

Environmental - Geotechnical - Laboratory - Foundations

Mr Neville Andrew
Hargreaves Property Ltd
Rustington House,
Worthing Road,
Rustington,
West Sussex.
BN16 3PS

Ref : In12963 CL 013

1st September 2014

Dear Neville,

Verification Groundwater Monitoring Works – Retail Trade Park Phase I, Solent Road, Havant

As you are aware, following the various remedial works completed at the Retail Trade Park (Phase I) development site off Solent Road in Havant, the Environment Agency have requested additional groundwater verification monitoring be completed at the site. Please find enclosed the results of groundwater verification sampling that we completed at the end of August 2014.

1.1 Permanent Monitoring Well Installations – Phase I Site Area

Following the installation of our remedial intercept trench network across the area of waste oil contamination that we had encountered at the north western end of the site, construction of the new Unit 1 building progressed throughout late 2013.

During the construction works all our previous monitoring wells were destroyed and we agreed locations for three permanent replacement wells with the Environment Agency, designed to allow long term monitoring of groundwater quality along the sites north western boundaries. The wells are located immediately north and west of the remedial trench system and are designed to assess groundwater quality at the hydraulic down-gradient boundary of the site.

We have also maintained the three sentinel groundwater monitoring wells (BH201 – 203) that we installed during 2013 in grass verge areas on the far side of Solent Road from the site, to assess the potential offsite migration of the previously identified shallow waste oil contamination.

Locations of the various wells and remedial sumps are provided as site plans attached to this letter.

1.2 Summary of Verification Monitoring – February 2014

We completed our initial verification groundwater monitoring visit to the site on the 24th February 2014. The results indicated a significant improvement in underlying groundwater quality at the site, with no detectable concentrations of hydrocarbons identified in any of the permanent monitoring wells we had installed. As before, no detectable concentrations of hydrocarbons were identified in any of the sentinel wells installed along Solent Road to the north.

On [REDACTED] the site as [REDACTED] force. Our [REDACTED]

1.3 Verification Monitoring Works – 20th August 2014

We returned to the site on the 20th August 2014 to complete a further round of groundwater verification monitoring. As before, we inspected each of the six permanent groundwater wells and obtained groundwater samples for chemical analysis, following suitable well development and purging.

A summary of our monitoring observations and subsequent chemical analysis are provided overleaf.

1.3.1 Groundwater Monitoring Data – 20th August 2014

Borehole	Groundwater Level	Depth to Base of Well	Comments
BH301	1.530	3.6	Water brown in colour. No hydrocarbon odours or sheen noted.
BH302	1.560	3.6	
BH303	1.395	4.2	Water light brown (chalky) in colour. No hydrocarbon odours or sheen noted.
BH201	1.205	2.90	Water light brown (chalky) in colour. No hydrocarbon odours or sheen noted
BH202	1.410	2.87	
BH203	1.40	2.71	Water brown in colour. No hydrocarbon odours or sheen noted

All dimensions in metres below ground level

Table One: Groundwater Monitoring Data, August 2014

1.3.2 Chemical Analysis Results – 20th August 2014

We have completed the following analysis on each of the representative groundwater samples we collected from the site:

- Total petroleum hydrocarbons (TPH) reported by carbon range – Representative of compounds present in diesel and waste oils, as previously identified under the north western corner of the Phase I site.

The results of the analyses are summarised below. Chemical Analysis Certificates are included in Attachment Two.

Sampling Location	Depth (m)	Total Petroleum Hydrocarbon Concentration (µg/l)				
		>C ₈ -C ₁₀	>C ₁₀ -C ₁₂	>C ₁₂ -C ₁₆	>C ₁₆ -C ₂₁	>C ₂₁ -C ₃₅
BH301	1.530	<10	<10	<10	<10	<10
BH302	1.560	<10	<10	<10	<10	<10
BH303	1.395	<20	<20	<20	<20	<20

Table Two: TPH Analysis Results – Groundwater, Onsite Monitoring Wells, August 2014

Sampling Location	Depth (m)	Total Petroleum Hydrocarbon Concentration (µg/l)				
		>C ₈ -C ₁₀	>C ₁₀ -C ₁₂	>C ₁₂ -C ₁₆	>C ₁₆ -C ₂₁	>C ₂₁ -C ₃₅
BH201	1.205	<20	<20	<20	<20	<20
BH202	1.410	<10	<10	<10	<10	<10
BH203	1.40	<10	<10	<10	<10	<10

Table Three: TPH Analysis Results – Groundwater, Sentinel Wells, August 2014

1.4 Conclusions

Our latest groundwater verification monitoring data confirms that the remedial works undertaken at the site as part of the redevelopment have been effective at removing the contamination (waste oil) source.

No detectable concentrations of total petroleum hydrocarbons have been identified in any of the permanent monitoring wells installed on the site and our sentinel well data again confirms that no offsite migration of hydrocarbons has occurred.

We consider the verification data we have obtained during 2014 to be sufficient to demonstrate that the remedial works completed at the site have been effective and that the site no longer poses a significant risk of impact to the adjacent Brockhampton Stream, or the underlying aquifer units. We would recommend that this letter report be submitted to Havant Borough Council and the Environment Agency by way of 'close-out' of any outstanding requirements for the site.

I trust the enclosed summary of works that we have completed and results of our monitoring are of interest. If you have any queries regarding any of the works we have completed, please contact me directly.

