18/2/75	0.2m																																																
19/2/75	0.2m																																																
20/2/75	0.2m																																																
21/2/75	0.2m																																																
22/2/75	0.2m																																																
23/2/75	0.2m																																																
24/2/75	0.2m																																																
25/2/75	0.2m																																																
26/2/75	0.2m																																																
2/7/75	0.5m																																																
CLAY: variegated in red, brown and grey. (READING BEDS - Type C)	2.0-4.0	I	4.0	55.1																																													
CLAY: gravelly (flints), brown/grey. Flints seen up to 100mm size. (READING BEDS - Type CG)	4.0-5.5	I	5.5	53.6																																													
CHALK: rubble consisting of hard chalk & flints with clay.	5.5-6.3	I	6.3	52.8																																													
CHALK: rubble, with flints and patches of brown clay. (resembles GRADE IV)	6.3-6.5	I	6.5	52.6																																													
	6.5-6.7	I	6.7	52.4																																													
	6.7-8.0	I	8.0	51.1 (approx)																																													
CHALK: rubble to blocky, but with some joints open to 10mm and filled with remoulded chalk. Many flints are present including a large one at 9.8m. (resembles GRADE III)	8.0-8.5	I	8.5	50.6																																													
	8.5-9.0	I	9.0	50.1																																													
	9.0-10.0	I	10.0	49.1	SPT attempted - no penetration * (large flint in sample)																																												

End of borehole

UPPER CHALK

37 MRQ's

LOVEDEAN
(HMS Mercury)

BOREHOLE LOG

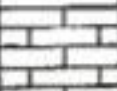
SU 61SE 12 F 11:316
N.G.R. 687.120

Borehole No. 6
Ground Level 58.1 m O.D.
Date 20th - 22nd February 1975

Note:- Standpipe inserted to depth of 8.5m.
Bottom of borehole grouted up to 8.5m.
Top of borehole grouted from surface to depth of 1.0m with bentonite/cement mix.

Description of Strata	Legend	Sample	Depth (m)	O.D. (m)	Remarks
TOPSOIL: turf and organic CLAY			0.0 - 58.1		Water levels in standpipe
CLAY: brown/gray sandy with stones (MADE GROUND)		I	0.4 - 57.7		23/2/75 5.2 m
SAND: yellow-brown, gravelly and clayey (MADE GROUND)			0.6 - 57.8		24/2/75 5.0 m
CLAY: sandy, variegated in gray, brown and red. (READING BEDS - Type CB)		16	1.0 - 57.1		25/2/75 5.0 m
			1.1 - 57.0		26/2/75 4.9 m
CLAY: variegated in red, yellow and gray. Dark red concretions present. (READING BEDS - Type C)		I	1.7 - 56.4 (approx)		2/7/75 Dry (to 7.7m)
			2.0 - 56.1		
CLAY: sandy, brown/gray, with small stones. (READING BEDS - Type CB)		I	2.5 - 55.6		
			3.5 - 54.0		
CLAY: variegated in red, gray and brown. (READING BEDS - Type C)		I	4.0 - 54.1		
			4.2 - 53.9		
CLAY: gravelly (flints), brown/gray. (READING BEDS - Type CG)			4.5 - 53.6		
CHALK: hard and indurated, with some brown clay. Possibly rubble below 4.7m		*	4.7 - 53.4		* SPT attempted no penetration chiselling not required.
			5.2 - 52.9		
CHALK: cream, rubble, with patches of buff/brown clay and remoulded chalk below 6.0m. Frequent flints present. (resembles GRADE IV)		I	5.5 - 52.6		
			6.0 - 52.1		
			7.0 - 51.1 (approx)		
CHALK: cream, rubble to blocky with flints. Joints about 60mm apart. (resembles GRADE III)		45	7.2 - 50.9		no flints present in SPT sample
			8.5 - 49.6		Water Entry 7.5m
			9.0 - 49.1		
			10.0 - 48.1		

End of borehole

Department of the Environment		Investigation No.		Appendix A	
CIVIL ENGINEERING LABORATORY		Cardington		FGE / 185	
				Sheet No. 9	
37 MRQ's			LOVEDEAN (HMS Mercury)		
BOREHOLE LOG			SUBISE / W F 1":316 N.G.R. 687.120		
Borehole No. 6 cont'd			Note:-		
Ground Level.....					
Date.....					
Description of Strata	Legend	Sample	Depth (m)	O.D. (m)	Remarks
CHALK: cream, blocky with a few flints. (resembles GRADE III)		(51)	10.0 - 48.1 10.2 - 47.9 10.5 - 47.6		UPPER CHALK (cont'd.) ----- End of borehole

Department of the Environment		Investigation No.	Appraisal																																										
CIVIL ENGINEERING LABORATORY	Cardington	FGE/185	Sheet No. 10																																										
37 MRQ's		LOVEDEAN (HMS Mercury)																																											
BOREHOLE LOG		SU61SE 12 & 11.31b N.G.R. 687.120																																											
Borehole No. <u>7</u> Ground Level <u>55.9 m O.D.</u> Date <u>17th - 18th February 1975</u>		Note:- Standpipes inserted to 6m. Borehole grouted with bentonite / cement mix to depth of 1.5m.																																											
Description of Strata	Legend	Sample	Depth (m)	O.D. (m)	Remarks																																								
TOPSOIL: turf and grey CLAY with stones	T		0.0 - 55.9																																										
CLAY: variegated in red, brown and yellow. (READING BEDS - Type C)	I		0.4 - 55.5																																										
			0.8 - 55.1																																										
			1.3 - 54.6																																										
			1.8 - 54.1																																										
CHALK: remoulded and mixed with brown clay. Frequent flints including large ones (resembles GRADE V)			2.2 - 53.7		} flints present in S.P.T. sample (approx)																																								
			2.7 - 53.2																																										
			3.0 - 52.9																																										
CHALK: buff to cream, rubbly, with brown staining. Flints present. Appears softened between 3.5m and 4.5m (resembles GRADE IV)			3.5 - 52.4																																										
			4.5 - 51.4																																										
CHALK: cream, rubbly to blocky, with flints. Appears softened between 5.0m and 5.5m. (resembles GRADE III)			5.0 - 50.9		} UPPER CHALK																																								
			6.0 - 49.9																																										
CHALK: cream, blocky, but some brown-staining is present. (resembles GRADE II)			6.2 - 49.7																																										
			6.5 - 49.4		} no flints in S.P.T. sample																																								
			End of borehole																																										
<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <th colspan="4">Water levels in standpipes</th> </tr> <tr> <td>19/2/75</td> <td>dry</td> <td></td> <td></td> </tr> <tr> <td>20/2/75</td> <td>dry</td> <td></td> <td></td> </tr> <tr> <td>21/2/75</td> <td>dry</td> <td></td> <td></td> </tr> <tr> <td>22/2/75</td> <td>dry</td> <td></td> <td></td> </tr> <tr> <td>23/2/75</td> <td>dry</td> <td></td> <td></td> </tr> <tr> <td>24/2/75</td> <td>dry</td> <td></td> <td></td> </tr> <tr> <td>25/2/75</td> <td>dry</td> <td></td> <td></td> </tr> <tr> <td>26/2/75</td> <td>dry</td> <td></td> <td></td> </tr> <tr> <td>2/7/75</td> <td>dry</td> <td></td> <td></td> </tr> </table>						Water levels in standpipes				19/2/75	dry			20/2/75	dry			21/2/75	dry			22/2/75	dry			23/2/75	dry			24/2/75	dry			25/2/75	dry			26/2/75	dry			2/7/75	dry		
Water levels in standpipes																																													
19/2/75	dry																																												
20/2/75	dry																																												
21/2/75	dry																																												
22/2/75	dry																																												
23/2/75	dry																																												
24/2/75	dry																																												
25/2/75	dry																																												
26/2/75	dry																																												
2/7/75	dry																																												

BOREHOLE LOG

- Disturbed Sample
- ↑ Bulk Disturbed Sample
- 105mm Undisturbed Sample
- | Standard Penetration Test
- △ Water Sample

Date started 20.7.82 Date completed 20.7.82

Scheme LOVE DEAN LANE, HAVANT.

Location AT JUNCTION OF MILTON ROAD AND LOVE DEAN LANE

Borehole No 1 Ground Level

Sample			Section	Depth above O.D. or below Ground Level	Thickness of Stratum m.	Description of Soil	Penetration Test			
No	Type	Depth m.					Pen'n mm.	No. o Blow		
1	●	1.2		1.2	1.2	Topsoil, flint and brick fragments. (FILL)	305	10		
2		1.7			2.2	Stiff brown silty CLAY matrix with fine and medium and locally coarse GRAVEL fragments, being more clayey below 2.50m. (VALLEY GRAVEL)			305	12
3										
4										
5										
6										
7		3.5		0.1 pen'd	Stiff pale brown calcareous SILT with some firm brown silty CLAY and medium soft CHALK fragments (<10mm) (HEAD)	305	15			
1. Borehole remained dry during boring										

SOUTH EASTERN SOILS LTD

Scale 1:50

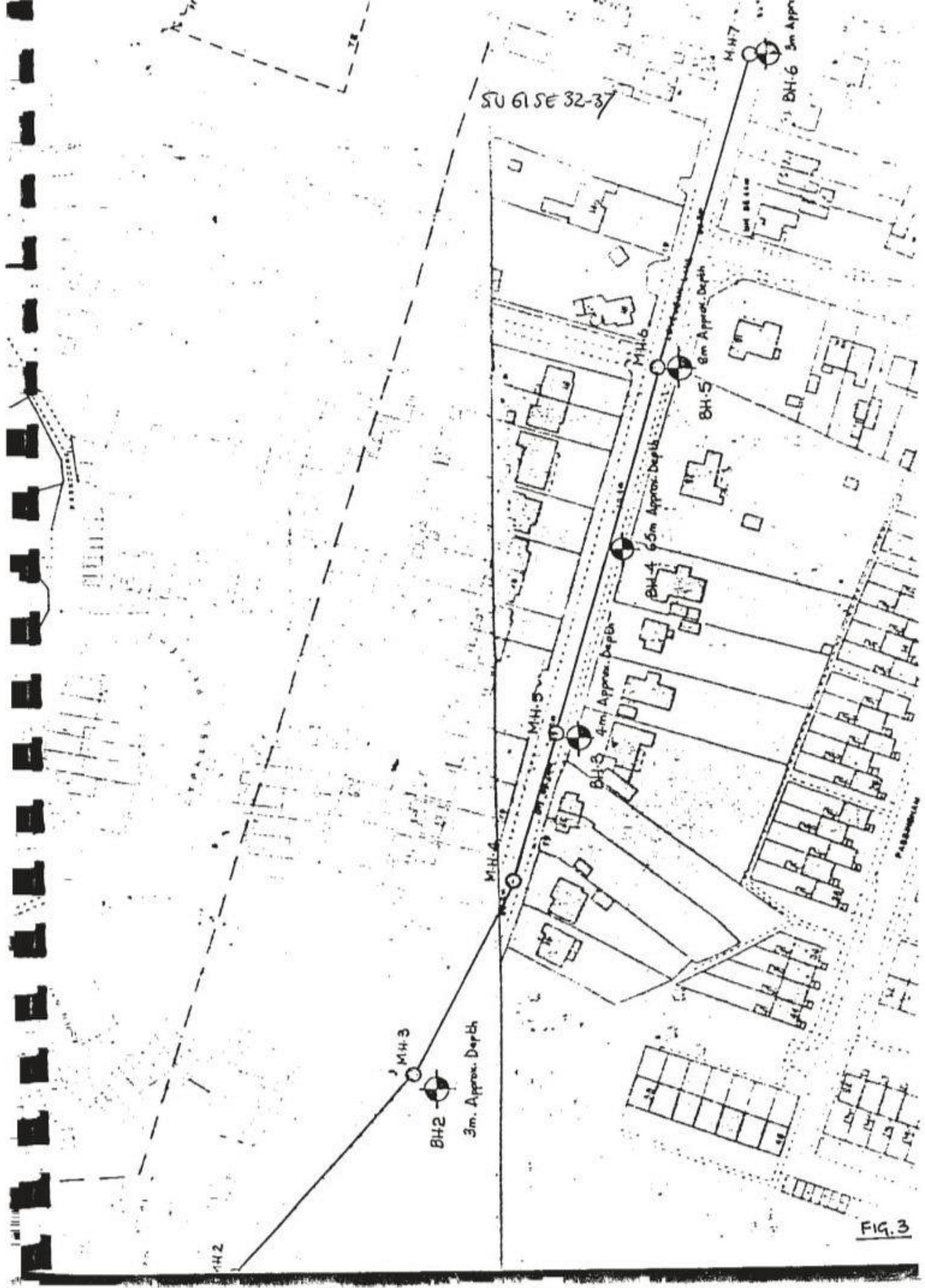


FIG. 3

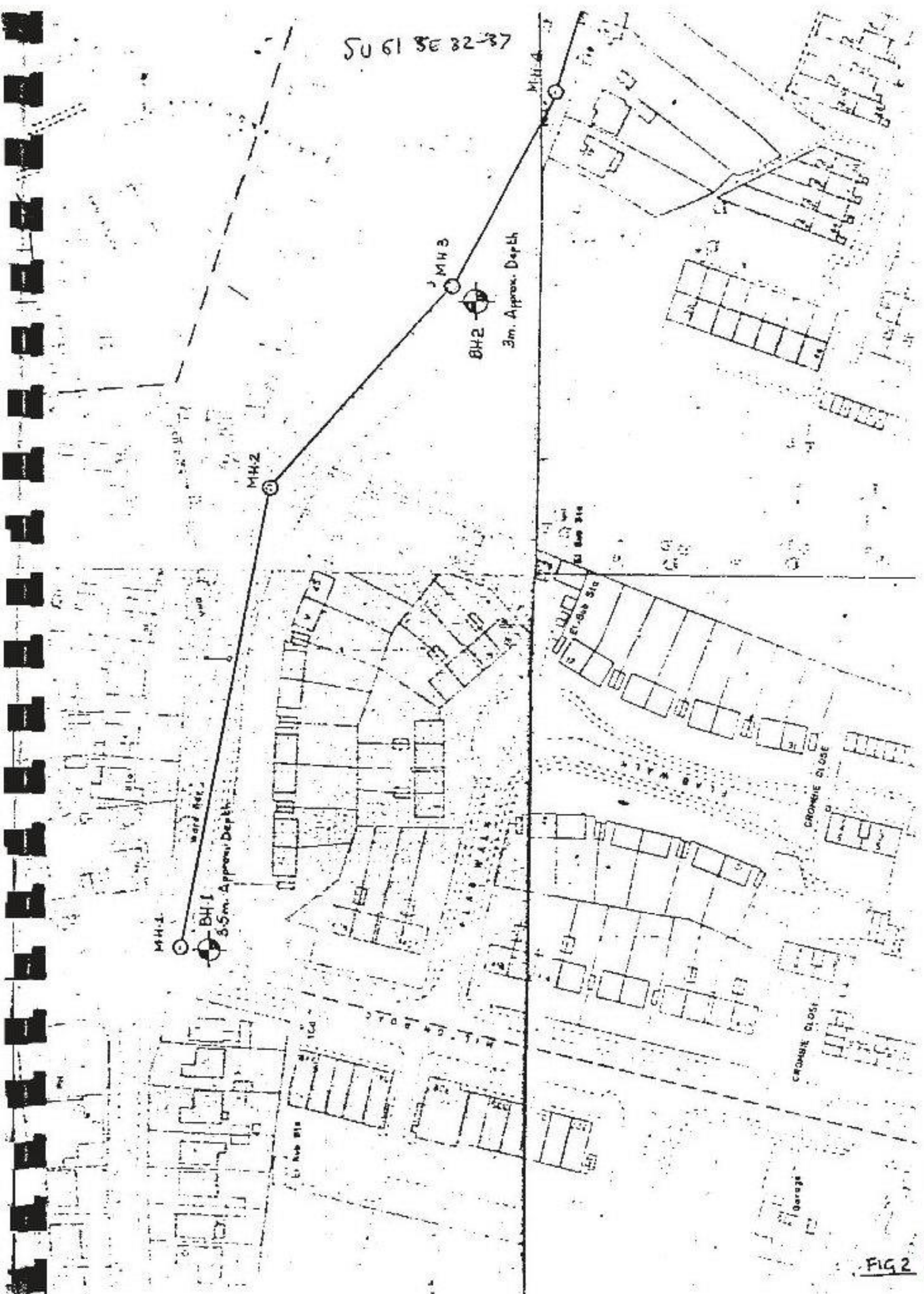


FIG 2

RECORD OF WELL (SHAFT OR BORE)

S461/37
For Survey use only

316/267

EXACT SITE
OF WELL

At Woodcroft Farm
S46812 1195

Town or Village Gillingham Cow plain

Licence No. _____

County Hants

Six-inch quarter sheet 68 SW/W

For Portsmouth Water Co.

State whether owner, tenant, builder, contractor, consultant, etc.:—

Address (if different from above) _____

Level of ground surface
above sea-level (O.D.) 198.78 ft.

If well-top is not at ground level, state how far { above: _____ ft.
below: _____ ft.

SHAFT 104.56 ft.; diameter _____ ft.; Full details of headings (dimensions and directions)

BORE _____ ft.; diameter of bore: at top _____ ins.; at bottom _____ ins.

Full details of permanent lining tubes (position, length, diameter, plain, slotted etc.) _____

Water struck at depths of _____ ft. below well-top.

TEST
CONDITIONS

Rest level of water _____ ft. above well-top. Suction at _____ ft. Yield on _____ hours' test
pumping at _____ galls. per _____ with depression to _____ ft. below well-top.

Recovery to rest-level in _____ mins. Capacity of pump _____ g.p.h. Date of measurements _____

NORMAL
CONDITIONS

DESCRIPTION OF PERMANENT PUMPING EQUIPMENT:

Make and/or type _____ Motive power _____

Capacity _____ gallons per hour. Suction at _____ ft.

Amount pumped _____ galls. per day. Estimated consumption _____ galls. per week.

Well made by _____ Date of well _____

Information from _____

ADDITIONAL NOTES

ANALYSIS (please attach copy if available)

Sited by ○ on 6' Hants 68 SW/W 1/2/57
Data Bank

Visited - Concrete cover over well, with access hole
8" square. Suitable for recorder installation.

Automatic water level recorder installed 11/1/58
Visited and levelled. Well top = ground level = +198.41 O.D.W.
Recorder datum + 198.26 O.D. (W) 7.10.66
Recorder removed 12.9.68. Access hole covered by concrete slab. M.J.B.

LOG OF STRATA OVERLEAF.

GEOLOGICAL SURVEY AND MUSEUM,
SOUTH KENSINGTON,
LONDON, S.W.7.

Section 6.

Date
Received

1" O.S. Map
No.

Site marked
on 1" Map

(use symbol)
on 6" Map

(1527) D3574/W3575/3 12,000 8/54 JCS Gp609



British
Geological Survey

NATURAL ENVIRONMENT RESEARCH COUNCIL

© All rights are reserved by the copyright proprietors.

[SU61SE BJ 114.]

(For Survey use only)
GEOLOGICAL
CLASSIFICATION

NATURE OF STRATA

If measurements start below
ground surface, state how far ..

THICKNESS

DEPTH

Feet Inches

Feet Inches

ADDN INFO.

Reference

Su61/37

WDU No. ~~S~~U6137

Southern WA (Hants) No. 552

316

267

Portsmouth Water Company
Observation Well.

Ref No: Portsmouth No. 28
Woodcroft Farm, Cowplain, Havant.

Well head at +60.588 m A.O.D.

Monthly water levels available in Manual Water level file

IGS recorder installed 11-MAR-1966, removed 12-SEP-1968

DMT 27-SEP-1979

Data Bank

STATION Woodcroft Farm

DATUM POINT O.D. 198.78'

Date and Time	Water Level Ft.	Rate G.P.H.	Notes	Date and Time	Water Level Ft.	Rate G.P.H.	Notes
4.2.53	105.8	—	Fr. To C.D.	30.3.55	110.0	—	Fr. To C.D.
4.3.53	107.1			27.4.55	107.0		
1.4.53	104.0			25.5.55	105.6		
29.4.53	102.4			22.6.55	104.4		
27.5.53	101.5			20.7.55	102.6		
17.6.53	100.4			17.8.55	101.3		
22.7.53	99.9			14.9.55	100.0		
19.8.53	99.6			12.10.55	99.8		
16.9.53	99.3			9.11.55	106.0		
21.10.53	99.0			7.12.55	101.0		
11.11.53	103.2			4.1.56	107.7		
9.12.53	99.9			1.2.56	122.8		
6.1.54	99.8			29.2.56	113.3		
10.2.54	106.5			28.3.56	108.4		
3.3.54	107.5			25.4.56	105.4		
31.3.54	106.5			23.5.56	102.8		
28.4.54	105.0			20.6.56	100.6		
2.6.54	103.0			18.7.56	99.9		
23.6.54	104.0			15.8.56	99.2		
21.7.54	101.7			12.9.56	101.1		
18.8.54	102.0			10.10.56	99.2		
15.9.54	100.8			7.11.56	99.1		
13.10.54	100.8			5.12.56	96.8		
10.11.54	107.2			2.1.57	104.0		
8.12.54	115.7			30.1.57	105.8		
5.1.55	119.0						
2.2.55	119.4						
2.3.55	115.0						
23.3.55	110.0						

Data Bank

Continued.

Sub 1/37 316

267

STATION WOODCROFT FARM

DATUM POINT O.D. 198.78'

Date and Time	Water Level Ft. In.	Rate G.P.H.	Notes	Date and Time	Water Level Ft. In.	Rate G.P.H.	Notes
2.1.57	104.0	—	Ft. To C.D.	22.1.59	106.6		
30.1.57	105.8			25.2.59	111.1		
27.2.57	115.0			25.3.59	108.6		
27.3.57	110.9			22.4.59	107.5		
24.4.57	110.3			20.5.59	104.8		
22.5.57	106.5			18.6.59	103.0		
17.7.57	101.5			15.7.59	101.2		
14.8.57	99.8			13.8.59	100.4		
11.9.57	99.6			10.9.59	99.5		
9.10.57	98.6			7.10.59	99.0		
6.11.57	103.8			4.11.59	99.3		
4.12.57	99.4			2.12.59	102.6		
1.1.58	101.9			30.12.59	121.0		
29.1.58	110.2			27.1.60	124.0		
26.2.58	—			24.2.60	122.0		
26.3.58	108.5			23.3.60	120.5		
23.4.58	106.5			20.4.60	112.5		
21.5.58	104.0			18.5.60	108.1		
18.6.58	102.4			15.6.60	106.5		
16.7.58	101.0			13.7.60	102.4		
13.8.58	99.7			10.8.60	101.5		
10.9.58	100.3			7.9.60	103.2		
8.10.58	108.6			5.10.60	115.4		
5.11.58	112.1						
3.12.58	106.9						
31.12.58	112.5						

Data Bank

Sub 137
316/267

Station ... Woodcroft Farm
Datum point ... O.D. ... 198.78
Observation well during test on ...



British Geological Survey

NATURAL ENVIRONMENT RESEARCH COUNCIL

Date and Time	Water Level	Rate G.P.H.	Notes	Date and Time	Water Level	Rate G.P.H.	Notes
2.11.60	131.3		R.W.L. to O.D.	20.2.63	106.0		R.W.L. to O.D.
30.11.60	139.1			20.3.63	114.8		
28.12.60	138.8			17.4.63	115.8		
26.1.61	134.5			15.5.63	117.6		
22.2.61	133.1			12.6.63	107.0		
22.3.61	123.5			10.7.63	104.5		
19.4.61	115.8			7.8.63	102.1		
17.5.61	113.5						
14.6.61	109.4						
12.7.61	106.1						
9.8.61	103.7						
6.9.61	101.8						
4.10.61	100.6						
1.11.61	100.1						
29.11.61	100.0						
27.12.61	101.7						
24.1.62	117.8						
21.2.62	107.7						
21.3.62	106.2						
18.4.62	105.5						
16.5.62	103.0						
13.6.62	101.7						
11.7.62	100.4						
8.8.62	100.2						
5.9.62	99.4						
3.10.62	101.3						
31.10.62	99.2						
28.11.62	103.3						

Data Book

JW

Station Woodcroft Farm

Datum point O.D. ... 198.78 ...

Observation well during test on

Su61/37
316/
267

Date and Time	Water Level ft	Rate G.P.H.	Notes	Date and Time	Water Level ft	Rate G.P.H.	Notes
2.11.60	131.3		R.W.L. to O.D.	20.2.63	106.0		R.W.L. to O.D.
30.11.60	129.1			20.3.63	114.8		
29.12.60	138.8			17.4.63	115.8		
26.1.61	134.5			15.5.63	112.6		
22.2.61	133.1			12.6.63	107.0		
22.3.61	123.5			10.7.63	104.5		
19.4.61	115.8			7.8.63	102.1		
17.5.61	113.5						
14.6.61	109.4						
12.7.61	106.1						
9.8.61	103.7						
6.9.61	101.8						
4.10.61	100.6						
1.11.61	100.1						
29.11.61	100.0						
27.12.61	101.7						
24.1.62	117.8						
21.2.62	107.7						
21.3.62	106.2						
18.4.62	105.5						
16.5.62	102.0						
13.6.62	101.7						
11.7.62	100.4						
8.8.62	100.2						
5.9.62	99.4						
3.10.62	101.3						
31.10.62	99.2						
28.11.62	103.3						

JW

Data Book

SITE. WOODCROFT. LOVEDEAN

(O.D.) + 198.26

Date	R.W.L. at beginning of trace	Rising trace	Falling trace	Weekly W.L. (below datum)	Weekly W.L. (O.D.)	Weekly W.L. to +140 O.D.	Weekly W.L. to
2-7	94.16		1.00	95.16	103.10	-36.90	
9			1.55	95.71	102.55	-37.45	
16			2.25	96.41	101.85	-38.15	
23	96.77		0.30	97.07	101.19	-38.81	
30			0.80	97.57	100.69	-39.31	
6-8			1.20	97.97	100.29	-39.71	
13			1.60	98.37	99.89	-40.11	
20	98.40		0.20	98.60	99.66	-40.34	
27			0.55	98.95	99.31	-40.69	
3-9			0.85	99.25	99.01	-40.99	
10			1.25	99.65	98.61	-41.39	
17	99.80		0.10	99.90	98.36	-41.64	
24			0.25	100.05	98.21	-41.79	
1-10			0.25	100.05	98.21	-41.79	
8			0.30	100.10	98.16	-41.84	
15	99.34	1.65		97.69	100.57	-39.83	
22		5.10		94.24	104.02	-35.98	
29		8.30		91.04	107.22	-32.78	
5-11		17.60		91.74	106.52	-33.48	
12	no visits made due to foot & mouth outbreak						
19							
26							
3-12							
10							
17							
24							
31							

WORKING SHEET 1968

Site WOODCROFT

I.G.S. Ref. No.

SU 61/37

316/267

Measuring point (O.D.)

198.26

Date	R.W.L. at beginning of trace	Rising trace	Falling trace	Weekly W.L. (below datum)	Weekly W.L. (O.D.)	Weekly W.L. to +140 O.D.	Weekly W.L. to
7 - 1							
14	no visits made - due to foot & mouth outbreaks						
21							
28							
4 - 2	89.97	0.00		89.97	108.29	-31.71	
11		1.40		88.57	109.69	-30.31	
18		2.30		87.67	110.59	-29.41	
25		0.45		89.52	108.74	-31.26	
3 - 3	90.10		0.45 E	90.55 E	107.71 E	-32.29 E	
10			1.30 E	91.40 E	106.86 E	-33.14 E	
17			2.20 E	92.30 E	105.96 E	-34.04 E	
24			3.05 E	93.15 E	105.11 E	-34.89 E	
31							
7 - 4							
14							
21							
28							
5 - 5							
12							
19							
26							
2 - 6							
9							
16							
23							
30							
							Over

Date	R.W.L. at beginning of trace	Rising trace	Falling trace	Weekly W.L. (below datum)	Weekly W.L. (O.D.)	Weekly W.L. to +140 O.D.	Weekly W.L. to
7 - 7							
14							
21							
28							
4 - 8							
11							
18							
25							
1 - 9							
8							
15							
22							
29							
6 - 10							
13							
20							
27							
3 - 11							
10							
17							
24							
1 - 12							
8							
15							
22							
29							

SITE Woodcroft,
Lonsdale.MEASURING POINT (O.D.) 60.430 metres

Date	No. of drum revs.	Correction to trace datum	Trace datum	Rising trace	Falling trace	Weekly water level (below datum)
31 Mar.			28.502		0.12	28.622
7 Apr.					0.21	28.712
14					0.47	28.972
21				0.03		28.472
28			28.872		0.01	28.882
5 May				0.68		28.192
12				1.08		27.792
19				0.25		28.622
26			28.918	0.56		28.358
2 June					0.15	29.068
9					0.04	28.958
16					0.42	29.328
23			29.457		0.01	29.467
30	1	- 1.25		0.55		27.657
7 July				0.50		28.957
14	1	- 1.25		0.22		27.987
21			28.497		0.66	29.157
28					0.95	29.447
4 Aug.					1.11	29.607
11	1	+ 1.25			0.02	29.767
18			29.819		0.04	29.859
25					0.13	29.949
1 Sept.					0.19	30.009
8					0.29	30.109
15						
22		Recorder Removed		12.9.68		
29						
6 Oct.						
13						
20						
27						
3 Nov.						
10						
17						
24						
1 Dec.						
8						
15						
22						
29						

Maximum recorded level metres below datum.

Date

Minimum recorded level metres below datum.

Date



316/Su61/37
267

SOUTHERN WATER AUTHORITY
formerly:

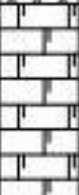
HRA well no 552
RWL + 29.90 M = + 98' OD Oct 72
+ 30.20 M = + 99' OD April 73
Dry Oct 73

Infm HRA Report on Well Surveys
Jan 75 LW.

Data Bank 8/78

PBA STD WS LOG 21834 WS LOGS.GPJ AGS3 ALL GDT 2/11/11

Project Woodcroft Farm, Waterloooville		Date 26-08-11				Window Sample No. WS01	
Job No 21834/030		Ground Level (m OD) 56.60				Sheet 1 of 1	
Client Grainger plc		Coordinates (OS National Grid) 468053.5 , 111976.4		All dimensions in metres Scale 1:40			

SAMPLES/TESTS/PROGRESS						Water	STRATA		Instrument/ Backfill
Sample Depth (m)	Sample Type	Test Depth (m)	Test Type	Test Result	Window Run (Size(mm))		Legend	Depth (Thickness) (m)	
0.50	S				0 - 1 (70) 100% rec		0.05	Topsoil	
					1 - 2 (70) 100% rec		1.05	MADE GROUND: Firm brown slightly sandy and gravelly clay. Gravel is angular and subangular of flint, chalk and fragments of brick.	
					2 - 4 (60) 80% rec		1.10	MADE GROUND: Soft brown and grey slightly sandy, gravelly clay. Gravel is angular to subrounded fine to coarse of flint, chalk, and fragments of brick. Organic odour.	
							1.90	Between 1.1 and 1.6m: Frequent fragments of very weak chalk. Between 2.2 and 3.0m: Grey staining and organic odour.	
2.50	S						3.00	Structureless CHALK composed of cream slightly gravelly sandy silt with pockets <60 mm thick of brown soft clay. Clasts are fine to coarse, subrounded extremely and very weak, low-density, off white with black specks and occasional orange staining. (Upper Chalk Formation, Grade Dm)	
							3.80	Recovered as structureless CHALK composed of slightly sandy silty gravel. Gravel is fine to coarse, subangular, very weak, low and medium density, off white with black specks. (Upper Chalk Formation, Grade Dc)	
							4.00	End of Borehole at 4m	

GENERAL REMARKS: 1. Groundwater was not encountered during drilling. 2. On completion a 19mm HDPE standpipe was installed in the borehole, fitted with a gas valve and completed with a flush cover. KEY S - Geoenvironmental sample		WATER: Strike: m Standing: m Flow:	
Contractor Risk Management Limited	Method/ Plant Used H. H. Window Sampler	Logged By az	Checked By ad

PBA STD WS LOG 21834 WS LOGS.GPJ AGS3 ALL GDT 2/11/11

Project Woodcroft Farm, Waterloooville		Date 26-08-11				Window Sample No. WS02			
Job No 21834/030		Ground Level (m OD) 56.50				All dimensions in metres Scale 1:40		Sheet 1 of 1	
Client Grainger plc		Coordinates (OS National Grid) 468037.5 , 111993.7							

SAMPLES/TESTS/PROGRESS						Water	STRATA		Instrument/ Backfill
Sample Depth (m)	Sample Type	Test Depth (m)	Test Type	Test Result	Window Run (Size(mm))		Legend	Depth (Thickness) (m)	
0.15	S				0 - 1 (70) 100% rec		0.05	Topsoil	
							0.75	MADE GROUND: Soft brown slightly sandy and gravelly clay. Gravel is angular and subangular fine to coarse of flint, rare extremely weak chalk and fragments of brick and rare charcoal.	
					1 - 2 (70) 100% rec		0.80	MADE GROUND: Brown and grey sandy gravel. Gravel is fragments of brick and concrete.	
1.50	S				2 - 4 (60) 80% rec		0.40	MADE GROUND: Soft and firm brown and grey slightly gravelly sandy clay with pockets of organic matter. Gravel is angular fine to coarse of brick, concrete and chalk. Organic odour.	
							1.20		
2.50	S				4 - 6 (60) 80% rec		(4.00)		
							5.20	Firm slightly gravelly sandy CLAY. Gravel is subrounded fine to coarse of white very weak chalk. (Possible Made Ground))	
5.20	S						0.60		
							5.80		
							0.20	Recovered as structureless CHALK composed of slightly sandy silty gravel. Gravel is fine to coarse, subangular, very weak, low and medium density, off white with black specks. (Upper Chalk Formation, Grade Dc)	
						6.00	End of Borehole at 6m		

GENERAL REMARKS: 1. Groundwater was not encountered during drilling. 2. On completion a 19mm HDPE standpipe was installed in the borehole, fitted with a gas valve and completed with a flush cover. KEY S - Geoenvironmental sample				WATER: Strike: m Standing: m Flow:	
Contractor Risk Management Limited		Method/ Plant Used H. H. Window Sampler		Logged By az Checked By ad	

PBA STD WS LOG 21834 WS LOGS.GPJ AGS3 ALL GDT 2/11/11

Project Woodcroft Farm, Waterloooville		Date 30-08-11				Window Sample No. WS03	
Job No 21834/030		Ground Level (m OD) 58.10				Sheet 1 of 1	
Client Grainger plc		Coordinates (OS National Grid) 468100.2 , 111979.4		All dimensions in metres Scale 1:40			

SAMPLES/TESTS/PROGRESS						Water	STRATA		Instrument/ Backfill
Sample Depth (m)	Sample Type	Test Depth (m)	Test Type	Test Result	Window Run (Size(mm))		Legend	Depth (Thickness) (m)	
0.10	S				0 - 1 (75) 100% rec		0.10	MADE GROUND: Brown very clayey gravel. Gravel is angular fine to coarse of flint and fragments of brick.	
							0.30	MADE GROUND: Black clayey gravelly sand. Gravel is angular fine to coarse of flint and fragments of clinker and brick. Slight hydrocarbon odour.	
0.70	S				1 - 2 (75) 100% rec		0.40	MADE GROUND: Off white with grey staining gravel. Gravel is subangular and subrounded fine to coarse of chalk.	
							0.50	MADE GROUND: Off white with grey staining gravel. Gravel is subangular and subrounded fine to coarse of chalk.	
1.50	S				2 - 4 (50) 70% rec		1.20	Soft brown slightly gravelly CLAY. Gravel subangular fine to coarse of flint. (Head Deposits)	
							1.70	Soft to firm brown grey CLAY. (Possible Lambeth Group)	
							1.60	Structureless CHALK composed of soft cream slightly gravelly sandy silt. Gravel is fine to coarse, subrounded extremely and very weak, low-density, off white with black specks. (Upper Chalk Formation, Grade Dm)	
							3.30	Structureless CHALK composed of soft cream slightly gravelly sandy silt. Gravel is fine to coarse, subrounded extremely and very weak, low-density, off white with black specks. (Upper Chalk Formation, Grade Dm)	
							4.00	Structureless CHALK composed of soft cream slightly gravelly sandy silt. Gravel is fine to coarse, subrounded extremely and very weak, low-density, off white with black specks. (Upper Chalk Formation, Grade Dm)	
								End of Borehole at 4m	

GENERAL REMARKS: 1. Groundwater was not encountered during drilling. 2. On completion a 19mm HDPE standpipe was installed in the borehole, fitted with a gas valve and completed with a flush cover. KEY S - Geoenvironmental sample		WATER: Strike: m Standing: m Flow:	
Contractor Risk Management Limited	Method/ Plant Used H. H. Window Sampler	Logged By az	Checked By ad

PBA STD WS LOG 21834 WS LOGS.GPJ AGS3 ALL GDT 2/11/11

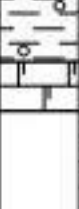
Project Woodcroft Farm, Waterloooville		Date 30-08-11				Window Sample No. WS04			
Job No 21834/030		Ground Level (m OD) 60.10				All dimensions in metres Scale 1:40		Sheet 1 of 1	
Client Grainger plc		Coordinates (OS National Grid) 468160.2 , 111959.9							

SAMPLES/TESTS/PROGRESS						Water	STRATA			Instrument/ Backfill
Sample Depth (m)	Sample Type	Test Depth (m)	Test Type	Test Result	Window Run (Size(mm))		Legend	Depth (Thickness) (m)	DESCRIPTION	
0.10	S				0 - 1 (75) 100% rec		0.05 (0.25) 0.30	Topsoil MADE GROUND: Soft brown slightly gravelly sandy clay. Gravel is subangular and subrounded fine to coarse of chalk and fragments of brick.		
0.70	S				1 - 2 (75) 100% rec		0.70 1.00	Soft brown slightly gravelly sandy CLAY. Gravel is subangular fine to coarse of flint. (Head Deposits)		
1.70	S				2 - 3 (60) 100% rec		0.70 1.70	Firm brown gravelly CLAY. Gravel is subrounded fine to coarse of flint. (Head Deposits)		
							1.70 (1.30) 3.00	Stiff red mottled blue CLAY. (Lambeth Group)		
								End of Borehole at 3m		

GENERAL REMARKS: 1. Groundwater was not encountered during drilling. 2. On completion a 19mm HDPE standpipe was installed in the borehole, fitted with a gas valve and completed with a flush cover. KEY S - Geoenvironmental sample								WATER: Strike: m Standing: m Flow:			
Contractor Risk Management Limited				Method/ Plant Used H. H. Window Sampler				Logged By az		Checked By ad	

PBA STD WS LOG 21834 WS LOGS.GPJ AGS3 ALL GDT 2/11/11

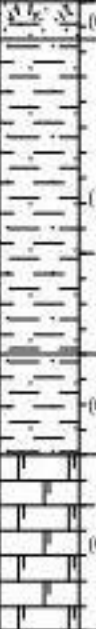
Project Woodcroft Farm, Waterlooille		Date 22-08-11				Window Sample No. WS05	
Job No 21834/030		Ground Level (m OD) 59.10				All dimensions in metres Scale 1:40	
Client Grainger plc		Coordinates (OS National Grid) 468150.9 , 112031.5					

SAMPLES/TESTS/PROGRESS						Water	STRATA			Instrument/ Backfill
Sample Depth (m)	Sample Type	Test Depth (m)	Test Type	Test Result	Window Run (Size(mm))		Legend	Depth (Thickness) (m)	DESCRIPTION	
							(0.20) 0.20	Topsoil		
							(1.70)	Brown orange slightly clayey SAND with occasional pockets < 40 mm in diameter of soft sandy clay. (Head Deposits)		
							1.90	Firm slightly sandy and gravelly CLAY. Gravel is subangular fine to coarse of flint. (Head Deposits)		
							(1.90)	Structureless CHALK composed of soft cream slightly gravelly sandy silt. Gravel is fine to coarse, subrounded extremely and very weak, low-density, off white with black specks. (Upper Chalk Formation, Grade Dm)		
							3.80	End of Borehole at 4m		
							(0.20) 4.00			

GENERAL REMARKS: 1. Groundwater was not encountered during drilling. 2. On completion a 19mm HDPE standpipe was installed in the borehole, fitted with a gas valve and completed with a flush cover. KEY S - Geoenvironmental sample								WATER: Strike: m Standing: m Flow:			
Contractor Risk Management Limited				Method/ Plant Used H. H. Window Sampler				Logged By az		Checked By ad	

PBA STD WS LOG 21834 WS LOGS.GPJ AGS3 ALL GDT 2/11/11

Project Woodcroft Farm, Waterloooville		Date 22-08-11				Window Sample No. WS05A	
Job No 21834/030		Ground Level (m OD) 58.95				All dimensions in metres Scale 1:40	
Client Grainger plc		Coordinates (OS National Grid) 468149.1 , 112023.9					

SAMPLES/TESTS/PROGRESS						Water	STRATA		Instrument/ Backfill
Sample Depth (m)	Sample Type	Test Depth (m)	Test Type	Test Result	Window Run (Size(mm))		Legend	Depth (Thickness) (m)	
					0 - 1 (75) 100% rec		0.15	Topsoil	
					1 - 2 (75) 100% rec		1.25	Brown clayey SAND / sandy CLAY with rare gravel. Gravel is subrounded medium and coarse of flint. (Head Deposits) Below 1.0 m: clayey sand.	
					2 - 4 (60) 75% rec		1.40	Firm brown orange and grey slightly sandy and sandy CLAY. (Head Deposits)	
							1.80	Cream CHALK recovered as silty gravel. Gravel is fine to coarse, subrounded extremely and very weak, low-density, off white with black specks. Rare Flint nodules. (Upper Chalk Formation, Grade Dm)	
							2.50	End of Borehole at 2.5m	

GENERAL REMARKS: 1. Groundwater was not encountered during drilling. 2. Hole was refused at 2.5 m. 3. On completion the hole was backfilled with arisings.								WATER: Strike: m Standing: m Flow:			
Contractor Risk Management Limited				Method/ Plant Used H. H. Window Sampler				Logged By az		Checked By ad	

PBA STD WS LOG 21834 WS LOGS.GPJ AGS3 ALL GDT 2/11/11

Project Woodcroft Farm, Waterloooville		Date 30-08-11				Window Sample No. WS06	
Job No 21834/030		Ground Level (m OD) 58.50				Sheet 1 of 1	
Client Grainger plc		Coordinates (OS National Grid) 468102.3 , 111960.9		All dimensions in metres Scale 1:40			

SAMPLES/TESTS/PROGRESS						Water	STRATA		Instrument/ Backfill
Sample Depth (m)	Sample Type	Test Depth (m)	Test Type	Test Result	Window Run (Size(mm))		Legend	Depth (Thickness) (m)	
0.10	S				0 - 1 (75) 100% rec		0.60	MADE GROUND: Soft brown slightly sandy and gravelly clay. Gravel is angular fine to coarse of flint and fragments of brick and concrete.	
0.80	S				1 - 2 (75) 100% rec		1.60	Soft to firm with depth grey mottled red and brown CLAY. (Lambeth Group)	
					2 - 2.4 (50) 100% rec		2.20		
					2.4 - 2.6 (40) 100% rec		2.40	Firm grey and orange gravelly CLAY. Gravel is rounded medium and coarse of red flint pebbles. (Lambeth Group)	
							2.50	Cream clayey SAND with 1 no. cobble. Cobble is subrounded of flint.	
							2.60	Recovered as structureless CHALK composed of slightly sandy silty gravel. Gravel is fine to coarse, subangular, very weak, low and medium density, off white with black specks. (Upper Chalk Formation, Grade Dc)	
								End of Borehole at 2.6m	

GENERAL REMARKS: 1. Groundwater was not encountered during drilling. 2. Hole was refused at 2.6 m. 3. On completion a 19mm HDPE standpipe was installed in the borehole, fitted with a gas valve and completed with a flush cover. KEY S - Geoenvironmental sample								WATER: Strike: m Standing: m Flow:	
Contractor Risk Management Limited				Method/ Plant Used H. H. Window Sampler		Logged By az		Checked By ad	

PBA STD WS LOG 21834 WS LOGS.GPJ AGS3 ALL GDT 2/11/11

Project Woodcroft Farm, Waterloooville		Date 22-08-11				Window Sample No. WS07	
Job No 21834/030		Ground Level (m OD) 61.50				All dimensions in metres Scale 1:40	
Client Grainger plc		Coordinates (OS National Grid) 468211.9 , 112135.7					

