DEFENCE ESTATE ORGANISATION

RAF UPPER HEYFORD
GROUNDWATER QUALITY MONITORING ASSESSMENT

PROJECT NO: 07686 - FINAL REPORT

Technical Report
September 1998
by
Aspinwall & Company Ltd

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Prepared by Aspinwall & Company Limited
for the Ministry of Defence Estate
Organisation
under Commission WS13/1982/2

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RAF UPPER HEYFORD: Groundwater Quality Monitoring Assessment

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2. Please archive this report under 'Land Quality Assessment'. This should also be archived under the following key words

   contaminated land

3. Please contact me if I can be of further assistance.

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REPORT RELEASE SHEET

DEFENCE ESTATE ORGANISATION

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Summary

1. Aspinwall & Company was commissioned by Defence Estate Organisation to undertake groundwater and spring water sampling, analysis and assessment at RAF Upper Heyford. The work was required following completion of a land quality assessment in 1997.

2. Samples were taken from eleven springs and seven boreholes (two of which have dual completions) and submitted to Geochem Laboratory for analysis. Each sample was analysed for a range of inorganic and organic compounds. The specification for the analyses was agreed with the Environment Agency prior to commencement.

3. The results indicate that the groundwater beneath the site is generally of good quality, with only limited significant changes in chemistry between 1997 and 1998. These changes include:

- a substantial increase in ammoniacal nitrogen concentration in all boreholes;
- an increase in phosphate concentration at a number of boreholes;
- elevated arsenic in borehole 7 with substantial reductions in boreholes 2 and 3B;
- the isolated instances of slightly elevated boron, cadmium, chromium and copper identified in 1997 were not repeated in 1998;
- a significant reduction in BOD at borehole 1; and
- diesel range organics were identified at all locations, although these were only slightly elevated at three locations. No other hydrocarbons were detected and the source of the diesel range organics could not be positively identified. They may be due to "naturally" occurring compounds or surfactants, plasticisers, detergents etc. which can be present at low concentrations.

4. Most of the determinands measured in groundwater beneath the site were at concentrations less than the maximum admissible concentration (MAC) detailed in the UK Drinking Water Standards relating to the quality of water for human consumption. The main exception was ammoniacal nitrogen which exceeded the MAC at 5 out of 9 locations. The MAC's for nitrate and sulphate were also exceeded at isolated locations, but by less than 10%, whilst the MAC for arsenic was exceeded at one location (borehole 7) by an order of magnitude.

5. The spring water quality is generally reasonable with a small number of significant changes from 1997 to 1998 including:

- an increase in phosphate concentration at a number of locations;

Summary *continued*

- a slight increase in heavy metal concentrations, especially at spring M; and
- diesel range organics were detected at all locations, positively identified as diesel and weathered diesel at springs N and I respectively.

6. Most of the determinands in spring water were present at concentrations less than the EC MAC, although three locations exceeded the MAC for nitrate and one for ammoniacal nitrogen. The MAC's for arsenic, chromium, lead and selenium were exceeded at a small number of locations.

7. In summary the groundwater beneath the Upper Heyford site is generally of good quality although there is one isolated instance where arsenic exceeds the standard for potable water quality. Volatile and semi volatile organics are low. Diesel range organics are present although the source of these could not be identified. The spring water around the site is of reasonable quality although arsenic, chromium, lead and zinc exceed potable water quality standards in isolated instances. Diesel range organics are present at all springs although the source of these could not be identified.

8. Only by undertaking long term monitoring will any trends in groundwater quality be identifiable. Of particular concern are diesel range organics, heavy metals, phosphate and ammoniacal nitrogen. The increase in the latter was especially significant. Its coincidence with an increase in phosphate suggests fertiliser as a source. This has been confirmed by farmers using the airfield for grazing, the large increase being due to fertiliser application prior to a very wet period.

9. Excepting the recent impact of fertiliser application, operations at RAF Upper Heyford do not appear to have significantly impacted upon the sensitive groundwater regime beneath the base. It is recommended that regular groundwater quality monitoring be undertaken throughout any redevelopment of the site to confirm that this remains the case.

Introduction 1

1.1 In March 1997 Aspinwall & Company (Aspinwall) was commissioned by Defence Estate Organisation (DEO) to undertake a Land Quality Assessment at RAF Upper Heyford near Bicester in Oxfordshire. The assessment, which was undertaken in late April 1997, included excavation of trial pits and boreholes with subsequent laboratory analysis of soil and water samples to determine the nature and extent of any contamination present. The investigation identified a small number of slightly contaminated areas although groundwater and surface water monitored beneath and around the site was, excepting a small number of anomalous results, generally good. Due to these anomalies, and the fact that the above interpretation is based on analysis of a single set of water samples, it was recommended that a further series of samples be taken.