Yours Sincerely,

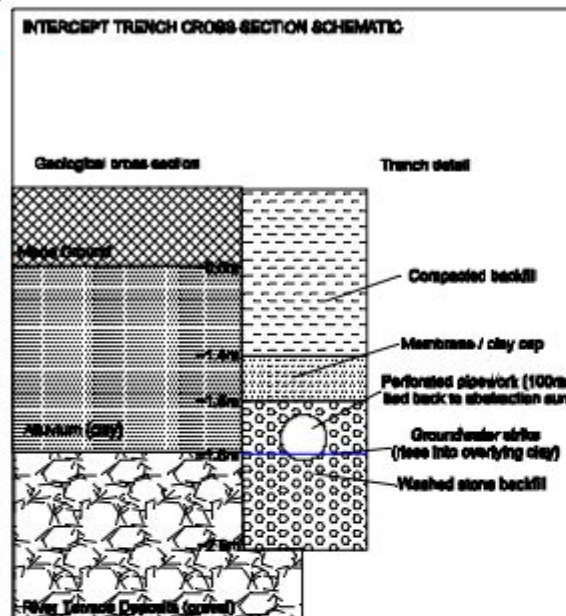
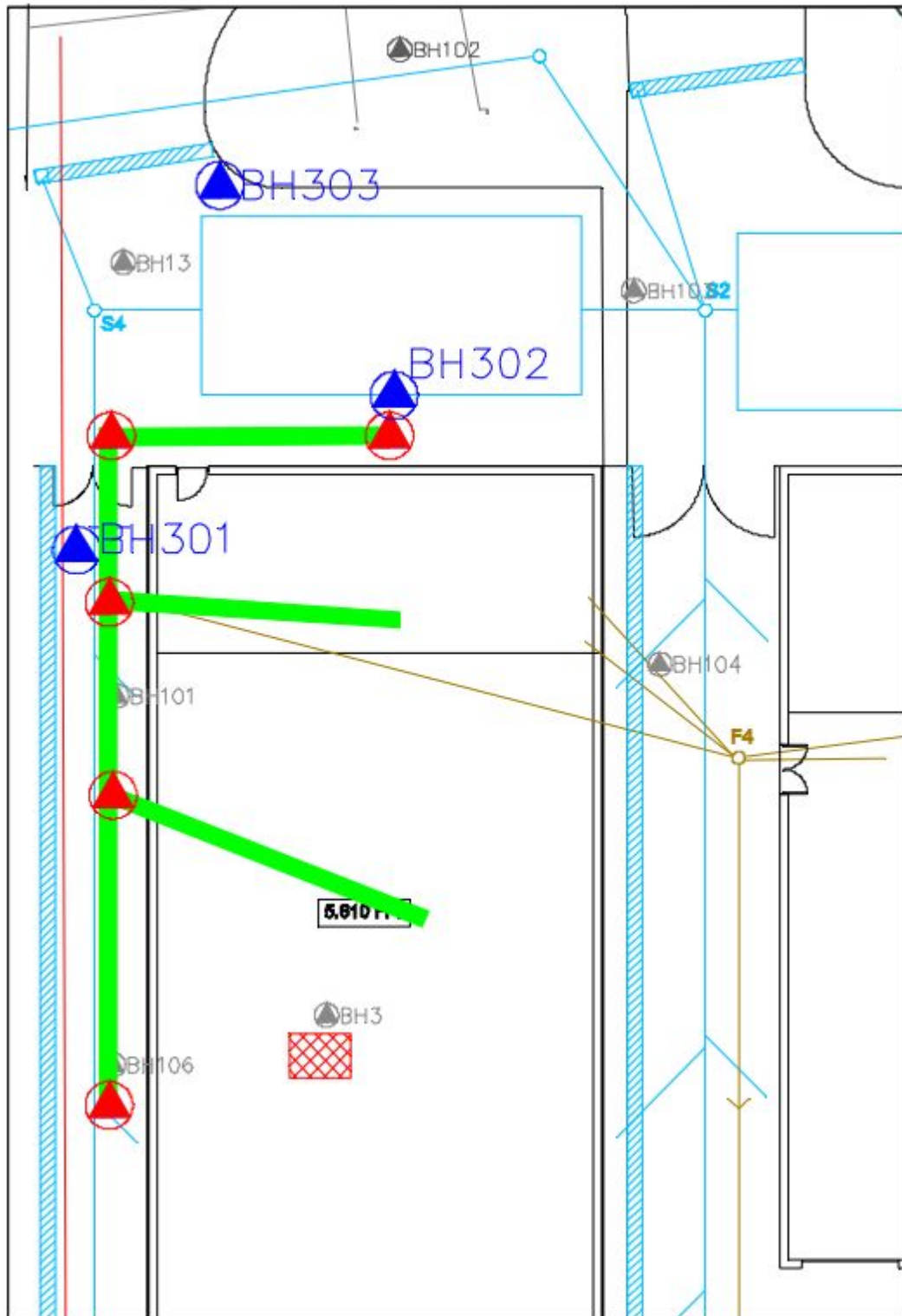


James Skinner

Subadra Consulting Limited

- Enc. Figure One – Remedial Trench and Well Locations
 Figure Two – Sentinel Well Locations
 Attachment One – Notice to Interested Parties
 Attachment Two – Chemical Analysis Certificates

FIGURES



SUBADRA

Unit 13, Triangle Business Park
Stoke Mandeville, Bucks HP22 6BL
Tel. 01296 739400 Fax. 01296 739401

Proposed Retail Trade Park - Phase I
Solent Road, Havant
PO9 1JH

DATE : February 2014

SUBADRA ARCHIVE NO : IN12963 DR 014

DRAWING BY : JS CHECKED BY : JE

KEY

- SURFACE DRAINAGE (PROPOSED)
- FOUL DRAINAGE (PROPOSED)
- 11Kva ELECTRICITY CABLE (EXISTING)
- ▣ Former oil tank location (approx)
- Intercept trench location (approx)
- Sump1 Recovery / treatment sump location
- ▲ BH301 Permanent groundwater monitoring well location - 2014
- BH3 2012 / 13 groundwater monitoring well location (approx)