SAMPLES/TESTS/PROGRESS						Water	STRATA		Instrument/ Backfill
Sample Depth (m)	Sample Type	Test Depth (m)	Test Type	Test Result	Window Run (Size(mm))		Legend	Depth (Thickness) (m)	
					0 - 1 (75) 100% rec		0.15	Topsoil	
							0.25 0.40	Firm brown friable sandy CLAY with rare gravel. Gravel is subrounded fine to coarse of flint. (Head Deposits)	
					1 - 2 (75) 100% rec			Soft to firm orange with grey mottling slightly sandy CLAY. Occasional calcareous nodules <10 mm in diameter. (Head Deposits)	
					2 - 4 (60) 90% rec		(2.60)		
							3.00	Soft to firm grey orange slightly gravelly, sandy CLAY. Gravel is subrounded fine to coarse of flint. (Solution Feature Infill)	
					4 - 6 (50) 75% rec		(0.80) 3.80	Orange brown clayey SAND with occasional pockets <40 mm of sandy clay and rare gravel. Gravel is fine to coarse subrounded of flint. (Solution Feature Infill)	
					6 - 8 (40) 50% rec		(2.10) 5.90	Structureless CHALK composed of soft cream slightly gravelly silt. Gravel is fine to coarse, subrounded extremely and very weak, low-density, off white with black specks. (Upper Chalk Formation, Grade Dm)	
							(1.60) 7.50	Soft and very soft with depth grey brown slightly gravelly, sandy CLAY. Gravel is subrounded fine to coarse of flint. (Solution Feature Infill)	
							(0.50) 8.00	Structureless CHALK composed of soft cream slightly gravelly silt. Gravel is fine to coarse, subrounded extremely and very weak, low-density, off white with black specks. (Upper Chalk Formation, Grade Dm)	

GENERAL REMARKS: 1. Groundwater was not encountered during drilling. 2. On completion the hole was backfilled with arisings.		WATER: Strike: m Standing: m Flow:	
Contractor Risk Management Limited	Method/ Plant Used H. H. Window Sampler	Logged By az	Checked By ad

PBA STD WS LOG 21834 WS LOGS.GPJ AGS3 ALL GDT 2/11/11

Project Woodcroft Farm, Waterloooville		Date 22-08-11				Window Sample No. WS07				
Job No 21834/030		Ground Level (m OD) 61.50				Sheet 2 of 2				
Client Grainger plc		Coordinates (OS National Grid) 468211.9 , 112135.7		All dimensions in metres Scale 1:40						
SAMPLES/TESTS/PROGRESS						STRATA		Instrument/ Backfill		
Sample Depth (m)	Sample Type	Test Depth (m)	Test Type	Test Result	Window Run (Size(mm))	Water	Legend		Depth (Thickness) (m)	DESCRIPTION
									End of Borehole at 8m	
GENERAL REMARKS: 1. Groundwater was not encountered during drilling. 2. On completion the hole was backfilled with arisings.										WATER: Strike: m Standing: m Flow:
Contractor Risk Management Limited				Method/ Plant Used H. H. Window Sampler			Logged By az		Checked By ad	

PBA STD WS LOG 21834 WS LOGS.GPJ AGS3 ALL GDT 2/11/11

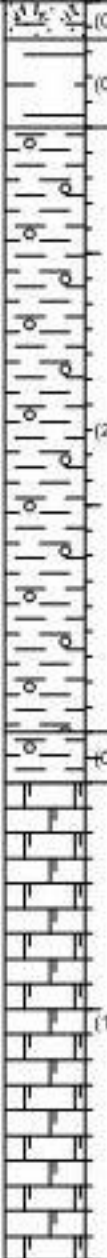
Project Woodcroft Farm, Waterlooville		Date 22-08-11				Window Sample No. WS08			
Job No 21834/030		Ground Level (m OD) 60.70				All dimensions in metres Scale 1:40		Sheet 1 of 1	
Client Grainger plc		Coordinates (OS National Grid) 468206.3 , 112126.7							

SAMPLES/TESTS/PROGRESS						Water	STRATA		Instrument/ Backfill
Sample Depth (m)	Sample Type	Test Depth (m)	Test Type	Test Result	Window Run (Size(mm))		Legend	Depth (Thickness) (m)	
							(0.15) 0.15	Topsoil	
							(0.35) 0.50	Firm to soft brown slightly gravelly sandy CLAY. Gravel subangular fine to coarse of flint. (Solution Feature Infill)	
							(0.60) 1.10	Firm to soft orange slightly sandy CLAY with few pockets of black silt. (Solution Feature Infill)	
							(0.70) 1.80	Orange slightly clayey SAND with rare gravel. Sand is mainly coarse gravel is subrounded fine to coarse of flint. (Solution Feature Infill)	
							(1.30) 3.10	Firm grey slightly sandy and gravelly CLAY. Gravel is subangular fine to coarse of flint. Rare calcareous nodules <20 mm in diameter. (Solution Feature Infill)	
							(1.80) 4.90	Soft brown slightly sandy and gravelly CLAY with pockets <0.5 m in diameter of structureless off white CHALK composed of slightly gravelly silt. Gravel is rare flint and occasional extremely weak chalk. (Solution Feature Infill)	
							(3.10) 8.00	Structureless CHALK composed of soft white with orange staining slightly gravelly and gravelly silt. Gravel is fine to coarse, subrounded extremely and very weak, low-density, off white with black specks. (Upper Chalk Formation, Grade Dm)	

GENERAL REMARKS: 1. Groundwater was not encountered during drilling. 3. On completion the hole was backfilled with arisings.		End of Borehole at 8m		WATER: Strike: m Standing: m Flow:	
Contractor Risk Management Limited		Method/ Plant Used H. H. Window Sampler		Logged By az	
				Checked By ad	

PBA STD WS LOG 21834 WS LOGS.GPJ AGS3 ALL GDT 2/11/11

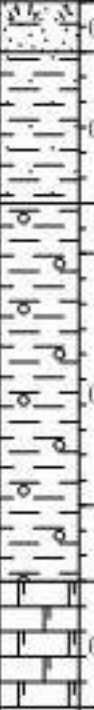
Project Woodcroft Farm, Waterlooville		Date 22-08-11				Window Sample No. WS09	
Job No 21834/030		Ground Level (m OD) 58.20				All dimensions in metres Scale 1:40	
Client Grainger plc		Coordinates (OS National Grid) 468095.5 , 468095.5					

SAMPLES/TESTS/PROGRESS						Water	STRATA		Instrument/ Backfill
Sample Depth (m)	Sample Type	Test Depth (m)	Test Type	Test Result	Window Run (Size(mm))		Legend	Depth (Thickness) (m)	
					0 - 1 (75) 100% rec		0.15	Topsoil	
					1 - 3 (60) 65% rec		0.35	Firm brown slightly sandy and gravelly CLAY. Gravel is subrounded fine to coarse of flint. (Solution Feature Infill)	
					3 - 5 (50) 85% rec		0.50	Firm brown slightly sandy gravelly CLAY. Gravel is fine to coarse subrounded extremely weak chalk and subangular flint. (Solution Feature Infill)	
							2.40		
							2.90	Firm brown and cream gravelly CLAY. Gravel is subrounded fine to coarse of extremely weak chalk. (Solution Feature Infill)	
							3.10	Structureless CHALK composed of soft white with orange staining slightly gravelly and gravelly silt. Occasional seams <5 mm thick of soft brown clay. Gravel is fine to coarse, subrounded extremely and very weak, low-density, off white with black specks. (Upper Chalk Formation, Grade Dm)	
							3.90		
							5.00	End of Borehole at 5m	

GENERAL REMARKS: 1. Groundwater was not encountered during drilling. 2. Borehole refused at 5.0 m. 3. On completion the hole was backfilled with arisings.		WATER: Strike: m Standing: m Flow:	
Contractor Risk Management Limited		Method/ Plant Used H. H. Window Sampler	
Logged By az		Checked By ad	

PBA STD WS LOG 21834 WS LOGS.GPJ AGS3 ALL GDT 2/11/11

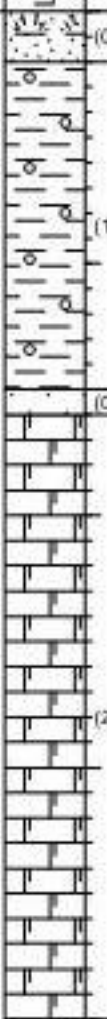
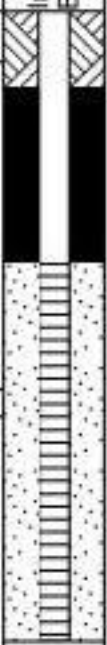
Project Woodcroft Farm, Waterloooville		Date 22-08-11				Window Sample No. WS10	
Job No 21834/030		Ground Level (m OD) 57.40				All dimensions in metres Scale 1:40	
Client Grainger plc		Coordinates (OS National Grid) 468089.9 , 112118.4					

SAMPLES/TESTS/PROGRESS						Water	STRATA			Instrument/ Backfill
Sample Depth (m)	Sample Type	Test Depth (m)	Test Type	Test Result	Window Run (Size(mm))		Legend	Depth (Thickness) (m)	DESCRIPTION	
					0 - 1 (75) 100% rec		0.20	Topsoil		
							0.60	Soft to firm brown orange slightly sandy and sandy CLAY with rare flint gravel. (Solution Feature Infill)		
					1 - 2 (75) 100% rec		0.80	Soft to firm, brown slightly sandy, gravelly CLAY. Gravel is subrounded fine to coarse of extremely weak white chalk and rare flint. (Solution Feature Infill)		
					2 - 2.8 (60) 100% rec		1.50			
							2.30	Structureless CHALK composed of soft white slightly gravelly silt. Gravel is fine to coarse, subrounded extremely and very weak, low-density, off white with black specks. (Upper Chalk Formation, Grade Dm)		
							2.80	End of Borehole at 2.8m		

GENERAL REMARKS: 1. Groundwater was not encountered during drilling. 2. Borehole refused at 2.8 m. 3. On completion the hole was backfilled with arisings.								WATER: Strike: m Standing: m Flow:			
Contractor Risk Management Limited				Method/ Plant Used H. H. Window Sampler				Logged By az		Checked By ad	

PBA STD WS LOG 21834 WS LOGS.GPJ AGS3 ALL GDT 2/11/11

Project Woodcroft Farm, Waterlooille		Date 22-08-11				Window Sample No. WS11			
Job No 21834/030		Ground Level (m OD) 57.50				All dimensions in metres Scale 1:40		Sheet 1 of 1	
Client Grainger plc		Coordinates (OS National Grid) 468056.2 , 112029.7							

SAMPLES/TESTS/PROGRESS						Water	STRATA		Instrument/ Backfill
Sample Depth (m)	Sample Type	Test Depth (m)	Test Type	Test Result	Window Run (Size(mm))		Legend	Depth (Thickness) (m)	
0.50	S				0 - 1 (75) 100% rec		0.20	Topsoil	
1.00	S				1 - 2 (75) 100% rec		1.30	Soft to firm slightly sandy, gravelly CLAY with rare cobbles. Gravel is subrounded medium and coarse of flint. (Head Deposits)	
					2 - 4 (60) 100% rec		1.50 (0.10) 1.60	Brown cream SAND. Sand is fine to coarse.	
							2.40	Recovered as structureless CHALK composed of slightly sandy silty gravel. Gravel is fine to coarse, subangular, very weak, low and medium density, off white with black specks. (Upper Chalk Formation, Grade Dc)	
							4.00	End of Borehole at 4m	

GENERAL REMARKS: 1. Groundwater was not encountered during drilling. 2. On completion a 19mm HDPE standpipe was installed in the borehole, fitted with a gas valve and completed with a flush cover. KEY S - Geoenvironmental sample								WATER: Strike: m Standing: m Flow:			
Contractor Risk Management Limited				Method/ Plant Used H. H. Window Sampler				Logged By az		Checked By ad	



Peter Brett Associates
Caversham Bridge House
Waterman Place
Reading
Berkshire
RG1 8DN

Attention: Arie Zamler

CERTIFICATE OF ANALYSIS

Date: 19 September 2011
Customer: H_PBRETT_REA
Sample Delivery Group (SDG): 110831-47
Your Reference: 21834/030
Location: Woodcroft Farm, Waterloooville
Report No: 150822

This report has been revised and directly supersedes 149065 in its entirety.

We received 33 samples on Wednesday August 31, 2011 and 24 of these samples were scheduled for analysis which was completed on Monday September 19, 2011. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

Should this report require incorporation into client reports, it must be used in its entirety and not simply with the data sections alone.

All chemical testing (unless subcontracted) is performed at ALcontrol Hawarden Laboratories.

Approved By:



Sonia McWhan
Operations Manager





SDG: 110831-47
Job: H_PBRETT_REA-49
Client Reference: 21834/030

Location: Woodcroft Farm, Waterloooville
Customer: Peter Brett Associates
Attention: Arie Zamler

Order Number: PBA007983
Report Number: 150822
Superseded Report: 149065

Received Sample Overview

Lab Sample No(s)	Customer Sample Ref.	AGS Ref.	Depth (m)	Sampled Date
4200333	BH 1		0.30 - 0.80	25/08/2011
4200335	BH 4		0.15 - 0.60	25/08/2011
4200337	TP 1		0.50 - 0.50	25/08/2011
4200341	TP 1		2.20 - 2.20	25/08/2011
4200336	TP 18		0.50 - 0.50	26/08/2011
4200342	TP 2		0.50 - 0.50	26/08/2011
4200344	TP 2		1.00 - 1.00	26/08/2011
4200346	TP 2		2.00 - 2.00	26/08/2011
4200347	TP 2		2.00 - 2.80	26/08/2011
4200348	TP 2		3.00 - 3.00	26/08/2011
4200303	TP 3		0.50 - 0.50	25/08/2011
4200304	TP 3		1.10 - 1.10	25/08/2011
4200305	TP 3		2.00 - 2.00	25/08/2011
4200306	TP 3		3.40 - 3.40	25/08/2011
4200308	TP 4		0.50 - 0.50	25/08/2011
4200309	TP 4		1.00 - 1.00	25/08/2011
4200311	TP 4		2.00 - 2.00	25/08/2011
4200325	WS 1		0.50 - 1.00	26/08/2011
4200328	WS 1		2.50 - 3.00	26/08/2011
4200317	WS 11		0.20 - 0.50	30/08/2011
4200329	WS 2		0.15 - 0.50	26/08/2011
4200330	WS 2		1.50 - 2.00	26/08/2011
4200331	WS 2		2.50 - 3.00	26/08/2011
4200332	WS 2		5.20 - 5.50	26/08/2011
4200318	WS 3		0.10 - 0.40	30/08/2011
4200319	WS 3		0.70 - 1.00	30/08/2011
4200320	WS 3		1.50 - 1.70	30/08/2011
4200312	WS 4		0.10 - 0.30	30/08/2011
4200313	WS 4		0.70 - 1.00	30/08/2011
4200316	WS 4		1.70 - 2.00	30/08/2011
4200321	WS 6		0.10 - 0.50	30/08/2011
4200322	WS 6		0.80 - 1.00	30/08/2011

Only received samples which have had analysis scheduled will be shown on the following pages.



CERTIFICATE OF ANALYSIS

SDG: 110831-47
 Job: H_PBRETT_REA-49
 Client Reference: 21834/030

Location: Woodcroft Farm, Waterlooville
 Customer: Peter Brett Associates
 Attention: Arie Zamler

Order Number: PBA007983
 Report Number: 150822
 Superseded Report: 149065

SOLID Results Legend X Test N No Determination Possible	Lab Sample No(s)		Customer Sample Reference	AGS Reference	Depth (m)	Container																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
							4200336	4200317	4200322	4200321	4200313	4200312	4200309	4200308	4200335	4200319	4200318	4200305	4200304	4200330	4200348	4200347	4200346	4200344	4200328	4200325	4200341	4200339	4200337	4200333																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
							TP 18	WS 11	WS 6	WS 6	WS 4	WS 4	TP 4	TP 4	BH 4	WS 3	WS 3	TP 3	TP 3	WS 2	TP 2	TP 2	TP 2	TP 2	TP 2	WS 1	WS 1	TP 1	TP 1	TP 1	BH 1																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
							0.50 - 0.50	0.20 - 0.50	0.80 - 1.00	0.10 - 0.50	0.70 - 1.00	0.10 - 0.30	1.00 - 1.00	0.50 - 0.50	0.15 - 0.60	0.70 - 1.00	0.10 - 0.40	2.00 - 2.00	1.10 - 1.10	1.50 - 2.00	3.00 - 3.00	2.00 - 2.80	2.00 - 2.00	1.00 - 1.00	2.50 - 3.00	0.50 - 1.00	2.20 - 2.20	1.10 - 1.10	0.50 - 0.50	0.30 - 0.80																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
							250g Amber Jar (AL 1kg TUB)	250g Amber Jar (AL 1kg TUB)	250g Amber Jar (AL 60g VOC (ALE215) 1kg TUB)	250g Amber Jar (AL 60g VOC (ALE215) 1kg TUB)	250g Amber Jar (AL 60g VOC (ALE215) 1kg TUB)	250g Amber Jar (AL 60g VOC (ALE215) 1kg TUB)	250g Amber Jar (AL 60g VOC (ALE215) 1kg TUB)	250g Amber Jar (AL 60g VOC (ALE215) 1kg TUB)	250g Amber Jar (AL 60g VOC (ALE215) 1kg TUB)	250g Amber Jar (AL 60g VOC (ALE215) 1kg TUB)	250g Amber Jar (AL 60g VOC (ALE215) 1kg TUB)	250g Amber Jar (AL 1kg TUB)	250g Amber Jar (AL 1kg TUB)	250g Amber Jar (AL 250g Amber Jar (AL 250g Amber Jar (AL 1kg TUB)	250g Amber Jar (AL 1kg TUB)	250g Amber Jar (AL 1kg TUB)	250g Amber Jar (AL 1kg TUB)	250g Amber Jar (AL 1kg TUB)	250g Amber Jar (AL 1kg TUB)	250g Amber Jar (AL 1kg TUB)	250g Amber Jar (AL 1kg TUB)	250g Amber Jar (AL 1kg TUB)	250g Amber Jar (AL 1kg TUB)	250g Amber Jar (AL 1kg TUB)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
Anions by Kone (soil)	All	NDPs: 0 Tests: 11																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													

Order Number:	PBA007983
Report Number:	150822
Superseded Report:	149065

Page 4 of 60

CERTIFICATE OF ANALYSIS

SDG: 110831-47
Job: H_PBRETT_REA-49
Client Reference: 21834/030

Location: Woodcroft Farm, Waterlooville
Customer: Peter Brett Associates
Attention: Arie Zamler

Order Number:	PBA007983
Report Number:	150822
Superseded Report:	149065

SOLID				
Results Legend				
X	Test			
N	No Determination Possible			
Lab Sample No(s)	Customer Sample Reference	AGS Reference	Depth (m)	Container
4200336	TP 18		0.50 - 0.50	250g Amber Jar (AL) 1kg TUB
4200317	WS 11		0.20 - 0.50	250g Amber Jar (AL) 1kg TUB
4200322	WS 6		0.80 - 1.00	250g Amber Jar (AL)
4200321	WS 6		0.10 - 0.50	60g VOC (ALE215) 250g Amber Jar (AL)
4200313	WS 4		0.70 - 1.00	250g Amber Jar (AL)
4200312	WS 4		0.10 - 0.30	60g VOC (ALE215) 250g Amber Jar (AL) 1kg TUB
4200309	TP 4		1.00 - 1.00	250g Amber Jar (AL)
4200308	TP 4		0.50 - 0.50	250g Amber Jar (AL)
4200335	BH 4		0.15 - 0.60	250g Amber Jar (AL)
4200319	WS 3		0.70 - 1.00	250g Amber Jar (AL)
4200318	WS 3		0.10 - 0.40	60g VOC (ALE215) 250g Amber Jar (AL) 1kg TUB
4200305	TP 3		2.00 - 2.00	250g Amber Jar (AL) 1kg TUB
4200304	TP 3		1.10 - 1.10	250g Amber Jar (AL)
4200330	WS 2		1.50 - 2.00	250g Amber Jar (AL) 1kg TUB
4200348	TP 2		3.00 - 3.00	250g Amber Jar (AL)
4200347	TP 2		2.00 - 2.80	1kg TUB
4200346	TP 2		2.00 - 2.00	250g Amber Jar (AL) 1kg TUB
4200344	TP 2		1.00 - 1.00	250g Amber Jar (AL)
4200328	WS 1		2.50 - 3.00	250g Amber Jar (AL) 1kg TUB
4200325	WS 1		0.50 - 1.00	250g Amber Jar (AL) 1kg TUB
4200341	TP 1		2.20 - 2.20	250g Amber Jar (AL)
4200339	TP 1		1.10 - 1.10	250g Amber Jar (AL)
4200337	TP 1		0.50 - 0.50	250g Amber Jar (AL)
4200333	BH 1		0.30 - 0.80	250g Amber Jar (AL) 1kg TUB
TPH CWG GC (S)	All	NDPs: 0 Tests: 3		
VOC MS (S)	All	NDPs: 0 Tests: 2		



SDG: 110831-47
 Job: H_PBRETT_REA-49
 Client Reference: 21834/030

Location: Woodcroft Farm, Waterloooville
 Customer: Peter Brett Associates
 Attention: Arie Zamler

Order Number: PBA007983
 Report Number: 150822
 Superseded Report: 149065

Sample Descriptions

Grain Sizes

very fine	<0.063mm	fine	0.063mm - 0.1mm	medium	0.1mm - 2mm	coarse	2mm - 10mm	very coarse	>10mm
-----------	----------	------	-----------------	--------	-------------	--------	------------	-------------	-------

Lab Sample No(s)	Customer Sample Ref.	Depth (m)	Colour	Description	Grain size	Inclusions	Inclusions 2
4200333	BH 1	0.30 - 0.80	Light Brown	Clay	<0.063 mm	Stones	Vegetation
4200335	BH 4	0.15 - 0.60	Light Brown	Clay Loam	<0.063 mm	Vegetation	None
4200337	TP 1	0.50 - 0.50	Light Brown	Clay	<0.063 mm	Stones	Coal fragments
4200339	TP 1	1.10 - 1.10	Light Brown	Silty Clay Loam	0.063 - 0.1 mm	Stones	None
4200341	TP 1	2.20 - 2.20	Grey	Sandy Clay	0.063 - 0.1 mm	Stones	Vegetation
4200344	TP 2	1.00 - 1.00	Light Brown	Sandy Clay Loam	0.063 - 0.1 mm	Stones	None
4200346	TP 2	2.00 - 2.00	Dark Brown	Silty Clay	0.063 - 0.1 mm	Stones	None
4200348	TP 2	3.00 - 3.00	Dark Brown	Sandy Clay Loam	0.063 - 0.1 mm	Stones	None
4200304	TP 3	1.10 - 1.10	Dark Brown	Silty Clay	0.063 - 0.1 mm	None	None
4200305	TP 3	2.00 - 2.00	Dark Brown	Silty Clay Loam	0.063 - 0.1 mm	None	None
4200308	TP 4	0.50 - 0.50	Dark Brown	Sandy Clay	0.063 - 0.1 mm	Stones	None
4200309	TP 4	1.00 - 1.00	Light Brown	Sandy Clay	0.1 - 2 mm	Stones	N/A
4200336	TP 18	0.50 - 0.50	Beige	Clay	<0.063 mm	Vegetation	Stones
4200325	WS 1	0.50 - 1.00	Light Brown	Clay	<0.063 mm	Vegetation	None
4200328	WS 1	2.50 - 3.00	Dark Brown	Sandy Clay	0.1 - 2 mm	Stones	N/A
4200330	WS 2	1.50 - 2.00	Dark Brown	Silty Clay	0.063 - 0.1 mm	Stones	Vegetation
4200318	WS 3	0.10 - 0.40	Dark Brown	Sand	0.1 - 2 mm	Stones	None
4200319	WS 3	0.70 - 1.00	Light Brown	Clay	<0.063 mm	None	None
4200312	WS 4	0.10 - 0.30	Dark Brown	Sandy Clay Loam	0.063 - 0.1 mm	Vegetation	Stones
4200313	WS 4	0.70 - 1.00	Yellow	Clay	<0.063 mm	Vegetation	None
4200321	WS 6	0.10 - 0.50	Dark Brown	Sandy Clay	0.1 - 2 mm	Stones	Vegetation
4200322	WS 6	0.80 - 1.00	Light Brown	Silty Clay Loam	0.063 - 0.1 mm	None	None
4200317	WS 11	0.20 - 0.50	Light Brown	Clay Loam	<0.063 mm	Stones	Vegetation

These descriptions are only intended to act as a cross check if sample identities are questioned, and to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions.

We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample.

Other coarse granular materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

Order Number: PBA007983
Report Number: 150822
Superseded Report: 149065

Page 7 of 60

Order Number: PBA007983
Report Number: 150822
Superseded Report: 149065

Page 8 of 60

Order Number: PBA007983
Report Number: 150822
Superseded Report: 149065

Page 9 of 60

Order Number: PBA007983
Report Number: 150822
Superseded Report: 149065

Page 10 of 60

Order Number: PBA007983
Report Number: 150822
Superseded Report: 149065

Page 11 of 60



CERTIFICATE OF ANALYSIS

SDG: 110831-47
 Job: H_PBRETT_REA-49
 Client Reference: 21834/030

Location: Woodcroft Farm, Waterloooville
 Customer: Peter Brett Associates
 Attention: Arie Zamler

Order Number: PBA007983
 Report Number: 150822
 Superseded Report: 149065

OC, OP Pesticides and Triazine Herb

Results Legend		Customer Sample R	TP 18				
#	ISO17025 accredited.	Depth (m) Sample Type Date Sampled Date Received SDG Ref Lab Sample No.(s) AGS Reference	0.50 - 0.50 Sol/Solid 26/08/2011 31/08/2011 110831-47 4200336				
M	mCERTS accredited.						
S	Deviating sample.						
aq	Aqueous / settled sample.						
diss.filt	Dissolved / filtered sample.						
tot.unfilt	Total / unfiltered sample.						
-	Subcontracted test.						
~	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery						
(F)	Trigger breach confirmed						
Component	LOD/Units	Method					
Mevinphos	<50 µg/kg	TM073	<50				
Dichlorvos	<50 µg/kg	TM073	<50				
Hexachlorobenzene	<50 µg/kg	TM073	<50				
Tecnazene	<50 µg/kg	TM073	<50				
alpha-Hexachlorocyclohexane (HCH / Lindane)	<50 µg/kg	TM073	<50				
Trifluralin	<50 µg/kg	TM073	<50				
Diazinon	<50 µg/kg	TM073	<50				
Quintozone (PCNB)	<50 µg/kg	TM073	<50				
Etrimephos	<50 µg/kg	TM073	<50				
Triallate	<50 µg/kg	TM073	<50				
gamma-Hexachlorocyclohexane (HCH / Lindane)	<50 µg/kg	TM073	<50				
Heptachlor	<50 µg/kg	TM073	<50				
Propetamphos	<50 µg/kg	TM073	<50				
Dimethoate	<50 µg/kg	TM073	<50				
Chlorpyrifos methyl	<50 µg/kg	TM073	<50				
Chlorothalonil	<50 µg/kg	TM073	<50				
Aldrin	<50 µg/kg	TM073	<50				
beta-Hexachlorocyclohexane (HCH / Lindane)	<50 µg/kg	TM073	<50				
Pirimiphos-methyl	<50 µg/kg	TM073	<50				
Telodrin	<50 µg/kg	TM073	<50				
Chlorpyrifos	<50 µg/kg	TM073	<50				
Isodrin	<50 µg/kg	TM073	<50				
Methyl parathion	<50 µg/kg	TM073	<50				
Malathion	<50 µg/kg	TM073	<50				
Fenthion	<50 µg/kg	TM073	<50				
Fenitrothion	<50 µg/kg	TM073	<50				
Triadimefon	<50 µg/kg	TM073	<50				
Heptachlor epoxide	<50 µg/kg	TM073	<50				
Parathion	<50 µg/kg	TM073	<50				
Pendimethalin	<50 µg/kg	TM073	<50				
Chlorfenvinphos	<50 µg/kg	TM073	<50				
o,p-DDE	<50 µg/kg	TM073	<50				
Trans-chlordane	<50 µg/kg	TM073	<50				
Endosulphan I	<50 µg/kg	TM073	<50				
p,p-DDE	<50 µg/kg	TM073	<50				

Order Number: PBA007983
Report Number: 150822
Superseded Report: 149065

Page 13 of 60

Order Number: PBA007983
Report Number: 150822
Superseded Report: 149065

Page 14 of 60



CERTIFICATE OF ANALYSIS

SDG: 110831-47
 Job: H_PBRETT_REA-49
 Client Reference: 21834/030

Location: Woodcroft Farm, Waterloooville
 Customer: Peter Brett Associates
 Attention: Arie Zamler

Order Number: PBA007983
 Report Number: 150822
 Superseded Report: 149065

Semi Volatile Organic Compounds

Results Legend			Customer Sample R		WS 3	WS 6			
#	ISO17025 accredited.		Depth (m) Sample Type Date Sampled Date Received SDG Ref Lab Sample No.(s) AGS Reference		0.10 - 0.40	0.10 - 0.50			
M	mCERTS accredited.				Sol/Solid	Sol/Solid			
S	Devolving sample.				30/08/2011	30/08/2011			
AQ	Aqueous / settled sample.				31/08/2011	31/08/2011			
dis. fil	Dissolved / filtered sample.				110831-47	110831-47			
tot. unfil	Total / unfiltered sample.				4200318	4200321			
+	Subcontracted test.								
~	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery								
(F)	Trigger breach confirmed								
Component	LOD/Units	Method							
Phenol	<100 µg/kg	TM157			<200	<100			
Pentachlorophenol	<100 µg/kg	TM157			<200	<100			
n-Nitroso-n-dipropylamine	<100 µg/kg	TM157			<200	<100			
Nitrobenzene	<100 µg/kg	TM157			<200	<100			
Isophorone	<100 µg/kg	TM157			<200	<100			
Hexachloroethane	<100 µg/kg	TM157			<200	<100			
Hexachlorocyclopentadiene	<100 µg/kg	TM157			<200	<100			
Hexachlorobutadiene	<100 µg/kg	TM157			<200	<100			
Hexachlorobenzene	<100 µg/kg	TM157			<200	<100			
n-Dioctyl phthalate	<100 µg/kg	TM157			<200	<100			
Dimethyl phthalate	<100 µg/kg	TM157			<200	<100			
Diethyl phthalate	<100 µg/kg	TM157			<200	<100			
n-Dibutyl phthalate	<100 µg/kg	TM157			<200	<100			
Dibenzofuran	<100 µg/kg	TM157			1130	<100			
Carbazole	<100 µg/kg	TM157			509	<100			
Butylbenzyl phthalate	<100 µg/kg	TM157			<200	<100			
bis(2-Ethylhexyl) phthalate	<100 µg/kg	TM157			391	<100			
bis(2-Chloroethoxy)methane	<100 µg/kg	TM157			<200	<100			
bis(2-Chloroethyl)ether	<100 µg/kg	TM157			<200	<100			
Azobenzene	<100 µg/kg	TM157			<200	<100			
4-Nitrophenol	<100 µg/kg	TM157			<200	<100			
4-Nitroaniline	<100 µg/kg	TM157			<200	<100			
4-Methylphenol	<100 µg/kg	TM157			<200	<100			
4-Chlorophenylphenylether	<100 µg/kg	TM157			<200	<100			
4-Chloroaniline	<100 µg/kg	TM157			<200	<100			
4-Chloro-3-methylphenol	<100 µg/kg	TM157			<200	<100			
4-Bromophenylphenylether	<100 µg/kg	TM157			<200	<100			
3-Nitroaniline	<100 µg/kg	TM157			<200	<100			
2-Nitrophenol	<100 µg/kg	TM157			<200	<100			
2-Nitroaniline	<100 µg/kg	TM157			<200	<100			
2-Methylphenol	<100 µg/kg	TM157			<200	<100			
1,2,4-Trichlorobenzene	<100 µg/kg	TM157			<200	<100			
2-Chlorophenol	<100 µg/kg	TM157			<200	<100			
2,6-Dinitrotoluene	<100 µg/kg	TM157			<200	<100			
2,4-Dinitrotoluene	<100 µg/kg	TM157			<200	<100			

Order Number: PBA007983
Report Number: 150822
Superseded Report: 149065

Page 16 of 60



CERTIFICATE OF ANALYSIS

SDG: 110831-47
 Job: H_PBRETT_REA-49
 Client Reference: 21834/030

Location: Woodcroft Farm, Waterloooville
 Customer: Peter Brett Associates
 Attention: Arie Zamler

Order Number: PBA007983
 Report Number: 150822
 Superseded Report: 149065

TPH CWG (S)

Results Legend			Customer Sample R	WS 3	WS 4	WS 6			
#	ISO17025 accredited.	Depth (m) Sample Type Date Sampled Date Received SDG Ref Lab Sample No.(s) AGS Reference							
M	mCERTS accredited.								
S	Deviating sample.								
AQ	Aqueous / settled sample.								
dis. fil.	Dissolved / filtered sample.								
tot. unfil.	Total / unfiltered sample.								
-	Subcontracted test.								
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery								
(F)	Trigger breach confirmed								
Component	LOD/Units	Method							
GRO Surrogate % recovery**	%	TM089	38	58	88				
GRO >C5-C12	<44 µg/kg	TM089	95.5	<44	<44				
Methyl tertiary butyl ether (MTBE)	<5 µg/kg	TM089	<5 #	<5 #	<5 #				
Benzene	<10 µg/kg	TM089	<10 M	<10 M	<10 M				
Toluene	<2 µg/kg	TM089	<2 M	<2 M	<2 M				
Ethylbenzene	<3 µg/kg	TM089	<3 M	<3 M	<3 M				
m,p-Xylene	<6 µg/kg	TM089	<6 M	<6 M	<6 M				
o-Xylene	<3 µg/kg	TM089	<3 M	<3 M	<3 M				
sum of detected mpo xylene by GC	<9 µg/kg	TM089	<9	<9	<9				
sum of detected BTEX by GC	<24 µg/kg	TM089	<24	<24	<24				
Aliphatics >C5-C6	<10 µg/kg	TM089	25.5	<10	<10				
Aliphatics >C6-C8	<10 µg/kg	TM089	30	<10	<10				
Aliphatics >C8-C10	<10 µg/kg	TM089	<10	<10	<10				
Aliphatics >C10-C12	<10 µg/kg	TM089	13.3	<10	<10				
Aliphatics >C12-C16	<100 µg/kg	TM173	12400	2120	1580				
Aliphatics >C16-C21	<100 µg/kg	TM173	35800	1240	5760				
Aliphatics >C21-C35	<100 µg/kg	TM173	303000	11300	192000				
Aliphatics >C35-C44	<100 µg/kg	TM173	260000	1360	31900				
Total Aliphatics >C12-C44	<100 µg/kg	TM173	611000	16000	232000				
Aromatics >EC5-EC7	<10 µg/kg	TM089	<10	<10	<10				
Aromatics >EC7-EC8	<10 µg/kg	TM089	<10	<10	<10				
Aromatics >EC8-EC10	<10 µg/kg	TM089	<10	<10	<10				
Aromatics >EC10-EC12	<10 µg/kg	TM089	<10	<10	<10				
Aromatics >EC12-EC16	<100 µg/kg	TM173	28100	8750	2990				
Aromatics >EC16-EC21	<100 µg/kg	TM173	128000	8210	7110				
Aromatics >EC21-EC35	<100 µg/kg	TM173	733000	38000	53800				
Aromatics >EC35-EC44	<100 µg/kg	TM173	734000	17000	20200				
Aromatics >EC40-EC44	<100 µg/kg	TM173	350000	8280	7720				
Total Aromatics >EC12-EC44	<100 µg/kg	TM173	1620000	71900	84100				
Total Aliphatics & Aromatics >C5-C44	<100 µg/kg	TM173	2230000	88000	316000				
Total Aliphatics >C5-35	<100 µg/kg	TM173	351000	14700	200000				
Total Aromatics >C5-35	<100 µg/kg	TM173	889000	54900	63900				
Total Aliphatics & Aromatics >C5-35	<100 µg/kg	TM173	1240000	69600	264000				



CERTIFICATE OF ANALYSIS

SDG: 110831-47
 Job: H_PBRETT_REA-49
 Client Reference: 21834/030

Location: Woodcroft Farm, Waterloooville
 Customer: Peter Brett Associates
 Attention: Arie Zamler

Order Number: PBA007983
 Report Number: 150822
 Superseded Report: 149065

VOC MS (S)

Results Legend			Customer Sample R		WS 3	WS 6				
#	ISO17025 accredited.		Depth (m) Sample Type Date Sampled Date Received SDG Ref Lab Sample No.(s) AGS Reference	0.10 - 0.40 Sol/Solid 30/08/2011 31/08/2011 110831-47 4200318	0.10 - 0.50 Sol/Solid 30/08/2011 31/08/2011 110831-47 4200321					
M	mCERTS accredited.									
S	Deviating sample.									
AQ	Aqueous / settled sample.									
dis.filt	Dissolved / filtered sample.									
tot.unfilt	Total / unfiltered sample.									
+	Subcontracted test.									
~	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery									
(F)	Trigger breach confirmed									
Component	LOD/Units	Method								
Dibromofluoromethane**	%	TM116		98.2	99.9					
Toluene-d8**	%	TM116		92.8	100					
4-Bromofluorobenzene**	%	TM116		150	129					
Dichlorodifluoromethane	<4 µg/kg	TM116		<8	<4					
Chloromethane	<7 µg/kg	TM116		<14	<7					
Vinyl Chloride	<10 µg/kg	TM116		<20	<10					
Bromomethane	<13 µg/kg	TM116		<26	<13					
Chloroethane	<14 µg/kg	TM116		<28	<14					
Trichlorofluoromethane	<6 µg/kg	TM116		<12	<6					
1,1-Dichloroethene	<10 µg/kg	TM116		<20	<10					
Carbon Disulphide	<7 µg/kg	TM116		53.6	<7					
Dichloromethane	<10 µg/kg	TM116		<20	<10					
Methyl Tertiary Butyl Ether	<11 µg/kg	TM116		<22	<11					
trans-1-2-Dichloroethene	<11 µg/kg	TM116		<22	<11					
1,1-Dichloroethane	<8 µg/kg	TM116		<16	<8					
cis-1-2-Dichloroethene	<5 µg/kg	TM116		<10	<5					
2,2-Dichloropropane	<12 µg/kg	TM116		<24	<12					
Bromochloromethane	<14 µg/kg	TM116		<28	<14					
Chloroform	<8 µg/kg	TM116		<16	<8					
1,1,1-Trichloroethane	<7 µg/kg	TM116		<14	<7					
1,1-Dichloropropene	<11 µg/kg	TM116		<22	<11					
Carbontetrachloride	<14 µg/kg	TM116		<28	<14					
1,2-Dichloroethane	<5 µg/kg	TM116		<10	<5					
Benzene	<9 µg/kg	TM116		<18	<9					
Trichloroethene	<9 µg/kg	TM116		<18	<9					
1,2-Dichloropropane	<12 µg/kg	TM116		<24	<12					
Dibromomethane	<9 µg/kg	TM116		<18	<9					
Bromodichloromethane	<7 µg/kg	TM116		<14	<7					
cis-1-3-Dichloropropene	<14 µg/kg	TM116		<28	<14					
Toluene	<5 µg/kg	TM116		<10	7.37					
trans-1-3-Dichloropropene	<14 µg/kg	TM116		<28	<14					
1,1,2-Trichloroethane	<10 µg/kg	TM116		<20	<10					
1,3-Dichloropropane	<7 µg/kg	TM116		<14	<7					
Tetrachloroethene	<5 µg/kg	TM116		<10	<5					
Dibromochloromethane	<13 µg/kg	TM116		<26	<13					



CERTIFICATE OF ANALYSIS

SDG: 110831-47
 Job: H_PBRETT_REA-49
 Client Reference: 21834/030

Location: Woodcroft Farm, Waterloooville
 Customer: Peter Brett Associates
 Attention: Arie Zamler

Order Number: PBA007983
 Report Number: 150822
 Superseded Report: 149065

VOC MS (S)

Results Legend		Customer Sample R	WS 3		WS 6					
#	ISO17025 accredited.		0.10 - 0.40		0.10 - 0.50					
M	mCERTS accredited.		Soil/Solid		Soil/Solid					
S	Deviating sample.		30/08/2011		30/08/2011					
aq	Aqueous / settled sample.		31/08/2011		31/08/2011					
dis.filt	Dissolved / filtered sample.		110831-47		110831-47					
tot.unfilt	Total / unfiltered sample.		4200318		4200321					
"	Subcontracted test.									
"	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery									
(P)	Trigger breach confirmed									
Component	LOD/Units	Method								
1,2-Dibromoethane	<12 µg/kg	TM116	<24	M	<12	M				
Chlorobenzene	<5 µg/kg	TM116	<10	M	<5	M				
1,1,1,2-Tetrachloroethane	<10 µg/kg	TM116	<20	M	<10	M				
Ethylbenzene	<4 µg/kg	TM116	<8	M	<4	M				
p/m-Xylene	<14 µg/kg	TM116	<28	#	<14	#				
o-Xylene	<10 µg/kg	TM116	<20	M	<10	M				
Styrene	<10 µg/kg	TM116	<20	M	<10	M				
Bromoform	<10 µg/kg	TM116	<20	M	<10	M				
Isopropylbenzene	<5 µg/kg	TM116	<10	M	<5	M				
1,1,2,2-Tetrachloroethane	<10 µg/kg	TM116	<20	#	<10	#				
1,2,3-Trichloropropane	<17 µg/kg	TM116	<34	M	<17	M				
Bromobenzene	<10 µg/kg	TM116	<20	M	<10	M				
Propylbenzene	<11 µg/kg	TM116	<22	M	<11	M				
2-Chlorotoluene	<9 µg/kg	TM116	<18	M	<9	M				
1,3,5-Trimethylbenzene	<8 µg/kg	TM116	<16	#	<8	#				
4-Chlorotoluene	<12 µg/kg	TM116	<24	M	<12	M				
tert-Butylbenzene	<12 µg/kg	TM116	<24	#	<12	#				
1,2,4-Trimethylbenzene	<9 µg/kg	TM116	<18	#	<9	#				
sec-Butylbenzene	<10 µg/kg	TM116	<20	M	<10	M				
4-Isopropyltoluene	<11 µg/kg	TM116	<22	M	<11	M				
1,3-Dichlorobenzene	<6 µg/kg	TM116	<12	M	<6	M				
1,4-Dichlorobenzene	<5 µg/kg	TM116	<10	M	<5	M				
n-Butylbenzene	<10 µg/kg	TM116	<20	M	<10	M				
1,2-Dichlorobenzene	<12 µg/kg	TM116	<24	M	<12	M				
1,2-Dibromo-3-chloropropane	<14 µg/kg	TM116	<28	M	<14	M				
Tert-amyl methyl ether	<15 µg/kg	TM116	<30		<15					
1,2,4-Trichlorobenzene	<6 µg/kg	TM116	<12	#	<6	#				
Hexachlorobutadiene	<12 µg/kg	TM116	<24		<12					
Naphthalene	<13 µg/kg	TM116	<26	M	<13	M				
1,2,3-Trichlorobenzene	<6 µg/kg	TM116	<12	M	<6	M				



CERTIFICATE OF ANALYSIS

SDG: 110831-47
 Job: H_PBRETT_REA-49
 Client Reference: 21834/030

Location: Woodcroft Farm, Waterloooville
 Customer: Peter Brett Associates
 Attention: Arie Zamler

Order Number: PBA007983
 Report Number: 150822
 Superseded Report: 149065

Extractable Petroleum Hydrocarbons (EPH) By GC-FID

EPH (DRO) (C10-C40)

Sample No	Customer Sample Ref.	Depth	Matrix (mg/kg)	EPH	Interpretation
4234529	WS 1	2.50 - 3.00	SOLID	78.4	PAHS/Humic Acids
4234627	TP 4	1.00 - 1.00	SOLID	<35.0	No Identification Possible
4234722	WS 2	1.50 - 2.00	SOLID	240	Carboxylic Acids
4235469	TP 18	0.50 - 0.50	SOLID	44.2	PAHS/Humic Acids
4235584	TP 4	0.50 - 0.50	SOLID	145	PAHS/Humic Acids
4235621	TP 1	2.20 - 2.20	SOLID	138	PAHS/Humic Acids
4235653	TP 2	1.00 - 1.00	SOLID	207	PAHS/Humic Acids
4236908	WS 3	0.70 - 1.00	SOLID	42.8	No Identification Possible
4236936	WS 6	0.80 - 1.00	SOLID	420	PAHS
4236950	TP 3	2.00 - 2.00	SOLID	241	PAHS
4237355	WS 4	0.70 - 1.00	SOLID	<35.0	No Identification Possible
4237369	WS 1	0.50 - 1.00	SOLID	59.6	No Identification Possible
4237583	WS 11	0.20 - 0.50	SOLID	55.9	PAHS
4241036	TP 1	0.50 - 0.50	SOLID	110	PAHS/Humic Acids
4241056	TP 2	3.00 - 3.00	SOLID	152	PAHS/Humic Acids
4241083	BH 1	0.30 - 0.80	SOLID	<35.0	No Identification Possible
4241126	BH 4	0.15 - 0.60	SOLID	42.7	No Identification Possible
4248402	TP 2	2.00 - 2.00	SOLID	511	PAHS/Humic Acids
4248428	TP 3	1.10 - 1.10	SOLID	238	PAHS/Humic Acids

Extractable Petroleum Hydrocarbons (formally Diesel Range Organics) :- Any compound extractable in n-hexane within the carbon range C10-C40, includes Aliphatic (Min Oil), Aromatic (PAHs) and naturally occurring compounds.