1.2 In May 1998, following consultation with the Environment Agency, Aspinwall was commissioned to collect and analyse a second series of samples and to produce this interpretative report. The 1997 sampling was undertaken at a similar time of year to the 1998 sampling, and although climate conditions (and therefore hydrological conditions) vary, taking the samples at a similar time of year provides a degree of consistency for comparison.

1.3 The purpose of the repeat sampling was to confirm that the results obtained from analysis of the 1997 water samples were a true reflection of the groundwater quality in the area around and beneath the site. Furthermore, the Environment Agency requested that additional determinands be monitored and that lower limits of detection be used for the heavy metals analysis. The latter was required to enable direct comparison of the results with potable water quality standards. This, and a comparison between 1997 and 1998 data, has been undertaken in this report.

1.4 The Consultants Directive, issued by DEO, is included as Appendix 1.

Water Sample Collection and Analysis 2

Introduction

2.1 The water samples collected have been divided into those from springs/outfalls around the site and those from boreholes within the site boundary which were drilled during the 1997 investigation. The location of these points is shown on Figure 1.

Groundwater Sampling

2.2 In 1998, groundwater samples were obtained from boreholes 1, 2, 3, 4, 5, 6 and 7. At boreholes 1 and 3 two sets of samples were taken, one from the shallow completion and one from the deep completion. These locations were all sampled in 1997, detailed discussion of the results from which are included in Reference 1. All samples were analysed for the following suite of determinands:

Major ions:	calcium, magnesium, sodium, potassium, bicarbonate (alkalinity), sulphate, nitrate, chloride, ammoniacal nitrogen and phosphate;
Metals:	arsenic, cadmium, chromium, lead, mercury, copper, nickel and zinc;
Others:	pH (*in situ* & laboratory), electrical conductivity (EC - *in situ* & laboratory), solvent extractable matter (SEM), chemical oxygen demand (COD), biochemical oxygen demand (BOD), total organic carbon (TOC), mineral oil, non volatile aromatics (NVA), nitrogen/sulphur/oxygen & resins (NSO), petrol range organics (PRO) and diesel range organics (DRO); and
EA specified additional determinands	benzene, toluene, ethyl benzene, xylene, carbon tetrachloride, dichloromethane, trichloroethene, tetrachloroethene, 1,1,1 trichloroethane, vinyl chloride.

2.3 At each borehole an electronic dip meter was first used to determine the depth to water, data from which are summarised in Appendix 2. Following water level measurement a variable frequency electric submersible pump was installed in each borehole in turn. The pump allows purging to be undertaken at a high frequency (i.e. high discharge) rate to minimise the purge time, following which the frequency (and therefore discharge) can be reduced to minimise water disturbance during sampling.

2.4 In order to determine when purging was complete the following well head parameters were monitored using a multi-parameter probe : temperature, pH, electrical conductivity, dissolved oxygen, redox and turbidity. The results of this purging are presented in Appendix 3. Following sampling at each location the pump was cleaned with Decon 90, a laboratory grade detergent, then rinsed with tap water.

Water Sample Collection and Analysis 2
continued

2.5 Because some of the samples were to be analysed for volatile compounds these were collected with a disposable bailer following purging. The bailer minimises the potential for sample disturbance and loss of volatiles whilst use of a new bailer at each location prevents cross contamination.

2.6 The exception to the above sampling method was at borehole 1A where problems encountered during sampling in 1997 indicated that the electric pump could not be utilised. This borehole was therefore bailed prior to sampling. At borehole 2 the method was also varied slightly as the hole was rapidly dewatered by the pump. It was therefore allowed to recover before being pumped again and then sampled.

2.7 Each sample comprised six sub-samples which were stored in a variety of containers as recommended by the laboratory and as detailed in Appendix 4. All samples were stored in cool boxes on site and transported by courier to Geochem laboratory on a daily basis.

Spring Water Sampling

2.8 During the 1997 investigation twenty four locations were visited which had been identified from Ordnance Survey Maps of the area as being potential springs. Each location was visited and the major springs were sampled. A detailed discussion of the results is presented in Reference 1.

2.9 Twelve of the springs were revisited in 1998 and eleven samples (spring C2 being dry) were taken, each of which comprised six sub-samples. The locations visited (shown on Figure 1) are springs A, B, C2, D, F, G1, I, L, M, N, P1 and R2. As with the groundwater samples all spring water samples were stored in cool boxes and transported to the laboratory on the day of collection. The determinands analysed are as per the groundwater samples, except that the Environment Agency did not require analysis for volatile organic compounds.