**REMEDIAL TRENCH
AND WELL LOCATIONS**

FIGURE ONE

SUBADRA

Unit 13, Triangle Business Park
Stoke Mandeville, Bucks HP22 5BL
Tel. 01296 739400 Fax. 01296 739401

Retail Trade Park Development
Solent Road
Havant

DATE: Feb 2014 CHECKED: JE

SUBADRA ARCHIVE NO: In12963 DR 015

KEY

 Hargreaves Site Boundary

 BH1 Sentinel Monitoring Well

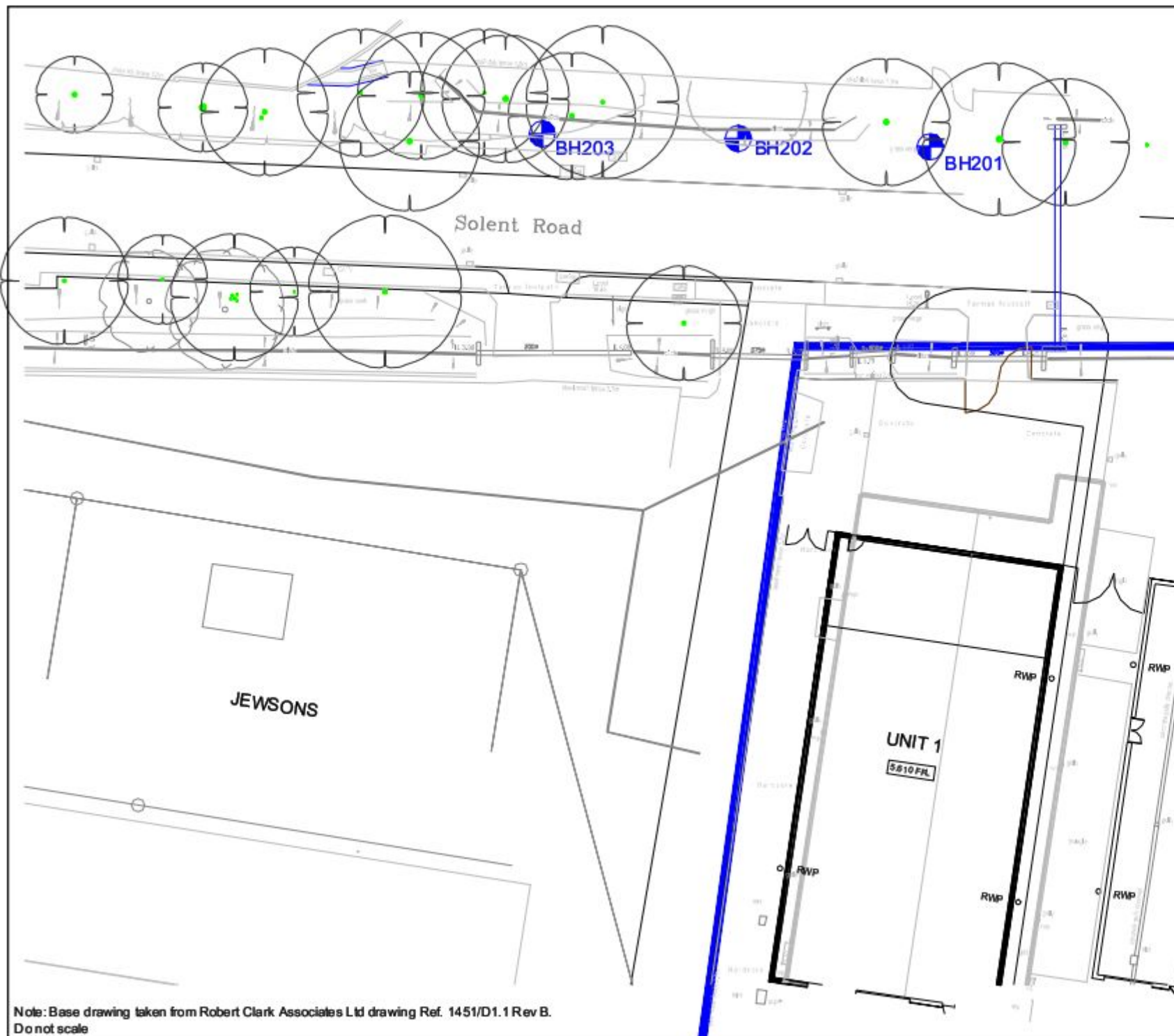
ABBREVIATIONS

NOTES

Electro-magnetic techniques have been used in the location of underground services. These results are not definitive, and to confirm service identification/location, trial excavations should be undertaken where these are critical. As reasonable effort has been made in searching available record drawings, the completeness of the underground service information cannot be guaranteed where services are non-metallic, options are taken from records, trench scans & surface data.

SENTINEL WELL
LOCATIONS

FIGURE TWO



Note: Base drawing taken from Robert Clark Associates Ltd drawing Ref. 1451/D1.1 Rev B.
Do not scale

ATTACHMENT ONE: NOTICE TO INTERESTED PARTIES

NOTICE TO INTERESTED PARTIES

The purpose of our site assessment is to provide general information on the environmental and/or geotechnical conditions existing at the site.

Where stated in this report, we have used information supplied by third parties. While we have evaluated as far as possible the validity of this information, we can not guarantee its accuracy in any way whatsoever.