CERTIFICATE OF ANALYSIS

SDG: 110831-47
 Job: H_PBRETT_REA-49
 Client Reference: 21834/030

Location: Woodcroft Farm, Waterloooville
 Customer: Peter Brett Associates
 Attention: Arie Zamler

Order Number: PBA007983
 Report Number: 150822
 Superseded Report: 149065

Asbestos Identification

		Date of Analysis	Analysed By	Comments	Amosite (Brown) Asbestos	Chrysotile (White) Asbestos	Crocidolite (Blue) Asbestos	Fibrous Actinolite	Fibrous Anthophyllite	Fibrous Tremolite	Non-Asbestos Fibre
Customer Sample Ref. Depth (m) Sample Type Date Sampled Date Received SDG Original Sample Method Number	TP 1 NS 2 1.10 - 1.10 SOLO 25/08/2011 00:00:00 110831-47 4,206,339 TM048	07/09/11	Tomasz Pawlikowski	Loose fibres in soil.	Not Detected (#)	Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Customer Sample Ref. Depth (m) Sample Type Date Sampled Date Received SDG Original Sample Method Number	TP 2 NS 2 2.00 - 2.00 SOLO 26/08/2011 00:00:00 110831-47 4,206,346 TM048	07/09/11	Tomasz Pawlikowski	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Customer Sample Ref. Depth (m) Sample Type Date Sampled Date Received SDG Original Sample Method Number	TP 2 NS 2 2.00 - 2.00 SOLO 26/08/2011 00:00:00 110831-47 4,206,347 TM048	07/09/11	Tomasz Pawlikowski	A large piece of tile typical of asbestos cement.	Not Detected (#)	Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Customer Sample Ref. Depth (m) Sample Type Date Sampled Date Received SDG Original Sample Method Number	TP 3 NS 2 1.10 - 1.10 SOLO 25/08/2011 00:00:00 110831-47 4,206,304 TM048	07/09/11	Tomasz Pawlikowski	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected



CERTIFICATE OF ANALYSIS

SDG: 110831-47
 Job: H_PBRETT_REA-49
 Client Reference: 21834/030

Location: Woodcroft Farm, Waterloooville
 Customer: Peter Brett Associates
 Attention: Arie Zamler

Order Number: PBA007983
 Report Number: 150822
 Superseded Report: 149065

CEN 10:1 STAGE BATCH TEST

WAC ANALYTICAL RESULTS

REF : BS EN 12457/2

Client Reference

Mass Sample taken (kg) 0.117
 Mass of dry sample (kg) 0.175
 Particle Size <4mm >95%

Site Location

Woodcroft Farm, Waterloooville

Moisture Content Ratio (%) 30.0
 Dry Matter Content Ratio (%) 76.9

Case

SDG 110831-47
 Lab Sample Number(s) 4200305
 Sampled Date 25-Aug-2011
 Customer Sample Ref. TP 3
 Depth (m) 2.00 - 2.00

Solid Waste Analysis

Result

Total Organic Carbon (%) 1.27
 Loss on Ignition (%) -
 Sum of BTEX (mg/kg) -
 Sum of 7 PCBs (mg/kg) -
 Mineral Oil (mg/kg) -
 PAH Sum of 17 (mg/kg) <10.0
 pH (pH Units) 7.63
 ANC to pH 6 (mol/kg) -
 ANC to pH 4 (mol/kg) -

Eluate Analysis

C₂Concⁿ in 10:1 eluate (mg/l)A₂10:1 concⁿ leached (mg/kg)Limit values for compliance leaching test
using BS EN 12457-3 at L/S 10 l/kg

	Result	Limit of Detection	Result	Limit of Detection	
Arsenic	0.00307	<0.00012	0.0307	<0.0012	-
Barium	-	-	-	-	-
Cadmium	<0.0001	<0.0001	<0.001	<0.001	-
Chromium	0.00331	<0.00022	0.0331	<0.0022	-
Copper	0.00211	<0.00085	0.0211	<0.0085	-
Mercury Dissolved (CVAF)	<0.00001	<0.00001	<0.0001	<0.0001	-
Molybdenum	-	-	-	-	-
Nickel	0.00283	<0.00015	0.0283	<0.0015	-
Lead	0.00069	<0.00002	0.0069	<0.0002	-
Antimony	-	-	-	-	-
Selenium	0.00115	<0.00039	0.0115	<0.0039	-
Zinc	0.00242	<0.00041	0.0242	<0.0041	-
Chloride	-	-	-	-	-
Fluoride	-	-	-	-	-
Sulphate (soluble)	90.3	<2	903	<20	-
Total Dissolved Solids	-	-	-	-	-
Total Monohydric Phenols (W)	-	-	-	-	-
Dissolved Organic Carbon	-	-	-	-	-

Leach Test Information

Date Prepared 05-Sep-2011
 pH (pH Units) 7.90
 Conductivity (µS/cm) 360.00
 Temperature (°C) 20.00
 Volume Leachant (Litres) 0.873
 Volume of Eluate VE1 (Litres)

Solid Results are expressed on a dry weight basis, after correction for moisture content where applicable
 Stated limits are for guidance only and ALcontrol cannot be held responsible for any discrepancies with current legislation
 Mcerts Certification does not apply to leachates

19/09/2011 14:33:25

14:33:20 19/09/2011



CERTIFICATE OF ANALYSIS

SDG: 110831-47
 Job: H_PBRETT_REA-49
 Client Reference: 21834/030

Location: Woodcroft Farm, Waterloooville
 Customer: Peter Brett Associates
 Attention: Arie Zamler

Order Number: PBA007983
 Report Number: 150822
 Superseded Report: 149065

CEN 10:1 STAGE BATCH TEST

WAC ANALYTICAL RESULTS

REF : BS EN 12457/2

Client Reference

Mass Sample taken (kg) 0.117
 Mass of dry sample (kg) 0.175
 Particle Size <4mm >95%

Site Location

Woodcroft Farm, Waterloooville

Moisture Content Ratio (%) 30.0
 Dry Matter Content Ratio (%) 76.9

Case

SDG 110831-47
 Lab Sample Number(s) 4200305
 Sampled Date 25-Aug-2011
 Customer Sample Ref. TP 3
 Depth (m) 2.00 - 2.00

Solid Waste Analysis

Result

Total Organic Carbon (%) 1.27
 Loss on Ignition (%) -
 Sum of BTEX (mg/kg) -
 Sum of 7 PCBs (mg/kg) -
 Mineral Oil (mg/kg) -
 PAH Sum of 17 (mg/kg) <10.0
 pH (pH Units) 7.63
 ANC to pH 6 (mol/kg) -
 ANC to pH 4 (mol/kg) -

Eluate Analysis

C₂Concⁿ in 10:1 eluate (mg/l)A₂10:1 concⁿ leached (mg/kg)Limit values for compliance leaching test
using BS EN 12457-3 at L/S 10 l/kg

	Result	Limit of Detection	Result	Limit of Detection	
pH	8	<0.001	80	<0.01	-
Beryllium	<0.00007	<0.00007	<0.0007	<0.0007	-
Vanadium	0.00193	<0.00024	0.0193	<0.0024	-
PAH Spec MS - Aqueous (W)					
Naphthalene by GCMS	<0.0001	<0.0001	<0.001	<0.001	-
Acenaphthene by GCMS	<0.000015	<0.000015	<0.00015	<0.00015	-
Acenaphthylene by GCMS	<0.000011	<0.000011	<0.00011	<0.00011	-
Fluoranthene by GCMS	0.0000318	<0.000017	0.000318	<0.00017	-
Anthracene by GCMS	0.0000199	<0.000015	0.000199	<0.00015	-
Phenanthrene by GCMS	<0.000022	<0.000022	<0.00022	<0.00022	-
Fluorene by GCMS	<0.000014	<0.000014	<0.00014	<0.00014	-
Chrysene by GCMS	<0.000013	<0.000013	<0.00013	<0.00013	-
Pyrene by GCMS	0.0000428	<0.000015	0.000428	<0.00015	-
Benz(a)anthracene by GCMS	<0.000017	<0.000017	<0.00017	<0.00017	-
Benzo(b)fluoranthene by GCMS	<0.000023	<0.000023	<0.00023	<0.00023	-
Benzo(k)fluoranthene by GCMS	<0.000027	<0.000027	<0.00027	<0.00027	-
Benzo(a)pyrene by GCMS	<0.000009	<0.000009	<0.00009	<0.00009	-
Dibenzo(ah)anthracene by GCMS	<0.000016	<0.000016	<0.00016	<0.00016	-
Benzo(ghi)perylene by GCMS	<0.000016	<0.000016	<0.00016	<0.00016	-
Indeno(123cd)pyrene by GCMS	<0.000014	<0.000014	<0.00014	<0.00014	-
PAH 16 EPA Total by GCMS	<0.000247	<0.000247	<0.00247	<0.00247	-

Leach Test Information

Date Prepared 05-Sep-2011
 pH (pH Units) 7.90
 Conductivity (µS/cm) 360.00
 Temperature (°C) 20.00
 Volume Leachant (Litres) 0.873
 Volume of Eluate VE1 (Litres)

Solid Results are expressed on a dry weight basis, after correction for moisture content where applicable
 Stated limits are for guidance only and ALcontrol cannot be held responsible for any discrepancies with current legislation
 Mcerts Certification does not apply to leachates

19/09/2011 14:33:25

14:33:20 19/09/2011



CERTIFICATE OF ANALYSIS

SDG: 110831-47
Job: H_PBRETT_REA-49
Client Reference: 21834/030

Location: Woodcroft Farm, Waterloooville
Customer: Peter Brett Associates
Attention: Arie Zamler

Order Number: PBA007983
Report Number: 150822
Superseded Report: 149065

CEN 10:1 STAGE BATCH TEST

WAC ANALYTICAL RESULTS

REF : BS EN 12457/2

Client Reference

Mass Sample taken (kg)

Mass of dry sample (kg) 0.175

Particle Size <4mm >95%

Site Location

Woodcroft Farm, Waterloooville

Moisture Content Ratio (%)

Dry Matter Content Ratio (%)

Case

SDG 110831-47

Lab Sample Number(s) 4200339

Sampled Date 25-Aug-2011

Customer Sample Ref. TP 1

Depth (m) 1.10 - 1.10

Solid Waste Analysis

Result

Total Organic Carbon (%)

-

Loss on Ignition (%)

-

Sum of BTEX (mg/kg)

<24.0

Sum of 7 PCBs (mg/kg)

-

Mineral Oil (mg/kg)

-

PAH Sum of 17 (mg/kg)

-

pH (pH Units)

-

ANC to pH 6 (mol/kg)

-

ANC to pH 4 (mol/kg)

-

Eluate Analysis

C₂Concⁿ in 10:1 eluate (mg/l)A₂10:1 concⁿ leached (mg/kg)Limit values for compliance leaching test
using BS EN 12457-3 at L/S 10 l/kg

	Result	Limit of Detection	Result	Limit of Detection	
Arsenic	-	-	-	-	-
Barium	-	-	-	-	-
Cadmium	-	-	-	-	-
Chromium	-	-	-	-	-
Copper	-	-	-	-	-
Mercury Dissolved (CVAF)	-	-	-	-	-
Molybdenum	-	-	-	-	-
Nickel	-	-	-	-	-
Lead	-	-	-	-	-
Antimony	-	-	-	-	-
Selenium	-	-	-	-	-
Zinc	-	-	-	-	-
Chloride	-	-	-	-	-
Fluoride	-	-	-	-	-
Sulphate (soluble)	-	-	-	-	-
Total Dissolved Solids	-	-	-	-	-
Total Monohydric Phenols (W)	-	-	-	-	-
Dissolved Organic Carbon	-	-	-	-	-

Leach Test Information

Date Prepared 06-Sep-2011

pH (pH Units)

Conductivity (µS/cm)

Temperature (°C)

Volume Leachant (Litres)

Volume of Eluate VE1 (Litres)

Solid Results are expressed on a dry weight basis, after correction for moisture content where applicable

Stated limits are for guidance only and ALcontrol cannot be held responsible for any discrepancies with current legislation

Mcerts Certification does not apply to leachates

19/09/2011 14:33:25

14:33:20 19/09/2011



CERTIFICATE OF ANALYSIS

SDG: 110831-47
 Job: H_PBRETT_REA-49
 Client Reference: 21834/030

Location: Woodcroft Farm, Waterloooville
 Customer: Peter Brett Associates
 Attention: Arie Zamler

Order Number: PBA007983
 Report Number: 150822
 Superseded Report: 149065

CEN 10:1 STAGE BATCH TEST

WAC ANALYTICAL RESULTS

REF : BS EN 12457/2

Client Reference		Site Location	Woodcroft Farm, Waterloooville
Mass Sample taken (kg)	0.115	Moisture Content Ratio (%)	27.8
Mass of dry sample (kg)	0.175	Dry Matter Content Ratio (%)	78.2
Particle Size <4mm	>95%		

Case

SDG 110831-47
 Lab Sample Number(s) 4200346
 Sampled Date 26-Aug-2011
 Customer Sample Ref. TP 2
 Depth (m) 2.00 - 2.00

Solid Waste Analysis

Result

Total Organic Carbon (%) 3.46
 Loss on Ignition (%) -
 Sum of BTEX (mg/kg) -
 Sum of 7 PCBs (mg/kg) -
 Mineral Oil (mg/kg) -
 PAH Sum of 17 (mg/kg) -
 pH (pH Units) 7.73
 ANC to pH 6 (mol/kg) -
 ANC to pH 4 (mol/kg) -

Eluate Analysis

C2 Concⁿ in 10:1 eluate (mg/l)A2 10:1 concⁿ leached (mg/kg)Limit values for compliance leaching test
using BS EN 12457-3 at L/S 10 l/kg

	Result	Limit of Detection	Result	Limit of Detection	
Arsenic	0.000595	<0.00012	0.00595	<0.0012	-
Barium	-	-	-	-	-
Cadmium	<0.0001	<0.0001	<0.001	<0.001	-
Chromium	0.00228	<0.00022	0.0228	<0.0022	-
Copper	0.00166	<0.00085	0.0166	<0.0085	-
Mercury Dissolved (CVAF)	<0.00001	<0.00001	<0.0001	<0.0001	-
Molybdenum	-	-	-	-	-
Nickel	0.000631	<0.00015	0.00631	<0.0015	-
Lead	0.000134	<0.00002	0.00134	<0.0002	-
Antimony	-	-	-	-	-
Selenium	0.00108	<0.00039	0.0108	<0.0039	-
Zinc	0.000595	<0.00041	0.00595	<0.0041	-
Chloride	-	-	-	-	-
Fluoride	-	-	-	-	-
Sulphate (soluble)	3.6	<2	36	<20	-
Total Dissolved Solids	-	-	-	-	-
Total Monohydric Phenols (W)	-	-	-	-	-
Dissolved Organic Carbon	-	-	-	-	-

Leach Test Information

Date Prepared 06-Sep-2011
 pH (pH Units) 8.21
 Conductivity (µS/cm) 124.00
 Temperature (°C) 19.90
 Volume Leachant (Litres) 0.675
 Volume of Eluate VE1 (Litres)

Solid Results are expressed on a dry weight basis, after correction for moisture content where applicable
 Stated limits are for guidance only and ALcontrol cannot be held responsible for any discrepancies with current legislation
 Mcerts Certification does not apply to leachates

19/09/2011 14:33:25

14:33:20 19/09/2011



CERTIFICATE OF ANALYSIS

SDG: 110831-47
 Job: H_PBRETT_REA-49
 Client Reference: 21834/030

Location: Woodcroft Farm, Waterloooville
 Customer: Peter Brett Associates
 Attention: Arie Zamler

Order Number: PBA007983
 Report Number: 150822
 Superseded Report: 149065

CEN 10:1 STAGE BATCH TEST

WAC ANALYTICAL RESULTS

REF : BS EN 12457/2

Client Reference		Site Location	Woodcroft Farm, Waterloooville
Mass Sample taken (kg)	0.115	Moisture Content Ratio (%)	27.8
Mass of dry sample (kg)	0.175	Dry Matter Content Ratio (%)	78.2
Particle Size <4mm	>95%		

Case

SDG 110831-47
 Lab Sample Number(s) 4200346
 Sampled Date 26-Aug-2011
 Customer Sample Ref. TP 2
 Depth (m) 2.00 - 2.00

Solid Waste Analysis

Result

Total Organic Carbon (%) 3.46
 Loss on Ignition (%) -
 Sum of BTEX (mg/kg) -
 Sum of 7 PCBs (mg/kg) -
 Mineral Oil (mg/kg) -
 PAH Sum of 17 (mg/kg) -
 pH (pH Units) 7.73
 ANC to pH 6 (mol/kg) -
 ANC to pH 4 (mol/kg) -

Eluate Analysis

C2

Concⁿ in 10:1 eluate (mg/l)

A2

10:1 concⁿ leached (mg/kg)Limit values for compliance leaching test
using BS EN 12457-3 at L/S 10 l/kg

	Result	Limit of Detection	Result	Limit of Detection	
pH	8	<0.001	80	<0.01	-
Beryllium	<0.00007	<0.00007	<0.0007	<0.0007	-
Vanadium	0.00114	<0.00024	0.0114	<0.0024	-
PAH Spec MS - Aqueous (W)					
Naphthalene by GCMS	0.000156	<0.0001	0.00156	<0.001	-
Acenaphthene by GCMS	0.0000187	<0.000015	0.000187	<0.00015	-
Acenaphthylene by GCMS	<0.000011	<0.000011	<0.00011	<0.00011	-
Fluoranthene by GCMS	<0.000017	<0.000017	<0.00017	<0.00017	-
Anthracene by GCMS	<0.000015	<0.000015	<0.00015	<0.00015	-
Phenanthrene by GCMS	0.0000248	<0.000022	0.000248	<0.00022	-
Fluorene by GCMS	<0.000014	<0.000014	<0.00014	<0.00014	-
Chrysene by GCMS	<0.000013	<0.000013	<0.00013	<0.00013	-
Pyrene by GCMS	<0.000015	<0.000015	<0.00015	<0.00015	-
Benz(a)anthracene by GCMS	<0.000017	<0.000017	<0.00017	<0.00017	-
Benzo(b)fluoranthene by GCMS	<0.000023	<0.000023	<0.00023	<0.00023	-
Benzo(k)fluoranthene by GCMS	<0.000027	<0.000027	<0.00027	<0.00027	-
Benzo(a)pyrene by GCMS	<0.000009	<0.000009	<0.00009	<0.00009	-
Dibenzo(ah)anthracene by GCMS	<0.000016	<0.000016	<0.00016	<0.00016	-
Benzo(ghi)perylene by GCMS	<0.000016	<0.000016	<0.00016	<0.00016	-
Indeno(123cd)pyrene by GCMS	<0.000014	<0.000014	<0.00014	<0.00014	-
PAH 16 EPA Total by GCMS	<0.000247	<0.000247	<0.00247	<0.00247	-

Leach Test Information

Date Prepared 06-Sep-2011
 pH (pH Units) 8.21
 Conductivity (µS/cm) 124.00
 Temperature (°C) 19.90
 Volume Leachant (Litres) 0.675
 Volume of Eluate VE1 (Litres)

Solid Results are expressed on a dry weight basis, after correction for moisture content where applicable
 Stated limits are for guidance only and ALcontrol cannot be held responsible for any discrepancies with current legislation
 Mcerts Certification does not apply to leachates

19/09/2011 14:33:25

14:33:20 19/09/2011



CERTIFICATE OF ANALYSIS

SDG: 110831-47
 Job: H_PBRETT_REA-49
 Client Reference: 21834/030

Location: Woodcroft Farm, Waterloooville
 Customer: Peter Brett Associates
 Attention: Arie Zamler

Order Number: PBA007983
 Report Number: 150822
 Superseded Report: 149065

Notification of Deviating Samples

Sample Number	Customer Sample Ref.	Depth (m)	Matrix	Test Name	Component Name	Comment
4234529	WS 1	2.50 - 3.00	SOLID	EPH by FID	EPH Range >C10 - C40	Sample holding time exceeded
4234529	WS 1	2.50 - 3.00	SOLID	EPH by FID	EPH Surrogate % recovery**	Sample holding time exceeded
4234529	WS 1	2.50 - 3.00	SOLID	EPH by FID	Interpretation	Sample holding time exceeded
4234627	TP 4	1.00 - 1.00	SOLID	EPH by FID	EPH Range >C10 - C40	Sample holding time exceeded
4234627	TP 4	1.00 - 1.00	SOLID	EPH by FID	EPH Surrogate % recovery**	Sample holding time exceeded
4234627	TP 4	1.00 - 1.00	SOLID	EPH by FID	Interpretation	Sample holding time exceeded
4234722	WS 2	1.50 - 2.00	SOLID	EPH by FID	EPH Range >C10 - C40	Sample holding time exceeded
4234722	WS 2	1.50 - 2.00	SOLID	EPH by FID	EPH Surrogate % recovery**	Sample holding time exceeded
4234722	WS 2	1.50 - 2.00	SOLID	EPH by FID	Interpretation	Sample holding time exceeded
4235469	TP 18	0.50 - 0.50	SOLID	EPH by FID	EPH Range >C10 - C40	Sample holding time exceeded
4235469	TP 18	0.50 - 0.50	SOLID	EPH by FID	EPH Surrogate % recovery**	Sample holding time exceeded
4235469	TP 18	0.50 - 0.50	SOLID	EPH by FID	Interpretation	Sample holding time exceeded
4235584	TP 4	0.50 - 0.50	SOLID	EPH by FID	EPH Range >C10 - C40	Sample holding time exceeded
4235584	TP 4	0.50 - 0.50	SOLID	EPH by FID	EPH Surrogate % recovery**	Sample holding time exceeded
4235584	TP 4	0.50 - 0.50	SOLID	EPH by FID	Interpretation	Sample holding time exceeded
4235621	TP 1	2.20 - 2.20	SOLID	EPH by FID	EPH Range >C10 - C40	Sample holding time exceeded
4235621	TP 1	2.20 - 2.20	SOLID	EPH by FID	EPH Surrogate % recovery**	Sample holding time exceeded
4235621	TP 1	2.20 - 2.20	SOLID	EPH by FID	Interpretation	Sample holding time exceeded
4235653	TP 2	1.00 - 1.00	SOLID	EPH by FID	EPH Range >C10 - C40	Sample holding time exceeded
4235653	TP 2	1.00 - 1.00	SOLID	EPH by FID	EPH Surrogate % recovery**	Sample holding time exceeded
4235653	TP 2	1.00 - 1.00	SOLID	EPH by FID	Interpretation	Sample holding time exceeded
4236908	WS 3	0.70 - 1.00	SOLID	EPH by FID	EPH Range >C10 - C40	Sample holding time exceeded
4236908	WS 3	0.70 - 1.00	SOLID	EPH by FID	EPH Surrogate % recovery**	Sample holding time exceeded
4236908	WS 3	0.70 - 1.00	SOLID	EPH by FID	Interpretation	Sample holding time exceeded
4236936	WS 6	0.80 - 1.00	SOLID	EPH by FID	EPH Range >C10 - C40	Sample holding time exceeded
4236936	WS 6	0.80 - 1.00	SOLID	EPH by FID	EPH Surrogate % recovery**	Sample holding time exceeded
4236936	WS 6	0.80 - 1.00	SOLID	EPH by FID	Interpretation	Sample holding time exceeded
4236950	TP 3	2.00 - 2.00	SOLID	EPH by FID	EPH Range >C10 - C40	Sample holding time exceeded
4236950	TP 3	2.00 - 2.00	SOLID	EPH by FID	EPH Surrogate % recovery**	Sample holding time exceeded
4236950	TP 3	2.00 - 2.00	SOLID	EPH by FID	Interpretation	Sample holding time exceeded
4237355	WS 4	0.70 - 1.00	SOLID	EPH by FID	EPH Range >C10 - C40	Sample holding time exceeded
4237355	WS 4	0.70 - 1.00	SOLID	EPH by FID	EPH Surrogate % recovery**	Sample holding time exceeded
4237355	WS 4	0.70 - 1.00	SOLID	EPH by FID	Interpretation	Sample holding time exceeded
4237369	WS 1	0.50 - 1.00	SOLID	EPH by FID	EPH Range >C10 - C40	Sample holding time exceeded
4237369	WS 1	0.50 - 1.00	SOLID	EPH by FID	EPH Surrogate % recovery**	Sample holding time exceeded
4237369	WS 1	0.50 - 1.00	SOLID	EPH by FID	Interpretation	Sample holding time exceeded
4241036	TP 1	0.50 - 0.50	SOLID	EPH by FID	EPH Range >C10 - C40	Sample holding time exceeded
4241036	TP 1	0.50 - 0.50	SOLID	EPH by FID	EPH Surrogate % recovery**	Sample holding time exceeded
4241036	TP 1	0.50 - 0.50	SOLID	EPH by FID	Interpretation	Sample holding time exceeded
4241056	TP 2	3.00 - 3.00	SOLID	EPH by FID	EPH Range >C10 - C40	Sample holding time exceeded
4241056	TP 2	3.00 - 3.00	SOLID	EPH by FID	EPH Surrogate % recovery**	Sample holding time exceeded
4241056	TP 2	3.00 - 3.00	SOLID	EPH by FID	Interpretation	Sample holding time exceeded
4241083	BH 1	0.30 - 0.80	SOLID	EPH by FID	EPH Range >C10 - C40	Sample holding time exceeded
4241083	BH 1	0.30 - 0.80	SOLID	EPH by FID	EPH Surrogate % recovery**	Sample holding time exceeded
4241083	BH 1	0.30 - 0.80	SOLID	EPH by FID	Interpretation	Sample holding time exceeded
4241126	BH 4	0.15 - 0.60	SOLID	EPH by FID	EPH Range >C10 - C40	Sample holding time exceeded
4241126	BH 4	0.15 - 0.60	SOLID	EPH by FID	EPH Surrogate % recovery**	Sample holding time exceeded
4241126	BH 4	0.15 - 0.60	SOLID	EPH by FID	Interpretation	Sample holding time exceeded
4248402	TP 2	2.00 - 2.00	SOLID	EPH by FID	EPH Range >C10 - C40	Sample holding time exceeded
4248402	TP 2	2.00 - 2.00	SOLID	EPH by FID	EPH Surrogate % recovery**	Sample holding time exceeded
4248402	TP 2	2.00 - 2.00	SOLID	EPH by FID	Interpretation	Sample holding time exceeded
4248428	TP 3	1.10 - 1.10	SOLID	EPH by FID	EPH Range >C10 - C40	Sample holding time exceeded
4248428	TP 3	1.10 - 1.10	SOLID	EPH by FID	EPH Surrogate % recovery**	Sample holding time exceeded
4248428	TP 3	1.10 - 1.10	SOLID	EPH by FID	Interpretation	Sample holding time exceeded
4249726	TP 2	2.00 - 2.00	SOLID	pH	pH	Sample holding time exceeded
4200399	TP 1	1.10 - 1.10	SOLID	GRO by GC-FID (S)	Aliphatics >C10-C12	Volatile container not received
4200399	TP 1	1.10 - 1.10	SOLID	GRO by GC-FID (S)	Aliphatics >C5-C6	Volatile container not received
4200399	TP 1	1.10 - 1.10	SOLID	GRO by GC-FID (S)	Aliphatics >C6-C8	Volatile container not received
4200399	TP 1	1.10 - 1.10	SOLID	GRO by GC-FID (S)	Aliphatics >C8-C10	Volatile container not received



CERTIFICATE OF ANALYSIS

SDG: 110831-47
Job: H_PBRETT_REA-49
Client Reference: 21834/030

Location: Woodcroft Farm, Waterloooville
Customer: Peter Brett Associates
Attention: Arie Zamler

Order Number: PBA007983
Report Number: 150822
Superseded Report: 149065

Sample Number	Customer Sample Ref.	Depth (m)	Matrix	Test Name	Component Name	Comment
4200399	TP 1	1.10 - 1.10	SOLID	GRO by GC-FID (S)	Aromatics >EC10-EC12	Volatile container not received
4200399	TP 1	1.10 - 1.10	SOLID	GRO by GC-FID (S)	Aromatics >EC5-EC7	Volatile container not received
4200399	TP 1	1.10 - 1.10	SOLID	GRO by GC-FID (S)	Aromatics >EC7-EC8	Volatile container not received
4200399	TP 1	1.10 - 1.10	SOLID	GRO by GC-FID (S)	Aromatics >EC8-EC10	Volatile container not received
4200399	TP 1	1.10 - 1.10	SOLID	GRO by GC-FID (S)	Benzene	Volatile container not received
4200399	TP 1	1.10 - 1.10	SOLID	GRO by GC-FID (S)	Ethylbenzene	Volatile container not received
4200399	TP 1	1.10 - 1.10	SOLID	GRO by GC-FID (S)	GRO >C5-C12	Volatile container not received
4200399	TP 1	1.10 - 1.10	SOLID	GRO by GC-FID (S)	GRO Surrogate % recovery**	Volatile container not received
4200399	TP 1	1.10 - 1.10	SOLID	GRO by GC-FID (S)	m,p-Xylene	Volatile container not received
4200399	TP 1	1.10 - 1.10	SOLID	GRO by GC-FID (S)	Methyl tertiary butyl ether (MTBE)	Volatile container not received
4200399	TP 1	1.10 - 1.10	SOLID	GRO by GC-FID (S)	o-Xylene	Volatile container not received
4200399	TP 1	1.10 - 1.10	SOLID	GRO by GC-FID (S)	sum of detected BTEX by GC	Volatile container not received
4200399	TP 1	1.10 - 1.10	SOLID	GRO by GC-FID (S)	sum of detected mpo xylene by GC	Volatile container not received
4200399	TP 1	1.10 - 1.10	SOLID	GRO by GC-FID (S)	Toluene	Volatile container not received

Note : Test results may be compromised



CERTIFICATE OF ANALYSIS

SDG: 110831-47
 Job: H_PBRETT_REA-49
 Client Reference: 21834/030

Location: Woodcroft Farm, Waterloooville
 Customer: Peter Brett Associates
 Attention: Arie Zamler

Order Number: PBA007983
 Report Number: 150822
 Superseded Report: 149065

Table of Results - Appendix

REPORT KEY

Results expressed as (e.g.) 1.03E-07 is equivalent to 1.03x10⁻⁷

NDP	No Determination Possible	#	ISO 17025 Accredited	*	Subcontracted Test	M	MCERTS Accredited
NFD	No Fibres Detected	PFD	Possible Fibres Detected	»	Result previously reported (Incremental reports only)	EC	Equivalent Carbon (Aromatics C8-C35)

Note: Method detection limits are not always achievable due to various circumstances beyond our control

Method No	Reference	Description	Wet/Dry Sample ¹	Surrogate Corrected
PM001		Preparation of Samples for Metals Analysis		
PM024	Modified BS 1377	Soil preparation including homogenisation, moisture screens of soils for Asbestos Containing Material		
PM114		Leaching Procedure for CEN Two Stage Batch Test 2:1/8:1 Cumulative		
PM115		Leaching Procedure for CEN One Stage Leach Test 2:1 & 10:1 1 Step		
TM048	HSG 248, Asbestos: The analysts' guide for sampling, analysis and clearance procedures	Identification of Asbestos in Bulk Material		
TM061	Method for the Determination of EPH, Massachusetts Dept. of EP, 1998	Determination of Extractable Petroleum Hydrocarbons by GC-FID (C10-C40)		
TM073	MEWAM BOOK 60 1980, 95 1985, HMSO / Modified: US EPA Method 8081A & 8141A	Determination of organochlorine and organophosphorous pesticides by GCMS		
TM089	Modified: US EPA Methods 8020 & 602	Determination of Gasoline Range Hydrocarbons (GRO) and BTEX (MTBE) compounds by Headspace GC-FID (C4-C12)		
TM116	Modified: US EPA Method 8260, 8120, 8020, 624, 610 & 602	Determination of Volatile Organic Compounds by Headspace / GC-MS		
TM132	In - house Method	ELTRA CS800 Operators Guide		
TM133	BS 1377: Part 3 1990; BS 6068-2.5	Determination of pH in Soil and Water using the GLpH pH Meter		
TM152	Method 3125B, AWWA/APHA, 20th Ed., 1999	Analysis of Aqueous Samples by ICP-MS		
TM157	HP 6890 Gas Chromatograph (GC) system and HP 5973 Mass Selective Detector (MSD).	Determination of SVOC in Soils by GC-MS extracted by sonication in DCM/Acetone		
TM173	Analysis of Petroleum Hydrocarbons in Environmental Media – Total Petroleum Hydrocarbon Criteria	Determination of Speciated Extractable Petroleum Hydrocarbons in Soils by GC-FID		
TM178	Modified: US EPA Method 8100	Determination of Polynuclear Aromatic Hydrocarbons (PAH) by GC-MS in Waters		
TM181	US EPA Method 6010B	Determination of Routine Metals in Soil by iCap 6500 Duo ICP-OES		
TM183	BS EN 23506:2002, (BS 6068-2.74:2002) ISBN 0 580 38924 3	Determination of Trace Level Mercury in Waters and Leachates by PSA Cold Vapour Atomic Fluorescence Spectrometry		
TM184	EPA Methods 325.1 & 325.2,	The Determination of Anions in Aqueous Matrices using the Kone Spectrophotometric Analysers		
TM213	In-house Method	Rapid Determination of PAHs by GC-FID		
TM218	Microwave extraction – EPA method 3546	Microwave extraction - EPA method 3546		
TM243		Mixed Anions In Soils By Kone		
TM256	The measurement of Electrical Conductivity and the Laboratory determination of pH Value of Natural, Treated and Wastewaters. HMSO, 1978. ISBN 011 751428 4.	Determination of pH in Water and Leachate using the GLpH pH Meter		

¹ Applies to Solid samples only. DRY indicates samples have been dried at 35°C. NA = not applicable.



SDG: 110831-47
 Job: H_PBRETT_REA-49
 Client Reference: 21834/030

Location: Woodcroft Farm, Waterloooville
 Customer: Peter Brett Associates
 Attention: Arie Zamler

Order Number: PBA007983
 Report Number: 150822
 Superseded Report: 149065

Test Completion Dates

Lab Sample No(s)	4200333	4200335	4200337	4200339	4200341	4200344	4200346	4200347	4200348	4200304
Customer Sample Ref.	BH 1	BH 4	TP 1	TP 1	TP 1	TP 2	TP 2	TP 2	TP 2	TP 3
AGS Ref.										
Depth	0.30 - 0.80	0.15 - 0.60	0.50 - 0.50	1.10 - 1.10	2.20 - 2.20	1.00 - 1.00	2.00 - 2.00	2.00 - 2.80	3.00 - 3.00	1.10 - 1.10
Type	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID
Anions by Kone (soil)	07-Sep-2011						08-Sep-2011			
Anions by Kone (w)							08-Sep-2011			
Asbestos Identification (Soil)				07-Sep-2011			07-Sep-2011	07-Sep-2011		07-Sep-2011
CEN 10:1 Leachate (1 Stage)							06-Sep-2011			
CEN Readings							08-Sep-2011			
Dissolved Metals by ICP-MS							08-Sep-2011			
EPH by FID	08-Sep-2011	08-Sep-2011	08-Sep-2011		08-Sep-2011	08-Sep-2011	08-Sep-2011		08-Sep-2011	08-Sep-2011
GRO by GC-FID (S)				19-Sep-2011						
Mercury Dissolved							08-Sep-2011			
Metals by iCap-OES (Soil)	07-Sep-2011	07-Sep-2011	07-Sep-2011		08-Sep-2011	07-Sep-2011	09-Sep-2011		07-Sep-2011	08-Sep-2011
PAH by GCMS					09-Sep-2011		08-Sep-2011			08-Sep-2011
PAH Spec MS - Aqueous (W)							08-Sep-2011			
PAH Value of soil	07-Sep-2011	07-Sep-2011				07-Sep-2011				
pH	07-Sep-2011						08-Sep-2011			
pH Value							08-Sep-2011			
Sample description	05-Sep-2011	05-Sep-2011	05-Sep-2011	13-Sep-2011	05-Sep-2011	05-Sep-2011	08-Sep-2011		05-Sep-2011	08-Sep-2011
Total Organic Carbon	07-Sep-2011						08-Sep-2011			

Lab Sample No(s)	4200305	4200308	4200309	4200336	4200325	4200328	4200330	4200318	4200319	4200312
Customer Sample Ref.	TP 3	TP 4	TP 4	TP 16	WS 1	WS 1	WS 2	WS 3	WS 3	WS 4
AGS Ref.										
Depth	2.00 - 2.00	0.50 - 0.50	1.00 - 1.00	0.50 - 0.50	0.50 - 1.00	2.50 - 3.00	1.50 - 2.00	0.10 - 0.40	0.70 - 1.00	0.10 - 0.30
Type	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID
Anions by Kone (soil)	08-Sep-2011			07-Sep-2011	08-Sep-2011	07-Sep-2011	07-Sep-2011	08-Sep-2011		08-Sep-2011
Anions by Kone (w)	08-Sep-2011									
CEN 10:1 Leachate (1 Stage)	05-Sep-2011									
CEN Readings	08-Sep-2011									
Dissolved Metals by ICP-MS	08-Sep-2011									
EPH by FID	08-Sep-2011	08-Sep-2011	08-Sep-2011	08-Sep-2011	08-Sep-2011	08-Sep-2011	08-Sep-2011		08-Sep-2011	
EPH CWG (Aliphatic) GC (S)								08-Sep-2011		08-Sep-2011
EPH CWG (Aromatic) GC (S)								08-Sep-2011		08-Sep-2011
GRO by GC-FID (S)								09-Sep-2011		09-Sep-2011
Mercury Dissolved	08-Sep-2011									
Metals by iCap-OES (Soil)	08-Sep-2011	08-Sep-2011	08-Sep-2011	08-Sep-2011	07-Sep-2011	08-Sep-2011	08-Sep-2011	08-Sep-2011		07-Sep-2011
OC, OP Pesticides and Triazine Herb				09-Sep-2011						
PAH by GCMS								07-Sep-2011		07-Sep-2011
PAH Spec MS - Aqueous (W)	08-Sep-2011									
PAH Value of soil	07-Sep-2011	07-Sep-2011	07-Sep-2011	07-Sep-2011	07-Sep-2011	07-Sep-2011	07-Sep-2011		07-Sep-2011	
pH	07-Sep-2011			07-Sep-2011	07-Sep-2011	07-Sep-2011	07-Sep-2011	07-Sep-2011		07-Sep-2011
pH Value	08-Sep-2011									
Sample description	05-Sep-2011	05-Sep-2011	05-Sep-2011	05-Sep-2011	05-Sep-2011	05-Sep-2011	05-Sep-2011	05-Sep-2011	05-Sep-2011	05-Sep-2011
Semi Volatile Organic Compounds								07-Sep-2011		
Total Organic Carbon	07-Sep-2011			07-Sep-2011	07-Sep-2011	07-Sep-2011	07-Sep-2011	07-Sep-2011		07-Sep-2011
TPH CWG GC (S)								09-Sep-2011		09-Sep-2011
VOC MS (S)								12-Sep-2011		

Lab Sample No(s)	4200313	4200321	4200322	4200317
Customer Sample Ref.	WS 4	WS 6	WS 6	WS 11
AGS Ref.				
Depth	0.70 - 1.00	0.10 - 0.50	0.80 - 1.00	0.20 - 0.50
Type	SOLID	SOLID	SOLID	SOLID
Anions by Kone (soil)		08-Sep-2011		08-Sep-2011
EPH by FID	08-Sep-2011		08-Sep-2011	08-Sep-2011
EPH CWG (Aliphatic) GC (S)		07-Sep-2011		
EPH CWG (Aromatic) GC (S)		07-Sep-2011		
GRO by GC-FID (S)		09-Sep-2011		
Metals by iCap-OES (Soil)		07-Sep-2011		08-Sep-2011
PAH by GCMS		08-Sep-2011		
PAH Value of soil	07-Sep-2011		07-Sep-2011	07-Sep-2011
pH		07-Sep-2011		07-Sep-2011
Sample description	05-Sep-2011	05-Sep-2011	05-Sep-2011	05-Sep-2011
Semi Volatile Organic Compounds		08-Sep-2011		
Total Organic Carbon		07-Sep-2011		07-Sep-2011
TPH CWG GC (S)		09-Sep-2011		
VOC MS (S)		08-Sep-2011		



CERTIFICATE OF ANALYSIS

SDG: 110831-47
Job: H_PBRETT_REA-49
Client Reference: 21834/030

Location: Woodcroft Farm, Waterloooville
Customer: Peter Brett Associates
Attention: Arie Zamler

Order Number: PBA007983
Report Number: 150822
Superseded Report: 149065

Chromatogram

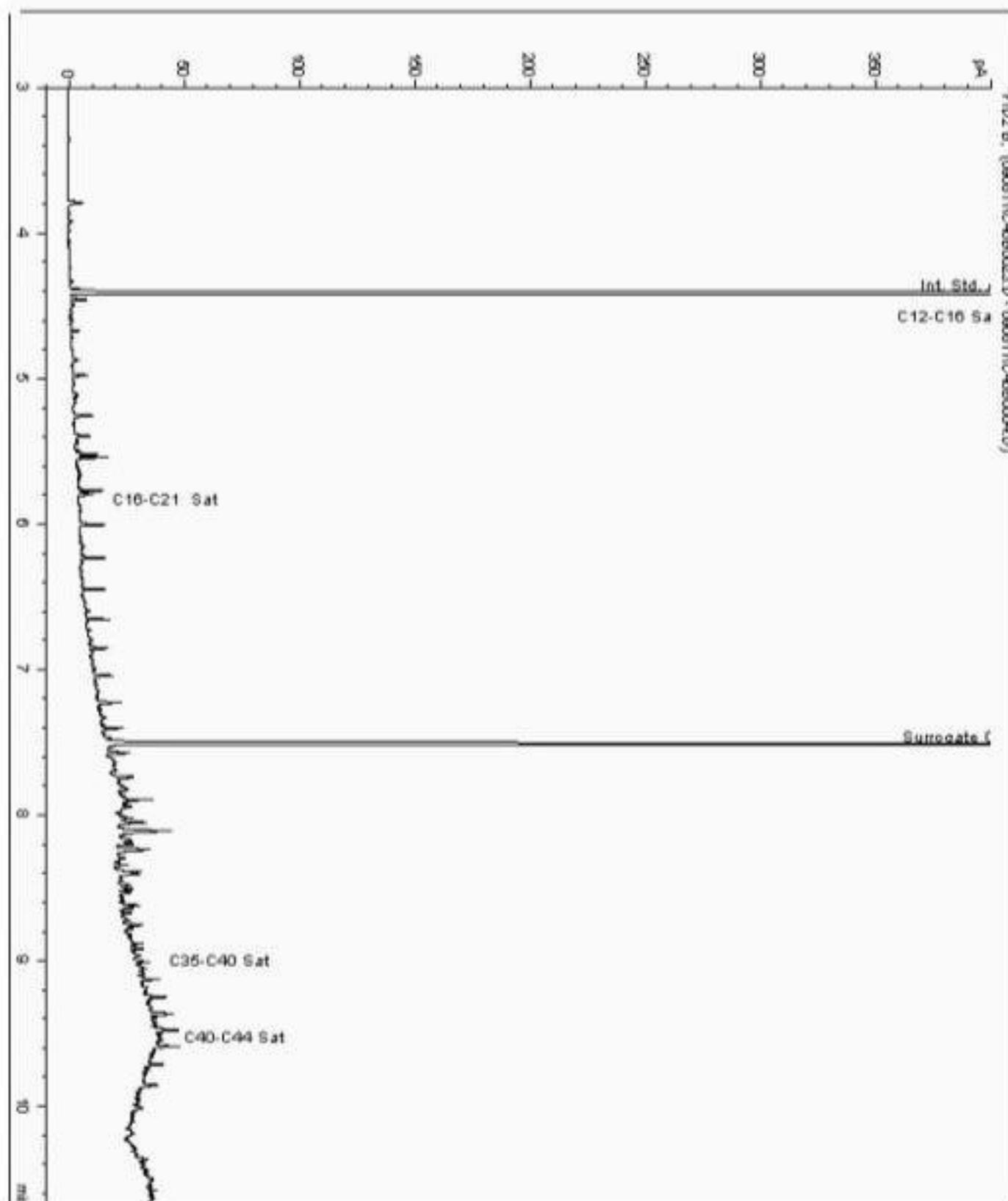
Analysis: EPH CWG (Aliphatic) GC (S)

Sample No : 4236917
Sample ID : WS 3

Depth : 0.10 - 0.40

Alcontrol/Geochem Analytical Services
Speciated TPH - SATS (C12 - C40)