2.10 At each location *in situ* measurements were made to determine water temperature, pH, electrical conductivity, dissolved oxygen, redox and turbidity. These results are presented in Appendix 5.

Laboratory Analysis

2.11 The results of the laboratory analysis are presented in Appendix 6. These have been divided into four sub-sets as follows:

- Appendix 6a - miscellaneous data including major ions, heavy metals and "general indicators" of contamination such as total organic carbon and biochemical oxygen demand;

Water Sample Collection and Analysis 2
continued

- Appendix 6b - hydrocarbon analyses including diesel range organics, petrol range organics and BTEX (benzene, toluene, ethyl-benzene and xylene) compounds;
- Appendix 6c - phenol analyses which include nine major compounds; and
- Appendix 6d - volatile organic compounds which include fifty-nine major compounds.

2.12 These results including a comparison with the 1997 results, are discussed in Chapter 3.

Results

3

Introduction

3.1 A detailed discussion of the groundwater/spring water chemistry at Upper Heyford, based on the 1997 data, has already been undertaken (Reference 1), a copy of which is included here for completeness as Appendix 6. This report discusses any major changes observed between the 1997 and 1998 data, and any instances where potable water quality standards (Reference 2) are exceeded. The additional data requested by the Environment Agency in 1998 is also discussed.

3.2 The data, excepting detailed organic analyses, has been summarised in Tables 1 and 2 for borehole and spring samples respectively. The tables each include 4 sub-tables, the first indicating UK potable water quality standards (Maximum Admissible Concentration - MAC), the second the 1997 data, the third the 1998 data and the fourth a table showing percentage change from 1997 to 1998 (calculated as the 1998 concentration minus the 1997 concentration divided by 1997 concentration). Within this a negative value indicates a decrease in concentration from 1997 to 1998. A comparison of the 1997 and 1998 diesel range organics results is presented in Table 3.

Results of Chemical Analysis of Groundwater from Boreholes

Major Ions/Heavy Metals

3.3 The 1998 results broadly follow the trend of the 1997 results indicating neutral to slightly alkaline pH with a slightly elevated electrical conductivity. A piper plot for the 1998 data (Figure 2) demonstrates a similar pattern as for 1997 with groundwater quality dominated by calcium and bicarbonate ions at all locations. The water encountered at borehole 2 is of a slightly different quality with sulphate and chloride being important, although the difference is not as great as in 1997.

3.4 With regard to the major ions and heavy metals there is no significant general overall change in water quality except for the following:

- a substantial increase in ammoniacal nitrogen concentrations at all locations; and
- an increase in phosphate concentration at five locations, although the increase is only substantial at three of these.

3.5 There are increases in some determinands such as nitrate at borehole 3A, alkalinity at borehole 2 and chloride at boreholes 1A and 1B although these are isolated instances. There is no location at which a significant number of determinands have all increased in concentration.

Table 1 Comparison of 1997 and 1998 Water Quality Data from the on site Boreholes

Potable Water Quality Standards

	EC	pH	Na	K	Ca	Mg	Cl	NO_3	Phos	SO_4	Amm N	ALK	HCO3		COD	BOD	TOC	As	B	Cd	Cr	Cu	Hg	Ni	Pb	Se	Zn	M.Oil	NVA	NSO	TPH	DCM	TSE	DRO
	mS/cm		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
MAC			150	12	250	50	400	50	2.2	250	0.39							0.05	2	0.005	0.05	3	0.001	0.05	0.05	0.01	5	0.01						
TV																		0.01		4E - 04	0.001	0.015	5E - 05	0.015	0.015		0.065	0.05						
IV																		0.06		0.006	0.03	0.075	3E - 04	0.075	0.075		0.8	0.8						