No investigation technique is capable of completely identifying all of the contaminants that might be present in the soil or groundwater under a site. Where specified in our report, we have examined the ground by constructing a number of boreholes and/or trial pits. We recovered samples of soil and/or groundwater from available exposures. The depth and spacing of our sampling locations were selected to ensure with a reasonable probability that they would be representative of the actual conditions across the whole site.

Soil is, however, intrinsically variable and the spread of contaminants within the soil is therefore subject to a degree of non-uniformity. For these reasons no sampling technique can completely eliminate the possibility of obtaining samples that are not representative of the actual conditions. Our sampling techniques have simply reduced the possibility to an acceptable level.

Groundwater levels and soil vapour levels that we report were accurate at the time of the investigation. Groundwater and soil vapour levels are variable. Long term monitoring may be required to ensure that the levels recorded during our investigation are representative of long term and possible 'worst case' conditions.

We do not accept any responsibility for the cost of remedial works or other costs incurred in whatever way whatsoever as a result of any omissions, errors or other shortcomings in this report unless we have been given reasonable opportunity to verify ourselves that such faults exist and we have been given a reasonable opportunity to carry out works to remedy such faults ourselves using the most practicable means available to us. We do not accept liability for any consequential losses incurred by you while we carry out any remedial works we deem necessary.

This report has been prepared for Hargreaves Property Ltd. Use of, and reliance on, this report by other third parties will be at such third parties own risk, and we are unable to accept any liability or responsibility to third parties.

Neither the whole nor any part of this report, or any reference to it, may be included in any published document circular or statement or published in any way without our prior written approval.

This report and its contents, together with any supporting correspondence or other documentation, remain the property of Subadra Consulting Limited until paid for in full.

ATTACHMENT TWO: CHEMICAL ANALYSIS CERTIFICATES

Laboratory Analysis Report

Report Number 005274

Sampling Date 20th August 2014

Report Date 29th August 2014

Client	Site Name/Address
Hargreaves Properties Ltd Rustington House Worthing Road Rustington West Sussex BN16 3PS	Retail Trade Park

Number of Samples	Sample Type	Analysis Completed	Blind Testing	UKAS	MCERTS
7	Water	IH QM:E9.5 based on TNRCC 1005 by GC-FID	RTCorp	Yes	No

QM E9.5: IH TPH Banded method C8 - C35 - Solvent (pentane) extraction then Liquid injection into GC-FID.
Samples were received 22/08/14
Samples were prepared and analysed 22/08/14
Samples returned low CRF, LoRs have been raised accordingly.

Analysis Report Approved By

Katherine Clark
Duty Reporting Manager



Glossary of Terms Used in This Report

Blank - A sample known to contain none of the compounds being analysed, and used to confirm that the analytical instrument is not giving false positives during analysis.

Blind Testing: Name of any blind testing scheme participated in. The laboratory's accuracy is reported as a Z score; the lower the Z score the more accurate the analysis, with a score of less than 2 considered excellent.

CRM - Certified Reference Material. A sample prepared by an accredited source and containing a known concentration of a given compound or compounds, which can be used to validate an analysis method.

Duplicate - A duplicate sample, used to give a measure of the repeatability of a given analysis.

External Calibration - External calibration samples are samples containing a known concentration of the compounds being analysed. They are added to the analysis sequence after every nth sample being analysed and provide confirmation that the instrument remains within its calibration range.

Field Blank - Similar to a blank sample, except a field blank accompanies the samples throughout their existence (i.e. from the site being sampled to the laboratory) and used to provide a check that the samples aren't being cross-contaminated during the transportation/storage process.

IRM - In house reference material. A sample prepared by our laboratory and containing a known concentration of a given compound or compounds, which can be used to validate an analysis method.

Linearity - The linearity of a given analytical method is the range of concentrations between which the analytical instrument's response is directly proportional to the concentration being analysed, and hence the range of concentrations that the instrument can be said to give quantitative results.

LOD - Limit of detection. This is the lowest response for any given compound generated at the instrument's detector, that can be differentiated from the instrument's baseline noise.

LOQ - Limit of quantification. This is the lowest concentration that a given compound can be both detected and its concentration accurately measured in a sample.

MCERTS - An accreditation scheme created by the Environment Agency for the analysis of soil samples used to determine land quality. The scheme does not apply to analysis of soil samples used for waste classification purposes or to the analysis of water samples.

Method Calibration - The means by which an analytical method is calibrated. Usually this involves analysing a number of external calibration samples, containing different concentrations of the compounds to be analysed.

Precision - A measure of the repeatability of the analysis.

Sample - The material provided by the client to the laboratory for analysis.

Sensitivity - The smallest increment in analytical result that can be reliably quantified.

Spike - Also known as an internal calibration, a spike sample is a sample to be analysed which has a known concentration of another compound added. This provides a check on that the compounds being analysed are being correctly extracted from the sample matrix.

UKAS - The UK's implementation of ISO 17025, the international standard accreditation for laboratory analysis

Quality Control/Quality Assurance Information

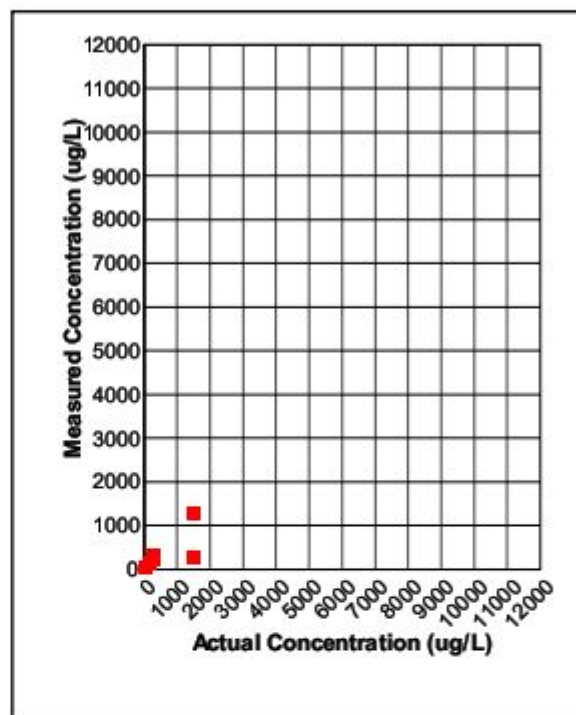
TPH Banded - Water

Our laboratory carries out a wide variety of verification analyses in order to ensure the validity of the analysis results we produce.