Sample Identity: 4187967-4236917
Date Acquired : 08/09/11 12:10:02 PM
Units : ppb
Dilution:





CERTIFICATE OF ANALYSIS

SDG: 110831-47
Job: H_PBRETT_REA-49
Client Reference: 21834/030

Location: Woodcroft Farm, Waterloooville
Customer: Peter Brett Associates
Attention: Arie Zamler

Order Number: PBA007983
Report Number: 150822
Superseded Report: 149065

Chromatogram

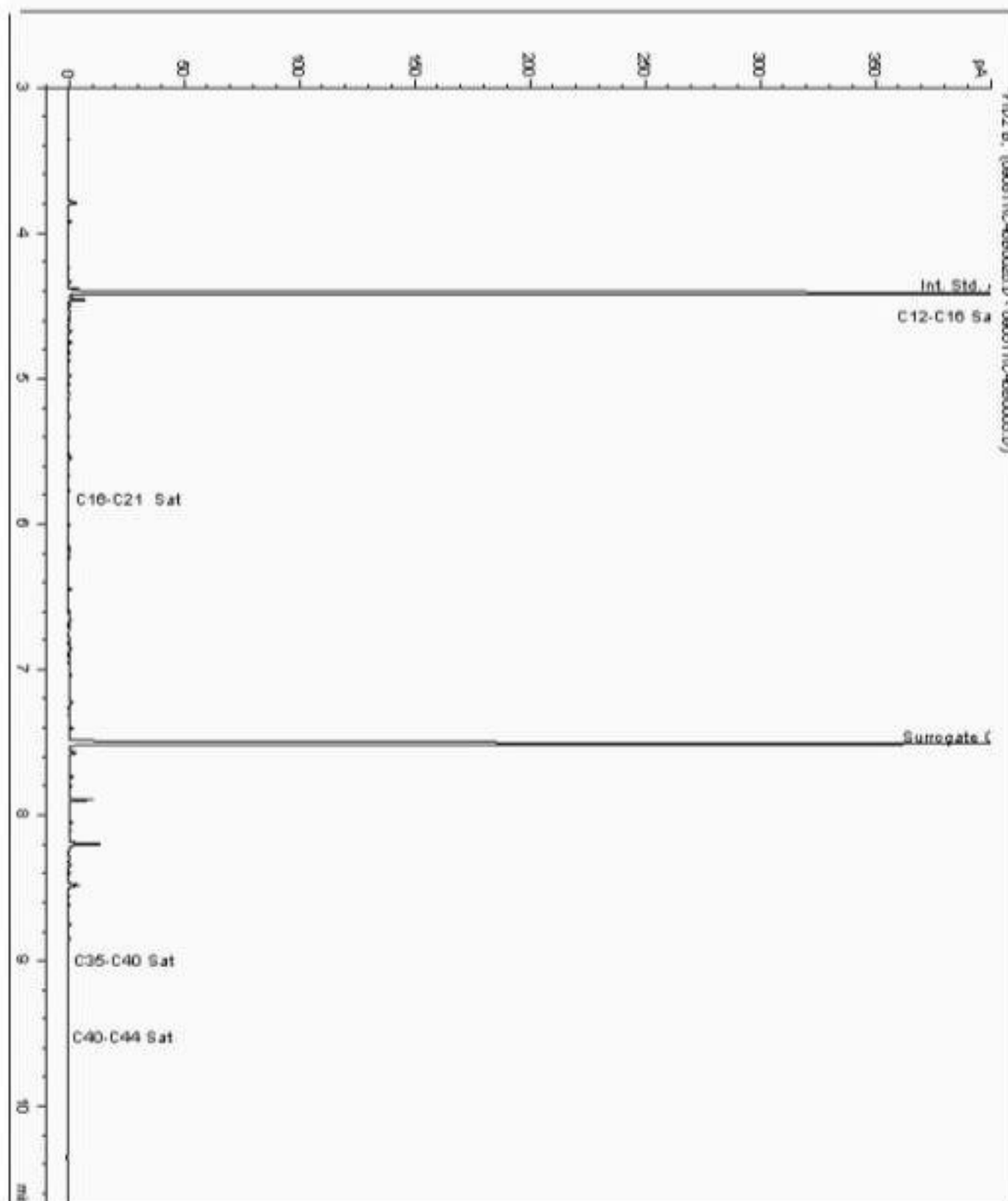
Analysis: EPH CWG (Aliphatic) GC (S)

Sample No : 4237417
Sample ID : WS 4

Depth : 0.10 - 0.30

Alcontrol/Geochem Analytical Services
Speciated TPH - SATS (C12 - C40)

Sample Identity: 4187935-4237417
Date Acquired : 08/09/11 12:49:31 PM
Units : ppb
Dilution:





CERTIFICATE OF ANALYSIS

SDG: 110831-47
Job: H_PBRETT_REA-49
Client Reference: 21834/030

Location: Woodcroft Farm, Waterloooville
Customer: Peter Brett Associates
Attention: Arie Zamler

Order Number: PBA007983
Report Number: 150822
Superseded Report: 149065

Chromatogram

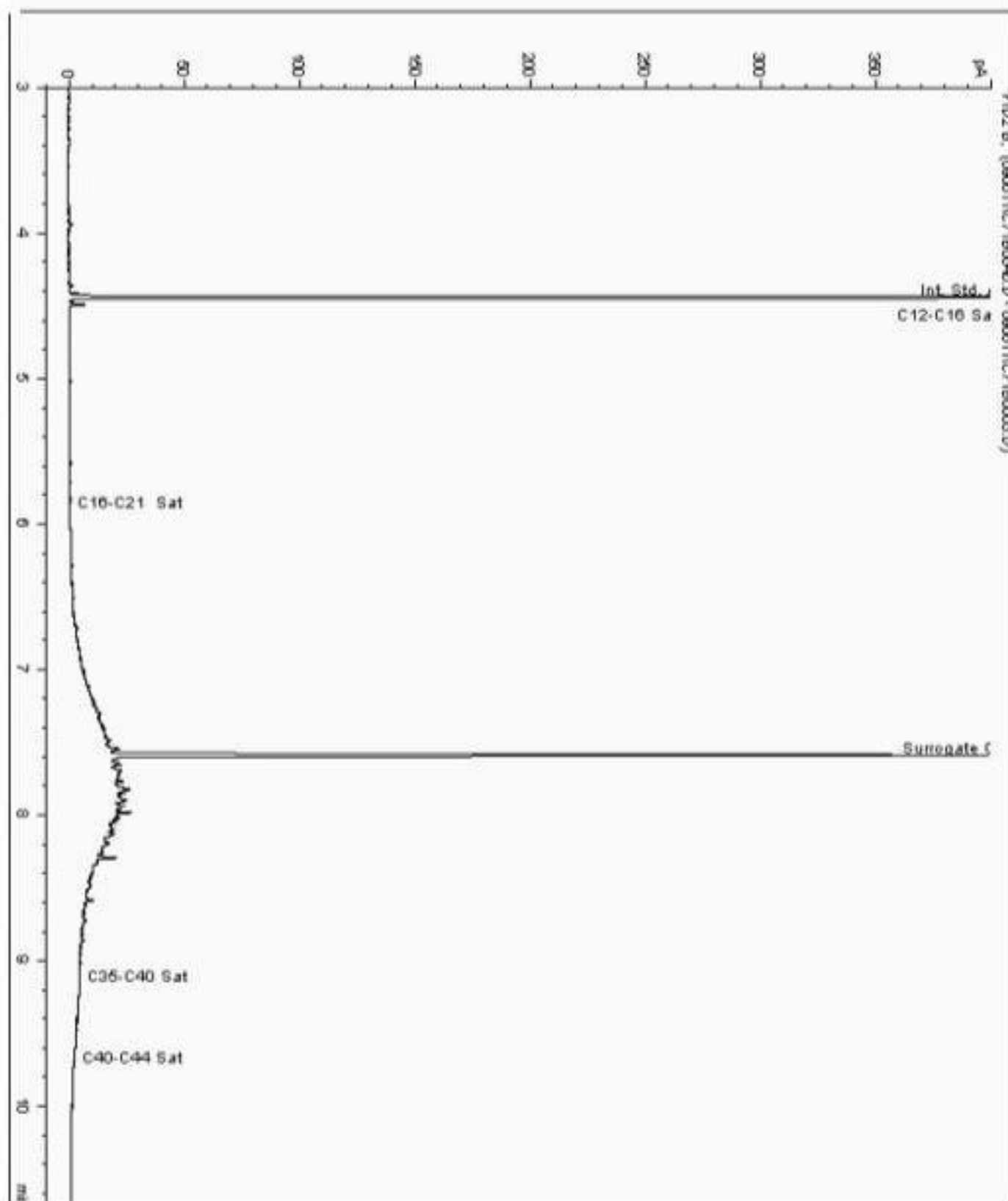
Analysis: EPH CWG (Aliphatic) GC (S)

Sample No : 4238224
Sample ID : WS 6

Depth : 0.10 - 0.50

Alcontrol/Geochem Analytical Services
Speciated TPH - SATS (C12 - C40)

Sample Identity: 4187997-4238224
Date Acquired : 07/09/2011 01:22:06 PM
Units : ppb
Dilution:





CERTIFICATE OF ANALYSIS

SDG: 110831-47
Job: H_PBRETT_REA-49
Client Reference: 21834/030

Location: Woodcroft Farm, Waterloooville
Customer: Peter Brett Associates
Attention: Arie Zamler

Order Number: PBA007983
Report Number: 150822
Superseded Report: 149065

Chromatogram

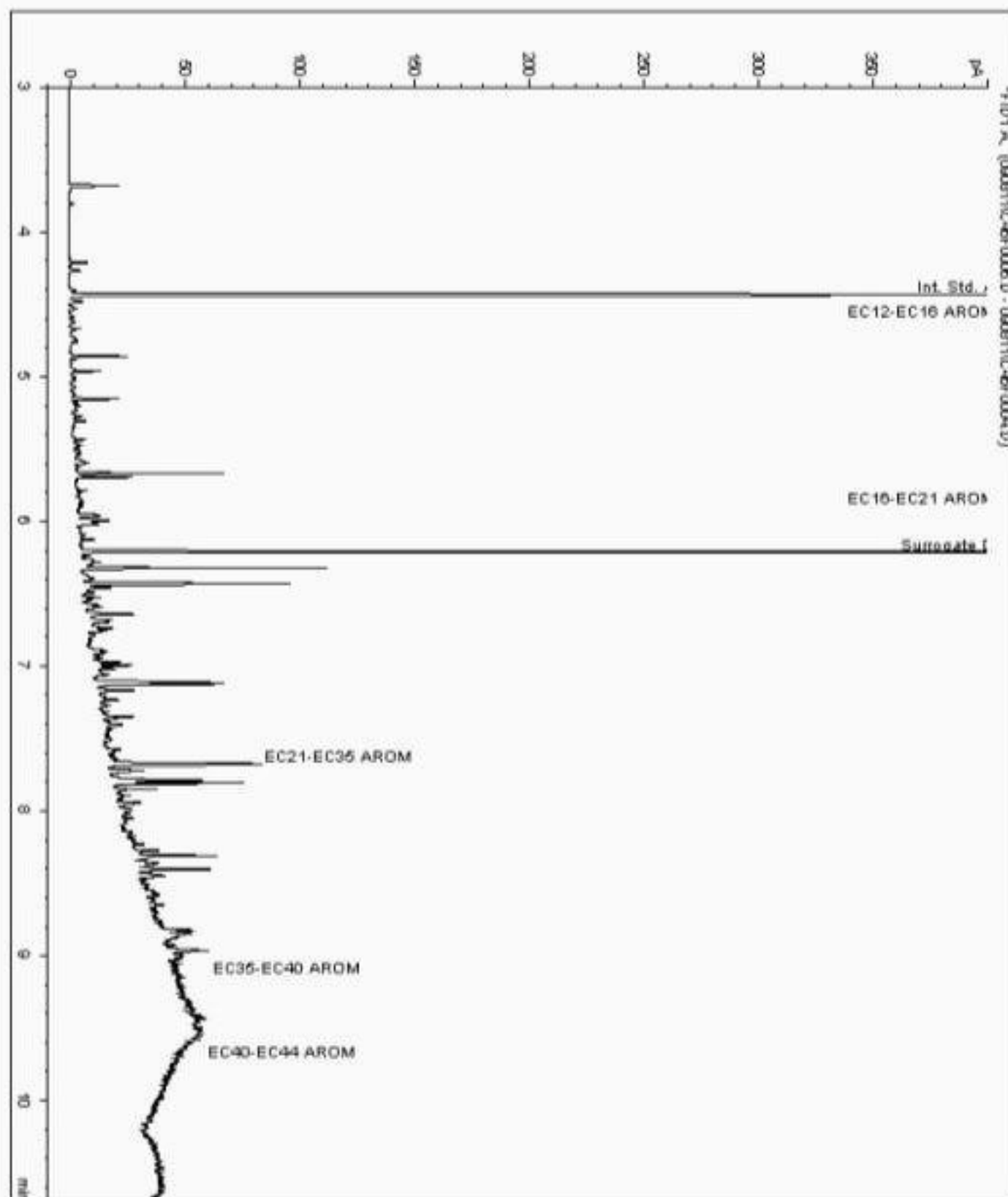
Analysis: EPH CWG (Aromatic) GC (S)

Sample No : 4236917
Sample ID : WS 3

Depth : 0.10 - 0.40

Alcontrol/Geochem Analytical Services
Speciated TPH - AROM (C12 - C40)

Sample Identity: 4187968-4236917
Date Acquired : 08/09/11 07:09:09 PM
Units : ppb
Dilution:





CERTIFICATE OF ANALYSIS

SDG: 110831-47
Job: H_PBRETT_REA-49
Client Reference: 21834/030

Location: Woodcroft Farm, Waterloooville
Customer: Peter Brett Associates
Attention: Arie Zamler

Order Number: PBA007983
Report Number: 150822
Superseded Report: 149065

Chromatogram

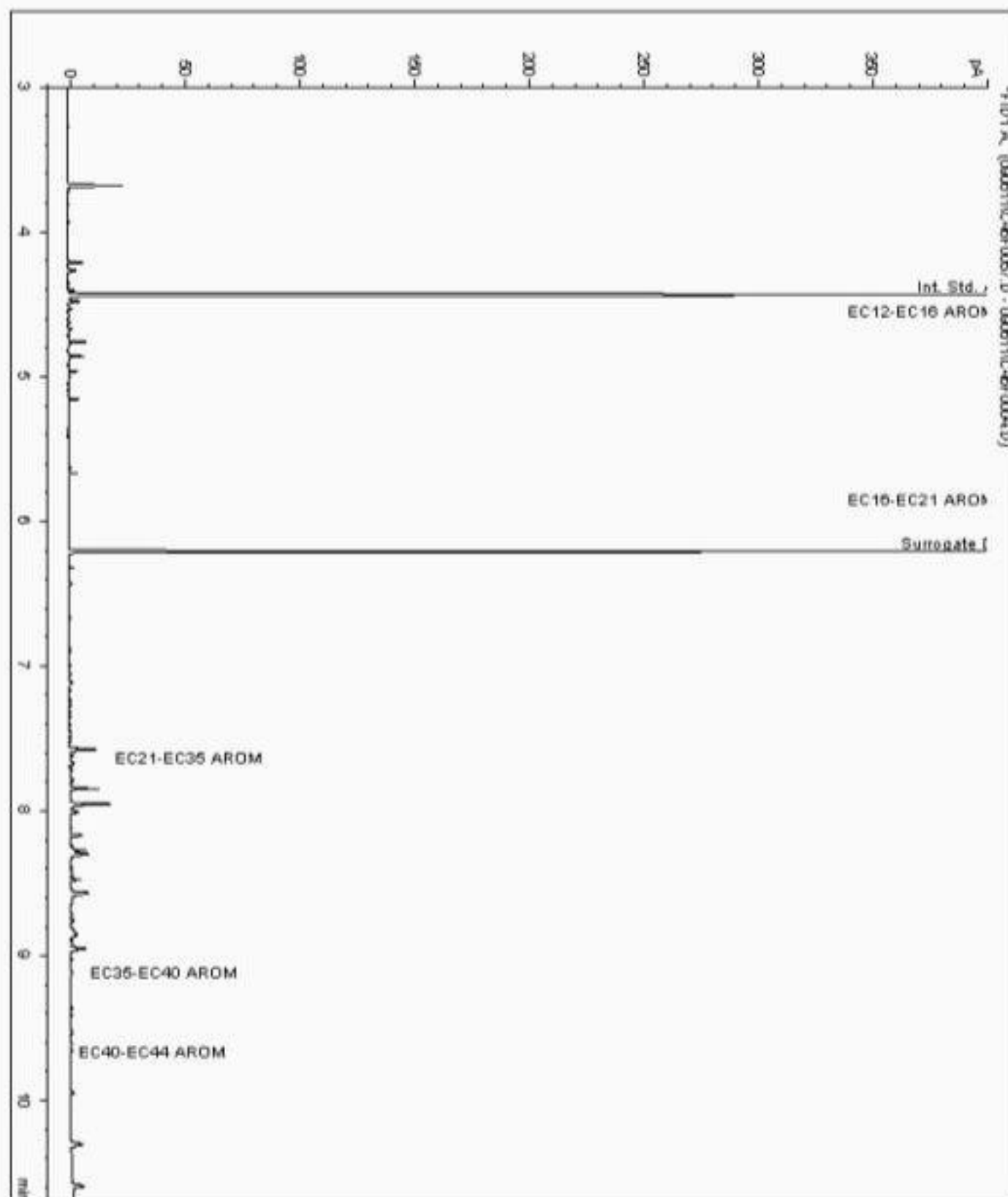
Analysis: EPH CWG (Aromatic) GC (S)

Sample No : 4237417
Sample ID : WS 4

Depth : 0.10 - 0.30

Alcontrol/Geochem Analytical Services
Speciated TPH - AROM (C12 - C40)

Sample Identity: 4187936-4237417
Date Acquired : 07/09/11 03:39:14 PM
Units : ppb
Dilution:





CERTIFICATE OF ANALYSIS

SDG: 110831-47
Job: H_PBRETT_REA-49
Client Reference: 21834/030

Location: Woodcroft Farm, Waterloooville
Customer: Peter Brett Associates
Attention: Arie Zamler

Order Number: PBA007983
Report Number: 150822
Superseded Report: 149065

Chromatogram

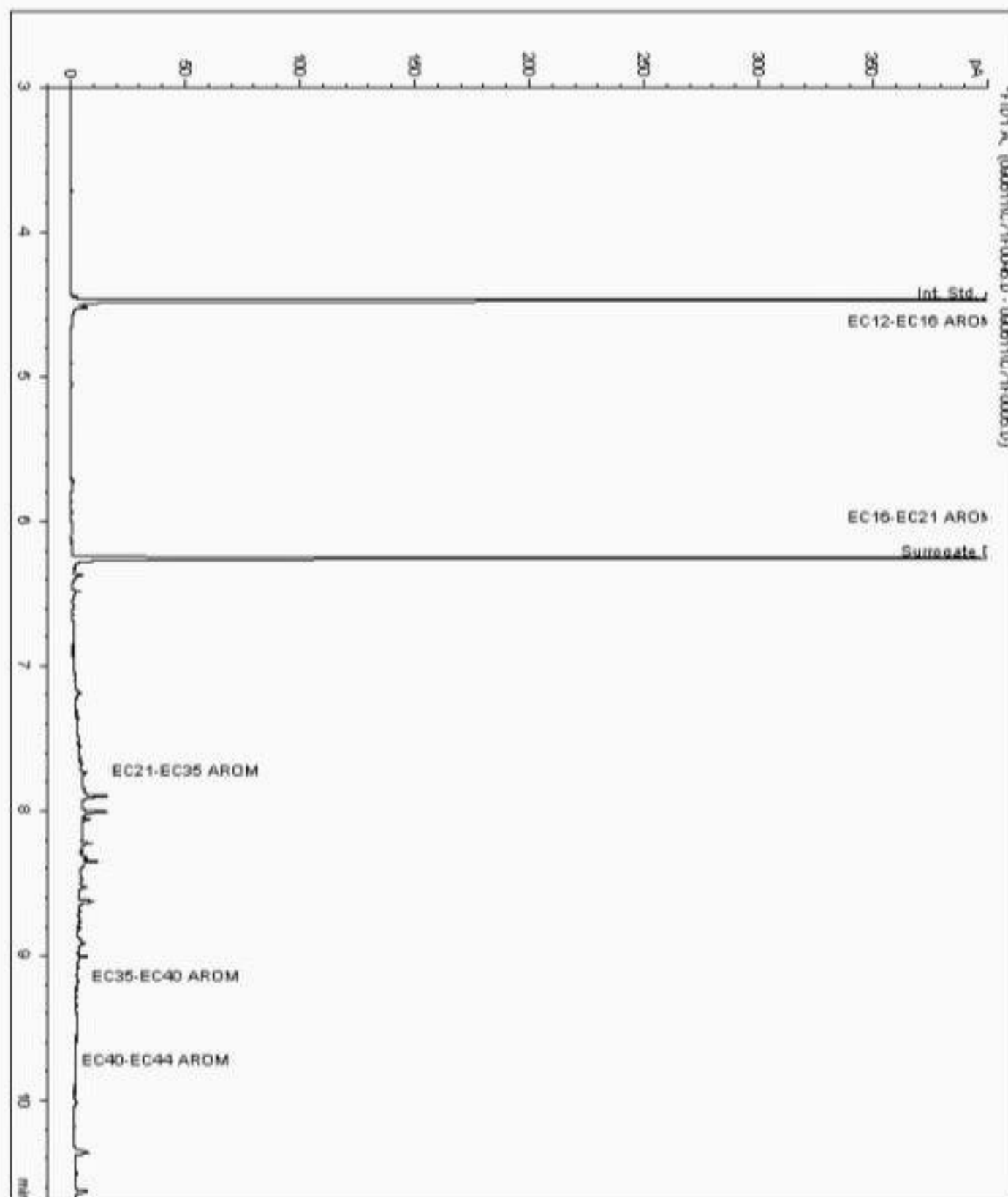
Analysis: EPH CWG (Aromatic) GC (S)

Sample No : 4238224
Sample ID : WS 6

Depth : 0.10 - 0.50

Alcontrol/Geochem Analytical Services
Speciated TPH - AROM (C12 - C40)

Sample Identity: 4187998-4238224
Date Acquired : 07/09/2011 01:22:06 PM
Units : ppb
Dilution:





CERTIFICATE OF ANALYSIS

SDG: 110831-47
Job: H_PBRETT_REA-49
Client Reference: 21834/030

Location: Woodcroft Farm, Waterloooville
Customer: Peter Brett Associates
Attention: Arie Zamler

Order Number: PBA007983
Report Number: 150822
Superseded Report: 149065

Chromatogram

Analysis: EPH by FID

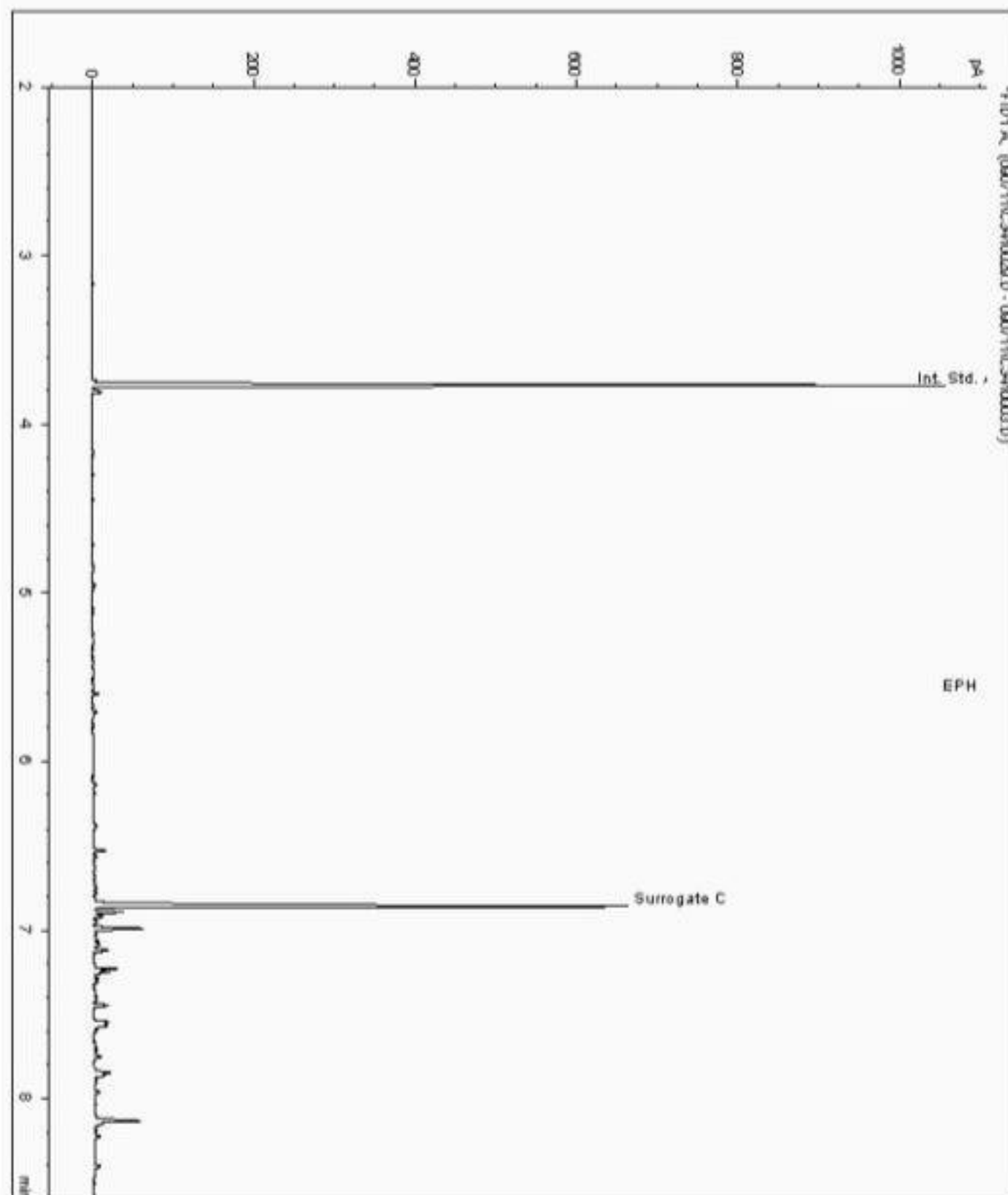
Sample No : 4234529
Sample ID : WS 1

Depth : 2.50 - 3.00

Alcontrol Laboratories
EPH Range Organics (C10 - C40)

Sample Identity : 4188028-4234529
Date Acquired : 07/09/11 16:24:35 PM
Units : mg/kg
Sample Multiplier : 0.000
Dilution : 1.0

->





CERTIFICATE OF ANALYSIS

SDG: 110831-47
Job: H_PBRETT_REA-49
Client Reference: 21834/030

Location: Woodcroft Farm, Waterloooville
Customer: Peter Brett Associates
Attention: Arie Zamler

Order Number: PBA007983
Report Number: 150822
Superseded Report: 149065

Chromatogram

Analysis: EPH by FID

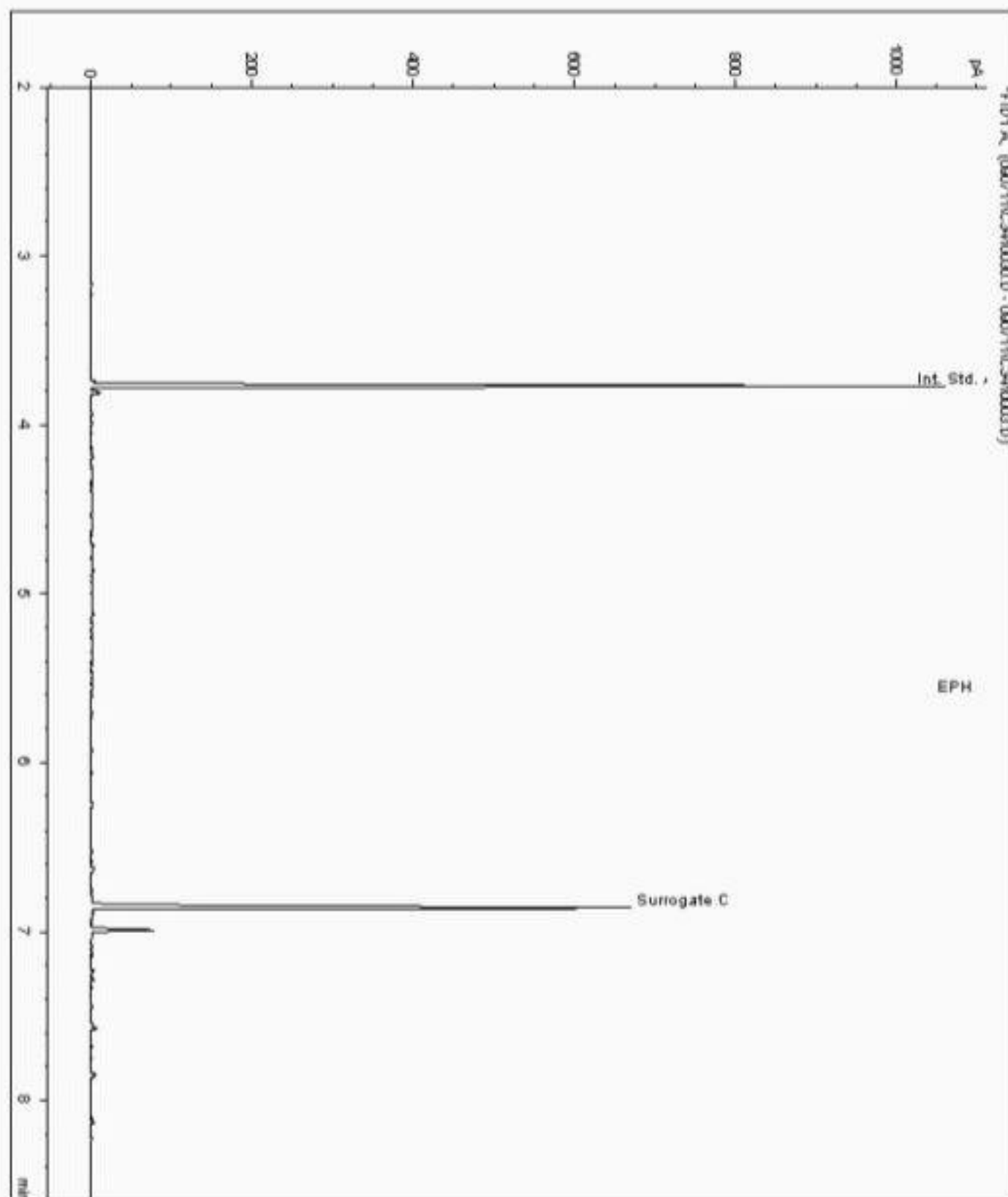
Sample No : 4234627
Sample ID : TP 4

Depth : 1.00 - 1.00

Alcontrol Laboratories
EPH Range Organics (C10 - C40)

Sample Identity : 4187923-4234627
Date Acquired : 07/09/11 16:46:34 PM
Units : mg/kg
Sample Multiplier : 0.000
Dilution : 1.0

->





CERTIFICATE OF ANALYSIS

SDG: 110831-47
Job: H_PBRETT_REA-49
Client Reference: 21834/030

Location: Woodcroft Farm, Waterloooville
Customer: Peter Brett Associates
Attention: Arie Zamler

Order Number: PBA007983
Report Number: 150822
Superseded Report: 149065

Chromatogram

Analysis: EPH by FID

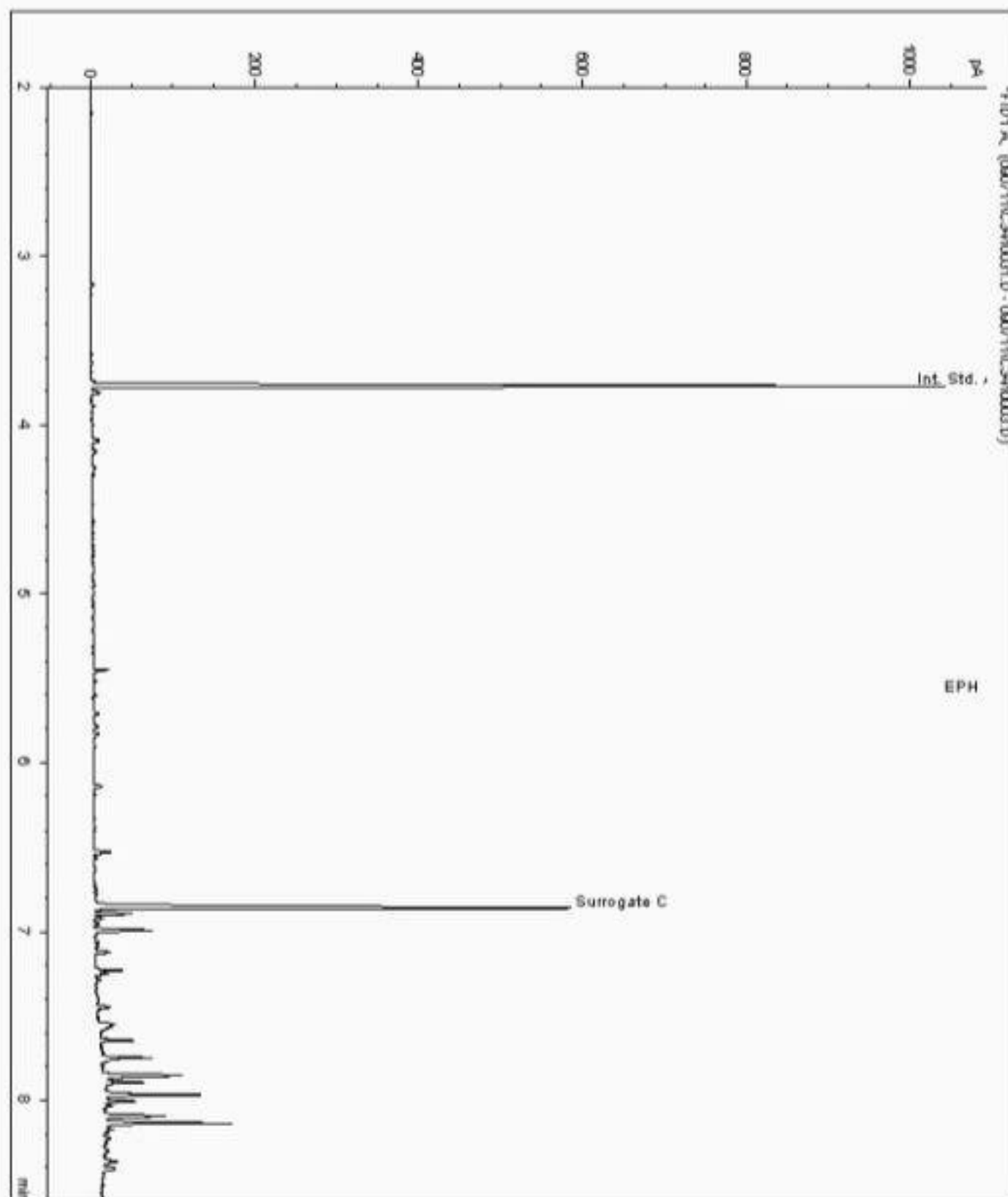
Sample No : 4234722
Sample ID : WS 2

Depth : 1.50 - 2.00

Alcontrol Laboratories
EPH Range Organics (C10 - C40)

Sample Identity : 4188035-4234722
Date Acquired : 07/09/11 17:08:30 PM
Units : mg/kg
Sample Multiplier : 0.000
Dilution : 1.0

->





CERTIFICATE OF ANALYSIS

SDG: 110831-47
Job: H_PBRETT_REA-49
Client Reference: 21834/030

Location: Woodcroft Farm, Waterloooville
Customer: Peter Brett Associates
Attention: Arie Zamler

Order Number: PBA007983
Report Number: 150822
Superseded Report: 149065

Chromatogram

Analysis: EPH by FID

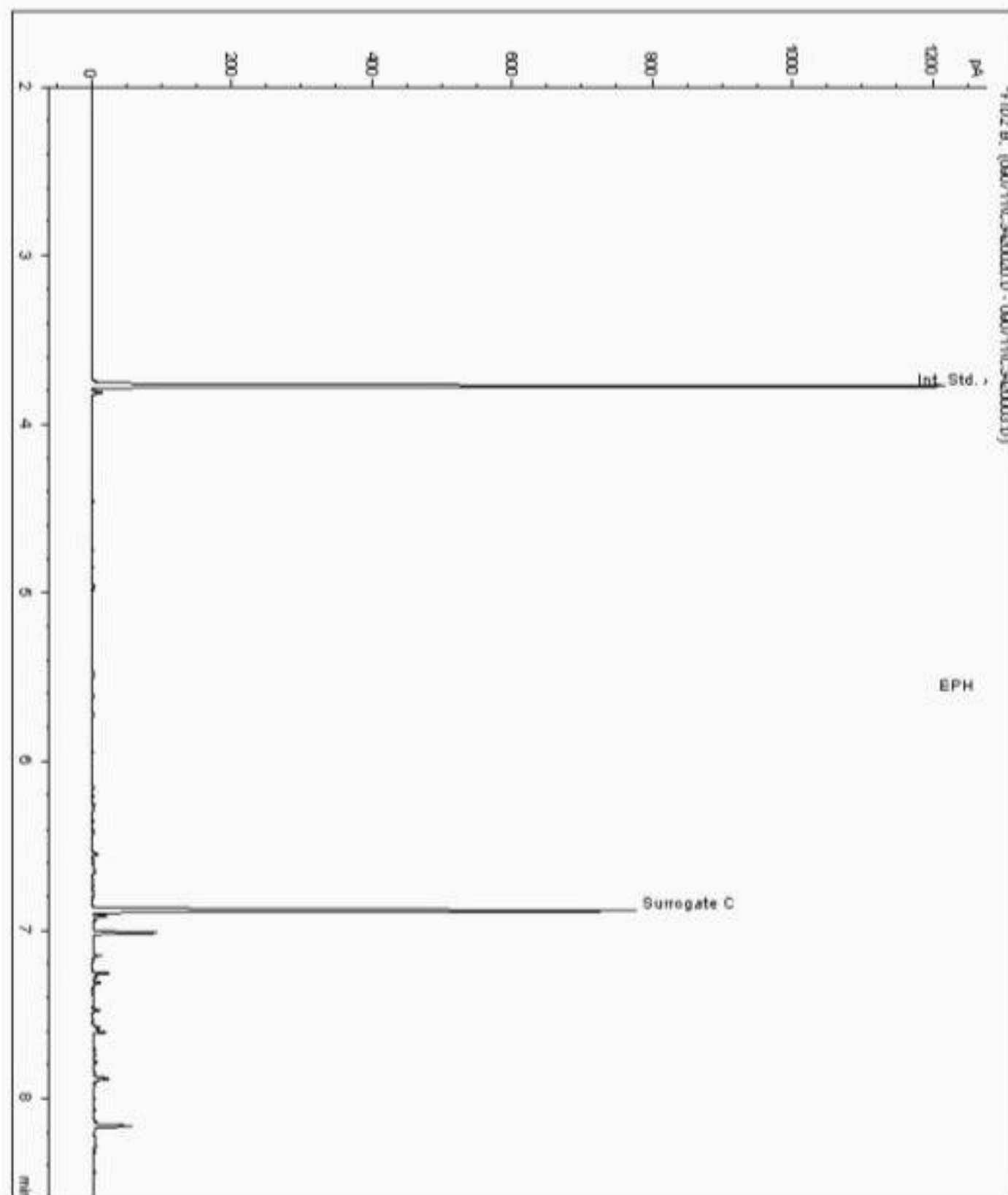
Sample No : 4235469
Sample ID : TP 18

Depth : 0.50 - 0.50

Alcontrol Laboratories
EPH Range Organics (C10 - C40)

Sample Identity : 4188072-4235469
Date Acquired : 07/09/11 13:05:10 PM
Units : mg/kg
Sample Multiplier : 0.000
Dilution : 1.0

->





CERTIFICATE OF ANALYSIS

SDG: 110831-47
Job: H_PBRETT_REA-49
Client Reference: 21834/030

Location: Woodcroft Farm, Waterloooville
Customer: Peter Brett Associates
Attention: Arie Zamler

Order Number: PBA007983
Report Number: 150822
Superseded Report: 149065

Chromatogram

Analysis: EPH by FID

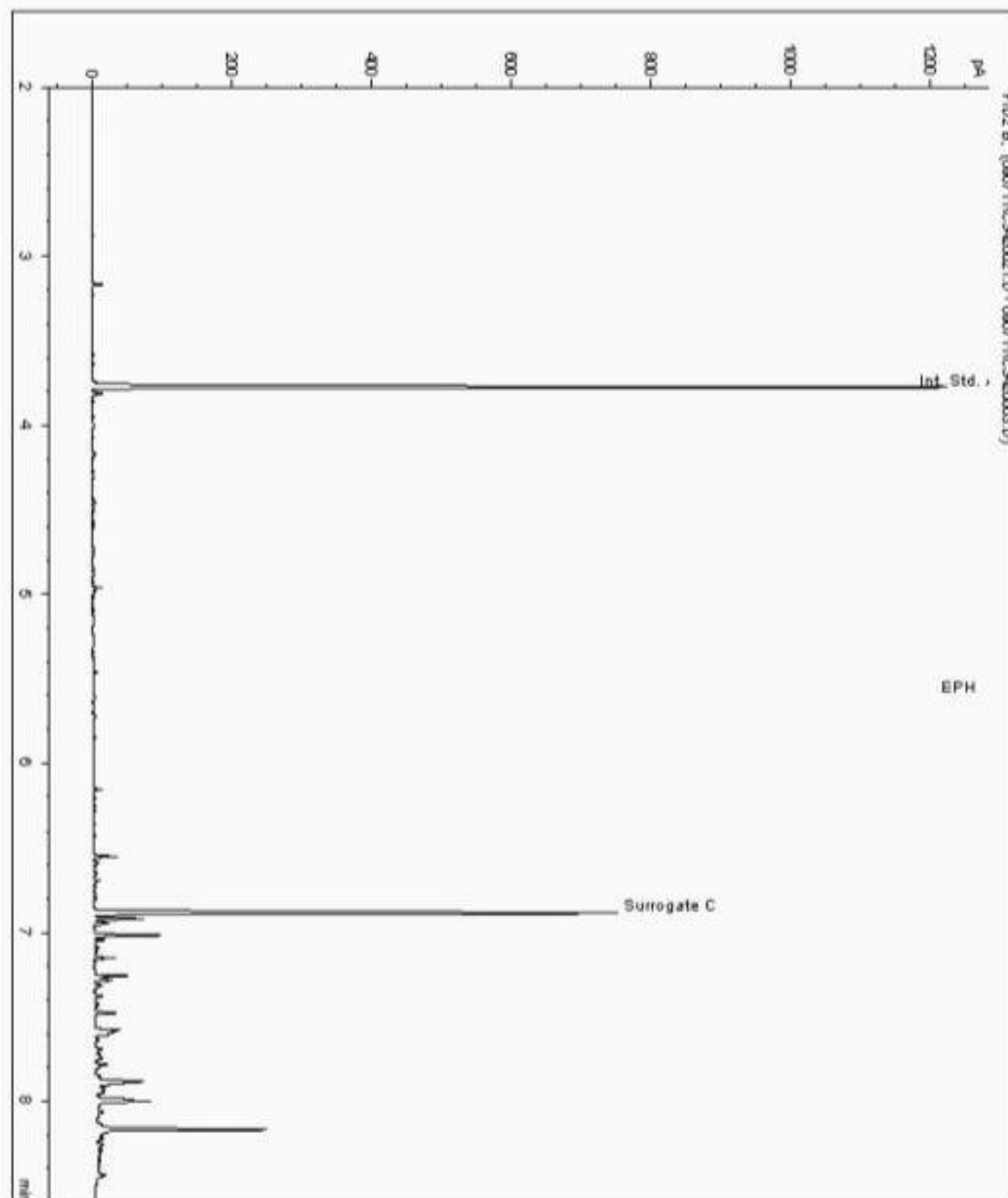
Sample No : 4235584
Sample ID : TP 4

Depth : 0.50 - 0.50

Alcontrol Laboratories
EPH Range Organics (C10 - C40)

Sample Identity : 4187916-4235584
Date Acquired : 07/09/11 13:27:14 PM
Units : mg/kg
Sample Multiplier : 0.000
Dilution : 1.0

->





CERTIFICATE OF ANALYSIS

SDG: 110831-47
Job: H_PBRETT_REA-49
Client Reference: 21834/030

Location: Woodcroft Farm, Waterloooville
Customer: Peter Brett Associates
Attention: Arie Zamler