Groundwater Quality - Boreholes, 1997 Data

BH	EC	pH	Na	K	Ca	Mg	Cl	NO_3	Phos	SO_4	Amm N	ALK	HCO3	[HCO3]	COD	BOD	TOC	As	B	Cd	Cr	Cu	Hg	Ni	Pb	Se	Zn	M.Oil	NVA	NSO	TPH	DCM	TSE	DRO
	mS/cm		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	ug/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	ug/l
1A	0.645	7.27	40	6	178.2	11.97	36	23.3	0.12	101	0.04	480	480	585	478	11.1	2	< 0.05	0.12	< 0.05	< 0.05	< 0.05	0.14	< 0.05	0.06	< 0.1	< 0.05	2	< 1	1	2	3	3	< 10
1B	0.549	7.25	12	< 3	197.8	2.87	19	93.4	0.06	56	< 0.01	330	330	402	< 10	20.5	2	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.08	< 0.05	< 0.05	< 0.1	< 0.05	1	< 1	1	1	2	2	< 10
2	1.029	8.11	96	7	115.3	8.13	46	52.6	0.63	324	0.26	90	90	110	30	1.2	7	0.71	0.37	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.1	< 0.05	< 1	< 1	1	3	< 1	3	2	77
3A	0.572	7.38	14	< 3	124.4	2.46	13	41.3	0.07	53	< 0.01	480	480	585	14	0.7	2	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.1	< 0.05	< 1	< 1	1	2	< 1	2	< 10
3B	0.814	7.21	12	< 3	164	2.13	13	14.1	0.18	42	< 0.08	400	400	488	10	< 0.5	5	2.28	< 0.05	< 0.05	< 0.05	0.13	< 0.05	0.21	0.11	< 0.1	0.55	< 1	< 1	1	3	< 1	3	3	< 10
4	0.557	7.43	21	< 3	113.4	6.58	15	< 0.5	0.03	58	< 0.01	280	280	341	< 10	< 0.5	9	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.06	< 0.05	< 0.05	< 0.1	< 0.05	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 10
5	0.624	7.21	14	< 3	141.8	2.71	53	< 0.5	0.02	29	< 0.01	300	300	366	< 10	< 0.5	5	< 0.05	0.22	0.22	0.07	< 0.05	< 0.05	< 0.05	0.23	< 0.1	0.15	< 1	< 1	1	1	< 1	1	1	10
6	0.602	7.32	19	5	152.5	9.31	5	< 0.5	0.11	82	0.02	1400	1400	1707	77	2.8	6	< 0.05	0.8	0.1	< 0.05	< 0.05	0.09	< 0.05	< 0.05	< 0.1	0.08	< 1	< 1	1	< 1	< 1	< 1	< 1	17
7	0.587	7.14	12	< 3	135	2.78	10	< 0.5	0.02	10	0.04	400	400	488	< 10	< 0.5	5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.09	< 0.1	0.08	< 1	< 1	1	< 1	< 1	< 1	< 1	< 10
																												< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 10

Groundwater Quality - Boreholes, 1998 Data

BH	EC	pH	Na	K	Ca	Mg	Cl	NO_3	Phos	SO_4	Amm N	ALK	HCO3	[HCO3]	COD	BOD	TOC	As	B	Cd	Cr	Cu	Hg	Ni	Pb	Se	Zn	M.Oil	NVA	NSO	SEM
	mS/cm		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	ug/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
1A	0.996	7.38	23.8	2.5	210	8.96	74	28.3	0.1	142	1.09	400	400	488	124	11	3	0.05	0.05	< 0.0004	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.005	0.05	< 1	< 1	< 1	1
1B	0.744	7.49	13.8	2	145	5.22	43	54	0.1	27	0.6	420	420	512	47	2	6	0.05	< 0.05	< 0.0004	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.005	< 0.05	< 1	< 1	< 1	< 1
2	0.992	7.9	71.3	5.4	138	10	46	7.1	0.08	271	0.67	340	340	414	89	6	5	< 0.05	0.49	< 0.0004	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.005	< 0.05	< 1	< 1	< 1	< 1
3A	0.679	7.21	12.5	1.6	109	1.94	15	32.7	0.04	48	0.1	290	290	354	< 10	< 1	3	< 0.05	< 0.05	< 0.0004	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.005	< 0.05	< 1	< 1	1	-
3B	0.594	7.28	13.1	1.1	127	1.78	10	23.3	1.67	38	0.09	250	250	305	22	< 1	3	< 0.05	< 0.05	< 0.0004	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.005	< 0.05	< 1	< 1	1	1
4	0.585	7.38	20	4.1	83.7	11	10	< 0.05	0.07	51	0.6	270	270	329	73	2	3	< 0.05	0.08	< 0.0004	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.005	< 0.05	< 1	< 1	1	1
5	0.671	7.21	19	1.7	127	2.01	29	1.5	1.4	54	0.36	310	310	378	16	< 1	2	< 0.05	< 0.05	< 0.0004	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.016	< 0.05	< 1	< 1	< 1	1
6	0.433	7.59	12.5	3.6	158	7.3	NDP	NDP	0.03	45	0.09	320	320	390	16	< 1		< 0.05	< 0.05	< 0.0004	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.005	< 0.05	< 1	< 1	< 1	< 1
7	0.375	7.38	11.8	0.8	191	3.31	28	3.1	0.02	20	1.11	380	380	463	< 10	< 1	4	0.44	< 0.05	< 0.0004	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.005	< 0.05	< 1	< 1	< 1	1