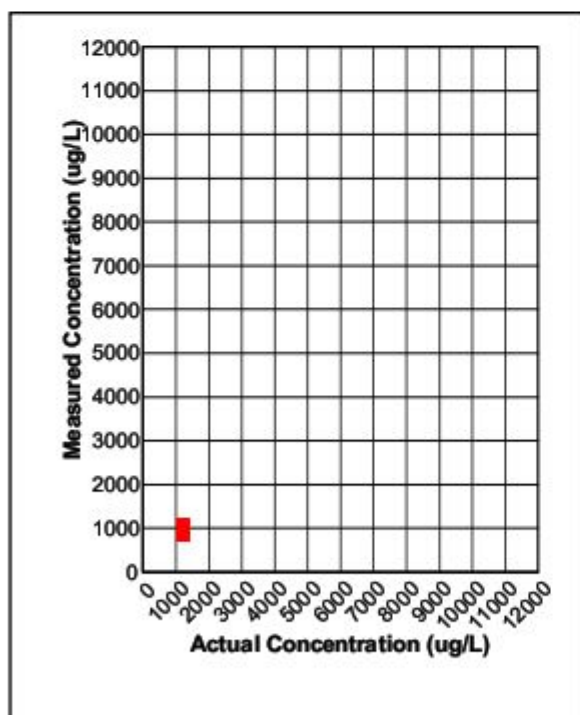
Samples are analysed in batches, usually according to the sample chain of custody form we receive. However, we also add additional samples into the sample sequence. These additional samples may include blanks, calibration samples, in-house reference material samples and duplicate samples. In addition to

this, each sample is 'spiked' with a known concentration of a compound. In the case of this analysis, we use a combination of

2-fluorobiphenyl and 1-chlorooctadecane. The results of the analyses we have carried out on the additional quality assurance samples during the ten days prior to the samples reported here are shown in the accompanying graphs. Results are reported in ug/litre for the C8-C10 band. These provide a visual indication of the stability of our laboratory analysis.



Calibration Samples - Previous 10 days



Spike Samples - Previous 10 days

Retail Trade Park

Summary of Results

TPH Banded - Water

Accreditation	UKAS	Blind Testing	RTCorp		
Results Reported As	Not Applicable	Last Three Z Scores	0.57	-0.43	-0.91

Analysis Method Parameters			
Reporting Units	µg/litre	Limit of Detection	5ug/litre
Linearity	10-10,000 ug/litre	Limit of Quantification	10 ug/litre
Sensitivity	100 ug/litre	Precision	+/-1.0ug/litre

Sample Location	Sample	Depth	Total Petroleum Hydrocarbons				
			C8-C10	>C10-C12	>C12-C16	>C16-C21	>C21-C35
Stream	wln12963.009001	0.00	<10	<10	<10	<10	<10
BH201	wln12963.009002	1.21	<20	<20	<20	<20	<20
BH202	wln12963.009003	1.41	<10	<10	<10	<10	<10
BH203	wln12963.009004	1.40	<10	<10	<10	<10	<10
BH301	wln12963.009005	1.53	<10	<10	<10	<10	<10
BH302	wln12963.009006	1.56	<10	<10	<10	<10	<10
BH303	wln12963.009007	1.40	<20	<20	<20	<20	<20

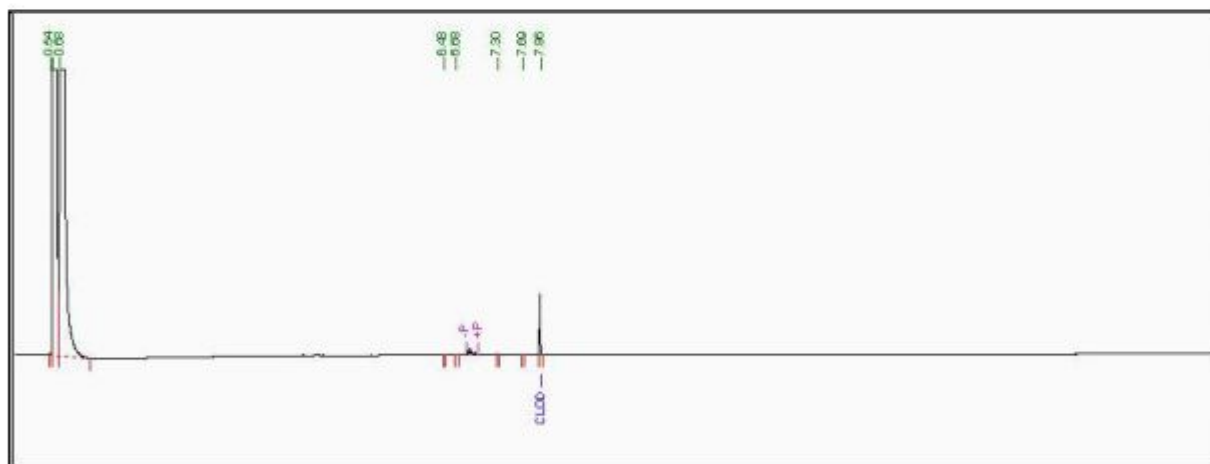
Individual Sample Results

TPH Banded - Water

Sample Location	Stream	Results Reported As	Not Applicable
Sample	wln12963.009001	Reporting Units	ug/litre
Depth(m)	0.00	Date Received	22/08/2014
Chain of Custody No.	8844	Date of Sampling	20/08/2014
Accreditation	UKAS	Date of Analysis	22/08/2014