Order Number: PBA007983
Report Number: 150822
Superseded Report: 149065

Chromatogram

Analysis: EPH by FID

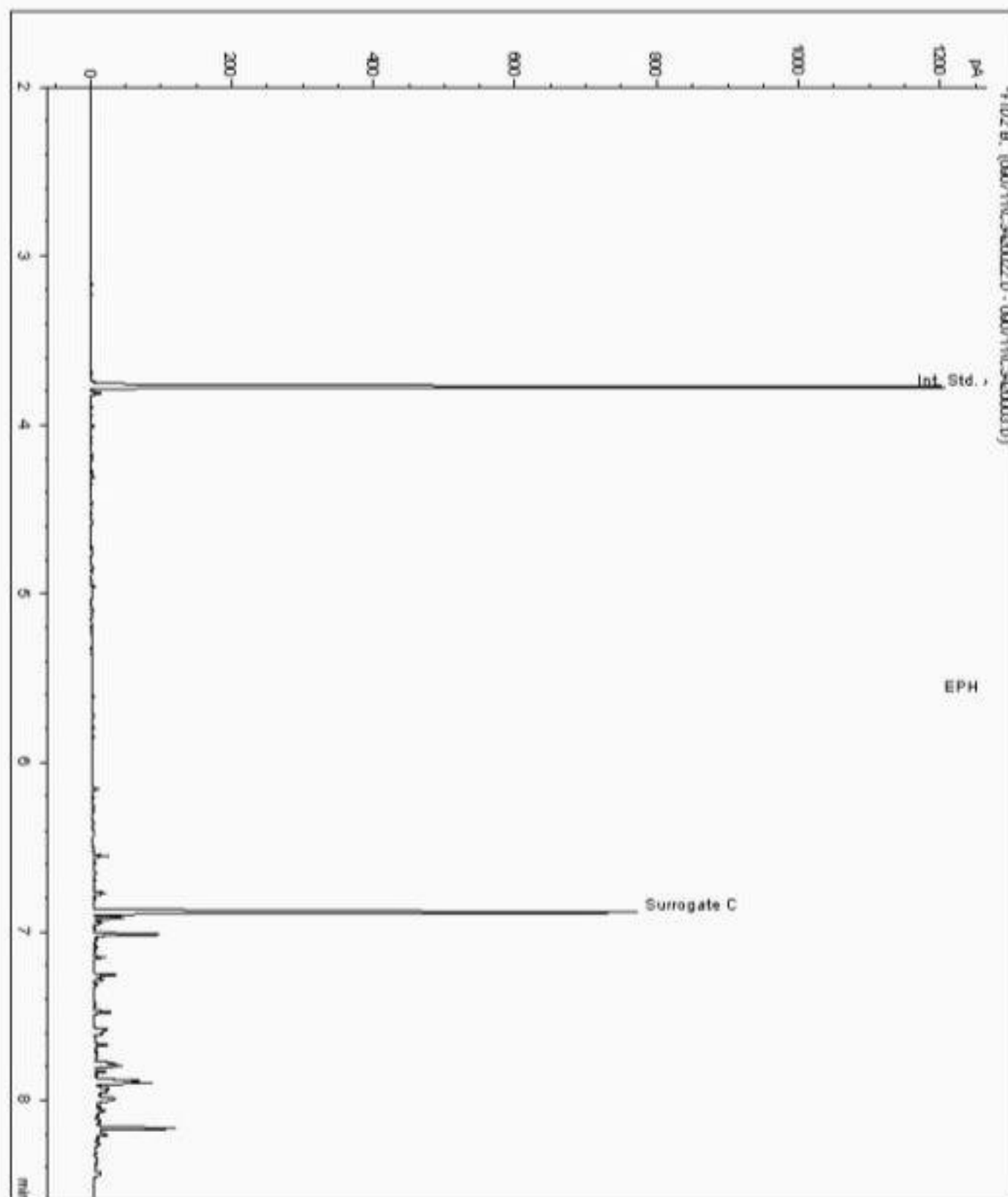
Sample No : 4235621
Sample ID : TP 1

Depth : 2.20 - 2.20

Alcontrol Laboratories
EPH Range Organics (C10 - C40)

Sample Identity : 4188103-4235621
Date Acquired : 07/09/11 13:49:20 PM
Units : mg/kg
Sample Multiplier : 0.000
Dilution : 1.0

->





CERTIFICATE OF ANALYSIS

SDG: 110831-47
Job: H_PBRETT_REA-49
Client Reference: 21834/030

Location: Woodcroft Farm, Waterloooville
Customer: Peter Brett Associates
Attention: Arie Zamler

Order Number: PBA007983
Report Number: 150822
Superseded Report: 149065

Chromatogram

Analysis: EPH by FID

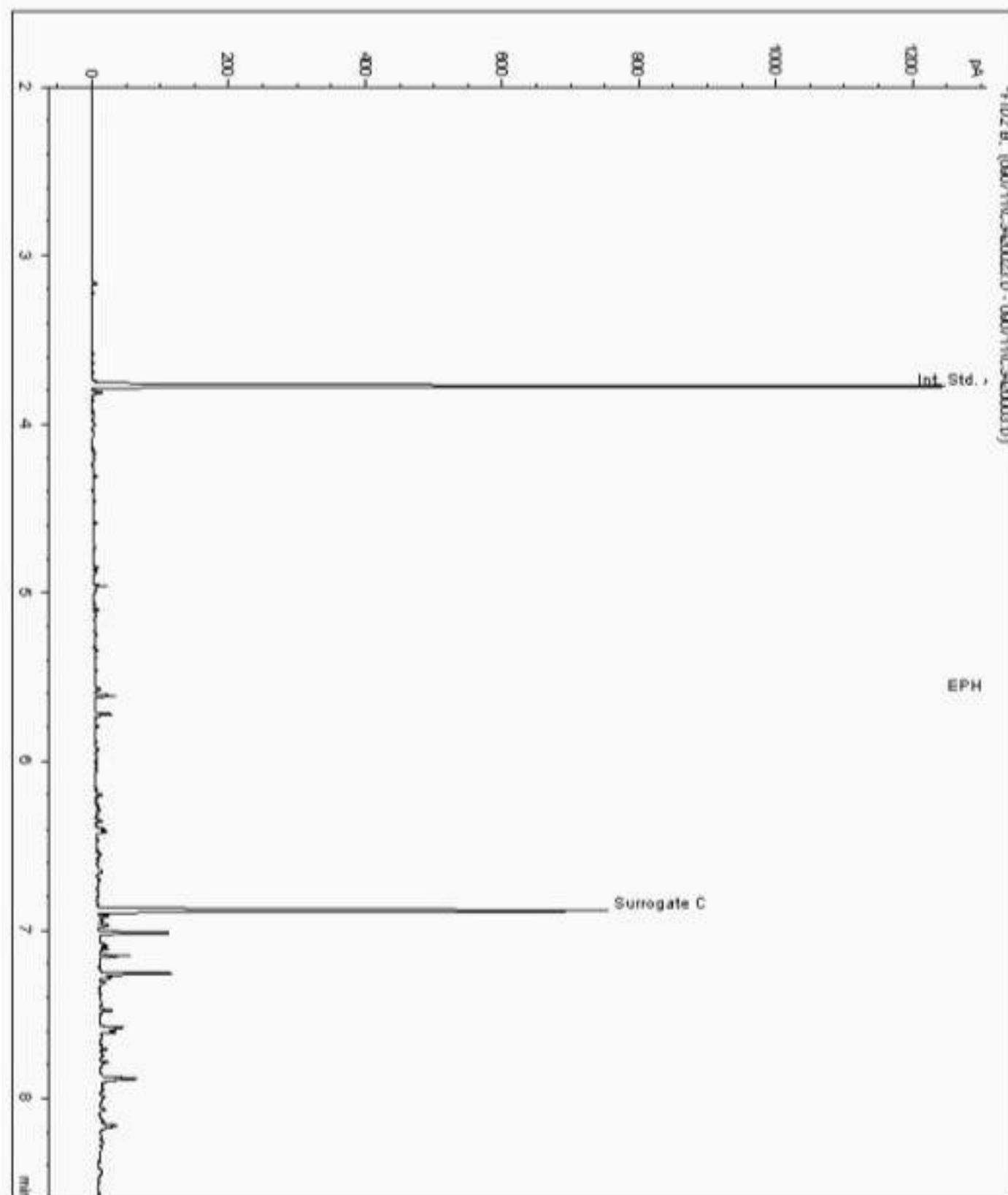
Sample No : 4235653
Sample ID : TP 2

Depth : 1.00 - 1.00

Alcontrol Laboratories
EPH Range Organics (C10 - C40)

Sample Identity : 4188112-4235653
Date Acquired : 07/09/11 14:11:41 PM
Units : mg/kg
Sample Multiplier : 0.000
Dilution : 1.0

->





CERTIFICATE OF ANALYSIS

SDG: 110831-47
Job: H_PBRETT_REA-49
Client Reference: 21834/030

Location: Woodcroft Farm, Waterloooville
Customer: Peter Brett Associates
Attention: Arie Zamler

Order Number: PBA007983
Report Number: 150822
Superseded Report: 149065

Chromatogram

Analysis: EPH by FID

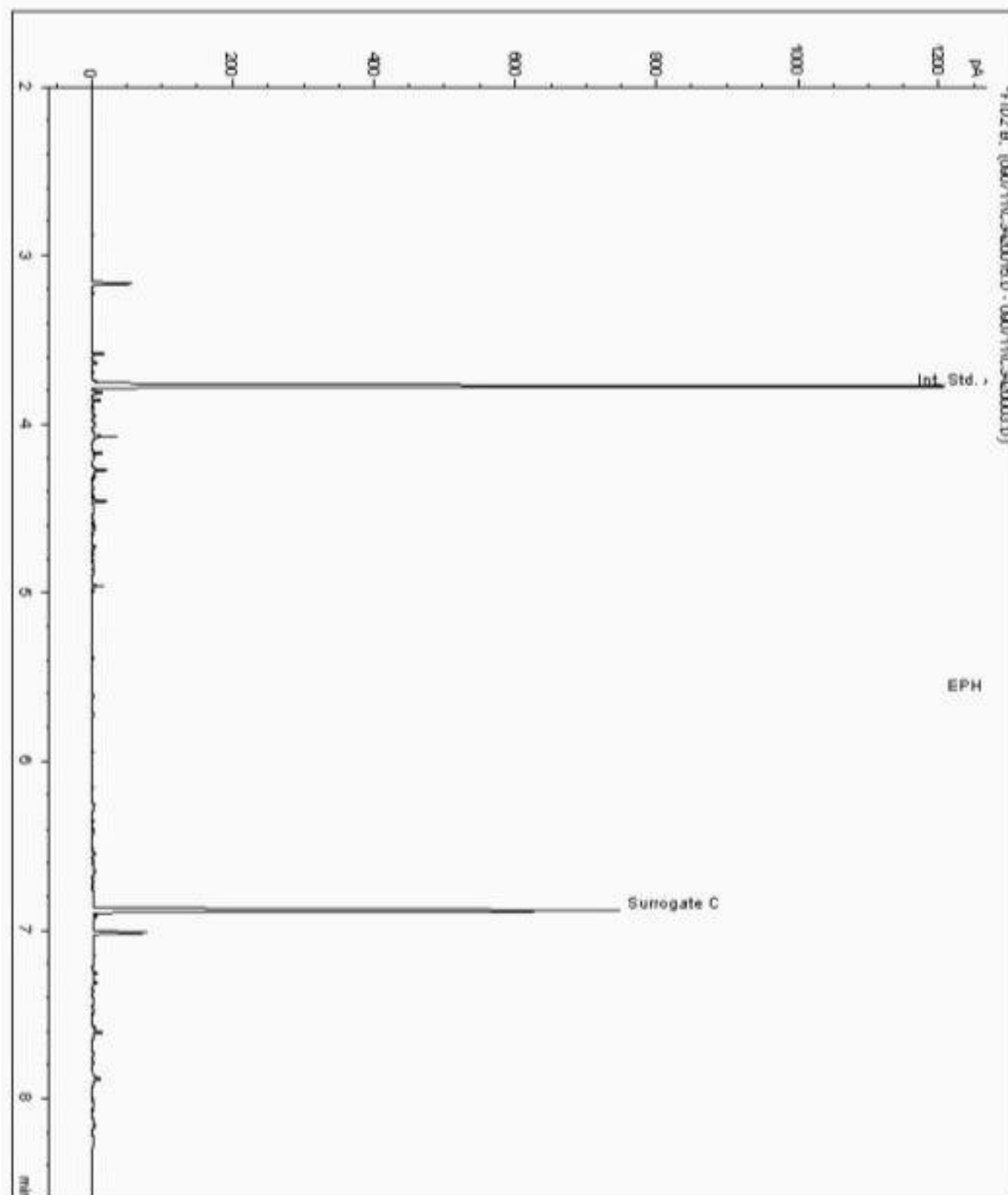
Sample No : 4236908
Sample ID : WS 3

Depth : 0.70 - 1.00

Alcontrol Laboratories
EPH Range Organics (C10 - C40)

Sample Identity : 4187984-4236908
Date Acquired : 07/09/11 11:14:39 PM
Units : mg/kg
Sample Multiplier : 0.000
Dilution : 1.0

->





CERTIFICATE OF ANALYSIS

SDG: 110831-47
Job: H_PBRETT_REA-49
Client Reference: 21834/030

Location: Woodcroft Farm, Waterloooville
Customer: Peter Brett Associates
Attention: Arie Zamler

Order Number: PBA007983
Report Number: 150822
Superseded Report: 149065

Chromatogram

Analysis: EPH by FID

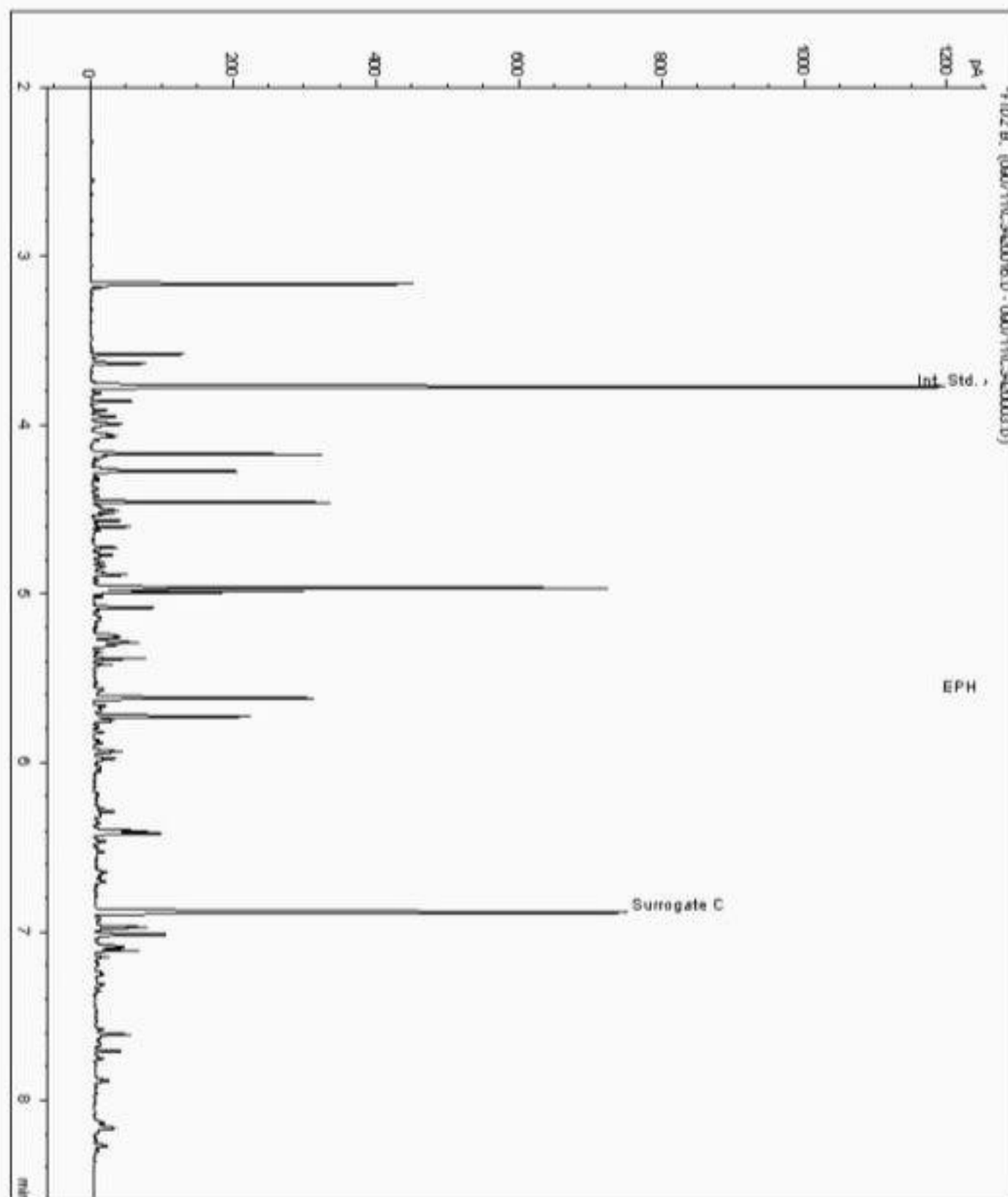
Sample No : 4236936
Sample ID : WS 6

Depth : 0.80 - 1.00

Alcontrol Laboratories
EPH Range Organics (C10 - C40)

Sample Identity : 4188005-4236936
Date Acquired : 07/09/11 11:36:34 PM
Units : mg/kg
Sample Multiplier : 0.000
Dilution : 1.0

->





CERTIFICATE OF ANALYSIS

SDG: 110831-47
Job: H_PBRETT_REA-49
Client Reference: 21834/030

Location: Woodcroft Farm, Waterloooville
Customer: Peter Brett Associates
Attention: Arie Zamler

Order Number: PBA007983
Report Number: 150822
Superseded Report: 149065

Chromatogram

Analysis: EPH by FID

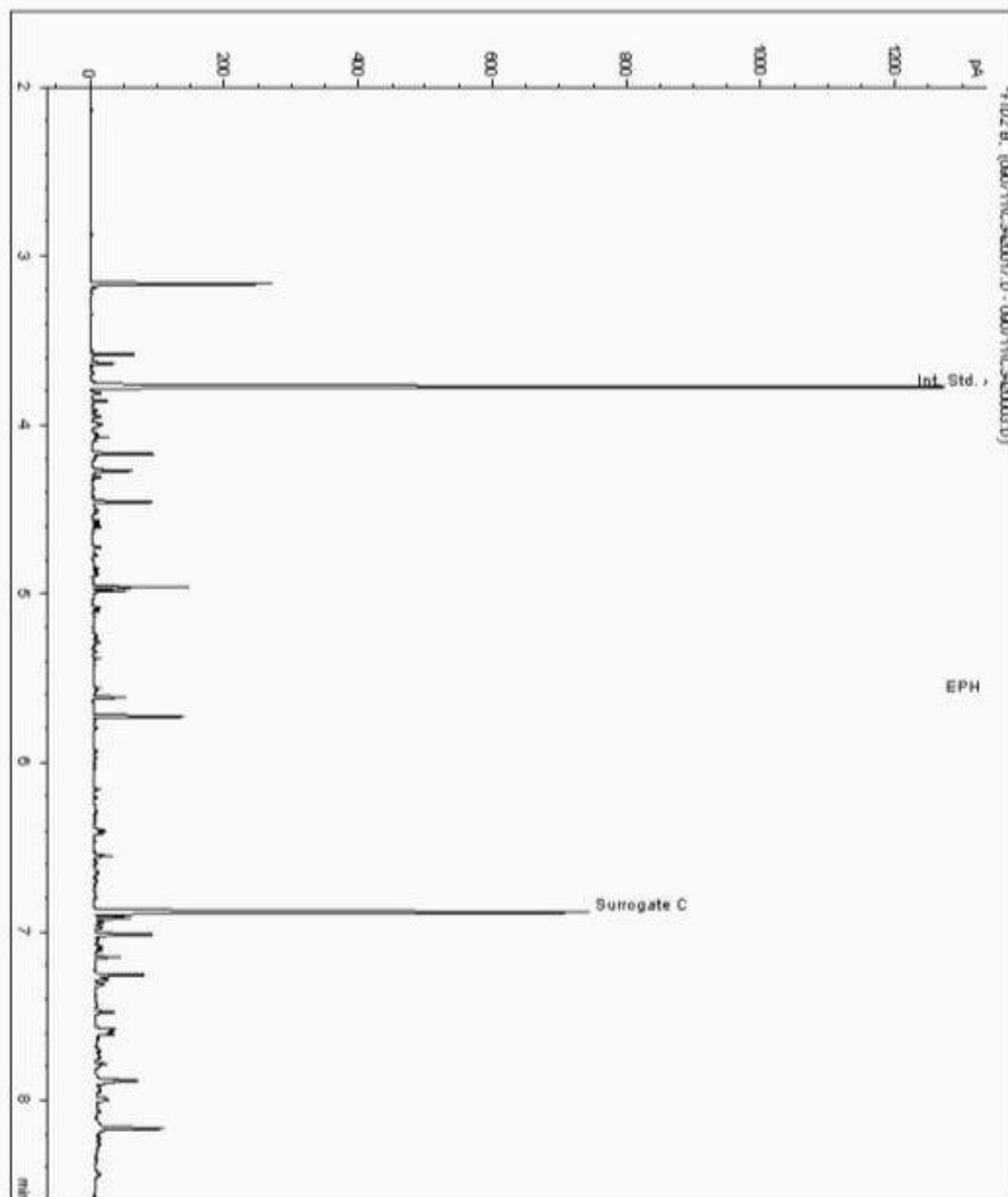
Sample No : 4236950
Sample ID : TP 3

Depth : 2.00 - 2.00

Alcontrol Laboratories
EPH Range Organics (C10 - C40)

Sample Identity : 4187908-4236950
Date Acquired : 07/09/11 11:58:47 PM
Units : mg/kg
Sample Multiplier : 0.000
Dilution : 1.0

->





CERTIFICATE OF ANALYSIS

SDG: 110831-47
Job: H_PBRETT_REA-49
Client Reference: 21834/030

Location: Woodcroft Farm, Waterloooville
Customer: Peter Brett Associates
Attention: Arie Zamler

Order Number: PBA007983
Report Number: 150822
Superseded Report: 149065

Chromatogram

Analysis: EPH by FID

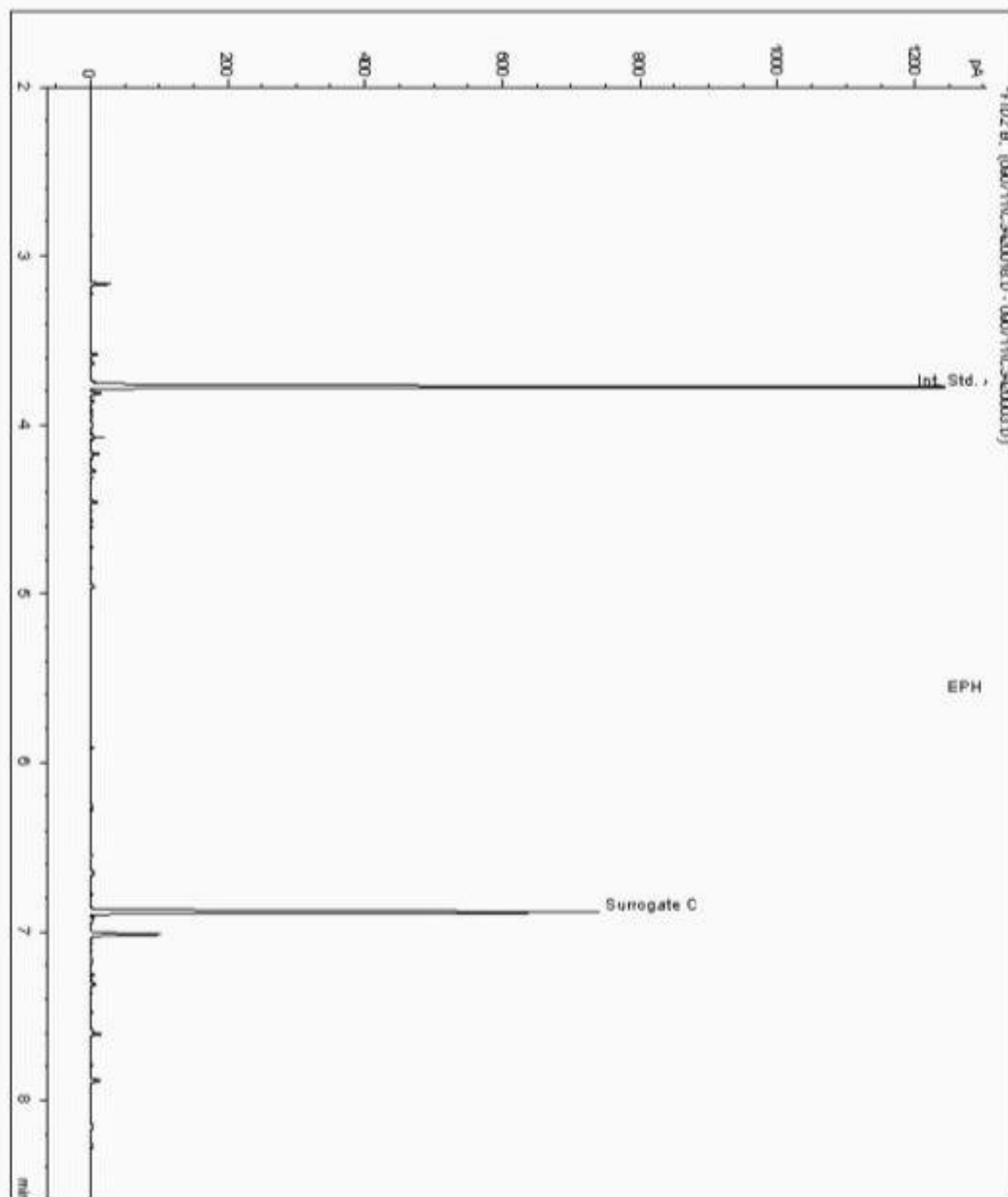
Sample No : 4237355
Sample ID : WS 4

Depth : 0.70 - 1.00

Alcontrol Laboratories
EPH Range Organics (C10 - C40)

Sample Identity : 4187943-4237355
Date Acquired : 07/09/11 12:20:48 PM
Units : mg/kg
Sample Multiplier : 0.000
Dilution : 1.0

->





CERTIFICATE OF ANALYSIS

SDG: 110831-47
Job: H_PBRETT_REA-49
Client Reference: 21834/030

Location: Woodcroft Farm, Waterloooville
Customer: Peter Brett Associates
Attention: Arie Zamler

Order Number: PBA007983
Report Number: 150822
Superseded Report: 149065

Chromatogram

Analysis: EPH by FID

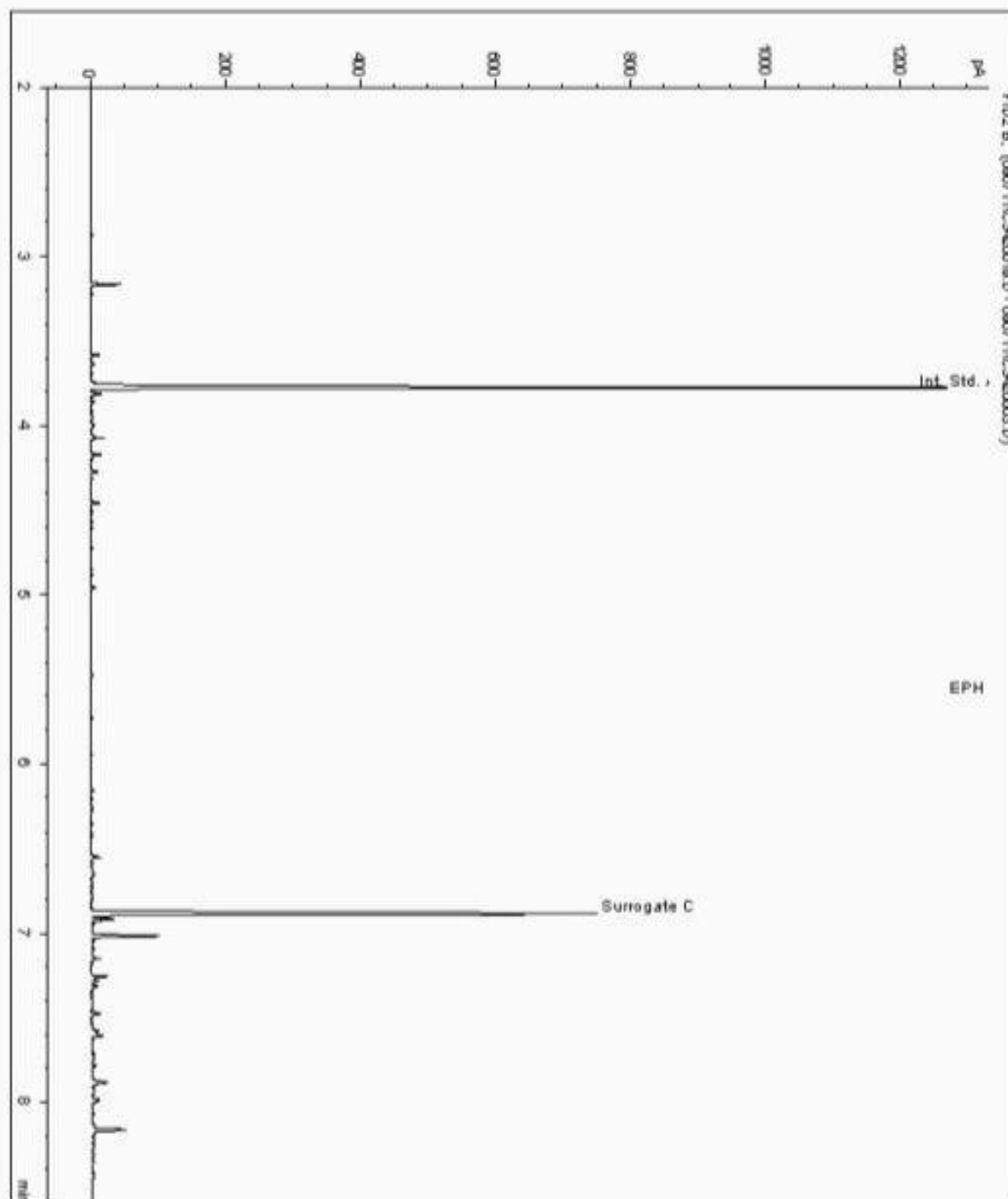
Sample No : 4237369
Sample ID : WS 1

Depth : 0.50 - 1.00

Alcontrol Laboratories
EPH Range Organics (C10 - C40)

Sample Identity : 4188017-4237369
Date Acquired : 07/09/11 12:43:37 PM
Units : mg/kg
Sample Multiplier : 0.000
Dilution : 1.0

->





CERTIFICATE OF ANALYSIS

SDG: 110831-47
Job: H_PBRETT_REA-49
Client Reference: 21834/030

Location: Woodcroft Farm, Waterloooville
Customer: Peter Brett Associates
Attention: Arie Zamler

Order Number: PBA007983
Report Number: 150822
Superseded Report: 149065

Chromatogram

Analysis: EPH by FID

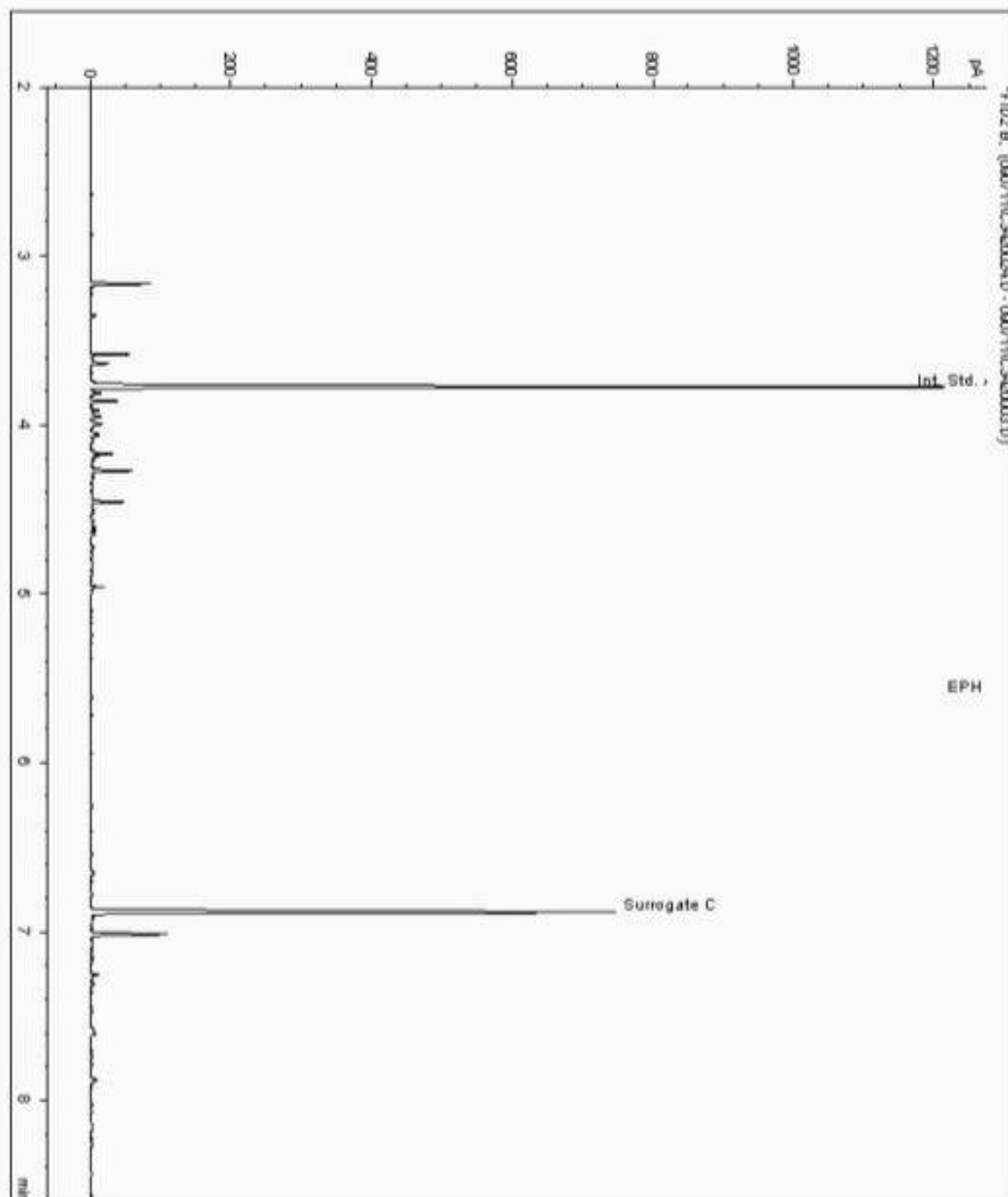
Sample No : 4237583
Sample ID : WS 11

Depth : 0.20 - 0.50

Alcontrol Laboratories
EPH Range Organics (C10 - C40)

Sample Identity : 4187952-4237583
Date Acquired : 07/09/11 14:33:47 PM
Units : mg/kg
Sample Multiplier : 0.000
Dilution : 1.0

->





CERTIFICATE OF ANALYSIS

SDG: 110831-47
Job: H_PBRETT_REA-49
Client Reference: 21834/030

Location: Woodcroft Farm, Waterloooville
Customer: Peter Brett Associates
Attention: Arie Zamler

Order Number: PBA007983
Report Number: 150822
Superseded Report: 149065

Chromatogram

Analysis: EPH by FID

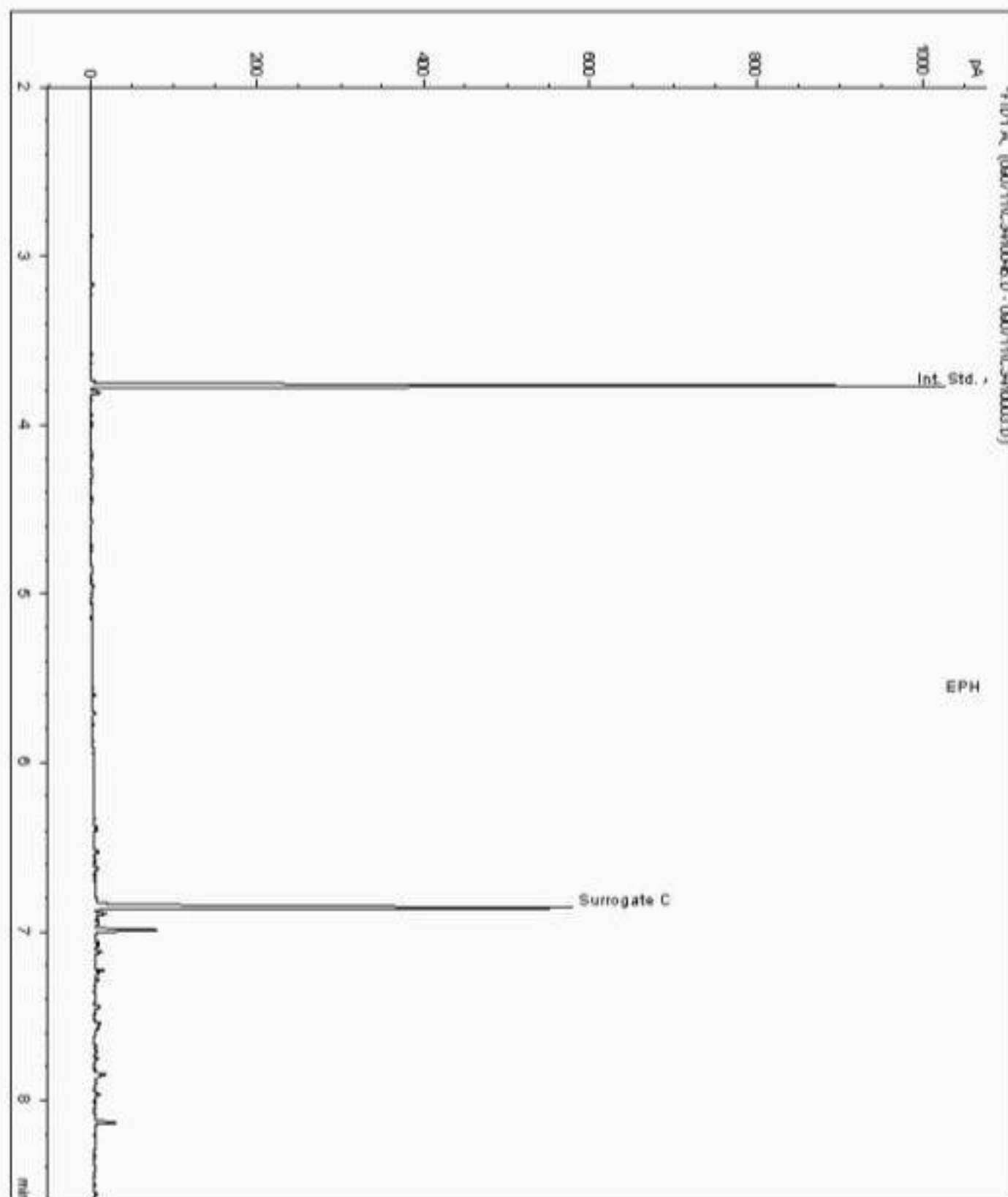
Sample No : 4241036
Sample ID : TP 1

Depth : 0.50 - 0.50

Alcontrol Laboratories
EPH Range Organics (C10 - C40)

Sample Identity : 4188080-4241036
Date Acquired : 07/09/11 23:26:57 PM
Units : mg/kg
Sample Multiplier : 0.000
Dilution : 1.0

->





CERTIFICATE OF ANALYSIS

SDG: 110831-47
Job: H_PBRETT_REA-49
Client Reference: 21834/030

Location: Woodcroft Farm, Waterloooville
Customer: Peter Brett Associates
Attention: Arie Zamler

Order Number: PBA007983
Report Number: 150822
Superseded Report: 149065

Chromatogram

Analysis: EPH by FID

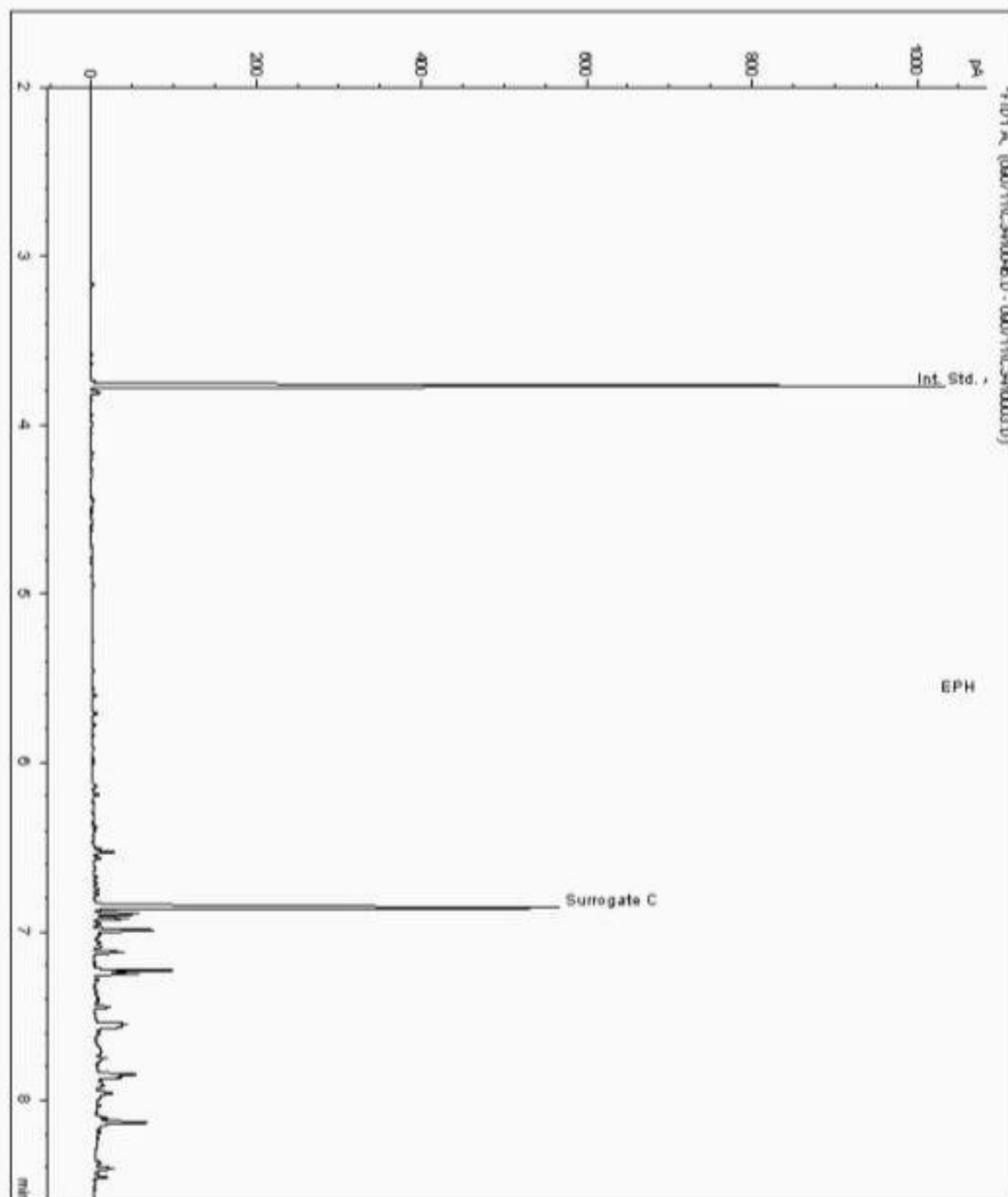
Sample No : 4241056
Sample ID : TP 2

Depth : 3.00 - 3.00

Alcontrol Laboratories
EPH Range Organics (C10 - C40)

Sample Identity : 4188132-4241056
Date Acquired : 07/09/11 23:49:05 PM
Units : mg/kg
Sample Multiplier : 0.000
Dilution : 1.0

->





CERTIFICATE OF ANALYSIS

SDG: 110831-47
Job: H_PBRETT_REA-49
Client Reference: 21834/030

Location: Woodcroft Farm, Waterloooville
Customer: Peter Brett Associates
Attention: Arie Zamler