Notes: * - based sample, GL - EC Guide Level, MAC - EC Maximum Admissible Concentration, TV - Dutch target value, IV - Dutch Intervention Value
EC - electrical conductivity, Amm N - ammoniacal nitrogen, ALK - alkalinity, COD - chemical oxygen demand, BOD - biochemical oxygen demand, TOC - total organic carbon, M.Oil - mineral oil/paraffin, NVA - total non-volatile aromatics
NSO - NSO'ressins, TPH - total petroleum hydrocarbons, DCM - DCM/MeOH extract, TSE - total soluble extract, DRO - diesel range organics, Phos - phosphate (note MAC & GL expressed as P).
[HCO3] - calculated by multiplying alkalinity by 1.219, NDP - no determination possible.

Percentage change from 1997 to 1998

BH	EC	pH	Na	K	Ca	Mg	Cl	NO_3	Phos	SO_4	Amm N	ALK	HCO3	[HCO3]	COD	BOD	TOC	As	B	Cd	Cr	Cu	Hg	Ni	Pb	Se	Zn	M.Oil	NVA	NSO	SEM
	mS/cm		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	ug/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
1A	54	1	-41	-58	18	-25	147	21	-17	41	2625	-17	-17	-17	-74	-1		0	-58		0	0		0	-17		0	-50	0	0	-67
1B	36	3	15		-27	82	126	-42	67	-52	5900	27	27	27	370	-90	200	0	0		0	0		0	0		0	0	0	0	-50
2	-4	-3	-26	-23	20	23	0	-87	-87	-16	158	278	278	278	197	400	-29	-93	32		0	0		0	0		0	0	0	0	-67	-67
3A	19	-2	-11		-12	-21	15	-21	1243	-9	900	-40	-40	-40	-29		50	0	0		0	0		0	-17		0	0	0	0	-50	
3B	-3	1	9		-23	-15	-23	65	828	-10	13	-38	-38	-38	120		-40	-96	0		0	-62		-76	-55		-91	0	0		-67	-67
4	5	-1	-5		-26	67	-33	-90	133	-12	5900	-4	-4	-4	630		-67	0	60		0	0		0	0		0	0	0	0	0	
5	8	0	36		-10	-26			6900	86	3500	3	3	3	60		-60	0	-77		-29	0		0	-78		-67				0	
6	-28	4	-34	-28	2	-22			-73	-45	350	-77	-77	-77	-77			0	-94		0	0		0	0		-17				0	
7	-36	3	-2		41	19	180	520	0	100	2675	-5	-5	-5	0		-20	780	0		0	0		0	-44		-38	0	0	0	0	

Table 2 Comparison of 1997 and 1998 Water Quality Data from Springs/Outfalls around the Site

Potable Water Quality Standards

	EC mS/cm	pH	Na mg/l	K mg/l	Ca mg/l	Mg mg/l	Cl mg/l	NO_3 mg/l	Phos mg/l	SO_4 mg/l	Amm N mg/l	ALK mg/l	HCO_3 mg/l	COD mg/l	BOD mg/l	TOC mg/l	As mg/l	B mg/l	Cd mg/l	Cr mg/l	Cu mg/l	Hg mg/l	Ni mg/l	Pb mg/l	Se mg/l	Zn mg/l	MUB mg/l	MVA mg/l	NSO mg/l	TPH mg/l	DCM mg/l	TSE mg/l	DRO ug/l
MAC		<5.5->9.5	150	12	250	50	400	50	2.2	250	0.39								< 0.05			0.001											
TV																			4E - 04			5E - 06											
IV																						2E - 04											