VES (ml)	MES (g)	CRF	BSV	Results				
				C8-C10	>C10-C12	>C12-C16	>C16-C21	>C21-C35
3	124.98	0.74	0.00	<10	<10	<10	<10	<10

Note: VES denotes volume of extraction solvent; MES denotes mass of extracted sample; CRF denotes calibration recovery factor; BSV denotes blank subtraction value



Gas Chromatogram for Sample

Retail Trade Park

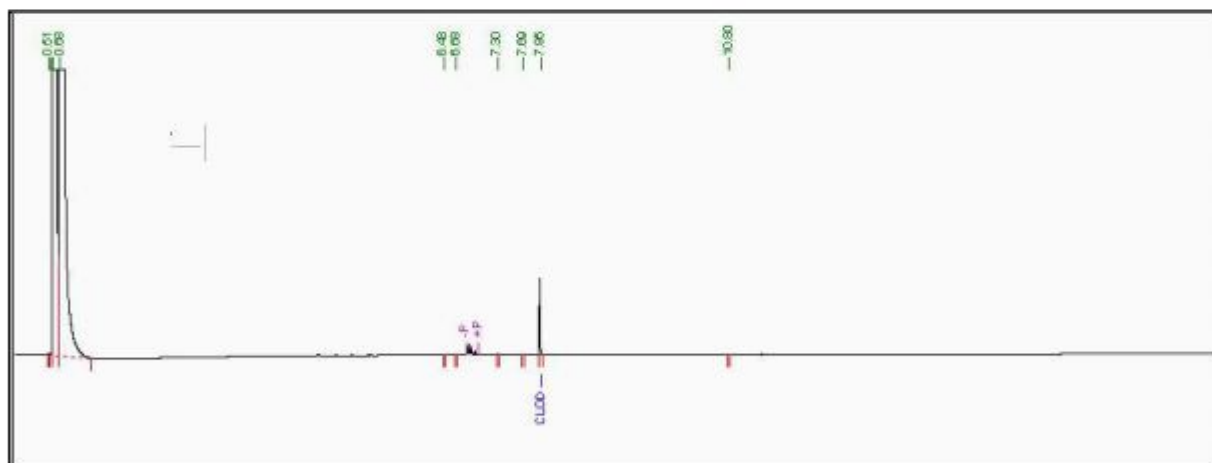
Individual Sample Results

TPH Banded - Water

Sample Location	BH201	Results Reported As	NotApplicable
Sample	wln12963.009002	Reporting Units	ug/litre
Depth(m)	1.21	Date Received	22/08/2014
Chain of Custody No.	8844	Date of Sampling	20/08/2014
Accreditation	UKAS	Date of Analysis	22/08/2014

VES (ml)	MES (g)	CRF	BSV	Results				
				C8-C10	>C10-C12	>C12-C16	>C16-C21	>C21-C35
3	125.02	0.68	0.00	<20	<20	<20	<20	<20

Note: VES denotes volume of extraction solvent; MES denotes mass of extracted sample; CRF denotes calibration recovery factor; BSV denotes blank subtraction value



Gas Chromatogram for Sample

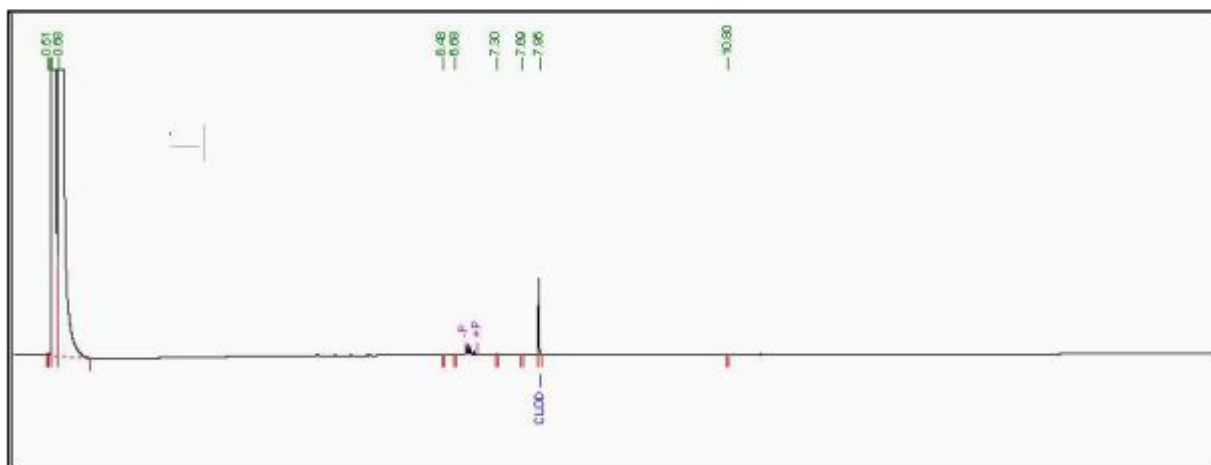
Individual Sample Results

TPH Banded - Water

Sample Location	BH202	Results Reported As	NotApplicable
Sample	wln12963.009003	Reporting Units	ug/litre
Depth(m)	1.41	Date Received	22/08/2014
Chain of Custody No.	8844	Date of Sampling	20/08/2014
Accreditation	UKAS	Date of Analysis	23/08/2014