Order Number: PBA007983
Report Number: 150822
Superseded Report: 149065

Chromatogram

Analysis: EPH by FID

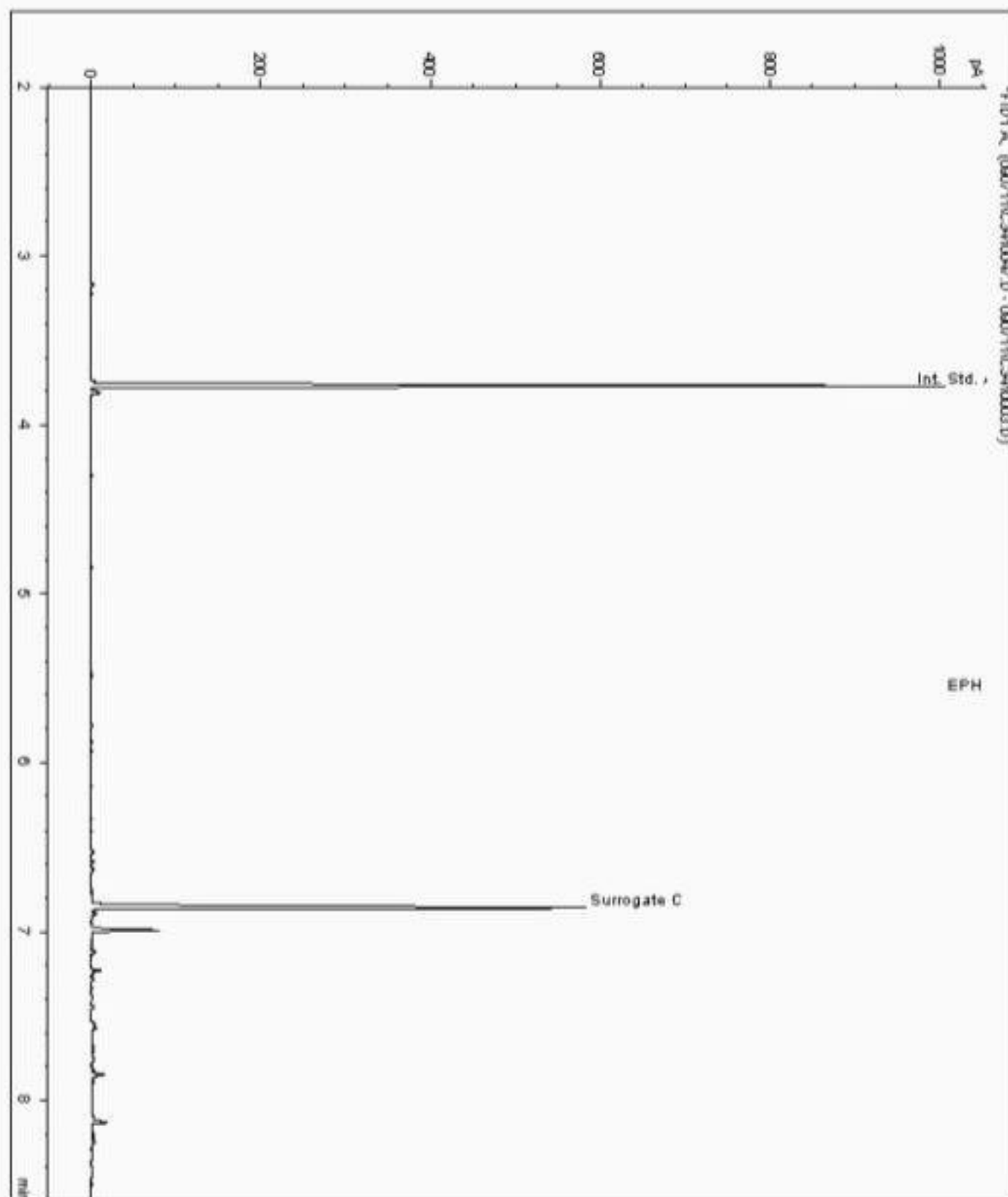
Sample No : 4241083
Sample ID : BH 1

Depth : 0.30 - 0.80

Alcontrol Laboratories
EPH Range Organics (C10 - C40)

Sample Identity : 4188052-4241083
Date Acquired : 08/09/11 00:11:32 PM
Units : mg/kg
Sample Multiplier : 0.000
Dilution : 1.0

->





CERTIFICATE OF ANALYSIS

SDG: 110831-47
Job: H_PBRETT_REA-49
Client Reference: 21834/030

Location: Woodcroft Farm, Waterloooville
Customer: Peter Brett Associates
Attention: Arie Zamler

Order Number: PBA007983
Report Number: 150822
Superseded Report: 149065

Chromatogram

Analysis: EPH by FID

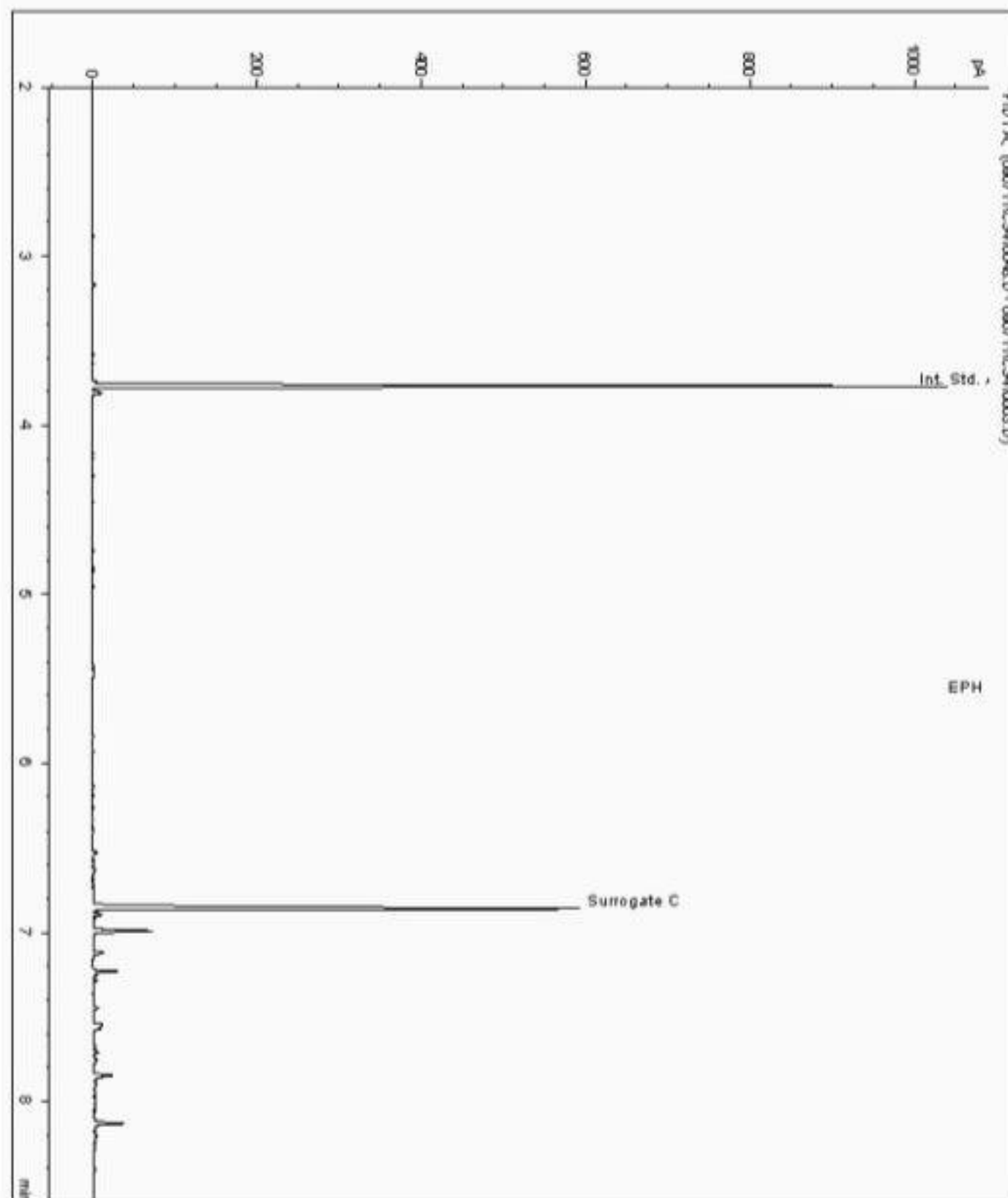
Sample No : 4241126
Sample ID : BH 4

Depth : 0.15 - 0.60

Alcontrol Laboratories
EPH Range Organics (C10 - C40)

Sample Identity : 4188060-4241126
Date Acquired : 08/09/11 00:33:49 PM
Units : mg/kg
Sample Multiplier : 0.000
Dilution : 1.0

->





CERTIFICATE OF ANALYSIS

SDG: 110831-47
Job: H_PBRETT_REA-49
Client Reference: 21834/030

Location: Woodcroft Farm, Waterville
Customer: Peter Brett Associates
Attention: Arie Zamler

Order Number: PBA007983
Report Number: 150822
Superseded Report: 149065

Chromatogram

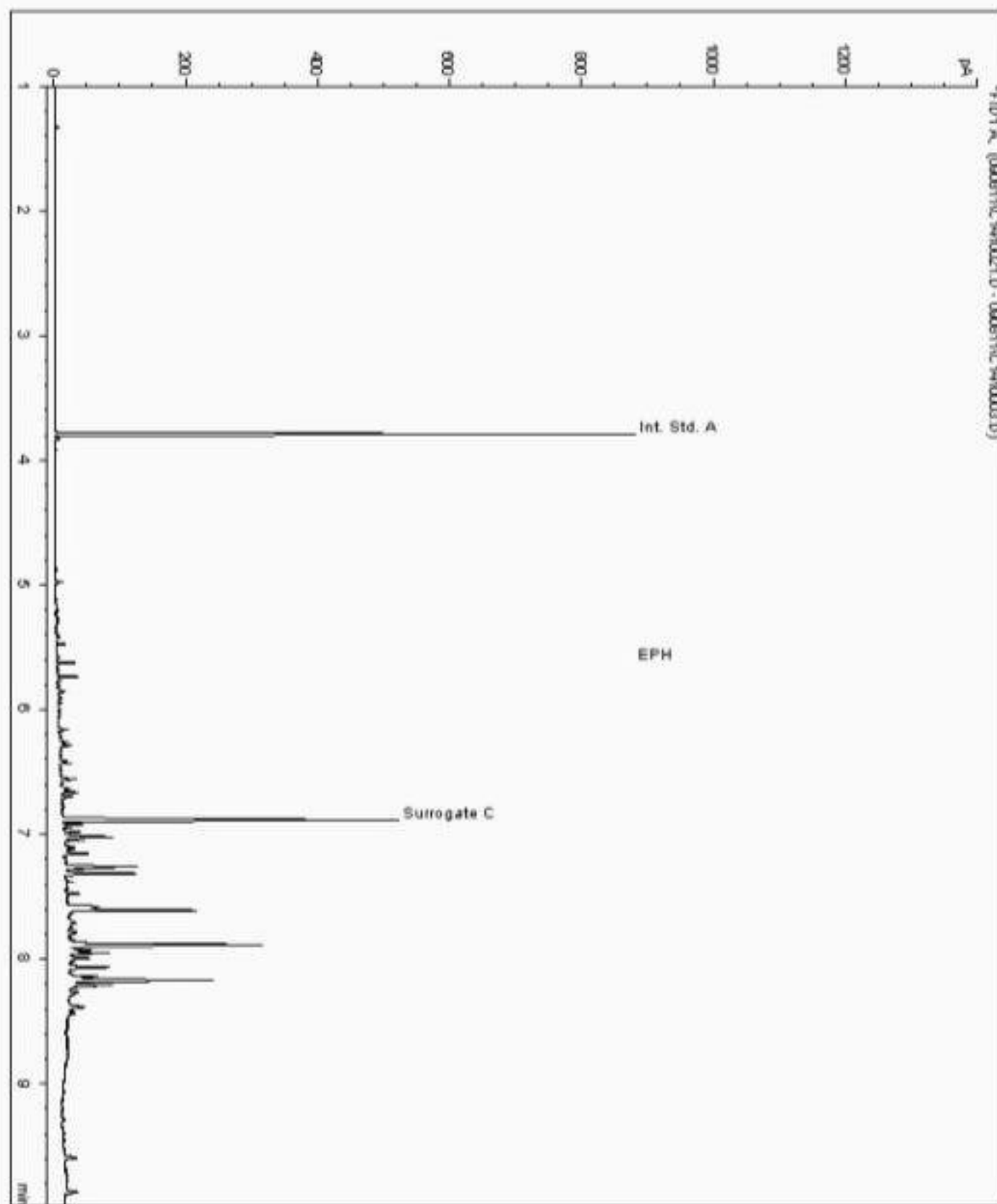
Analysis: EPH by FID

Sample No: 4248402
Sample ID: TP 2

Depth: 2.00 - 2.00

Alcontrol/Geochem Analytical Services
EPH Range Organics (C10 - C40)

Sample Identity : 4188123-4248402
Date Acquired : 08/09/11 13:20:56 PM
Units : mg/kg
Sample Multiplier : 0.000
Dilution :





CERTIFICATE OF ANALYSIS

SDG: 110831-47
Job: H_PBRETT_REA-49
Client Reference: 21834/030

Location: Woodcroft Farm, Waterloooville
Customer: Peter Brett Associates
Attention: Arie Zamler

Order Number: PBA007983
Report Number: 150822
Superseded Report: 149065

Chromatogram

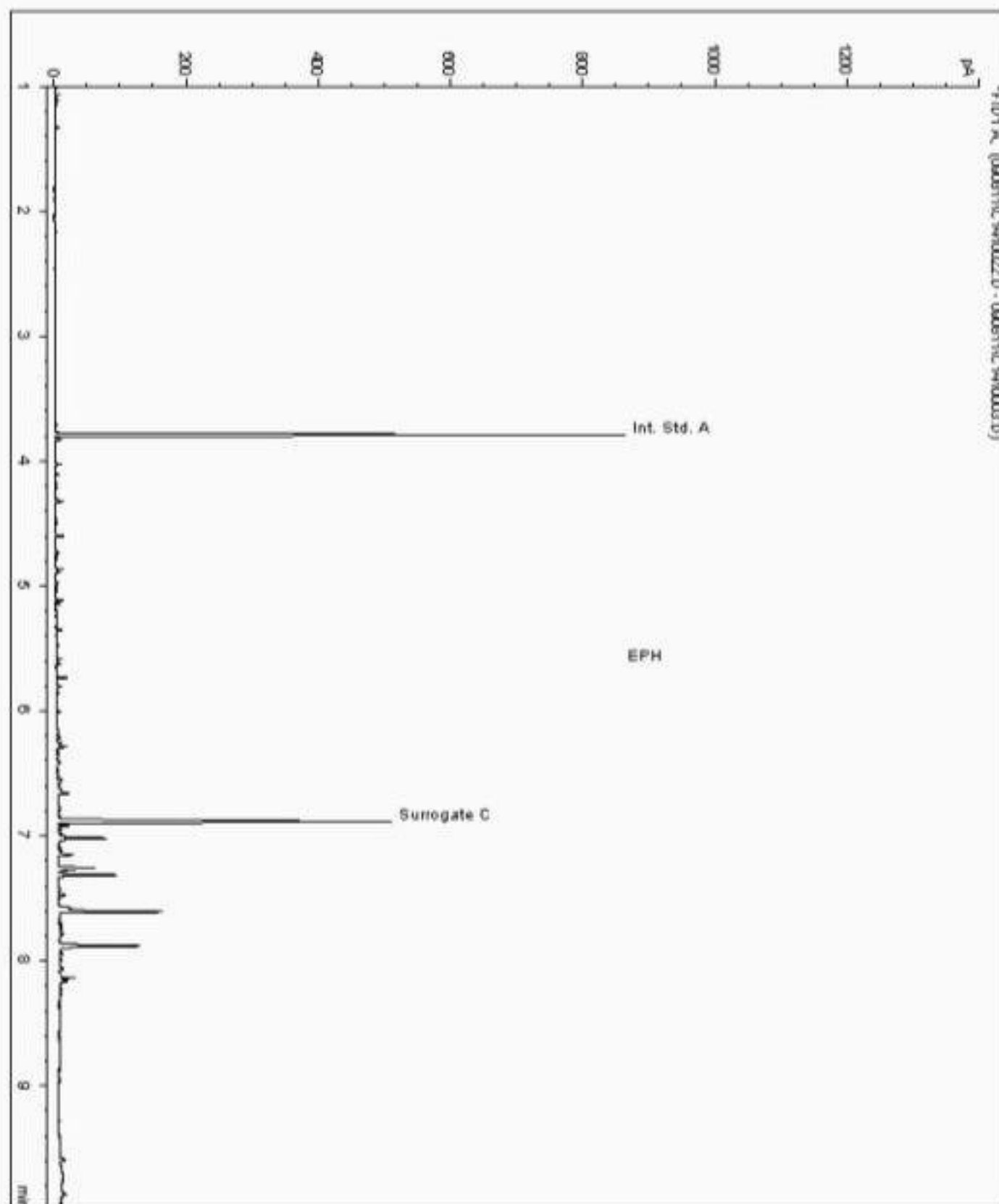
Analysis: EPH by FID

Sample No : 4248428
Sample ID : TP 3

Depth : 1.10 - 1.10

Alcontrol/Geochem Analytical Services
EPH Range Organics (C10 - C40)

Sample Identity : 4187898-4248428
Date Acquired : 08/09/11 13:43:28 PM
Units : mg/kg
Sample Multiplier : 0.000
Dilution :





CERTIFICATE OF ANALYSIS

SDG: 110831-47
Job: H_PBRETT_REA-49
Client Reference: 21834/030

Location: Woodcroft Farm, Waterloooville
Customer: Peter Brett Associates
Attention: Arie Zamler

Order Number: PBA007983
Report Number: 150822
Superseded Report: 149065

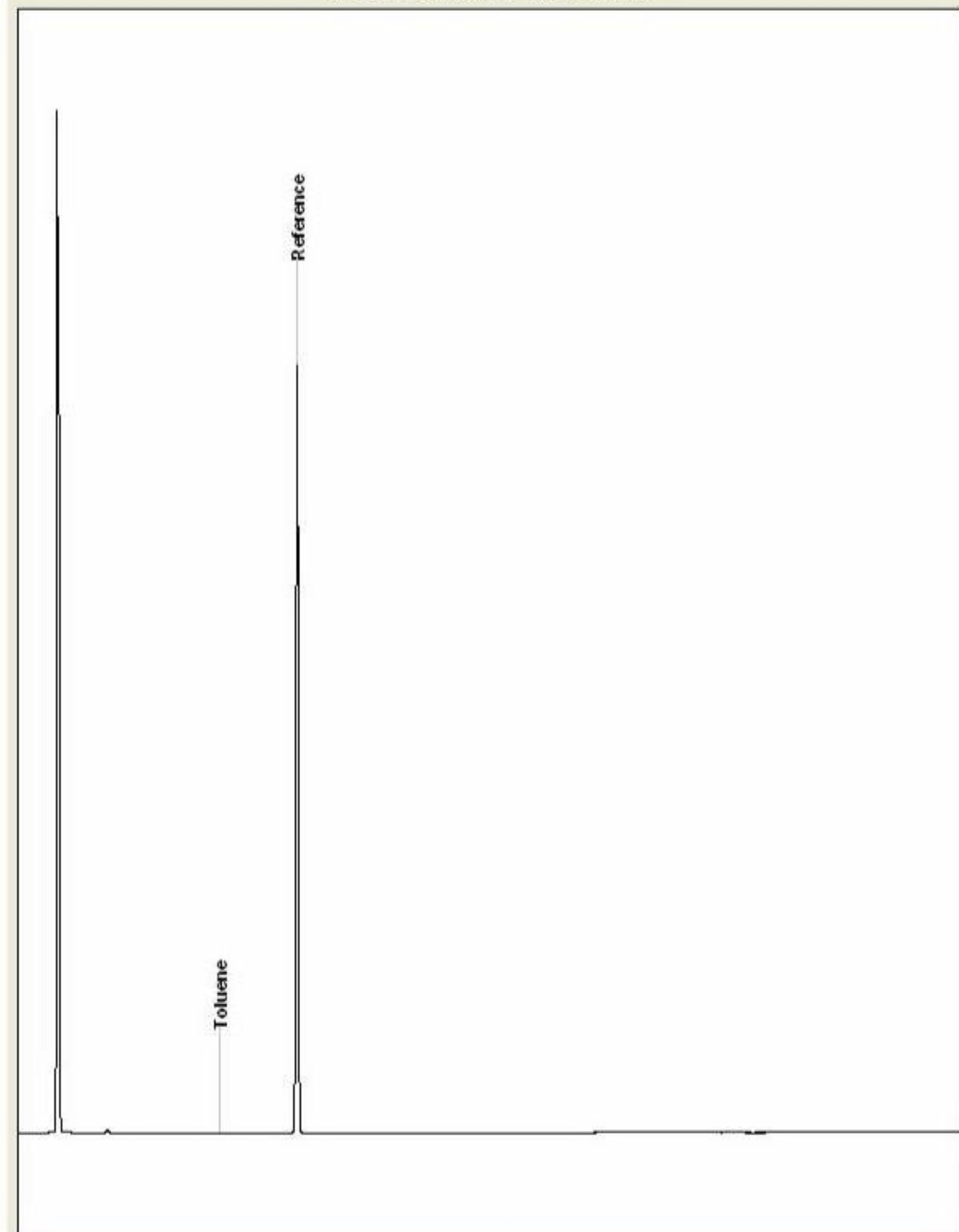
Chromatogram

Analysis: GRO by GC-FID (S)

Sample No : 4200399
Sample ID : TP 1

Depth : 1.10 - 1.10

4200399_GRO_S.DATA - HP6890 Signal 2





CERTIFICATE OF ANALYSIS

SDG: 110831-47
Job: H_PBRETT_REA-49
Client Reference: 21834/030

Location: Woodcroft Farm, Waterloooville
Customer: Peter Brett Associates
Attention: Arie Zamler

Order Number: PBA007983
Report Number: 150822
Superseded Report: 149065

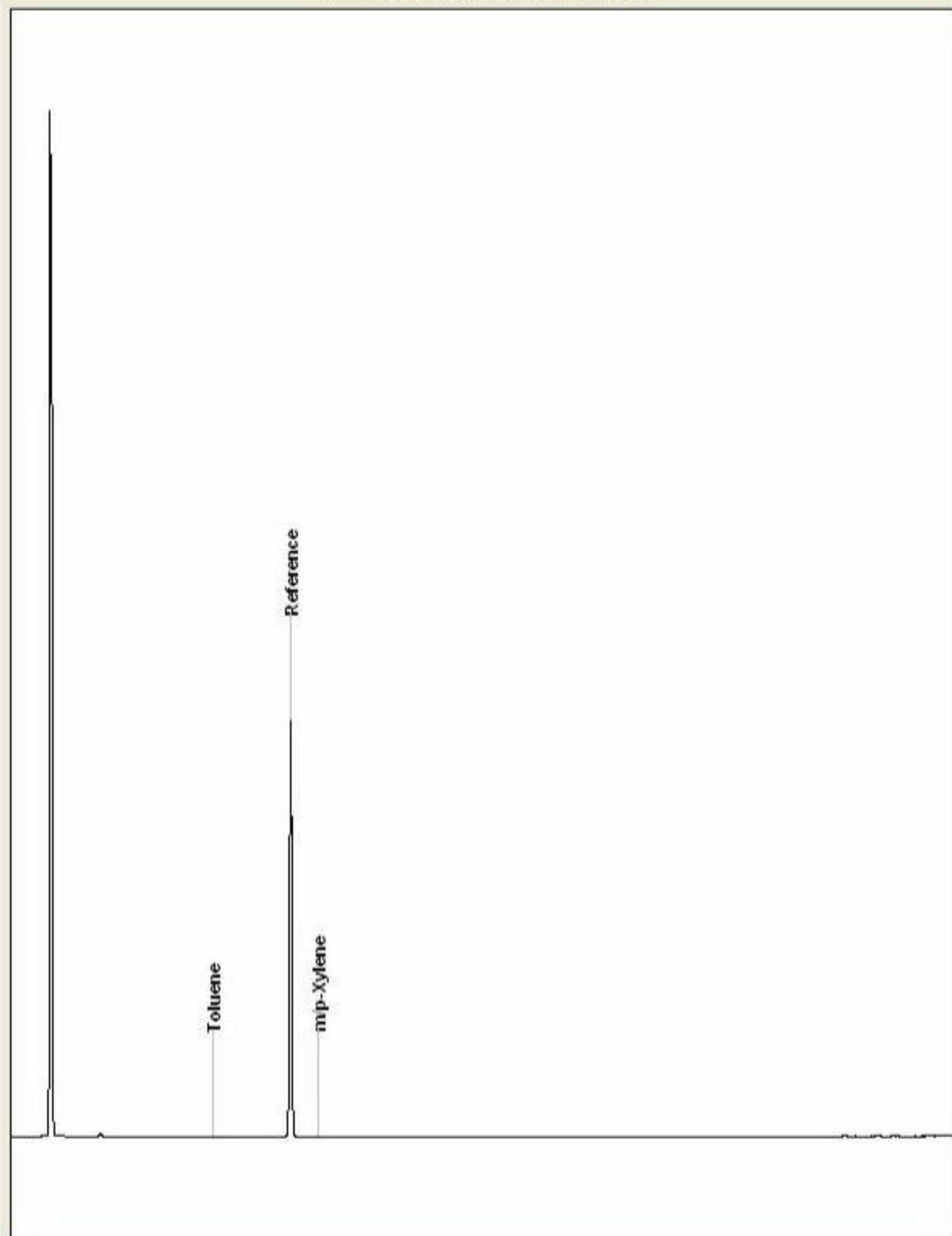
Chromatogram

Analysis: GRO by GC-FID (S)

Sample No : 4200420
Sample ID : WS 4

Depth : 0.10 - 0.30

4200420_GRO_S.DATA - HP6890 Signal 2





CERTIFICATE OF ANALYSIS

SDG: 110831-47
Job: H_PBRETT_REA-49
Client Reference: 21834/030

Location: Woodcroft Farm, Waterloooville
Customer: Peter Brett Associates
Attention: Arie Zamler

Order Number: PBA007983
Report Number: 150822
Superseded Report: 149065

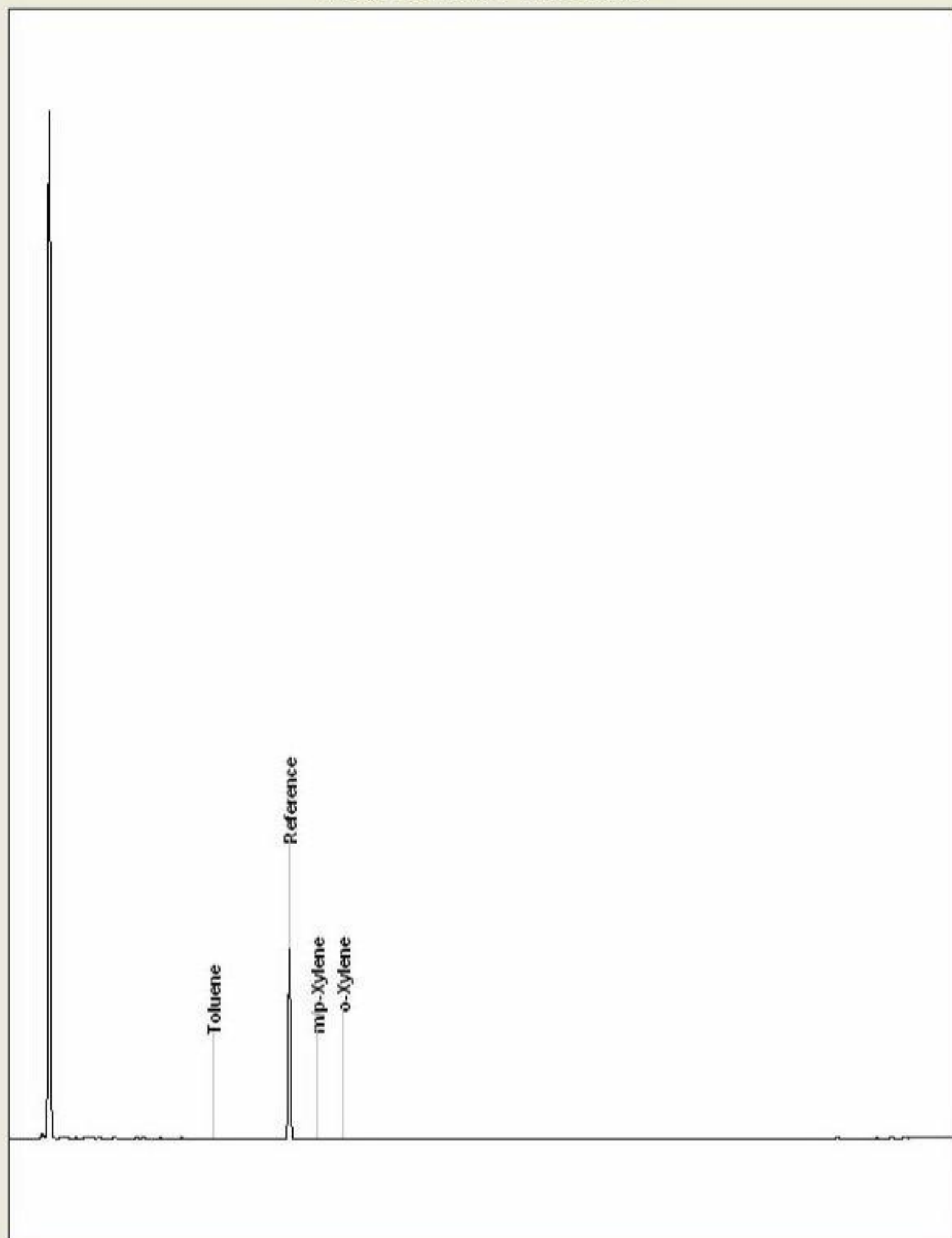
Chromatogram

Analysis: GRO by GC-FID (S)

Sample No : 4200452
Sample ID : WS 3

Depth : 0.10 - 0.40

4200452_GRO_S.DATA - HP6890 Signal 2





CERTIFICATE OF ANALYSIS

SDG: 110831-47
Job: H_PBRETT_REA-49
Client Reference: 21834/030

Location: Woodcroft Farm, Waterloooville
Customer: Peter Brett Associates
Attention: Arie Zamler

Order Number: PBA007983
Report Number: 150822
Superseded Report: 149065

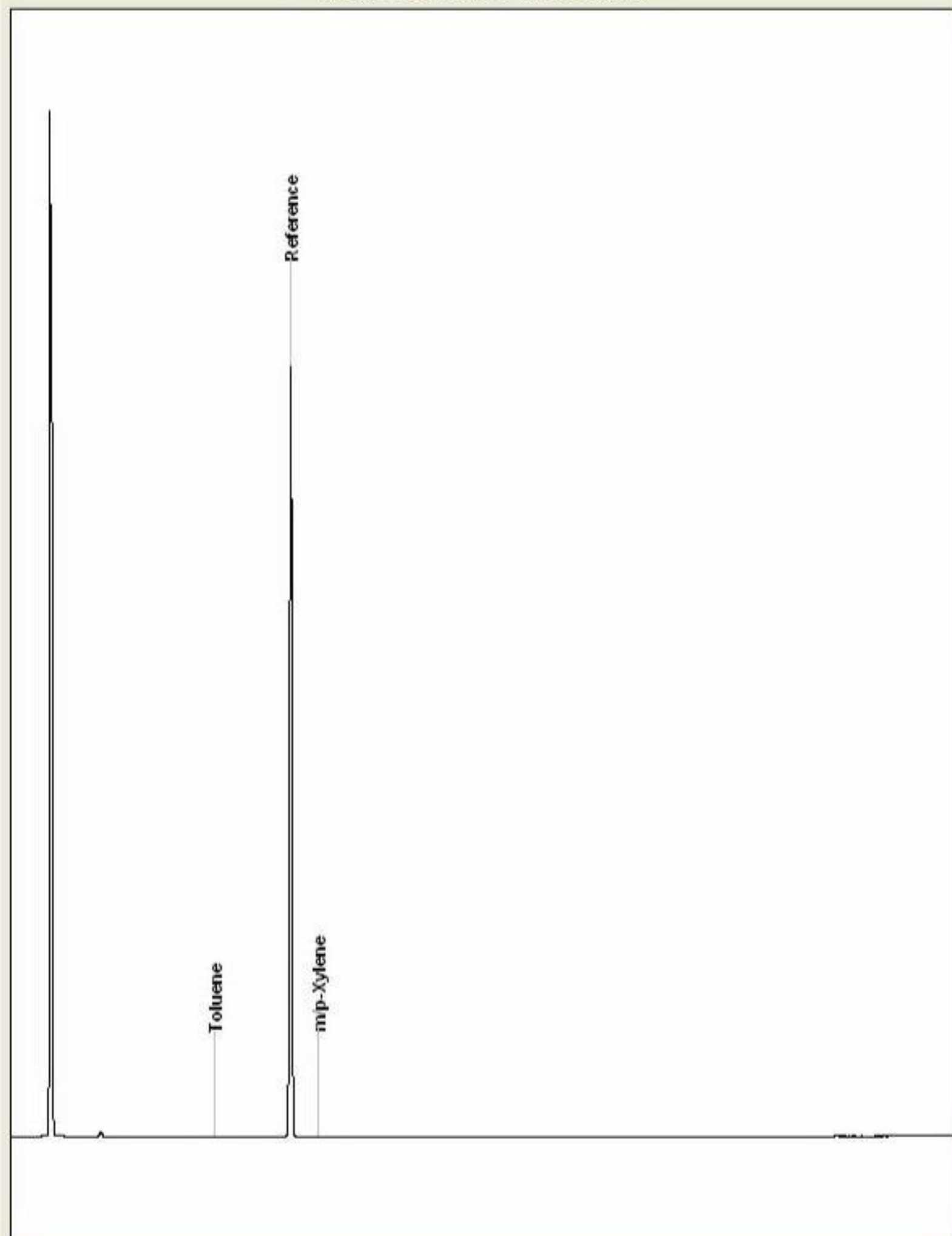
Chromatogram

Analysis: GRO by GC-FID (S)

Sample No : 4200465
Sample ID : WS 6

Depth : 0.10 - 0.50

4200465_GRO_S.DATA - HP6890 Signal 2





SDG: 110831-47
Job: H_PBRETT_REA-49
Client Reference: 21834/030

Location: Woodcroft Farm, Waterloooville
Customer: Peter Brett Associates
Attention: Arie Zamler

Order Number: PBA007983
Report Number: 150822
Superseded Report: 149065

Appendix

1. Results are expressed on a dry weight basis (dried at 35°C) for all soil analyses except for the following: NRA Leach tests, flash point, ammonium as NH₄ by the BRE method, VOC TICS, SVOC TICS, TOF-MS SCAN/SEARCH and TOF-MS TICS.

2. Samples will be run in duplicate upon request, but an additional charge may be incurred.

3. If sufficient sample is received a sub sample will be retained free of charge for 30 days after analysis is completed (e-mailed) for both soil jars, tubs and volatile jars. All waters and vials will be discarded 10 days after the analysis is completed (e-mailed). All material removed during an asbestos containing material screen and analysed for the presence of asbestos will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of one month after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALcontrol Laboratories reserve the right to charge for samples received and stored but not analysed.

4. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.

5. We take responsibility for any test performed by sub-contractors (marked with an asterisk). We endeavour to use UKAS/MCERTS Accredited Laboratories, who either complete a quality questionnaire or are audited by ourselves. For some determinands there are no UKAS/MCERTS Accredited Laboratories, in this instance a laboratory with a known track record will be utilised.

6. When requested, the individual sub sample scheduled will be screened in house for the presence of large asbestos containing material fragments/pieces. If no asbestos containing material is found this will be reported as 'no asbestos containing material detected'. If asbestos containing material is detected it will be removed and analysed by our documented in house method TM048 based on HSG 248 (2005), which is accredited to ISO17025. If asbestos containing material is present no further analysis will be undertaken. At no point is the fibre content of the soil sample determined.

7. If no separate volatile sample is supplied by the client, the integrity of the data may be compromised if the laboratory is required to create a sub-sample from the bulk sample -similarly, if a headspace or sediment is present in the volatile sample. This will be flagged up as an invalid VOC on the test schedule or recorded on the log sheet.

8. If appropriate preserved bottles are not received preservation will take place on receipt. However, the integrity of the data may be compromised.

9. NDP -No determination possible due to insufficient/unsuitable sample.

10. Metals in water are performed on a filtered sample, and therefore represent dissolved metals -total metals must be requested separately.

11. Results relate only to the items tested.

12. LODs for wet tests reported on a dry weight basis are not corrected for moisture content.

13. **Surrogate recoveries** -Most of our organic methods include surrogates, the recovery of which is monitored and reported. For EPH, MO, PAH, GRO and VOCs on soils the result is not surrogate corrected, but a percentage recovery is quoted. Acceptable limits for most organic methods are 70 -130 %.

14. **Product analyses** -Organic analyses on products can only be semi-quantitative due to the matrix effects and high dilution factors employed.

15. Phenols monohydric by HPLC include phenol, cresols (2-Methylphenol, 3-Methylphenol and 4-Methylphenol) and Xylenols (2,3 Dimethylphenol, 2,4 Dimethylphenol, 2,5 Dimethylphenol, 2,6 Dimethylphenol, 3,4 Dimethylphenol, 3,5 Dimethylphenol).

16. Total of 5 speciated phenols by HPLC includes Phenol, 2,3,5-Trimethyl Phenol, 2-Isopropylphenol, Cresols and Xylenols (as detailed in 15).

17. Stones/debris are not routinely removed. We always endeavour to take a representative sub sample from the received sample.

18. In certain circumstances the method detection limit may be elevated due to the sample being outside the calibration range. Other factors that may contribute to this include possible interferences. In both cases the sample would be diluted which would cause the method detection limit to be raised.

19. Mercury results quoted on soils will not include volatile mercury as the analysis is performed on a dried and crushed sample.

20. For the BSEN 12457-3 two batch process to allow the cumulative release to be calculated, the volume of the leachate produced is measured and filtered for all tests. We therefore cannot carry out any unfiltered analysis. The tests affected include volatiles GC/FID/GCMS and all subcontracted analysis.

21. For all leachate preparations (NRA, DIN, TCLP, BSEN 12457-1, 2, 3) volatile loss may occur, as we do not employ zero headspace extraction.

22. We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials -whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample. Other coarse granular material such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

23. Analysis and identification of specific compounds using GC/FID is by retention time only, and we routinely calibrate and quantify for benzene, toluene, ethylbenzenes and xylenes (BTEX). For total volatiles in the C4 -C10 range, the total area of the chromatogram is integrated and expressed as ug/kg or ug/l. Although this analysis is commonly used for the quantification of gasoline range organics (GRO), the system will also detect other compounds such as chlorinated solvents, and this may lead to a falsely high result with respect to hydrocarbons only. It is not possible to specifically identify these non-hydrocarbons, as standards are not routinely run for any other compounds, and for more definitive identification, volatiles by GC/MS should be utilised.

SOLID MATRICES EXTRACTION SUMMARY

ANALYSIS	DI OR VET	EXTRACTION SOLVENT	EXTRACTION METHOD	ANALYSIS
SOLVENT EXTRACTABLE MATTER	DAC	DOM	SOX THERM	GRAVIMETRIC
CYCLOHEXANE EXT. MATTER	DAC	CYCLOHEXANE	SOX THERM	GRAVIMETRIC
ELEMENTAL SULPHUR	DAC	DOM	SOX THERM	HPLC
PHENOLS BY GC/MS	VET	DOM	SOX THERM	GC/MS
HERBICIDES	DAC	HEXANE ACETONE	SOX THERM	GC/MS
PESTICIDES	DAC	HEXANE ACETONE	SOX THERM	GC/MS
EPH (DRO)	DAC	HEXANE ACETONE	END OVER END	GC/FID
EPH (MIN OIL)	DAC	HEXANE ACETONE	END OVER END	GC/FID
EPH (CLEANED UP)	DAC	HEXANE ACETONE	END OVER END	GC/FID
EPH CWS BY GC	DAC	HEXANE ACETONE	END OVER END	GC/FID
PCBTOT/PCB CON	DAC	HEXANE ACETONE	END OVER END	GC/MS
POLYAROMATIC HYDROCARBONS (MS)	VET	HEXANE ACETONE	MICROWAVE TM218	GC/MS
OS-040 (OS-040) EZ FLASH	VET	HEXANE ACETONE	SHAKER	GC-EZ
POLYAROMATIC HYDROCARBONS RAPID GC	VET	HEXANE ACETONE	SHAKER	GC-EZ
SEMI VOLATILE ORGANIC COMPOUNDS	VET	DOM ACETONE	SONICATE	GC/MS

LIQUID MATRICES EXTRACTION SUMMARY

ANALYSIS	EXTRACTION SOLVENT	EXTRACTION METHOD	ANALYSIS
PAHMS	HEXANE	STIRRED EXTRACTION (STIR-BAR)	GC/MS
EPH	HEXANE	STIRRED EXTRACTION (STIR-BAR)	GC/FID
EPH CWS	HEXANE	STIRRED EXTRACTION (STIR-BAR)	GC/FID
MINERAL OIL	HEXANE	STIRRED EXTRACTION (STIR-BAR)	GC/FID
PCB CONGENERS	HEXANE	STIRRED EXTRACTION (STIR-BAR)	GC/MS
PCB TOTAL	HEXANE	STIRRED EXTRACTION (STIR-BAR)	GC/MS
SVOC	DOM	LIQUID LIQUID SHAKE	GC/MS
FREE SULPHUR	DOM	SOLID PHASE EXTRACTION	HPLC
PEST COCOPP	DOM	LIQUID LIQUID SHAKE	GC/MS
TRAZINE HOMES	DOM	LIQUID LIQUID SHAKE	GC/MS
PHENOLS MS	DOM	SOLID PHASE EXTRACTION	GC/MS
TRI BY INFRARED (IR)	TCE	LIQUID LIQUID SHAKE	HPLC
MINERAL OIL BY IR	TCE	LIQUID LIQUID SHAKE	HPLC
GLYCOLS	NONE	DIRECT INJECTION	GC/MS

Identification of Asbestos in Bulk Materials & Soils

The results for identification of asbestos in bulk materials are obtained from supplied bulk materials or those identified as potentially asbestos containing during sample description which have been examined to determine the presence of asbestos fibres using ALcontrol Laboratories (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

The results for identification of asbestos in soils are obtained from a homogenised sub sample which has been examined to determine the presence of asbestos fibres using ALcontrol Laboratories (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

Visual Estimation Of Fibre Content

Estimation of fibre content is not permitted as part of our UKAS accredited test other than: - Trace -Where only one or two asbestos fibres were identified.

Further guidance on typical asbestos fibre content of manufactured products can be found in HSG 264.

The identification of asbestos containing materials and soils falls within our schedule of tests for which we hold UKAS accreditation, however opinions, interpretations and all other information contained in the report are outside the scope of UKAS accreditation.