Groundwater Quality - Springs, 1997 Data

Spring	EC mS/cm	pH	Na mg/l	K mg/l	Ca mg/l	Mg mg/l	Cl mg/l	NO_3 mg/l	Phos mg/l	SO_4 mg/l	Amm N mg/l	ALK mg/l	HCO_3 mg/l	[HCO_3] mg/l	COD mg/l	BOD mg/l	TOC mg/l	As mg/l	B mg/l	Cd mg/l	Cr mg/l	Cu mg/l	Hg mg/l	Ni mg/l	Pb mg/l	Se mg/l	Zn mg/l	MUB mg/l	MVA mg/l	NSO mg/l	TPH mg/l	DCM mg/l	TSE mg/l	DRO ug/l
A	Dry																																
B	0.885	7.52	18	< 3	173	2.76	25	27.5	0.02	44	0.49	300	300	366	< 10	< 0.5	3	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.1	< 0.05	< 1	< 1	1	< 1	1	< 10
C2	0.898	7.72	24	< 3	208	2.85	34	119.1	0.07	35	0.95	233	233	284	< 10	< 0.5	3	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.1	< 0.05	< 1	< 1	1	< 1	1	24
D	0.918	7.79	18	10	208	3.69	34	91.2	< 0.01	69	0.95	100	100	366	< 10	< 0.5	3	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.1	< 0.05	< 1	< 1	< 1	< 1	0.53	< 1	17
E	Inside																																
C1	0.701	7.83	15	< 3	248	3.33	28	30.1	0.02	71	0.61	400	400	488	< 10	< 0.05	7	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.1	< 0.05	< 1	< 1	1	< 1	1	< 1	< 10
I	0.362	7.87	13	< 3	58	1.37	17	4.7	0.04	17	0.04	550	550	670	< 10	< 0.05	8	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.07	< 0.1	0.1	< 1	< 1	< 1	< 1	< 1		
J	0.854	7.76	20	< 3	184	2.88	64	3.6	0.07	27	0.05	260	260	317	< 10	< 0.05	3	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.1	< 0.05	< 1	< 1	< 1	< 1	0.33	< 1	31
M	0.667	7.98	18	< 3	177	2.05	35	31	0.01	47	0.09	250	250	305	< 10	< 0.05	3	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.1	< 0.05	< 1	< 1	< 1	< 1	0.46	< 1	< 10
N	Dry																																
P1	0.706	7.94	20	6	215	3.72	34	36	0.02	77	0.04	367	367	447	< 10	< 0.05	3	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.1	< 0.05	< 1	< 1	< 1	< 1	1	< 1	< 10
P2	0.748	7.92	12	< 3	248	3.18	18	17.7	< 0.01	68	0.18	420	420	548	< 10	< 0.05	1	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.1	< 0.05	< 1	< 1	2	< 1	2	< 1	< 10

Groundwater Quality - Springs, 1998 Data

Spring	EC mS/cm	pH	Na mg/l	K mg/l	Ca mg/l	Mg mg/l	Cl mg/l	NO_3 mg/l	Phos mg/l	SO_4 mg/l	Amm N mg/l	ALK mg/l	HCO_3 mg/l	[HCO_3] mg/l	COD mg/l	BOD mg/l	TOC mg/l	As mg/l	B mg/l	Cd mg/l	Cr mg/l	Cu mg/l	Hg ug/l	Ni mg/l	Pb mg/l	Se mg/l	Zn mg/l	MUB mg/l	MVA mg/l	NSO mg/l	SEM mg/l
A	0.884	7.7	103	0.8	197	1.89	31	24.7	0.02	14	0.05	260	260	317	< 10	< 1	3	< 0.05	< 0.05	< 0.0004	< 0.05	< 0.05	< 0.05	< 0.05	0.11	< 0.005	< 0.05	< 1	< 1	1	1
B	0.853	7.43	11	1.4	150	2.45	37	30.7	0.03	25	< 0.01	300	300	366	< 10	< 1	3	0.19	< 0.05	< 0.0004	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.005	< 0.05	< 1	< 1	1	1
C2	Dry																														
D	0.921	7.34	18.5	18.6	210	3.41	45	78.4	0.02	45	0.2	300	300	366	< 10	< 1	4	< 0.05	< 0.05	< 0.0004	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.005	< 0.05	< 1	< 1	< 1	1
E	0.63	7.12	15	1.8	187	2.78	37	59.5	0.02	42	0.1	310	310	378	< 10	< 1	3	< 0.05	< 0.05	< 0.0004	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.005	< 0.05	< 1	< 1	< 1	1
C1	0.611	7.42	20	2.9	234	3.88	27	27.4	0.02	56	0.05	330	330	402	< 10	< 1	3	< 0.05	< 0.05	< 0.0004	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.005	< 0.05	< 1	< 1	< 1	1
I	0.694	7.68	18.3	4.9	170	2.94	39	7.6	0.01	19	0.07	320	320	390	< 10	< 1	5	< 0.05	< 0.05	< 0.0004	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.007	< 0.05	< 1	< 1	< 1	1
J	0.566	7.68	21.4	2	150	2.79	49	7.1	0.02	26	0.1	280	280	341	< 10	< 1	7	< 0.05	< 0.05	< 0.0004	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.005	< 0.05	< 1	< 1	< 1	1
M	0.686	7.62	12.3	0.9	144	1.8	20	32.3	0.04	35	0.1	280	280	341	< 10	< 1	3	0.24	< 0.05	< 0.0004	0.12	< 0.05	< 0.05	< 0.05	0.18	< 0.005	0.06	< 1	< 1	< 1	1
N	0.809	7.63	13	0.9	215	2.78	34	52.3	0.08	32	0.52	350	350	427	71	< 1	6	0.05	< 0.05	< 0.0004	< 0.05	< 0.05	< 0.05	< 0.05	0.26	< 0.005	0.14	< 1	< 1	< 1	2
P1	0.815	7.06	21.5	8.2	183	3.84	48	45.5	0.01	54	0.06	310	310	378	14	< 1	3	< 0.05	< 0.05	< 0.0004	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.005	< 0.05	< 1	< 1	< 1	< 1
P2	0.793	7.37	14	1.5	207	3.28	19	23.8	0.02	50	0.12	350	350	427	< 10	< 1	2	< 0.05	< 0.05	< 0.0004	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.005	< 0.05	< 1	< 1	< 1	< 1