VES (ml)	MES (g)	CRF	BSV	Results				
				C8-C10	>C10-C12	>C12-C16	>C16-C21	>C21-C35
3	124.86	0.76	0.00	<10	<10	<10	<10	<10

Note: VES denotes volume of extraction solvent; MES denotes mass of extracted sample; CRF denotes calibration recovery factor; BSV denotes blank subtraction value



Gas Chromatogram for Sample

Retail Trade Park

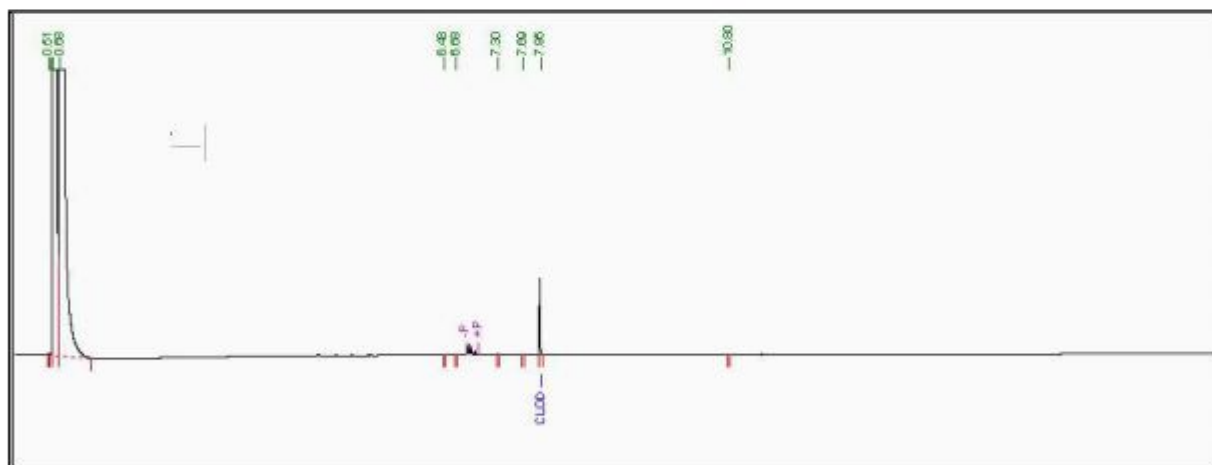
Individual Sample Results

TPH Banded - Water

Sample Location	BH203	Results Reported As	Not Applicable
Sample	win12963.009004	Reporting Units	ug/litre
Depth(m)	1.40	Date Received	22/08/2014
Chain of Custody No.	8844	Date of Sampling	20/08/2014
Accreditation	UKAS	Date of Analysis	23/08/2014

VES (ml)	MES (g)	CRF	BSV	Results				
				C8-C10	>C10-C12	>C12-C16	>C16-C21	>C21-C35
3	124.65	0.77	0.00	<10	<10	<10	<10	<10

Note: VES denotes volume of extraction solvent; MES denotes mass of extracted sample; CRF denotes calibration recovery factor; BSV denotes blank subtraction value



Gas Chromatogram for Sample

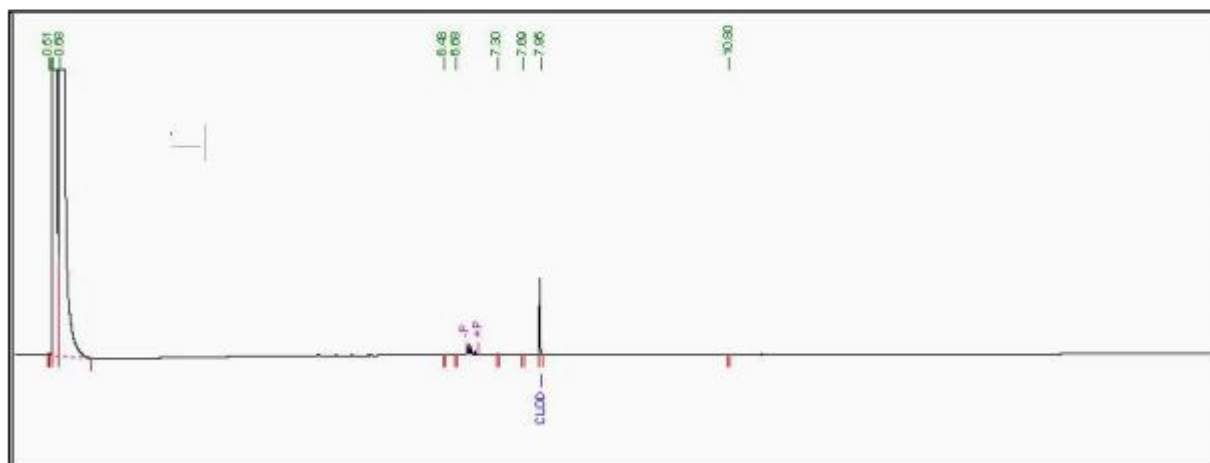
Individual Sample Results

TPH Banded - Water

Sample Location	BH301	Results Reported As	NotApplicable
Sample	wln12963.009005	Reporting Units	ug/litre
Depth(m)	1.53	Date Received	22/08/2014
Chain of Custody No.	8844	Date of Sampling	20/08/2014
Accreditation	UKAS	Date of Analysis	23/08/2014

VES (ml)	MES (g)	CRF	BSV	Results				
				C8-C10	>C10-C12	>C12-C16	>C16-C21	>C21-C35
3	124.76	0.99	0.00	<10	<10	<10	<10	<10