Asbestos Type	Common Name
Chrysotile	White Asbestos
Amosite	Brown Asbestos
Crocidolite	Blue Asbestos
Fibrous Actinolite	-
Fibrous Anthrophyllite	-
Fibrous Tremolite	-

Job Title	Woodcroft Farm, Waterloooville
Job No	21834/030
Date	08/09/2011
Operator	Arie Zamler

CALIBRATION			
	Limits (%)	Cal Gas Start/ End	Air Start/ End
CH4 (5%)	4.5 - 5.5	4.7/4.7	0.0/0.0
CO2 (5%)	4.5 - 5.5	6.1/6.1	0.0/0.0
O2 (6%)	5.0 - 7.0	5.5/5.5	21.2/21.1

Instrument (type/serial no) and date of last manufacturers service	
--	--

Atmospheric Pressure	Time	- 48 hrs	- 24 hrs	0	+ 24 hrs	+ 48 hrs	Comment
	mbar	unknown	1006	1004	1010	1002	

Ground conditions	Firm and dry
-------------------	--------------

Weather	Overcast and mild
---------	-------------------

Borehole identification and construction BH1									
Comment/Condition									
Start time with pump time (minutes)	Flow (l/hr) Peak/Steady	Pressure (mb) Peak/Steady	CH4 (%v/v) Peak/Steady	CO2 (%v/v) Peak/Steady	O2 (%v/v) Peak/Steady	CH4 (%LEL) Peak/Steady	H2S (ppm) Peak/Steady	Groundwater Level (mBGL)	Depth to base (mBGL)
0 to 1	-1.7	1005	0.0	1.8	12.1	0.0	0.0	DRY	5.18
1 to 2	-0.9		0.0	1.9	11.7	0.0	0.0		
2 to 3	-1.1		0.0	2.0	11.4	0.0	0.0		

Borehole identification and construction BH2									
Comment/Condition									
Start time with pump time (minutes)	Flow (l/hr) Peak/Steady	Pressure (mb) Peak/Steady	CH4 (%v/v) Peak/Steady	CO2 (%v/v) Peak/Steady	O2 (%v/v) Peak/Steady	CH4 (%LEL) Peak/Steady	H2S (ppm) Peak/Steady	Groundwater Level (mBGL)	Depth to base (mBGL)
0 to 1	0.2/0.0	1004	0.0	0.7	18.3	0.0	0.0	DRY	7.03
1 to 2			0.0	1.1	17.6	0.0	0.0		
2 to 3			0.0	1.4	16.7	0.0	0.0		

Borehole identification and construction BH3									
Comment/Condition									
Start time with pump time (minutes)	Flow (l/hr) Peak/Steady	Pressure (mb) Peak/Steady	CH4 (%v/v) Peak/Steady	CO2 (%v/v) Peak/Steady	O2 (%v/v) Peak/Steady	CH4 (%LEL) Peak/Steady	H2S (ppm) Peak/Steady	Groundwater Level (mBGL)	Depth to base (mBGL)
0 to 1	0.2/0.0	1004	0.0	0.7	16.8	0.0	0.0	6.49	7.02
1 to 2			0.0	0.7	16.5	0.0	0.0		
2 to 3			0.0	1.4	13.6	0.0	0.0		

Borehole identification and construction BH4									
Comment/Condition									
Start time with pump time (minutes)	Flow (l/hr) Peak/Steady	Pressure (mb) Peak/Steady	CH4 (%v/v) Peak/Steady	CO2 (%v/v) Peak/Steady	O2 (%v/v) Peak/Steady	CH4 (%LEL) Peak/Steady	H2S (ppm) Peak/Steady	Groundwater Level (mBGL)	Depth to base (mBGL)
0 to 1	0.6/0.2	1004	0.0	1.7	15.9	0.0	0.0	DRY	6.92
1 to 2			0.0	1.9	15.2	0.0	0.0		
2 to 3			0.0	2.0	14.7	0.0	0.0		

Borehole identification and construction WS1									
Comment/Condition									
Start time with pump time (minutes)	Flow (l/hr) Peak/Steady	Pressure (mb) Peak/Steady	CH4 (%v/v) Peak/Steady	CO2 (%v/v) Peak/Steady	O2 (%v/v) Peak/Steady	CH4 (%LEL) Peak/Steady	H2S (ppm) Peak/Steady	Groundwater Level (mBGL)	Depth to base (mBGL)
0 to 1	0.0	1004	0.0	3.3	10.8	0.0	0.0	DRY	3.12
1 to 2			0.0	4.1	8.0	0.0	0.0		
2 to 3			0.0	6.0	7.6	0.0	0.0		

Typed By:	Arie Zamler	Date	08/09/2011	Checked By:		Date	
-----------	-------------	------	------------	-------------	--	------	--

Borehole identification and construction WS2									
Comment/Condition									
Start time with pump time (minutes)	Flow (l/hr) Peak/Steady	Pressure (mb) Peak/Steady	CH4 (%v/v) Peak/Steady	CO2 (%v/v) Peak/Steady	O2 (%v/v) Peak/Steady	CH4 (%LEL) Peak/Steady	H2S (ppm) Peak/Steady	Groundwater Level (mBGL)	Depth to base (mBGL)
0 to 1	0.2/0.0	1004	27.5	15.0	0.0	>>>	0.0	DRY	4.20
1 to 2			26.0	15.0	0.0	>>>	0.0		
2 to 3			25.0	15.0	0.0	>>>	0.0		

Borehole identification and construction WS3									
Comment/Condition									
Start time with pump time (minutes)	Flow (l/hr) Peak/Steady	Pressure (mb) Peak/Steady	CH4 (%v/v) Peak/Steady	CO2 (%v/v) Peak/Steady	O2 (%v/v) Peak/Steady	CH4 (%LEL) Peak/Steady	H2S (ppm) Peak/Steady	Groundwater Level (mBGL)	Depth to base (mBGL)
0 to 1	0.0	1004	0.0	5.2	5.5	0.0	0.0	DRY	4.08
1 to 2			0.0	6.0	6.2	0.0	0.0		
2 to 3			0.0	6.1	6.4	0.0	0.0		

Borehole identification and construction WS4									
Comment/Condition									
Start time with pump time (minutes)	Flow (l/hr) Peak/Steady	Pressure (mb) Peak/Steady	CH4 (%v/v) Peak/Steady	CO2 (%v/v) Peak/Steady	O2 (%v/v) Peak/Steady	CH4 (%LEL) Peak/Steady	H2S (ppm) Peak/Steady	Groundwater Level (mBGL)	Depth to base (mBGL)
0 to 1	0.1/0.0	1004	0.0	1.4	17.3	0.0	0.0	DRY	3.13
1 to 2			0.0	2.0	17.2	0.0	0.0		
2 to 3			0.0	2.6	17.2	0.0	0.0		

Borehole identification and construction WS5									
Comment/Condition									
Start time with pump time (minutes)	Flow (l/hr) Peak/Steady	Pressure (mb) Peak/Steady	CH4 (%v/v) Peak/Steady	CO2 (%v/v) Peak/Steady	O2 (%v/v) Peak/Steady	CH4 (%LEL) Peak/Steady	H2S (ppm) Peak/Steady	Groundwater Level (mBGL)	Depth to base (mBGL)
0 to 1	0.3/0.0	1004	0.0	3.1	15.9	0.0	0.0	DRY	4.08
1 to 2			0.0	3.3	15.9	0.0	0.0		
2 to 3			0.0	3.2	15.9	0.0	0.0		

Borehole identification and construction WS6									
Comment/Condition Not accesable									
Start time with pump time (minutes)	Flow (l/hr) Peak/Steady	Pressure (mb) Peak/Steady	CH4 (%v/v) Peak/Steady	CO2 (%v/v) Peak/Steady	O2 (%v/v) Peak/Steady	CH4 (%LEL) Peak/Steady	H2S (ppm) Peak/Steady	Groundwater Level (mBGL)	Depth to base (mBGL)
0 to 1									
1 to 2									
2 to 3									

Borehole identification and construction WS11									
Comment/Condition									
Start time with pump time (minutes)	Flow (l/hr) Peak/Steady	Pressure (mb) Peak/Steady	CH4 (%v/v) Peak/Steady	CO2 (%v/v) Peak/Steady	O2 (%v/v) Peak/Steady	CH4 (%LEL) Peak/Steady	H2S (ppm) Peak/Steady	Groundwater Level (mBGL)	Depth to base (mBGL)
0 to 1	0.0	1004	0.0	3.6	14.8	0.0	0.0	DRY	2.74
1 to 2			0.0	3.8	14.7	0.0	0.0		
2 to 3			0.0	3.8	14.7	0.0	0.0		

Typed By: Arie Zamler	Date: 08/09/2011	Checked By:	Date:
-----------------------	------------------	-------------	-------

Job Title	Woodcroft Farm, Waterloooville
Job No	21834/030
Date	14/09/2011
Operator	Arie Zamler

CALIBRATION			
	Limits (%)	Cal Gas Start/ End	Air Start/ End
CH4 (5%)	4.5 - 5.5	4.5/4.6	0.0/0.0
CO2 (5%)	4.5 - 5.5	5.4/5.8	0.0/0.0
O2 (6%)	5.0 - 7.0	5.7/5.5	21.3/21.1

Instrument (type/serial no) and date of last manufacturers service	
--	--

Atmospheric Pressure	Time	- 48 hrs	- 24 hrs	0	+ 24 hrs	+ 48 hrs	Comment
	mbar	unknown	1013	1020	1021	1017	Rising pressure

Ground conditions	Firm and dry
-------------------	--------------

Weather	Sunny and mild
---------	----------------

Borehole identification and construction BH01									
Comment/Condition									
Start time with pump time (minutes)	Flow (l/hr) Peak/Steady	Pressure (mb) Peak/Steady	CH4 (%v/v) Peak/Steady	CO2 (%v/v) Peak/Steady	O2 (%v/v) Peak/Steady	CH4 (%LEL) Peak/Steady	H2S (ppm) Peak/Steady	Groundwater Level (mBGL)	Depth to base (mBGL)
0 to 1	0.0/0.1	1015	0.0	2.3	12.0	0.0	0.0	DRY	5.18
1 to 2			0.0	2.6	11.1	0.0	0.0		
2 to 3			0.0	2.6	10.7	0.0	0.0		

Borehole identification and construction BH02									
Comment/Condition									
Start time with pump time (minutes)	Flow (l/hr) Peak/Steady	Pressure (mb) Peak/Steady	CH4 (%v/v) Peak/Steady	CO2 (%v/v) Peak/Steady	O2 (%v/v) Peak/Steady	CH4 (%LEL) Peak/Steady	H2S (ppm) Peak/Steady	Groundwater Level (mBGL)	Depth to base (mBGL)
0 to 1	0.3/0.0	1013.0	0.0	1.8	15.0	0.0	0.0	DRY	7.03
1 to 2			0.0	1.9	14.8	0.0	0.0		
2 to 3			0.0	1.9	14.5	0.0	0.0		

Borehole identification and construction BH03									
Comment/Condition									
Start time with pump time (minutes)	Flow (l/hr) Peak/Steady	Pressure (mb) Peak/Steady	CH4 (%v/v) Peak/Steady	CO2 (%v/v) Peak/Steady	O2 (%v/v) Peak/Steady	CH4 (%LEL) Peak/Steady	H2S (ppm) Peak/Steady	Groundwater Level (mBGL)	Depth to base (mBGL)
0 to 1	0.1/0.0	1013	0.0	1.7	11.2	0.0	0.0	DRY	7.02
1 to 2			0.0	1.7	11.2	0.0	0.0		
2 to 3			0.0	1.7	11.2	0.0	0.0		

Borehole identification and construction BH04									
Comment/Condition									
Start time with pump time (minutes)	Flow (l/hr) Peak/Steady	Pressure (mb) Peak/Steady	CH4 (%v/v) Peak/Steady	CO2 (%v/v) Peak/Steady	O2 (%v/v) Peak/Steady	CH4 (%LEL) Peak/Steady	H2S (ppm) Peak/Steady	Groundwater Level (mBGL)	Depth to base (mBGL)
0 to 1	0.0	1015	0.3/0.2	0.0	21.0	6.0	0.0	DRY	6.92
1 to 2			1.0	0.0	21.0	20.0	0.0		
2 to 3			2.0	0.0	21.0	40.0	0.0		

Borehole identification and construction WS01									
Comment/Condition									
Start time with pump time (minutes)	Flow (l/hr) Peak/Steady	Pressure (mb) Peak/Steady	CH4 (%v/v) Peak/Steady	CO2 (%v/v) Peak/Steady	O2 (%v/v) Peak/Steady	CH4 (%LEL) Peak/Steady	H2S (ppm) Peak/Steady	Groundwater Level (mBGL)	Depth to base (mBGL)
0 to 1	0.0/0.1	1014	0.8/0.7	2.0	13.8	14.0	0.0	DRY	3.13
1 to 2			0.8/0.6	3.0	12.1	13.0	0.0		
2 to 3			0.8/0.7	5.6	6.6	10.0	0.0		

Typed By:	Arie Zamler	Date	Checked By:	Date
-----------	-------------	------	-------------	------

Borehole identification and construction WS02									
Comment/Condition									
Start time with pump time (minutes)	Flow (l/hr) Peak/Steady	Pressure (mb) Peak/Steady	CH4 (%v/v) Peak/Steady	CO2 (%v/v) Peak/Steady	O2 (%v/v) Peak/Steady	CH4 (%LEL) Peak/Steady	H2S (ppm) Peak/Steady	Groundwater Level (mBGL)	Depth to base (mBGL)
0 to 1	0.3/0.0	1014	42.5/40.0	17.0/16.0	0.0	>>>	0.0	DRY	4.20
1 to 2			38.0/36.5	16.0	0.0	>>>	0.0		
2 to 3			31.0	13.0	0.0	>>>	0.0		

Borehole identification and construction WS04									
Comment/Condition									
Start time with pump time (minutes)	Flow (l/hr) Peak/Steady	Pressure (mb) Peak/Steady	CH4 (%v/v) Peak/Steady	CO2 (%v/v) Peak/Steady	O2 (%v/v) Peak/Steady	CH4 (%LEL) Peak/Steady	H2S (ppm) Peak/Steady	Groundwater Level (mBGL)	Depth to base (mBGL)
0 to 1	0.0/0.1	1013	0.0	1.3	17.8	0.0	0.0	DRY	3.12
1 to 2			0.0	1.9	17.6	0.0	0.0		
2 to 3			0.0	2.1	17.6	0.0	0.0		

Borehole identification and construction WS05									
Comment/Condition									
Start time with pump time (minutes)	Flow (l/hr) Peak/Steady	Pressure (mb) Peak/Steady	CH4 (%v/v) Peak/Steady	CO2 (%v/v) Peak/Steady	O2 (%v/v) Peak/Steady	CH4 (%LEL) Peak/Steady	H2S (ppm) Peak/Steady	Groundwater Level (mBGL)	Depth to base (mBGL)
0 to 1	0.0/0.2	1013	0.0	3.3	15.5	0.0	0.0	DRY	4.1
1 to 2			0.0	3.5	15.4	0.0	0.0		
2 to 3			0.0	3.5	15.3	0.0	0.0		

Borehole identification and construction WS11									
Comment/Condition									
Start time with pump time (minutes)	Flow (l/hr) Peak/Steady	Pressure (mb) Peak/Steady	CH4 (%v/v) Peak/Steady	CO2 (%v/v) Peak/Steady	O2 (%v/v) Peak/Steady	CH4 (%LEL) Peak/Steady	H2S (ppm) Peak/Steady	Groundwater Level (mBGL)	Depth to base (mBGL)
0 to 1	0.3/0.0	1013	0.0	4.1	13.8	0.0	0.0	DRY	2.7
1 to 2			0.0	4.3	13.8	0.0	0.0		
2 to 3			0.0	4.3	13.9	0.0	0.0		

Borehole identification and construction Water well									
Comment/Condition									
Start time with pump time (minutes)	Flow (l/hr) Peak/Steady	Pressure (mb) Peak/Steady	CH4 (%v/v) Peak/Steady	CO2 (%v/v) Peak/Steady	O2 (%v/v) Peak/Steady	CH4 (%LEL) Peak/Steady	H2S (ppm) Peak/Steady	Groundwater Level (mBGL)	Depth to base (mBGL)
0 to 1	-	-	-	-	-	-	-	30.13	-
1 to 2									
2 to 3									

Borehole identification and construction									
Comment/Condition									
Start time with pump time (minutes)	Flow (l/hr) Peak/Steady	Pressure (mb) Peak/Steady	CH4 (%v/v) Peak/Steady	CO2 (%v/v) Peak/Steady	O2 (%v/v) Peak/Steady	CH4 (%LEL) Peak/Steady	H2S (ppm) Peak/Steady	Groundwater Level (mBGL)	Depth to base (mBGL)
0 to 1									
1 to 2									
2 to 3									

Typed By: Arie Zamler	14/09/2011 Date	Checked By:	Date
-----------------------	-----------------	-------------	------

Job Title	Woodcroft Farm, Waterloooville
Job No	21834/030
Date	22/09/2011
Operator	Arie Zamler

CALIBRATION			
	Limits (%)	Cal Gas Start/ End	Air Start/ End
CH4 (5%)	4.5 - 5.5	4.5/4.5	0.0/0.0
CO2 (5%)	4.5 - 5.5	5.8/5.7	0.0/0.0
O2 (6%)	5.0 - 7.0	5.6/5.7	21.3/21.1

Instrument (type/serial no) and date of last manufacturers service	
--	--

Atmospheric Pressure	Time	- 48 hrs	- 24 hrs	0	+ 24 hrs	+ 48 hrs	Comment
	mbar	1019	1017	1021	1018	1014	

Ground conditions	Wet after heavy rain in the previous day
-------------------	--

Weather	Overcast and mild
---------	-------------------

Borehole identification and construction BH01									
Comment/Condition Cover partially filled with water, water removed.									
Start time with pump time (minutes)	Flow (l/hr)	Pressure (mb)	CH4 (%v/v)	CO2 (%v/v)	O2 (%v/v)	CH4 (%LEL)	H2S (ppm)	Groundwater Level (mBGL)	Depth to base (mBGL)
	Peak/Steady	Peak/Steady	Peak/Steady	Peak/Steady	Peak/Steady	Peak/Steady	Peak/Steady		
0 to 1	-0.6	1017	0.0	3.8	7.1	0.0	0.0	DRY	5.20
1 to 2			0.0	3.5	7.0	0.0	0.0		
2 to 3			0.0	3.8	6.9	0.0	0.0		

Borehole identification and construction BH02									
Comment/Condition									
Start time with pump time (minutes)	Flow (l/hr)	Pressure (mb)	CH4 (%v/v)	CO2 (%v/v)	O2 (%v/v)	CH4 (%LEL)	H2S (ppm)	Groundwater Level (mBGL)	Depth to base (mBGL)
	Peak/Steady	Peak/Steady	Peak/Steady	Peak/Steady	Peak/Steady	Peak/Steady	Peak/Steady		
0 to 1	0.0	1015	0.0	2.4	13.9	0.0	0.0	DRY	7.12
1 to 2			0.0	2.5	13.7	0.0	0.0		
2 to 3				2.5	13.7	0.0	0.0		

Borehole identification and construction BH03									
Comment/Condition									
Start time with pump time (minutes)	Flow (l/hr)	Pressure (mb)	CH4 (%v/v)	CO2 (%v/v)	O2 (%v/v)	CH4 (%LEL)	H2S (ppm)	Groundwater Level (mBGL)	Depth to base (mBGL)
	Peak/Steady	Peak/Steady	Peak/Steady	Peak/Steady	Peak/Steady	Peak/Steady	Peak/Steady		
0 to 1	0.2/0.0	1004	0.0	0.7	16.8	0.0	0.0	4.50	7.02
1 to 2			0.0	0.9	16.5	0.0	0.0		
2 to 3			0.0	1.4	13.6	0.0	0.0		

Borehole identification and construction BH04									
Comment/Condition Some water in the cover									
Start time with pump time (minutes)	Flow (l/hr)	Pressure (mb)	CH4 (%v/v)	CO2 (%v/v)	O2 (%v/v)	CH4 (%LEL)	H2S (ppm)	Groundwater Level (mBGL)	Depth to base (mBGL)
	Peak/Steady	Peak/Steady	Peak/Steady	Peak/Steady	Peak/Steady	Peak/Steady	Peak/Steady		
0 to 1	0.0	1017	0.0	3.6	6.4	0.0	0.0	DRY	6.92
1 to 2			0.0	3.5	6.4	0.0	0.0		
2 to 3			0.0	3.4	6.4	0.0	0.0		

Borehole identification and construction WS01									
Comment/Condition									
Start time with pump time (minutes)	Flow (l/hr)	Pressure (mb)	CH4 (%v/v)	CO2 (%v/v)	O2 (%v/v)	CH4 (%LEL)	H2S (ppm)	Groundwater Level (mBGL)	Depth to base (mBGL)
	Peak/Steady	Peak/Steady	Peak/Steady	Peak/Steady	Peak/Steady	Peak/Steady	Peak/Steady		
0 to 1	0.0	1017	0.0	12.0	0.8	0.0	0.0	DRY	3.12
1 to 2			0.0	12.0	0.8	0.0	0.0		
2 to 3			0.0	12.0	0.8	0.0	0.0		

Typed By:	Arie Zamler	Date	22/09/2011	Checked By:		Date	
-----------	-------------	------	------------	-------------	--	------	--

Borehole identification and construction WS02									
Comment/Condition Cover partially full with water.									
Start time with pump time (minutes)	Flow (l/hr) Peak/Steady	Pressure (mb) Peak/Steady	CH4 (%v/v) Peak/Steady	CO2 (%v/v) Peak/Steady	O2 (%v/v) Peak/Steady	CH4 (%LEL) Peak/Steady	H2S (ppm) Peak/Steady	Groundwater Level (mBGL)	Depth to base (mBGL)
0 to 1	0.0	1017	36.5	17.0	0.0	>>>	0.0	DRY	4.20
1 to 2			34.5	17.0	0.0	>>>	0.0		
2 to 3			33.0	17.0	0.0	>>>	0.0		

Borehole identification and construction WS03									
Comment/Condition									
Start time with pump time (minutes)	Flow (l/hr) Peak/Steady	Pressure (mb) Peak/Steady	CH4 (%v/v) Peak/Steady	CO2 (%v/v) Peak/Steady	O2 (%v/v) Peak/Steady	CH4 (%LEL) Peak/Steady	H2S (ppm) Peak/Steady	Groundwater Level (mBGL)	Depth to base (mBGL)
0 to 1	0.0	1016	0.0	4.5	17.3	0.0	0.0	DRY	4.08
1 to 2			0.0	4.2	17.0	0.0	0.0		
2 to 3			0.0	4.3	17.0	0.0	0.0		

Borehole identification and construction WS04									
Comment/Condition									
Start time with pump time (minutes)	Flow (l/hr) Peak/Steady	Pressure (mb) Peak/Steady	CH4 (%v/v) Peak/Steady	CO2 (%v/v) Peak/Steady	O2 (%v/v) Peak/Steady	CH4 (%LEL) Peak/Steady	H2S (ppm) Peak/Steady	Groundwater Level (mBGL)	Depth to base (mBGL)
0 to 1	0.0	1016	0.0	0.8	17.9	0.0	0.0	DRY	3.12
1 to 2			0.0	1.9	17.3	0.0	0.0		
2 to 3			0.0	2.5	17.1	0.0	0.0		

Borehole identification and construction WS05									
Comment/Condition									
Start time with pump time (minutes)	Flow (l/hr) Peak/Steady	Pressure (mb) Peak/Steady	CH4 (%v/v) Peak/Steady	CO2 (%v/v) Peak/Steady	O2 (%v/v) Peak/Steady	CH4 (%LEL) Peak/Steady	H2S (ppm) Peak/Steady	Groundwater Level (mBGL)	Depth to base (mBGL)
0 to 1	0.0	1015/1016	0.0	2.0	17.5	0.0	0.0	DRY	4.12
1 to 2			0.0	2.7	17.0	0.0	0.0		
2 to 3			0.0	2.7	16.8	0.0	0.0		

Borehole identification and construction WS11									
Comment/Condition Cover filled with water water is removed.									
Start time with pump time (minutes)	Flow (l/hr) Peak/Steady	Pressure (mb) Peak/Steady	CH4 (%v/v) Peak/Steady	CO2 (%v/v) Peak/Steady	O2 (%v/v) Peak/Steady	CH4 (%LEL) Peak/Steady	H2S (ppm) Peak/Steady	Groundwater Level (mBGL)	Depth to base (mBGL)
0 to 1	0.1/0.0	1017	0.0	2.9	14.4	0.0	0.0	DRY	2.73
1 to 2			0.0	3.4	14.1	0.0	0.0		
2 to 3			0.0	3.7	13.8	0.0	0.0		

Borehole identification and construction									
Comment/Condition									
Start time with pump time (minutes)	Flow (l/hr) Peak/Steady	Pressure (mb) Peak/Steady	CH4 (%v/v) Peak/Steady	CO2 (%v/v) Peak/Steady	O2 (%v/v) Peak/Steady	CH4 (%LEL) Peak/Steady	H2S (ppm) Peak/Steady	Groundwater Level (mBGL)	Depth to base (mBGL)
0 to 1									
1 to 2									
2 to 3									

Typed By: Arie Zamler	Date: 22/09/2011	Checked By:	Date:
-----------------------	------------------	-------------	-------

Job Title	Woodcroft Farm, Waterloooville
Job No	21834/030
Date	28/09/2011
Operator	Arie Zamler

CALIBRATION			
	Limits (%)	Cal Gas Start/ End	Air Start/ End
CH4 (5%)	4.5 - 5.5		
CO2 (5%)	4.5 - 5.5		
O2 (6%)	5.0 - 7.0		

Instrument (type/serial no) and date of last manufacturers service	
--	--

Atmospheric Pressure	Time	- 48 hrs	- 24 hrs	0	+ 24 hrs	+ 48 hrs	Comment
	mbar	1026	1029	1025	1022	1022	Falling pressure

Ground conditions	Firm and dry
-------------------	--------------

Weather	Sunny and warm
---------	----------------

Borehole identification and construction BH01									
Comment/Condition									
Start time with pump time (minutes)	Flow (l/hr) Peak/Steady	Pressure (mb) Peak/Steady	CH4 (%v/v) Peak/Steady	CO2 (%v/v) Peak/Steady	O2 (%v/v) Peak/Steady	CH4 (%LEL) Peak/Steady	H2S (ppm) Peak/Steady	Groundwater Level (mBGL)	Depth to base (mBGL)
0 to 1	0.0	1021	0.0	4.6	8.2	0.0	0.0	DRY	5.18
1 to 2			0.0	4.6	8.0	0.0	0.0		
2 to 3			0.0	4.7	8.1	0.0	0.0		

Borehole identification and construction BH02									
Comment/Condition									
Start time with pump time (minutes)	Flow (l/hr) Peak/Steady	Pressure (mb) Peak/Steady	CH4 (%v/v) Peak/Steady	CO2 (%v/v) Peak/Steady	O2 (%v/v) Peak/Steady	CH4 (%LEL) Peak/Steady	H2S (ppm) Peak/Steady	Groundwater Level (mBGL)	Depth to base (mBGL)
0 to 1	0.1/0.0	1021.0	0.0	2.7	14.5	0.0	0.0	DRY	7.03
1 to 2			0.0	2.6	14.4	0.0	0.0		
2 to 3			0.0	2.7	14.5	0.0	0.0		

Borehole identification and construction BH03									
Comment/Condition									
Start time with pump time (minutes)	Flow (l/hr) Peak/Steady	Pressure (mb) Peak/Steady	CH4 (%v/v) Peak/Steady	CO2 (%v/v) Peak/Steady	O2 (%v/v) Peak/Steady	CH4 (%LEL) Peak/Steady	H2S (ppm) Peak/Steady	Groundwater Level (mBGL)	Depth to base (mBGL)
0 to 1	0.0	1019	0.0	1.8	8.8	0.0	0.0	4.05	7.02
1 to 2			0.0	1.8	8.7	0.0	0.0		
2 to 3			0.0	1.7	8.7	0.0	0.0		

Borehole identification and construction BH4									
Comment/Condition									
Start time with pump time (minutes)	Flow (l/hr) Peak/Steady	Pressure (mb) Peak/Steady	CH4 (%v/v) Peak/Steady	CO2 (%v/v) Peak/Steady	O2 (%v/v) Peak/Steady	CH4 (%LEL) Peak/Steady	H2S (ppm) Peak/Steady	Groundwater Level (mBGL)	Depth to base (mBGL)
0 to 1	0.0	1021	0.0	3.5	8.8	0.0	0.0	DRY	6.92
1 to 2				3.5	8.7	0.0	0.0		
2 to 3				3.6	8.6	0.0	0.0		

Borehole identification and construction WS01									
Comment/Condition									
Start time with pump time (minutes)	Flow (l/hr) Peak/Steady	Pressure (mb) Peak/Steady	CH4 (%v/v) Peak/Steady	CO2 (%v/v) Peak/Steady	O2 (%v/v) Peak/Steady	CH4 (%LEL) Peak/Steady	H2S (ppm) Peak/Steady	Groundwater Level (mBGL)	Depth to base (mBGL)
0 to 1	0.0	1021	0.0	15.0	0.8	0.0	0.0	DRY	3.12
1 to 2			0.0	15.0	0.7	0.0	0.0		
2 to 3			0.0	15.0	0.8	0.0	0.0		

Typed By:	Arie Zamler	Date	29/09/2011	Checked By:		Date	
-----------	-------------	------	------------	-------------	--	------	--

Borehole identification and construction WS02									
Comment/Condition									
Start time with pump time (minutes)	Flow (l/hr) Peak/Steady	Pressure (mb) Peak/Steady	CH4 (%v/v) Peak/Steady	CO2 (%v/v) Peak/Steady	O2 (%v/v) Peak/Steady	CH4 (%LEL) Peak/Steady	H2S (ppm) Peak/Steady	Groundwater Level (mBGL)	Depth to base (mBGL)
0 to 1	1.3/0.3	1021	35.5	19.0	0.0	>>>	1.2/1.1	DRY	4.20
1 to 2			34.5	16.0	0.0	>>>	1.1		
2 to 3			32.5	16.0	0.0	>>>	1.1		

Borehole identification and construction WS03									
Comment/Condition									
Start time with pump time (minutes)	Flow (l/hr) Peak/Steady	Pressure (mb) Peak/Steady	CH4 (%v/v) Peak/Steady	CO2 (%v/v) Peak/Steady	O2 (%v/v) Peak/Steady	CH4 (%LEL) Peak/Steady	H2S (ppm) Peak/Steady	Groundwater Level (mBGL)	Depth to base (mBGL)
0 to 1	0.5/0.0	1020	0.0	7.5	5.0	0.0	0.0	DRY	4.08
1 to 2				8.1	5.5	0.0	0.0		
2 to 3				8.2	5.7	0.0	0.0		

Borehole identification and construction WS04									
Comment/Condition									
Start time with pump time (minutes)	Flow (l/hr) Peak/Steady	Pressure (mb) Peak/Steady	CH4 (%v/v) Peak/Steady	CO2 (%v/v) Peak/Steady	O2 (%v/v) Peak/Steady	CH4 (%LEL) Peak/Steady	H2S (ppm) Peak/Steady	Groundwater Level (mBGL)	Depth to base (mBGL)
0 to 1	0.0	1021	0.0	0.8	17.8	0.0	0.0	DRY	3.14
1 to 2				1.6	17.0	0.0	0.0		
2 to 3				2.0	17.0	0.0	0.0		

Borehole identification and construction WS05									
Comment/Condition									
Start time with pump time (minutes)	Flow (l/hr) Peak/Steady	Pressure (mb) Peak/Steady	CH4 (%v/v) Peak/Steady	CO2 (%v/v) Peak/Steady	O2 (%v/v) Peak/Steady	CH4 (%LEL) Peak/Steady	H2S (ppm) Peak/Steady	Groundwater Level (mBGL)	Depth to base (mBGL)
0 to 1	0.0	1021	0.0	2.3	17.3	0.0	0.0	DRY	4.09
1 to 2			0.0	2.5	17.2	0.0	0.0		
2 to 3			0.0	2.4	17.2	0.0	0.0		

Borehole identification and construction WS06									
Comment/Condition									
Start time with pump time (minutes)	Flow (l/hr) Peak/Steady	Pressure (mb) Peak/Steady	CH4 (%v/v) Peak/Steady	CO2 (%v/v) Peak/Steady	O2 (%v/v) Peak/Steady	CH4 (%LEL) Peak/Steady	H2S (ppm) Peak/Steady	Groundwater Level (mBGL)	Depth to base (mBGL)
0 to 1	0.0	1021	0.0	5.2	12.0	0.0	0.0	DRY	2.5
1 to 2				6.0	10.0	0.0	0.0		
2 to 3				5.5	10.0	0.0	0.0		

Borehole identification and construction WS11									
Comment/Condition									
Start time with pump time (minutes)	Flow (l/hr) Peak/Steady	Pressure (mb) Peak/Steady	CH4 (%v/v) Peak/Steady	CO2 (%v/v) Peak/Steady	O2 (%v/v) Peak/Steady	CH4 (%LEL) Peak/Steady	H2S (ppm) Peak/Steady	Groundwater Level (mBGL)	Depth to base (mBGL)
0 to 1	0.2/0.1	1021	0.0	5.4	12.6	0.0	0.0	DRY	2.74
1 to 2			0.0	5.4	12.7	0.0	0.0		
2 to 3			0.0	5.3	12.7	0.0	0.0		

Typed By: Arie Zamler	Date	Checked By:	Date
-----------------------	------	-------------	------

1 Introduction

A Tier 2 Risk Assessment is a quantitative assessment using published generic criteria to "screen" the site-specific contamination testing data and identify potential hazards to specific receptors.

The aim of this document is to present an explanation for the selection of the assessment criteria routinely used by PBA when undertaking a Tier 2 risk assessment. This document is divided into general introductory text and sections on soils, waters and soil gases.

This document should be read in conjunction with another entitled "PBA methodology for ground condition assessment" which summarises the legislative regime and our approach to ground contamination and risk assessment.

2 General Notes

Any deviation from the routine criteria and/or selection of criteria for parameters not covered in this document will be described in the report text. The report will also comment on the appropriateness of the routine criteria for project objectives or ground conditions.

Any PBA interpretation of contamination test results is based on a scientific and engineering appraisal. The perceptions of, for example, banks, insurers, lay people etc are not taken into account.

Any summary tables included in this Appendix are produced for ease of reference to the criteria, they do not in any way replace the documents of origin (which are fully referenced) and which should be read to ensure appropriate use and interpretation of the data.

3 Tier 2 Criteria for Assessing Soils

3.1 Potential Harm to Human Health

The criteria routinely used by PBA as Tier 2 soil screening values for the protection of human health are the Governmental Soil Guidance Values (SGVs) and various non-Governmental Generic Assessment Criteria (GAC) and the criteria routinely adopted are presented in Table 1.

DEFRA has yet to produce a comprehensive list of assessment criteria that on its own, would be sufficient to enable the assessment of the potential risks posed by soil contaminants (to human health). A number of industry-driven initiatives have developed to generate contaminated land assessment criteria. This has led to the publication of a series of non-statutory non-Governmental contaminated land assessment criteria. It should be noted that the published DEFRA guidance is also non-statutory.

Both the Governmental and non Governmental sets of criteria have been generated using the

Contaminated Land Exposure Assessment model (CLEA) and supporting technical guidance (EA, 2009a, 2009b, 2009c).

PBA has reviewed these publications and where we consider that the non-Governmental criteria are authoritative and robust, and therefore we will refer to such criteria until such time that DEFRA derive and publish Governmental SGVs to replace the non Governmental GACs.

It is important to note that because the GACs are not published by the UK Government, they may be subject to challenge by a regulatory body or their representative. If use of the GACs is challenged, it may be necessary to carry out modelling to generate site-specific assessment criteria.

Soil Guideline Values (SGVs) - Governmental

The first series of SGVs were generated using a probabilistic version of the CLEA model. However, on 22 July 2008 DEFRA announced the withdrawal of these SGVs.

Revised SGVs have been calculated using the revised fully deterministic version of the CLEA model. The standard land use scenarios are residential with plant uptake, allotments and industrial/commercial.

Generic Assessment Criteria (GAC) - Non Governmental

SGVs generated for organic compounds are dependent on the amount of organic matter present in the soil (a lower SGV is generated for soils with lower organic matter contents since organic matter acts to immobilise organic contaminants). The SGVs for BTEX compounds and phenol assume that the 'host' soil has 6% organic matter.

UK soils often have organic matter concentrations below 6% and that it may therefore not be conservative to use the published SGVs for BTEX compounds when assessing the potential risks from these chemicals. The on-line Contaminated Land Strategies Digest (CLSD) formed a consortium of ten practitioners (including representatives from local authorities), to prepare generic assessment criteria for a number of contaminants at more conservative organic matter contents of 1% and 3% for the same end uses. The consortium also reproduced the SGVs using the EA's latest CLEA model and latest CLEA guidance and PBA independently verified the results published using CLEA v1.06. These criteria will be used by PBA where appropriate.

In addition the CLSD consortium derived GAC for selected substances for an additional end use, that being residential without plant uptake (CLSD, 2009).

In July 2009, GAC for 82 substances were published by the Chartered Institute of Environmental Health (CIEH) (LQM and CIEH,

2009) using the then current version of the CLEA software v1.04. These GAC replace those generated in 2006 using the original version of the model CLEA UK *beta*.

In January 2010, GAC for 35 substances were published by the Environmental Industries Commission (EIC), Association of Geotechnical and Geoenvironmental Specialists (AGS) and Contaminated Land: Applications in Real Environments (CL:AIRE), (CL:AIRE, 2010) using the then current version of the CLEA software v1.05. These substances are more rarely found to be contaminants of concern during contaminated land investigations and hence are not routinely tested for. The CL:AIRE GAC are not reproduced in Table 1 but may be referred to as required during the investigation of specific sites.

Note on Appropriate Use of SGV/GAC The SGVs and GACs generated using the CLEA model are based on numerous and complex assumptions. The appropriateness of these assumptions in a site-specific context requires confirmation on a project by project basis.

In general, SGVs/GACs have been developed using highly conservative assumptions and therefore exceedance does not necessarily indicate that a site is statutorily contaminated and/or unsuitable for use (CLAN2-05) and that whilst SGV/GAC provide an aid to decision-making, they do not replace the need for sound professional judgement in risk assessment (EA, 2006b).

Note on Mercury and Arsenic Assessment The analytical testing routinely undertaken by PBA determines total concentration, however, the toxicity of Mercury and Arsenic differ depending on the form.

If there a source of Mercury or Arsenic is identified or the total concentration exceeds the relevant worst case speciated criteria it will be desirable/necessary to undertake additional speciated testing.

3.2 Potential Harm to the Built Environment

PBA use the following primary guidance to assess the significance of soil chemistry with respect to its potential to harm the built environment.

- i) Site Preparation and Resistance to Contaminants and Moisture. Approved Document C (BRE 2004);
- ii) Concrete in aggressive ground SD1 (BRE 2005); and
- iii) Technical guidance on the assessment of soil chemistry with respect to its potential to corrode plastic service pipes has been published by the Water Regulations Advisory Scheme (WRAS, 2002).

3.3 Potential to Harm Ecosystems, Animals, Crops etc

The criteria routinely used by PBA as Tier 2 screening values to assess the potential of soil chemistry to harm ecosystems are taken from the following guidance and summarised in are given in Table 2.

- i) Ecological Risk Assessment (ERA) Science Report Series SC070009, published by the Environment Agency, Bristol (EA, 2008);
- ii) The Restoration and Aftercare of Metalliferous Mining Sites for Pasture and Grazing (ICRCL 70/90, 1990); and
- iii) Code of Practice for Agricultural Use of Sewage Sludge (DOE, 1993).

4 Tier 2 Screening Values for Assessing Controlled Waters

4.1 Potential Harm to Human Health

The criteria routinely used by PBA as Tier 2 water screening values are taken from the Water Supply (Water Quality) Regulations 2000 (DETR (2000a) and are given in Table 3.

It should be noted that some of the prescribed concentrations listed in the Water Supply Regulations have been set for reasons other than their potential to cause harm to human health. The concentrations of iron and manganese are controlled because they may taint potable water with an undesirable taste, odour or colour or may potentially deposit precipitates in water supply pipes.

4.2 Potential to Harm Controlled Waters

Controlled Waters are rivers, estuaries, coastal waters, lakes and groundwaters, but not perched waters.

The criteria routinely used by PBA as Tier 2 screening values are taken from the directions to the Environment Agency in regard to the implementation of the Water Framework Directive (EA 2009d) and are given in Tables 3, 4 and 5.

Table 3 presents the criteria for assessing the chemistry of groundwater bodies and Tables 4 and 5 present the criteria for assessing the chemistry of surface water bodies.

The results from any eluted liquids will be compared to appropriate assessment criteria depending on the receptor of concern.

5 Tier 2 Screening Guidance for Assessing Soil Gases

Guidance on the assessment of risks specifically for sites located adjacent to Landfill Sites has been published by the Environment Agency (EA, 2004d). A tiered approach to assessing risk is advocated by the guidance. This allows the level

of detail in a risk assessment to be proportionate to the nature and complexity of the risk.

The Tier 1 Risk Screening methodology advocated by the Environment Agency (EA) guidance document (EA, 2004) should:

- i) Identify complete source-pathway-receptor linkages;
- ii) Screen out insignificant risks;
- iii) Prioritise the risks and receptors; and
- iv) Provide an initial assessment of the potential impacts at a receptor.

A Tier 2 assessment comprises the quantitative analysis of risk following the collection and analysis of soil gas monitoring data.

Guidance on suitable methodologies for the collection of gas monitoring data is provided in CIRIA Report C665 (CIRIA, 2007).

Guidance Available PBA use the following primary guidance to assess the significance of soil gas chemistry with respect to its potential to harm human health.

- i) Assessing risks posed by hazardous gases to buildings C665 (CIRIA 2007);
- ii) Guidance on evaluation of development proposals on sites where methane and carbon dioxide are present. (NHBC 2007);
- iii) Code of practice for the characterization and remediation from ground gas is affected developments (BSI, 2007); and
- iv) Waste Management Paper No. 27 (DoE, 1991).

Waste Management Paper No. 27 (DoE, 1991) defines what constitutes a "significant quantity" of gas. WMP27 advises that a site producing (i) Methane concentrations in excess of 1% by volume and with a flow rate of greater than 15 litres per hour; or (ii) Carbon dioxide in excess of 1.5% by volume in air and with a flow rate of greater than 22 litres per hour would be considered as a significant source of soil gas.

Guidance on quantifying the risks from hazardous soil gases to properties and their occupiers is provided in CIRIA, 2007 (commercial developments), NHBC, 2007 (low rise residential developments) and British Standard BS 8485:2007. These documents provide guidance on gas monitoring methods and strategy, the assessment of risk posed by soil gases and mitigating the risks posed by soil gases during site development.

PBA use gas concentrations and borehole flow data in order to obtain the gas screening value (GSV) for methane and carbon dioxide at the site.

The GSV can be used to establish the characteristic situation of the site as detailed in CIRIA C665 and in order to make

recommendations for gas protection measures for buildings if required.

Radon In addition to the guidance listed above, PBA use the following primary guidance to assess the significance of the radon content of soil gas.

- i) Radon: guidance on protective measures for new dwellings. Report BR211 (BRE, 1999); and
- ii) Radon Atlas of England, R290 (NRPB, 1996).

6 References

BRE (2004) Site preparation and resistance to contaminants and moisture. Approved Document C, The Building Regulations 2000. Building Research Establishment, Garston, Herts.

BRE (2005) Concrete in aggressive ground. Special Digest 1, Building Research Establishment, Garston, Herts.

BRE (1999). Radon: guidance on protective measures for new dwellings. Report BR211, Building Research Establishment, Garston, Herts.

BSI (2007) BS 8485:2007 Code of practice for the characterization and remediation from ground gas is affected developments. British Standards Institute, London.

CIRIA (2007) Assessing risks posed by hazardous gases to buildings. C665, Construction Industry Research and Information Association, London.

CL:AIRE (2010). Soil Generic Assessment Criteria for Human Health Risk Assessment. Published in January 2010 by Contaminated Land: Applications in Real Environments, London. ISBN 978-1-905046-20-1.

CLAN2-05 Contaminated land advice note 02 from September 2005. Department for the Environment, Food and Rural Affairs, London.

CLSD (2009) Contaminated-Land-Strategies Digest - 30 Apr 2009 to 1 May 2009 - Special issue (#2009-89). Posting titled: "JISCMail GACs for SGV substances: April 2009 and subsequent postings".

DETR (2000a) The Water Supply (Water Quality) Regulations, 2000. Statutory Instrument 2000 No 3184, Department of the Environment, Transport and the Regions, London.

DoE (1991) Landfill Gas, Waste Management Paper No. 27. Department of the Environment, London.

DoE (1993) Code of Practice for Agricultural Use of Sewage Sludge. Department of the Environment, London.

EA (2004) Guidance on Assessment of Risks from Landfill Sites. Environment Agency, Bristol.

Rationale for Generic Assessment Criteria Routinely Used by PBA

- EA (2006b) CLEA update No. 4. Environment Agency, Bristol.
- EA (2008) Ecological Risk Assessment (ERA). Science Report Series SC070009, Environment Agency, Bristol.
- EA (2009a) Using Soil Guideline Values. Science Report SC050021/SGV Introduction. Environment Agency, Bristol.
- EA (2009b) Updated Technical Background to the CLEA model. Science Report SC050021/SR3 Introduction. Environment Agency, Bristol.
- EA (2009c) Human health toxicological assessment of contaminants in soil. Science Report SC050021/SR2. Environment Agency, Bristol.
- EA (2009d) River Basin Typology, Standards and Groundwater threshold values (Water Framework Directive) England and Wales) Direction 2009.
- ICRCL (1990) The Restoration and Aftercare of Metalliferous Mining Sites for Pasture and Grazing 70/90. Interdepartmental Committee on the Redevelopment of Contaminated Land, London.
- LQM & CIEH (2006) Generic Assessment Criteria for Human Health Risk Assessment. Land Quality Management Limited and the Chartered Institute of Environmental Health, London.
- LQM & CIEH (2009) The LQM/CIEH Generic Assessment Criteria for Human Health Risk Assessment (2nd Edition). Land Quality Press, Nottingham. ISBN 0-9547474-7-X.
- NRPB (1996) Radon Atlas of England. R290, National Radiological Protection Board, Didcot, Oxfordshire.
- NHBC (2007) Guidance on evaluation of development proposals on sites where methane and carbon dioxide are present. National House Building Council.
- WRAS (2002) The selection of materials for water supply pipes to be laid in contaminated land. Water Regulations Advisory Scheme.