Notes: GL - EC Guide Level, MAC - EC Maximum Admissible Concentration, TV - Dutch target value, IV - Dutch Intervention Value
EC - electrical conductivity, Amm-N - ammoniacal nitrogen, ALK - alkalinity, COD - chemical oxygen demand, BOD - biochemical oxygen demand, TOC - total organic carbon, M Oil - mineral oil/paraffin, MVA - total non-volatile aromatics,
NSO - NSO'ness, TPH - total petroleum hydrocarbons, DCM - DCM/Methanol extract, TSE - total soluble extract, DRO - diesel range organics, Phos - phosphate (note MAC & GL expressed as P)
[HCO_3] - calculated by multiplying alkalinity by 1.219

Percentage change from 1997 to 1998

Spring	EC mS/cm	pH	Na mg/l	K mg/l	Ca mg/l	Mg mg/l	Cl mg/l	NO_3 mg/l	Phos mg/l	SO_4 mg/l	Amm N mg/l	ALK mg/l	HCO_3 mg/l	[HCO_3] mg/l	COD mg/l	BOD mg/l	TOC mg/l	As mg/l	B mg/l	Cd mg/l	Cr mg/l	Cu mg/l	Hg mg/l	Ni mg/l	Pb mg/l	Se mg/l	Zn mg/l	MUB mg/l	MVA mg/l	NSO mg/l	SEM mg/l
A																															
B	-3	-1	-31	-50	-10	9	48	19	50	-43	98	0	0	0	0		50	280	0		0	0		0	80		0	0	0	0	0
C2																															
D	0	-8	-3	6	-27	8	-17	-18	150	-35	300	0	0	0	0		33	0	0		0	0		0	0		0	0	0	0	88
E																															
C1	-1	-5	-33	-13	-6	11	-4	-19	0	21	92	-18	-18	-18	0		56	0	0		0	0		0	0		0	0	0	0	0
I	64	-5	48	63	122	115	124	52	75	17	75	-42	-42	-42	0		-17	0	0		0	0		0	29		-50	0	0	0	0
J	-14	-1	7	-33	-16	-8	28	-87	986	4	100	8	8	8	0		133	0	0		0	0		0	0		0	0	0	0	203
M	-9	6	23	-73	-19	-12	-26	4	5000	-23	11	12	12	12	0		0	380	0		280	0		0	260		20	0	0	0	117
N																															
P1	2	-11	-2	20	-10	3	35	28	-50	-25	0	-16	-16	-16	40		0	0	0		0	0		0	0		0	0	0	0	0
P2	-1	1	17	-50	-15	3	0	34	100	-28	-33	-19	19	-19	0		100	0	0		0	0		0	0		0	0	0	-50	-50

Results *continued*

Table 3. Diesel Range Hydrocarbons (ug/l) identified in 1997 and 1998

Location	Apr-97	May-98	Comments
BH1A	<10	37	
BH1B	<10	36	
BH1B(bailed)	<10	-	additional bailed samples not taken in 1998
BH2	77	33	
BH3A	<10	204	
BH3B	<10	217	
BH4	<10	501	
BH4(bailed)	<10	-	additional bailed samples not taken in 1998
BH5	10	14	
BH5(bailed)	<10	-	additional bailed samples not taken in 1998
BH6	17	45	
BH7	<10	22	
Spring A	-	27	
Spring B	<10	28	
Spring C (C2)	24	-	spring dry in 1998
Spring D	17	38	
Spring F	-	42	spring only a trickle in 1997
Spring G (G1)	<10	29	
Spring I	-	783	Weathered diesel, spring dry in 1987
Spring L	31	33	
Spring M	<10	26	
Spring N	-	2489	Diesel, spring dry in 1997
Spring P (P1)	<10	40	
Spring R (R2)	<10	44	