Note: VES denotes volume of extraction solvent; MES denotes mass of extracted sample; CRF denotes calibration recovery factor; BSV denotes blank subtraction value



Gas Chromatogram for Sample

Retail Trade Park

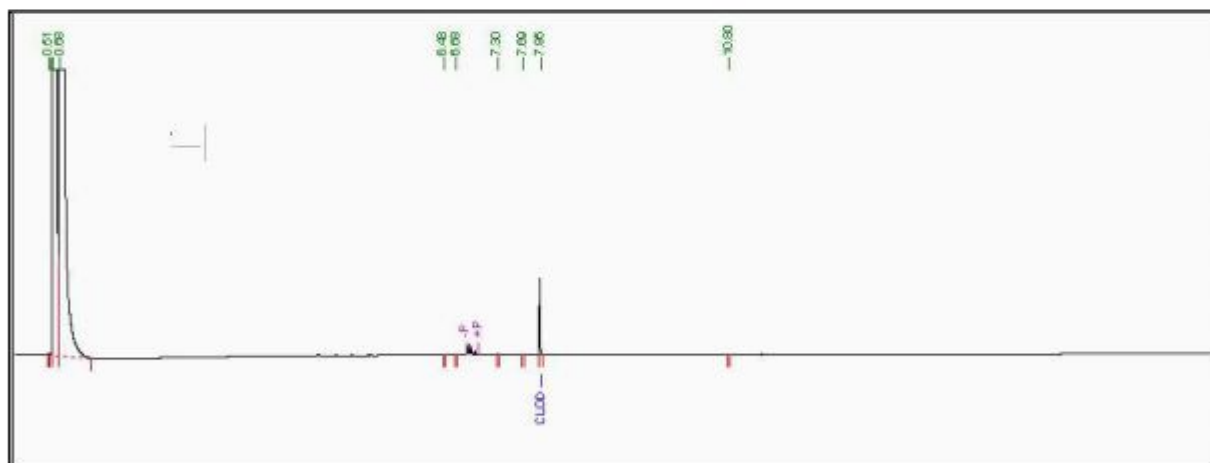
Individual Sample Results

TPH Banded - Water

Sample Location	BH302	Results Reported As	NotApplicable
Sample	wln12963.009006	Reporting Units	ug/litre
Depth(m)	1.56	Date Received	22/08/2014
Chain of Custody No.	8844	Date of Sampling	20/08/2014
Accreditation	UKAS	Date of Analysis	23/08/2014

VES (ml)	MES (g)	CRF	BSV	Results				
				C8-C10	>C10-C12	>C12-C16	>C16-C21	>C21-C35
3	124.51	0.85	0.00	<10	<10	<10	<10	<10

Note: VES denotes volume of extraction solvent; MES denotes mass of extracted sample; CRF denotes calibration recovery factor; BSV denotes blank subtraction value



Gas Chromatogram for Sample

Retail Trade Park

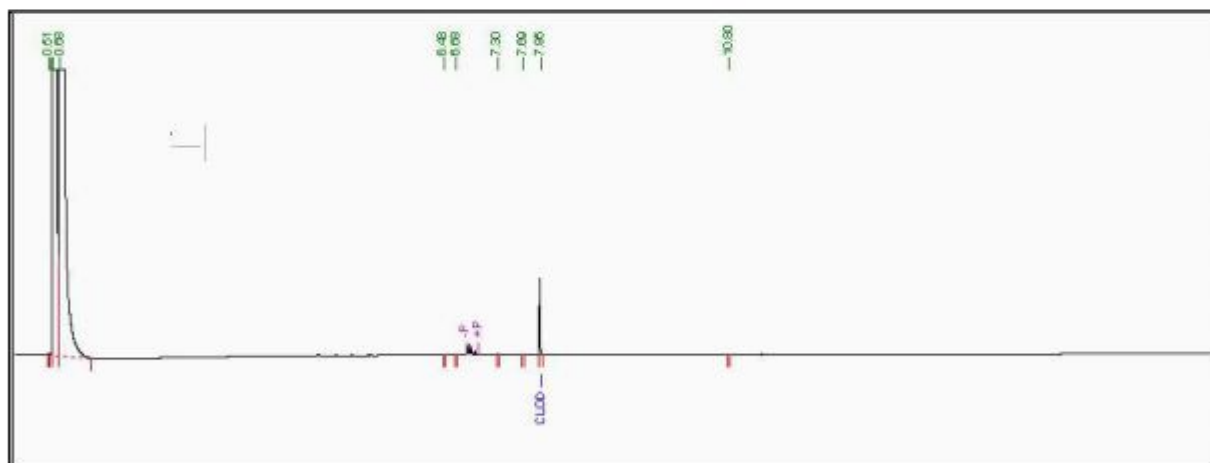
Individual Sample Results

TPH Banded - Water

Sample Location	BH303	Results Reported As	NotApplicable
Sample	wln12963.009007	Reporting Units	ug/litre
Depth(m)	1.40	Date Received	22/08/2014
Chain of Custody No.	8844	Date of Sampling	20/08/2014
Accreditation	UKAS	Date of Analysis	23/08/2014

VES (ml)	MES (g)	CRF	BSV	Results				
				C8-C10	>C10-C12	>C12-C16	>C16-C21	>C21-C35
3	125.27	0.49	0.00	<20	<20	<20	<20	<20

Note: VES denotes volume of extraction solvent; MES denotes mass of extracted sample; CRF denotes calibration recovery factor; BSV denotes blank subtraction value



Gas Chromatogram for Sample

Retail Trade Park

End of Report