Rationale for Generic Assessment Criteria Routinely Used by PBA

Table 1: Tier 2 Screening Criteria for the Assessment of Potential Contaminant Concentrations in Soil – Protection of Human Health

Determinand	Allotments	Residential with plant uptake	Residential without plant uptake	Commercial/Industrial
Metals/Metalloids				
Arsenic (Inorganic)	43 ^a	32 ^a	35 ^f	640 ^a
Beryllium	55 ^c	51 ^c	-	420 ^c
Boron	45 ^c	291 ^c	-	192,000 ^c
Cadmium	1.8 ^a	10 ^a	117 ^f	230 ^a
Chromium (trivalent)	34,600 ^c	3000 ^c	-	30,400 ^c
Chromium (hexavalent)	2.1 ^c	4.3 ^c	-	35 ^c
Copper	524 ^c	2330 ^c	-	71,700 ^c
Lead	-	450 ^b	450 ^b	750 ^b
Mercury (elemental)	1 ^a	26 ^a	-	26 ^a
Mercury (inorganic)	80 ^a	170 ^a	235 ^f	3600 ^a
Methyl Mercury	8 ^a	11 ^a	-	410 ^a
Nickel	230 ^a	130 ^a	130 ^f	1800 ^a
Selenium	120 ^a	350 ^a	595 ^f	13000 ^a
Vanadium	18 ^c	75 ^c	-	3160 ^c
Zinc	618 ^c	3750 ^c	-	665,000 ^c
BTEX Compounds (1%, 3% and 6% SOM)^d				
Benzene	0.02 ^f / 0.04 ^f / 0.07 ^a	0.08 ^f / 0.18 ^f / 0.33 ^a	0.27 ^f / 0.56 ^f / 1.0 ^f	28 ^f / 57 ^f / 95 ^a
Toluene	22 ^f / 60 ^f / 120 ^a	120 ^f / 320 ^f / 610 ^a	600 ^f / 1500 ^f / 2700 ^f	870 ^f / 2200 ^f / 4400 ^a
Ethylbenzene	16 ^f / 45 ^f / 90 ^a	65 ^f / 180 ^f / 350 ^a	165 ^f / 450 ^f / 840 ^f	520 ^f / 1400 ^f / 2800 ^a
Xylenes #	28 ^f / 80 ^f / 160 ^a	42 ^f / 120 ^f / 230 ^a	53 ^f / 145 ^f / 285 ^f	475 ^f / 1300 ^f / 2600 ^a
Polycyclic Aromatic Hydrocarbons (1%, 2.5% and 6% SOM)^d				
Acenaphthene	34 ^c / 85 ^c / 200 ^c	210 ^c / 480 ^c / 1000 ^c	-	85000 ^c / 98000 ^c / 100000 ^c
Acenaphthylene	28 ^c / 69 ^c / 160 ^c	170 ^c / 400 ^c / 850 ^c	-	84000 ^c / 97000 ^c / 100000 ^c
Anthracene	380 ^c / 950 ^c / 2200 ^c	2300 ^c / 4900 ^c / 9200 ^c	-	530000 ^c / 540000 ^c / 540000 ^c
Benzo(a)anthracene	2.5 ^c / 5.5 ^c / 10 ^c	3.1 ^c / 4.7 ^c / 5.9 ^c	-	90 ^c / 95 ^c / 97 ^c
Benzo(a)pyrene	0.60 ^c / 1.2 ^c / 2.1 ^c	0.83 ^c / 0.94 ^c / 1.0 ^c	-	14 ^c / 14 ^c / 14 ^c
benzo(b)fluoranthene	3.5 ^c / 7.4 ^c / 13 ^c	5.6 ^c / 6.5 ^c / 7.0 ^c	-	100 ^c / 100 ^c / 100 ^c
benzo(g,h,i)perylene	70 ^c / 120 ^c / 160 ^c	44 ^c / 46 ^c / 47 ^c	-	650 ^c / 660 ^c / 660 ^c
benzo(k)fluoranthene	6.8 ^c / 14 ^c / 23 ^c	8.5 ^c / 9.6 ^c / 10 ^c	-	140 ^c / 140 ^c / 140 ^c
Chrysene	2.6 ^c / 5.8 ^c / 12 ^c	6.0 ^c / 8.0 ^c / 9.3 ^c	-	140 ^c / 140 ^c / 140 ^c
Dibenzo(a,h)anthracene	0.76 ^c / 1.5 ^c / 2.3 ^c	0.76 ^c / 0.86 ^c / 0.90 ^c	-	13 ^c / 13 ^c / 13 ^c
Fluoranthene	52 ^c / 130 ^c / 290 ^c	260 ^c / 460 ^c / 670 ^c	-	23000 ^c / 23000 ^c / 23000 ^c
Fluorene	27 ^c / 67 ^c / 160 ^c	160 ^c / 380 ^c / 780 ^c	-	64000 ^c / 69000 ^c / 71000 ^c
Indeno(1,2,3-cd)pyrene	1.8 ^c / 3.8 ^c / 7.1 ^c	3.2 ^c / 3.9 ^c / 4.2 ^c	-	60 ^c / 61 ^c / 61 ^c
Naphthalene	4.1 ^c / 9.9 ^c / 23 ^c	1.5 ^c / 3.7 ^c / 8.7 ^c	-	200 ^c / 480 ^c / 1100 ^c
Phenanthrene	16 ^c / 38 ^c / 90 ^c	92 ^c / 200 ^c / 380 ^c	-	22000 ^c / 22000 ^c / 23000 ^c
Pyrene	110 ^c / 270 ^c / 620 ^c	560 ^c / 1000 ^c / 1600 ^c	-	54000 ^c / 54000 ^c / 54000 ^c
Aliphatic/Aromatic Hydrocarbons (1%, 2.5% and 6% SOM)^d				
TPH Aliphatic >C5-6	740 ^c / 1700 ^c / 3900 ^c	30 ^c / 55 ^c / 110 ^c	-	3400 ^c / 6200 ^c / 13000 ^c
TPH Aliphatic >C6-8	2300 ^c / 5600 ^c / 13000 ^c	73 ^c / 160 ^c / 370 ^c	-	8300 ^c / 18000 ^c / 42000 ^c
TPH Aliphatic >C8-10	320 ^c / 770 ^c / 1700 ^c	19 ^c / 46 ^c / 110 ^c	-	2100 ^c / 5100 ^c / 12000 ^c
TPH Aliphatic >C10-12	2200 ^c / 4400 ^c / 7300 ^c	93 ^c / 230 ^c / 540 ^c	-	10000 ^c / 24000 ^c / 49000 ^c
TPH Aliphatic >C12-16	11000 ^c / 13000 ^c / 13000 ^c	740 ^c / 1700 ^c / 3000 ^c	-	61000 ^c / 83000 ^c / 91000 ^c

Rationale for Generic Assessment Criteria Routinely Used by PBA

Determinand	Allotments	Residential with plant uptake	Residential without plant uptake	Commercial/Industrial
TPH Aliphatic >C16-35	260000 ^c / 270000 ^c / 270000 ^c	45000 ^c / 64000 ^c / 76000 ^c	-	1600000 ^c / 1800000 ^c / 1800000 ^c
TPH Aliphatic >C35-44	260000 ^c / 270000 ^c / 270000 ^c	45000 ^c / 64000 ^c / 76000 ^c	-	1600000 ^c / 1800000 ^c / 1800000 ^c
TPH Aromatic >C5-7 (benzene)	13 ^c / 27 ^c / 57 ^c	65 ^c / 130 ^c / 280 ^c	-	28000 ^c / 49000 ^c / 90000 ^c
TPH Aromatic >C7-8 (toluene)	22 ^c / 51 ^c / 120 ^c	120 ^c / 270 ^c / 611 ^c	-	59000 ^c / 110000 ^c / 190000 ^c
TPH Aromatic >C8-10	8.6 ^c / 21 ^c / 51 ^c	27 ^c / 65 ^c / 151 ^c	-	3700 ^c / 8600 ^c / 18000 ^c
TPH Aromatic >C10-12	13 ^c / 31 ^c / 74 ^c	69 ^c / 160 ^c / 346 ^c	-	17000 ^c / 29000 ^c / 34500 ^c
TPH Aromatic >C12-16	23 ^c / 57 ^c / 130 ^c	140 ^c / 310 ^c / 593 ^c	-	36000 ^c / 37000 ^c / 37800 ^c
TPH Aromatic >C16-21	46 ^c / 110 ^c / 260 ^c	250 ^c / 480 ^c / 770 ^c	-	28000 ^c / 28000 ^c / 28000 ^c
TPH Aromatic >C21-35	370 ^c / 820 ^c / 1600 ^c	890 ^c / 1100 ^c / 1230 ^c	-	28000 ^c / 28000 ^c / 28000 ^c
TPH Aromatic >C35-44	370 ^c / 820 ^c / 1600 ^c	890 ^c / 1100 ^c / 1230 ^c	-	28000 ^c / 28000 ^c / 28000 ^c
TPH Aliphatic + Aromatic >C44-70	1200 ^c / 2100 ^c / 3000 ^c	1200 ^c / 1300 ^c / 1300 ^c	-	28000 ^c / 28000 ^c / 28000 ^c
Chlorinated Hydrocarbons (1%, 2.5% and 6% SOM)^d				
1,2-dichloroethane	0.0046 ^c / 0.0083 ^c / 0.016 ^c	0.0054 ^c / 0.0080 ^c / 0.014 ^c	-	0.71 ^c / 1.0 ^c / 1.8 ^c
1,1,1 Trichloroethane (TCA)	48 ^c / 110 ^c / 240 ^c	6.2 ^c / 13 ^c / 28 ^c	-	700 ^c / 1400 ^c / 3100 ^c
1,1,1,2 Tetrachloroethane	0.79 ^c / 1.9 ^c / 4.4 ^c	0.90 ^c / 2.1 ^c / 4.8 ^c	-	120 ^c / 260 ^c / 590 ^c
1,1,2,2 Tetrachloroethane	0.41 ^c / 0.89 ^c / 2.0 ^c	1.4 ^c / 2.9 ^c / 6.3 ^c	-	290 ^c / 580 ^c / 1200 ^c
Tetrachloroethene (PCE)	1.6 ^c / 3.7 ^c / 8.7 ^c	0.94 ^c / 2.1 ^c / 4.8 ^c	-	130 ^c / 290 ^c / 660 ^c
Tetrachloromethane	0.16 ^c / 0.37 ^c / 0.85 ^c	0.018 ^c / 0.039 ^c / 0.089 ^c	-	3.0 ^c / 6.6 / 15 ^c
Trichloroethene (TCE)	0.43 ^c / 0.95 ^c / 2.2 ^c	0.11 ^c / 0.22 ^c / 0.49 ^c	-	12 ^c / 25 ^c / 55 ^c
Trichloromethane/Chloroform	0.36 ^c / 0.70 ^c / 1.5 ^c	0.75 ^c / 1.3 ^c / 2.7 ^c	-	110 ^c / 190 ^c / 370 ^c
Vinyl Chloride/Chloroethene	0.00055 ^c / 0.0010 ^c / 0.0018 ^c	0.00047 ^c / 0.00064 ^c / 0.00099 ^c	-	0.063 ^c / 0.081 ^c / 0.12 ^c
Pesticides and Other Organic Compounds (1%, 2.5% and 6% SOM)^d				
Aldrin	1.3 ^c / 2.6 ^c / 4.0 ^c	1.7 ^c / 2.0 ^c / 2.1 ^c	-	54 ^c / 54 ^c / 54 ^c
Atrazine	0.037 ^c / 0.085 ^c / 0.2 ^c	0.24 ^c / 0.56 ^c / 1.3 ^c	-	870 ^c / 880 ^c / 880 ^c
Dichlorvos	0.044 ^c / 0.091 ^c / 0.20 ^c	0.29 ^c / 0.6 ^c / 1.3 ^c	-	842 ^c / 872 ^c / 893 ^c
Dieldrin	0.13 ^c / 0.32 ^c / 0.73 ^c	0.69 ^c / 1.4 ^c / 2.2 ^c	-	90 ^c / 91 ^c / 92 ^c
Endosulfan	0.47 ^c / 1.2 ^c / 2.7 ^c	2.9 ^c / 7.0 ^c / 16 ^c	-	2310 ^c / 2990 ^c / 3390 ^c
Carbon Disulphide	4.8 ^c / 10 ^c / 23 ^c	0.10 ^c / 0.20 ^c / 0.44 ^c	-	12 ^c / 23 ^c / 50 ^c
Chlorobenzene	5.9 ^c / 14 ^c / 32 ^c	0.33 ^c / 0.73 ^c / 1.7 ^c	-	59 ^c / 130 ^c / 310 ^c
Hexachloro-1,3-butadiene	0.25 ^c / 0.61 ^c / 1.4 ^c	0.21 ^c / 0.51 ^c / 1.2 ^c	-	32 ^c / 69 ^c / 120 ^c
Hexachlorobenzene	0.18 ^c / 0.42 ^c / 0.92 ^c	0.59 ^c / 1.0 ^c / 1.4 ^c	-	48 ^c / 53 ^c / 55 ^c
Pentachlorobenzene	1.2 ^c / 3.1 ^c / 7.1 ^c	5.2 ^c / 10 ^c / 17 ^c	-	650 ^c / 770 ^c / 830 ^c
Pentachlorophenol	0.084 ^c / 0.21 ^c / 0.49 ^c	0.55 ^c / 1.3 ^c / 2.96 ^c	-	1200 ^c / 1300 ^c / 1400 ^c
Phenol (1, 3, 6% SOM)	66 ^f / 158 ^f / 280 ^a	184 ^f / 316 ^f / 420 ^a	310 ^f / 441 ^f / 519 ^f	3200 ^a
Dioxins, Furans and dioxin-like PCBs	8 ^a	8 ^a		240 ^a

Notes

Units mg/kg

most conservative of the three isomers selected for each scenario

a Soil Guideline Value (2009) with SOM of 6%

b Soil Guideline Value (2002)

c Generic Assessment Criteria (LQM & CIEH 2009)

d Where three values are presented, SGV/GAC for soils with SOM of 1%, 2.5% and 6% or 1%, 3% and 6% are given as detailed in the table. SOM denotes Soil Organic Matter.

f Generic Assessment Criteria generated using CLEA v 1.04 by an independent contaminated land working group and independently verified by PBA (CLSD, 2009)

Rationale for Generic Assessment Criteria Routinely Used by PBA

Table 2 Tier 2 Screening Criteria for the Assessment of Potential Contaminant Concentrations in Soil – Protection of Ecological Systems

Protection of Ecological Systems					
	ICRCL 70/90 ^a			Proposed SSVs ^b	Code of Practice for Agricultural Use of Sewage Sludge ^c
Parameter	Threshold ^d	Maximum			
		Livestock	Crop Growth		
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Benzo(a)pyrene				0.15	
Arsenic	50	500	1000		50
Cadmium	3	30	50	1.15	3
Chromium				21.1	400
Copper	250	500	250	88.4	80/ 100/ 135/ 200 ^e
Fluoride	500	1000			500
Lead	300	1000		167.9	300
Mercury				0.06	1
Molybdenum					4
Nickel				25.1	50/ 60/ 75/ 110 ^e
Pentachlorobenzene				0.029	
Pentachlorophenol				0.6	
Selenium					3
Tetrachloroethene				0.01	
Toluene				0.3	
Zinc	1000	3000	1000	90.1	200/ 200/ 200/ 300 ^e

Notes

- Interdepartmental Committee on the Redevelopment of Contaminated Land (ICRCL) 70/90 Restoration and Aftercare of Metalliferous Mining Sites for Pasture and Grazing 1st edition 1990.
- Proposed Soil Screening Values (SSVs) – Consultation, Environment Agency 2008. Threshold which if exceeded prompts further assessment.
- Maximum permissible concentration of potentially toxic elements from the Code of Practice for Agricultural Use of Sewage Sludge. Second Edition. DOE 1993.
- Concentrations are for contamination derived from mine spoil. In other situations the speciation may be more available. Factors include total concentration, speciation, particle size, pH, species of plant, type of animal/grazing habit.
- Where four values are presented, concentrations are for soils with pH values 5.0-5.5/ 5.5-6.0/ 6.0-7.0/ >7.0

Rationale for Generic Assessment Criteria Routinely Used by PBA

Table 3: Tier 2 Criteria for Screening Selected Contaminants in Groundwater

Parameter	Protection of Human Health	Protection of Controlled Waters			
	Water Supply (Water Quality) Regulations 2000	Test 2 Minimum	Test 2 Maximum	Test 4	Test 5
Metal/Semi Metal:					
Antimony (µg/l)	5				
Arsenic (µg/l)	10	51.6	199	7.5	
Boron (µg/l)	1000			750	
Cadmium (µg/l)	5	0.2	1.1	3.75	
Chromium (µg/l)	50	5	27.6	37.5	
Copper (µg/l)	2000	10.1	57.8	1500	
Iron (µg/l)	200				
Lead (µg/l)	25 (10 from 25/12/13)	7.3	39.8	18.8	
Manganese (µg/l)	50				
Mercury (µg/l)	1			0.75	
Nickel (µg/l)	20	20.2	116	15	
Selenium (µg/l)	10				
Zinc (µg/l)	-	75.8	414	3750	
Other:					
Ammonium NH ₄ (mg/l)	0.5				
Ammonia NH ₃ (mg/l)	-	0.3	1.73	0.29	0.29
Chloride (mg/l)	250			188	187.5
Cyanide (mg/l)	50				
Electrical Conductivity (µS/cm)	2500			1880	
pH (pH units)	6.5 to 10				
Nitrate (mg/l)	50			42	42
Sulphate (mg/l)	250			188	188
Organics:					
Anthracene		0.1	0.55		
Benzene (µg/l)	1	10.1	55.2	0.75	0.75
Benzo(a)pyrene (µg/l)	0.01			0.075	
Chloroform (µg/l)	100 a	2.53	13.8	75	75
1,2-Dichloroethane (µg/l)	3			2.25	2.25
Fluoranthene		0.1	0.6		
Naphthalene (µg/l)	-	2.4	13.2		
Phenol Total (mg/l)	0.5	15.2	82.8		
PAHs (µg/l)	0.1 b				
Toluene (µg/l)	-	50.5	276		
Trichloroethene TCE (µg/l)	10 c	10.1	55.2	7.5	7.5
Tetrachloroethene PCE (µg/l)	10 c	10.1	57.8	7.5	7.5
Vinyl Chloride (µg/l)	0.5				
Xylene (µg/l)	-	30.3	166		

Notes

- TV Threshold Values for each groundwater body are given in the River Basin Management Plans
- Test 2 Groundwater Impacts on Surface Water
- Test 4 Groundwater Drinking Water Protected Areas – designed to be equivalent to a 95% standard
- Test 5 General Quality of Groundwater Body – designed to be equivalent to a 95% standard
 - a. Sum for Trihalomethanes – chloroform, bromoform, dibromochloromethane, bromodichloromethane
 - b. Concentration for sum of benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(ghi)perylene, indeno(1,2,3-cd)pyrene
 - c. Sum of TCE and PCE

Rationale for Generic Assessment Criteria Routinely Used by PBA

Table 4: Surface Waters - Specific Pollutants – Standards for Ecological Status

Pollutant	Rivers and Freshwater Lakes	Transitional and Coastal Waters
2,4-Dichlorophenoxyacetic acid (2,4-D)	0.3 (1.3)*	0.3 (1.3)*
2,4-Dichlorophenol	20	20
Ammonia (Un-ionised) as Nitrogen	Not applicable	21
Arsenic #	50	25
Chlorine (total available)	2 (5)*	(10)*
Chromium VI	3.4	0.6 (32)*
Chromium III	4.7	(32)*
Copper – standard is hardness dependant for freshwater	1 (CaCO ₃ <50mg/l) 6 (CaCO ₃ 50-<100mg/l) 10 (CaCO ₃ 100-<250mg/l) 28 (CaCO ₃ >250mg/l)	5
Cyanide	1 (5)*	1 (5)*
Cypermethrin as ng/l	0.1 (0.4)*	0.1 (0.4)*
Diazinon	0.01 (0.02)*	0.01 (0.1)*
Dimethoate	0.48 (4)*	0.48 (4)*
Iron as mg/l	1	1
Linuron	0.5 (0.9)*	0.5 (0.9)*
Mecoprop	18 (187)*	18 (187)*
Permethrin	(0.01)	(0.01)
Phenol	7.7 (46)*	7.7 (46)*
Toluene	50 (380)*	40 (370)*
Zinc – standard is hardness dependant for freshwater	8 (CaCO ₃ <50mg/l) 50 (CaCO ₃ 50-<100mg/l) 75 (CaCO ₃ 100-<250mg/l) 125 (CaCO ₃ >250mg/l)	40

- All units ug/l unless otherwise stated.
- The standard is the annual mean standard over a period of 12 consecutive months unless otherwise stated.
- () indicates that this is the 95-percentile standard where the standard is failed if the measured concentration is above the standard for 5% or more of the time.
- * indicates that the standard is not to be used for the purpose of classifying the ecological status or potential of bodies of surface water.
- # indicates that the standard is the dissolved fraction obtained by filtration through a 0.45um filter.

Reproduced from Part 4 of The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) (England and Wales) Direction 2009.

Table 5: Surface Waters - Priority Substances – Standards for Chemical Status

Pollutant	Annual Average		Maximum Allowable Concentration	
	Inland	Other	Inland	Other
Alachlor	0.3	0.3	0.7	0.7
Anthracene	0.1	0.1	0.4	0.4
Atrazine	0.6	0.6	2.0	2.0
Benzene	10	8	50	50
Brominated diphenylether	0.0005	0.0002	NA	NA

Rationale for Generic Assessment Criteria Routinely Used by PBA

Pollutant	Annual Average		Maximum Allowable Concentration	
	Inland	Other	Inland	Other
Cadmium (and its compounds) # – hardness dependant – refer to Notes for definitions of C1 to C5	<0.08 C1 0.08 C2 0.09 C3 0.15 C4 0.25 C5	0.2	<0.45 C1 0.45 C2 0.6 C3 0.9 C4 1.5 C5	<0.45 C1 0.45 C2 0.6 C3 0.9 C4 1.5 C5
Carbon tetrachloride	12	12	NA	NA
C10-13 Chloroalkanes	0.4	0.4	1.4	1.4
Chlorfenvinphos	0.1	0.1	0.3	0.3
Chlorpyrifos	0.03	0.03	0.1	0.1
Aldrin, Dieldrin, Endrin, Isodrin (Sum)	0.01	0.005	NA	NA
DDT Total	0.025	0.25	NA	NA
Para-para-DDT	0.01	0.01	NA	NA
1,2-Dichloroethane	10	10	NA	NA
Dichloromethane	20	20	NA	NA
Di(2-ethylhexyl)-phthalate (DEHP)	1.3	1.3	NA	NA
Diuron	0.2	0.2	1.8	1.8
Endosulfan	0.005	0.005	0.01	0.01
Fluoranthene	0.1	0.1	1	1
Hexachlorobenzene	0.01	0.01	0.05	0.05
Hexachlorobutadiene	0.1	0.1	0.6	0.6
Hexachlorocyclohexane	0.02	0.002	0.04	0.02
Isoproturon	0.3	0.3	1	1
Lead (and its compounds) #	7.2	7.2	NA	NA
Mercury (and its compounds) #	0.05	0.05	0.07	0.07
Naphthalene	2.4	1.2	NA	NA
Nickel (and its compounds) #	20	20	NA	NA
Nonylphenol	0.3	0.3	2	2
Octylphenol	0.1	0.01	NA	NA
Pentachlorobenzene	0.007	0.0007	NA	NA
Pentachlorophenol	0.4	0.4	1	1
Benzo(a)pyrene	0.05	0.05	0.1	0.1
Benzo(b)fluoranthene + Benzo(k)fluoranthene	0.03	0.03	NA	NA
Benzo(ghi)perylene + Indeno(1,2,3-cd)pyrene	0.002	0.002	NA	NA
Simazine	1	1	4	4
Tetrachloroethylene	10	10	NA	NA
Trichloroethylene	10	10	NA	NA
Tributyl tin compounds	0.0002	0.0002	0.0015	0.0015
Trichlorobenzenes	0.4	0.4	NA	NA
Trichloromethane	2.5	2.5	NA	NA
Tifluralin	0.03	0.03	NA	NA

- The EQS are expressed as total concentrations in the whole water sample except for #.
- # indicates that the EQS is dissolved concentration obtained by filtration through 0.45um filter.
- Inland = surface waters encompassing rivers and lakes and related artificial or heavily modified water bodies.
- Hardness Classifications C1 <40 mg CaCO₃/l, C2 40 to <50 mg CaCO₃/l, C3 50 to <100 mg CaCO₃/l, C4 100 to <200 mg CaCO₃/l, C5 200 mg CaCO₃/l.

Reproduced from Part 5 of The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) (England and Wales) Direction 2009.

1 Introduction

This document defines the approach adopted by PBA in relation to the assessment of potentially contaminated land. The aim is for the approach to (i) be systematic and objective, (ii) provide for the assessment of uncertainty and (iii) provide a rational, consistent, transparent framework.

When preparing our methodology we have made reference to various technical guidance documents including the Model Procedures for the Management of Contamination (CLR 11) (EA 2003), Contaminated Land investigation, assessment and remediation (ICE 2007), Guidance for the Safe Development of Housing on Land Affected by Contamination (R&D Publication 66) (EA/NHBC/CIEH 2008) and Contaminated land risk assessment: A guide to good practice (C552) (CIRIA 2001).

2 Part 2A, Planning & Building Control

UK legislation aims to help address the problem of historic contamination of land and the risks it can pose to people's health and the environment. The legislation allows for required remediation and voluntary remediation through the planning system.

2.1 Part 2 A

The Environment Act 1995 introduced Part IIA into the Environmental Protection Act 1990. Part IIA, its accompanying regulations and Statutory Guidance contained in DETR Circular 02/2000 came into force in England in April 2000.

Part IIA defines contaminated land as *"land which appears to the Local Authority in whose area it is situated to be in such a condition that, by reason of substances in, on or under the land that significant harm is being caused, or there is a significant possibility that such harm could be caused, or pollution of controlled waters is being, or likely to be, caused"*.

Harm is defined as *"harm to the health of living organisms or other interference with the ecological systems of which they form part, and in the case of man, includes harm to his property"*.

The legislation was extended in August 2006 to include radiological hazards (now referred to as Part 2A). For the purposes of Part 2A land is contaminated if it poses a significant possibility of significant harm (SPOSH). Statutory guidance is given in Defra Circular 01/2006. Non statutory guidance on the legal definition of contaminated

land is given in Defra 2008 and para 18 states *"the law takes a risk-based approach because it is the only way in which it can, at least in principle, target land where there is SPOSH, whilst avoiding the disproportionate effects of catching land where there is no SPOSH. It also helps focus remediation on reducing risks, rather than the removal of contaminants from soil irrespective of risk (which would in some cases be unsustainable and unnecessary)"*.

2.2 Planning

The Local Planning Authority (LPA) is responsible under various Planning Acts for the control of development, and in doing so, it has a duty to take account of all material considerations, including contamination. "Planning Policy Statement 23 Planning & Pollution Control (ODPM 2004); and Annex 2: Development on Land Affected by Contamination" expands on the policy considerations the Government expects Local Planning Authorities (LPA) to have in regard to land affected by contamination when preparing policies for development plans and in taking decisions on applications. This PPS applies in England only.

For planning purposes, PPS23 states that the assessment of risks arising from contamination and remediation requirements should be considered on the basis of the current environmental setting, the current land use, and the circumstances of its proposed new use. In most other respects, however, the underlying approach to identifying and dealing with risk, and the overall policy objective of safeguarding human health and the environment, are similar to that outlined in Part 2A.

A wider range of contamination and receptors is relevant to planning because of its wider spatial perspective, but the degree of harm or pollution relevant to planning and the approach to remediation are essentially the same: i.e. unacceptable risk in planning terms includes the risks addressed by Part 2A. The developer is required to ensure that land, after development, is not capable of being determined as contaminated land under Part IIA of the EPA 1990 and that all unacceptable risks have been addressed.

The principal planning objective is to ensure that any unacceptable risks to human health, buildings and other property and the natural and historical environment from the contaminated condition of the land are identified so that appropriate action can be considered and taken to address those risks. In order to grant a planning permission the Local Planning Authority (LPA) has to be satisfied that there is sufficient information about the

condition of the land, its impacts and the availability of viable remedial options.

It should be noted that PPS23 states because of the widespread potential occurrence of contamination, the possibility should always be considered, regardless of past land use, when development is proposed involving or introducing a particularly sensitive use (housing, schools, hospitals, play areas).

2.3 Building Control

The building control department of the local authority (along with the private sector approved inspectors) are responsible for the operation and enforcement of the Building Regulations 2000 to protect the health, safety and welfare of people in and around buildings.

Building Control Regulations Approved Document C specifically requires the protection of buildings and associated land from the effects of contamination, to be applied (non-exclusively) in all changes of use from commercial or industrial premises, to residential property.

3 Approach

PPS 23 refers to CLR 11 which recommends a phased or tiered approach to risk assessment with the three tiers being:-

- Tier 1 - preliminary – a qualitative assessment forming part of a Phase 1 report,
- Tier 2 - generic - a quantitative assessment using published criteria to screen site specific ground condition data forming part of a Phase 2 report
- Tier 3 - detailed – a quantitative assessment involving the generation of site specific assessment criteria

Each tier of risk assessment comprises the following four stages:-

1. Hazard Identification – identifying potential contaminant sources on and off site;
2. Hazard Assessment – assessing the potential for unacceptable risks by identifying what pathways and receptors could be present, and what pollutant linkages could result (forming the Conceptual Site Model (CSM));
3. Risk Estimation – estimating the magnitude and probability of the possible consequences (what degree of harm might result to a defined receptor and how likely); and
4. Risk Evaluation – evaluating whether the risk needs to be, and can be, managed.

A PBA Phase 1 report normally comprises a desk study, walkover and Tier 1 risk assessment (the project specific offer defines the actual scope of

work). At Tier 1 the PBA approach to risk estimation involves identifying the magnitude of the potential consequence (taking into account both the potential severity of the hazard and the sensitivity of the receptor) and the magnitude of the likelihood i.e. the probability (taking into account the presence of the hazard and the receptor and the integrity of the pathway). This approach is promoted in current guidance such as R&D 66 (NHBC 2008).

The PBA approach is that if a pollution linkage is identified then it represents a potential risk which requires further consideration and either (1) remediation / direct risk management or (2) further tiers of assessment.

A PBA preliminary Phase 2 report comprises an intrusive investigation to collect site specific information, a Tier 2 quantitative generic risk assessment and a refinement of the CSM using the site specific data. Depending on the findings further investigation and/or progression to Tier 3 risk assessment and the generation of site specific assessment criteria may be required.

The PBA methodology provides an estimate of the level of risk, it does not identify a risk level at which the risk is considered "significant" and/or "unacceptable" as this is dependant on the view of the individual / stakeholder. For example; to a risk adverse stakeholder even a risk level of "very low" may be considered unacceptable and as such this stakeholder may require risk management options to be implemented.

4 Identification of Pollutant Linkages and Conceptual Site Model (CSM)

For all Tiers the underlying principle to ground condition assessment is the identification of *pollutant linkages* in order to evaluate whether the presence of a source of contamination could potentially lead to harmful consequences. A pollutant linkage consists of the following three elements:-

- A source/hazard – a substance or situation which has the potential to cause harm or pollution;
- A pathway – a means by which the hazard moves along / generates exposure; and
- A receptor/target – an entity which is vulnerable to the potential adverse effects of the hazard.

The *Conceptual Site Model* identifies the types and locations of potential contaminant sources/hazards and potential receptors and potential migration/transportation pathway(s). The

CSM is refined as the assessment progresses through the Tiers.

4.1 Hazard Identification

A hazard is a substance or situation that has the potential to cause harm. Hazards may be chemical, biological or physical (e.g. explosive gases).

At Tier 1 the potential for hazards to be present is determined from consideration of the previous or ongoing activities on or near to the site in accordance with the criteria presented in the **Table 1**.

Based on the land use information Potential Contaminants of Concern (PCOC) are identified. The PCOC direct the scope of the analytical testing selected for subsequent Tiers and the collection of site specific data.

At Tier 2 the site specific data is screened using published assessment criteria (refer to PBA document entitled Rationale for the Selection of Tier 2 Assessment Criteria). In general, published criteria have been developed using highly conservative assumptions and therefore if the criterion is not exceeded then the PCOC is eliminated as a potential Hazard. It should be noted that exceedance does not necessarily indicate that a site is contaminated and/or unsuitable for use only that the PCOC is retained as a potential Hazard. Published criteria are generated using models based on numerous and complex assumptions. The appropriateness of these assumptions in a site-specific context requires confirmation on a project by project basis.

4.2 Receptor and Pathway Identification

For all Tiers the potential receptors (for both on site and adjoining land) that will be considered are:

- Human Health – including current and future occupiers, construction and future maintenance workers, and neighbouring properties/third parties;
- Ecological systems; ^{*1}
- Controlled waters ^{*2} – including surface water and groundwater;
- Property, Animal or Crop (existing or proposed) - including buildings, service lines and pipes, crops, livestock, pets, woodland; and
- Archaeological sites and ancient monuments.

^{*1} Internationally or nationally designated sites (as defined in the statutory guidance (Draft Circular on Contaminated Land, DETR, 2000)) "in the local area" will be identified as potential ecological receptors. A search radius of 1, 2 or 5km will be utilised depending on the site specific circumstances (see also pathway identification). The Environment Agency has published an ecological risk assessment framework (EA 2008) which promotes (as opposed to statutorily enforces)

consideration of additional receptors to include locally protected sites and protected or notable species. These additional potential receptors will only be considered if a Phase 1 habitat survey, undertaken in accordance with guidance (JNCC 1993), is commissioned and the data provided to PBA. It should be noted that without such a survey the Tier 1 risk assessment may conclude that the identification of potential ecological receptors is inconclusive (see Specification).

^{*2} the definition of "pollution of controlled water" has been amended by the introduction of Section 86 of the Water Act 2003. For the purposes of Part 2A groundwater does not include waters above the saturated zone and our assessment does not therefore address perched water other than where development causes a pathway to develop.

If a receptor is taken forward for further assessment it will be classified in terms of its sensitivity, the criteria for which are presented in **Table 2**. Table 2 has been generated using descriptions of environmental receptor importance/value given in various guidance documents including R&D 66 (NHBC 2008) and Transport Analysis Guidance (based on DETR 2000). Human health and buildings classifications have been generated by PBA using the attribute description for each class.

The exposure pathway and modes of transport that will be considered are presented in **Table 3**.

4.3 Note regarding Ecological Systems

The Environment Agency (EA) has developed an ecological risk assessment framework which aims to provide a structured approach for assessing the risks to ecology from chemical contaminants in soils (EA 2008). In circumstances where contaminants in water represent a potential risk to aquatic ecosystems then risk assessors will need to consider this separately.

The framework consists of a three tiered process:-

- Tier 1 is a screening step where the site soils chemical data is compared to a soil screening value (SSV)
- Tier 2 uses various tools (including surveys and biological testing) to gather evidence for any harm to the ecological receptors
- Tier 3 seeks to attribute the harm to the chemical contamination

Tier 1 is preceded by a desk study to collate information about the site and the nature of the contamination to assess whether pollutant linkages are feasible. The framework presents ten steps for ecological desk studies and development of a conceptual site model as follows.

- 1 Establish Regulatory Context
- 2 Collate and Assess Documentary Information
- 3 Summarise Documentary Information
- 4 Identify Potential Contaminants of Concern

- 5 Identify Likely Fate Transport of Contaminants
- 6 Identify Potential Receptors of Concern
- 7 Identify Potential Pathways of Concern
- 8 Create a Conceptual Site Model
- 9 Identify Assessment and Measurement Endpoints
- 10 Identify Gaps and Uncertainties

The information in a standard PBA Phase 1 report covers Steps 1 to 4 inclusive. Step 5 considers fate and transport of contaminants and it should be noted that our standard report adopts a simplified approach considering only transport mechanisms. A simplified approach has also been adopted in respect of Steps 6 and 7 (receptors (a detailed review of the ecological attributes has not been undertaken) and pathways (a food chain assessment has not been undertaken). Step 9 is outside the scope of our standard Phase 1 report.

The Tier 1 prepared by PBA as part of a Phase 1 report will assess the viability of the mode of transport given the site specific circumstances not specific pathways. As with receptor identification it should be noted that without a habitat survey the Tier 1 risk assessment may conclude that the risk to potential ecological receptors is inconclusive (see PBA Specification for Phase 1 Assessment of Potentially Contaminated Land).

5 Risk Estimation

Risk estimation classifies what degree of harm might result to a receptor (defined as consequence) and how likely it is that such harm might arise (probability).

At Tier 1 the consequence classification is generated by multiplying the hazard classification score and the receptor sensitivity score. This approach follows that presented in the republished R&D 66 (NHBC 2008).

The criteria for classifying probability are set out in **Table 4** and have been taken directly from CIRIA C552 (Table 6.4). Probability considers the integrity of the exposure pathway.

The consequence classifications detailed in **Table 5** have been adapted from Table 6.3 presented in C552 and R&D 66 (Annex 4 Table A4.3).

The Tier 1 risk classification is estimated for each pollutant linkage using the matrix given in **Table 6** which is taken directly from C552 (Table 6.5).

Subsequent Tiers refine the CSM through retention or elimination of potential hazards and pollutant linkages.

6 Risk Evaluation

In order to put the Tier 1 risk classification into context the likely actions are described in Table 7 which is taken directly from C552 (Table 6.6).

Subsequent Tiers identify potential risk management options through remediation and/or mitigation measures.

7 References

- CIRIA 2001: Contaminated land risk assessment – a guide to good practice C552.
- CIRIA 2008: Assessing risks posed by hazardous ground gases to buildings C655
- DETR 2000 Methodology for Multi Modal Studies. Volume 2 Section 4 The Environmental Objective.
- Defra Circular 02/2000
- Defra Circular 01/2006
- EA 2004: The Model Procedures for the Management of Land Contamination CRL 11 published by the Environment Agency (EA).
- EA/NHBC/CIEH 2008: R&D Publication 66 Guidance for the safe development of housing on land affected by contamination.
- EA 2008 Ecological Risk Assessment Science Report Series SC070009 published by the Environment Agency (EA).
- ICE 2007: Contaminated Land investigation, assessment and remediation prepared by the Institute of Civil Engineers (ICE)
- JNCC 1993 Handbook for Phase 1 Habitat Survey – A Technique for Environmental Audit prepared by the Joint Nature Conservancy Council (JNCC)
- ODPM 2004: Planning Policy Statement 23 (PPS 23): Planning and Pollution Control.
- ODPM 2004 Building Regulations 2000 Approved Document C Site preparation and resistance to contaminants and moisture

Table 1: Criteria for Classifying Hazards / Potential for Generating Contamination

Classification/Score	Potential for generating contamination/gas based on land use
Very Low 1	Land Use: greenfield Contamination: None. Gas generation potential : Inert Made Ground
Low 2	Land Use: residential, retail or office use, recent small scale industrial. Contamination: None or locally slightly elevated concentrations. Gas generation potential : Alluvium or dock silt
Moderate 3	Land Use: railways, collieries, scrap yards, light industry, engineering works. Contamination: Locally elevated concentrations. Gas generation potential : Pre 1960's landfill
High 4	Land Use: gas works, chemical works, heavy industry, non-hazardous landfills. Contamination: Possible widespread elevated concentrations. Gas generation potential : Shallow mine workings
Very High 5	Land Use: hazardous waste landfills. Contamination: Likely widespread elevated concentrations. Gas generation potential : Domestic landfill post 1960

Table 2: Criteria for Classifying Receptor Sensitivity/Value

Classification/Score	Definition
Very Low 1	Receptor of limited importance Groundwater: Non aquifer Surface water: GQA Grade F Ecology: No local designation Buildings: Replaceable Human health: Unoccupied/limited access
Low 2	Receptor of local or county importance with potential for replacement Groundwater: Secondary aquifer Surface water: GQA Grade D/E Ecology: local habitat resources Buildings: Local value Human health: Industrial
Moderate 3	Receptor of local or county importance with potential for replacement Groundwater: Principal aquifer Surface water: GQA Grade B/C Ecology: County wildlife sites, Areas of Outstanding Natural Beauty (AONB) Buildings: Area of Historic Character Human health: Commercial
High 4	Receptor of county or regional importance with limited potential for replacement Groundwater: Source Protection Zone 2 Surface water: GQA Grade A Ecology: SSSI, National or Marine Nature Reserve (NNR or MNR) Buildings: Conservation Area Human health: Open spaces and uses where children are present
Very High 5	Receptor of national or international importance Groundwater: Source Protection Zone 1 Surface water: GQA Grade A Ecology: Special Areas of Conservation (SAC and candidates), Special Protection Areas (SPA and potentials) or wetlands of international importance (RAMSAR) Buildings: World Heritage site Human health: Residential

Table 3: Exposure Pathway and Modes of Transport

Receptor	Pathway	Mode of transport
Human health	Ingestion	Fruit or vegetable leaf or roots
		Contaminated water
		Soil/dust indoors
		Soil/dust outdoors
	Inhalation	Particles (dust / soil) – outdoor
		Particles (dust / soil) - indoor
		Vapours – outdoor - migration via natural or anthropogenic pathways
		Vapours - indoor - migration via natural or anthropogenic pathways
	Dermal absorption	Direct contact with soil
		Direct contact with waters (swimming / showering)
		Irradiation
Groundwater	Leaching	Gravity / permeation
	Migration	Natural – groundwater as pathway Anthropogenic (e.g. boreholes, culverts, pipelines etc.)
Surface Water	Direct	Runoff or discharges from pipes
	Indirect	Recharge from groundwater
	Indirect	Deposition of wind blown dust
Buildings	Direct contact	Sulphate attack on concrete, hydrocarbon corrosion of plastics
	Gas ingress	Migration via natural or anthropogenic paths
Ecological systems	See Notes	Runoff/discharge to surface water body
	See Notes	Windblown dust
	See Notes	Groundwater migration
	See Notes	At point of contaminant source
Animal and crop	Direct	Wind blown or flood deposited particles / dust / sediments
	Indirect	Plants via root up take or irrigation. Animals through watering
	Inhalation	By livestock / fish - gas / vapour / particulates / dust
	Ingestion	Consumption of vegetation / water / soil by animals

Table 4: Classification of Probability

Classification	Definition
High likelihood	There is a pollution linkage and an event either appears very likely in the short-term and almost inevitable over the long-term, or there is already evidence at the receptor of harm / pollution.
Likely	There is a pollution linkage and all the elements are present and in the right place, which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short-term and likely over the long-term.
Low likelihood	There is a pollution linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such event would take place, and is less likely in the shorter-term.
Unlikely	There is a pollution linkage but circumstances are such that it is improbable that an event would occur even in the very long-term.

Table 6: Classification of Risk (Combination of Consequence and Probability)

Probability	Consequence			
	Severe	Medium	Mild	Minor
High likelihood	Very high	High	Moderate	Low
Likely	High	Moderate	Moderate/low	Low
Low likelihood	Moderate	Moderate/low	Low	Very low
Unlikely	Moderate/low	Low	Very low	Very low

Table 5: Classification of Consequence (score = magnitude of hazard and sensitivity of receptor)

Classification / Score	Examples
Severe 20-25	Human health effect - exposure likely to result in "significant harm". Significant harm to humans is defined in circular 01/2006 as death, disease, serious injury, genetic mutation, birth defects or impairment of reproductive function. Controlled water effect - short-term risk of pollution (note: Water Resources Act contains no scope for considering significance of pollution) of sensitive water resource. Equivalent to EA Category 1 incident (persistent and/or extensive effects on water quality leading to closure of potable abstraction point or loss of amenity, agriculture or commercial value. Major fish kill. Ecological effect - short-term exposure likely to result in a substantial adverse effect. Catastrophic damage to crops, buildings or property
Medium 10-16	Human health effect - exposure could result in "significant harm". Significant harm to humans is defined in circular 01/2006 as death, disease, serious injury, genetic mutation, birth defects or impairment of reproductive function. Controlled water effect - equivalent to EA Category 2 incident requiring notification of abstractor Ecological effect - short-term exposure may result in a substantial adverse effect. Damage to crops, buildings or property
Mild 6-9	Human health effect - exposure may result in "significant harm". Significant harm to humans is defined in circular 01/2006 as death, disease, serious injury, genetic mutation, birth defects or impairment of reproductive function. Controlled water effect - equivalent to EA Category 3 incident (short lived and/or minimal effects on water quality). Ecological effect - unlikely to result in a substantial adverse effect. Minor damage to crops, buildings or property. Damage to building rendering it unsafe to occupy (for example foundation damage resulting in instability).
Minor 1-5	No measurable effect on humans. Protective equipment is not required during site works. Equivalent to insubstantial pollution incident with no observed effect on water quality or ecosystems. Repairable effects to crops, buildings or property. The loss of plants in a landscaping scheme. Discolouration of concrete.

Table 7: Description of Risks and Likely Action Required

Risk Classification	Description
Very high risk	There is a high probability that severe harm could arise to a designated receptor from an identified hazard, OR, there is evidence that severe harm to a designated receptor is currently happening. This risk, if realised, is likely to result in a substantial liability. Urgent investigation (if not undertaken already) and remediation is likely to be required in the short term.
High risk	Harm is likely to arise to a designated receptor from an identified hazard. Realisation of the risk is likely to present a substantial liability. Urgent investigation (if not undertaken already) is required and remedial works may be necessary in the short-term and are likely over the longer-term.
Moderate risk	It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that any such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild. Investigation (if not already undertaken) is normally required to clarify the risk and to determine the potential liability. Some remedial works may be required in the longer-term.
Low risk	It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be mild.
Very low risk	There is a low possibility that harm could arise to a receptor. In the event of such harm being realised it is not likely to be severe.