3.6 Comparison of the major ion concentrations with potable water quality standards (where present - Table 1) indicates the following:

sodium - all results less than the MAC;

potassium - all results less than the MAC;

calcium - all results less than the MAC;

magnesium - all results less than the MAC;

chloride - all results less than the MAC;

nitrate - concentration of 54 mg/l at borehole 1B slightly greater than the MAC of 50 mg/l. All other locations less than the MAC;

phosphate - all results less than the MAC;

Results *continued* 3

sulphate - all results less than the MAC, except borehole 2 which at 271 mg/l exceeded the MAC of 250 mg/l; and,

ammoniacal nitrogen - the MAC of 0.39 mg/l was exceeded at 5 locations (boreholes 1A, 1B, 2, 4 and 7).

3.7 The detection limits for heavy metals were reduced for the 1998 analysis to allow comparison of the results with potable water quality standards (Reference 2). In all instances except four, the results demonstrate heavy metal concentrations at or less than the limit of detection (i.e. less than the potable water quality standards). The four exceptions are:

- selenium in water from borehole 5 which is present at a concentration of 0.016 mg/l, just greater than the 0.01 mg/l maximum admissible concentration (MAC) in groundwater (Reference 2); and
- arsenic, which was present in the water from borehole 7 at a concentration of 0.44 mg/l (MAC of 0.05 mg/l). The elevated arsenic concentrations of 0.7 and 2.3 mg/l measured in 1997 at boreholes 2 and 3B (respectively) was not repeated.

3.8 The slightly elevated concentrations of copper, mercury, nickel, lead and zinc detected in the 1997 water samples were not detected in 1998.

Organic Determinands

3.9 The screening tests for organic contamination including mineral oil, non-volatile aromatics, NSO and solvent extractable material were all at or less than the limit of detection of 1 mg/l and were in all instances the same or less than the 1997 results.

3.10 Other screening tests undertaken include those to determine chemical oxygen demand (COD), biochemical oxygen demand (BOD) and total organic carbon (TOC). Both BOD and TOC were low in all instances although BOD in water from borehole 2 and TOC in water from borehole 1B had increased. COD has increased at a number of locations, although at borehole 1A which had the highest COD in 1997 the concentration has significantly reduced.

3.11 Detailed organic analyses undertaken are outlined in Chapter 2 with results presented in Appendix 6b, c and d. The analyses for gasoline range organics, BTEX compounds, phenols and volatile organic compounds did not identify any of these compounds at concentrations greater than the limit of detection or greater than the UK drinking water standards (where determinands are specified). No gasoline range organics were identified in 1997 whilst the BTEX, phenols and volatiles analyses were not undertaken in 1997.

Results *continued*

3.12 The analyses undertaken for diesel range organics indicated that these are present at all locations, albeit generally at relatively low concentrations. The highest concentration detected was 0.5 mg/l at borehole 4. The only location where diesel range organics were detected in 1997 at a concentration significantly greater than the limit of detection was borehole 2. In 1998 the concentration at this location had declined. These results are discussed further below.

Results of Chemical Analysis of Spring Water

Major Ions/Heavy Metals

3.13 The spring water quality measured in 1998 varies very little from that measured in 1997. The water is of neutral pH with a slightly elevated EC. The piper plot for 1998 (Figure 3) is very similar to that for 1997 albeit with a reduced spread in the points plotted.

3.14 The only determinand which has changed significantly at a number of locations is phosphate which has increased at five locations, although only substantially at two. Other determinands have increased such as calcium, magnesium and chloride at Spring I and ammoniacal nitrogen at Springs D and L.

3.15 Comparison of the major ion concentrations with potable water quality standards (where present - Table 2) indicates the following:

sodium	-	all results less than the MAC;
potassium	-	all results less than the MAC;
calcium	-	all results less than the MAC;
magnesium	-	all results less than the MAC;
chloride	-	all results less than the MAC;
nitrate	-	the MAC for nitrate of 50 mg/l is exceeded at three locations - spring D (79 mg/l), spring F (61 mg/l) and spring N (52 mg/l);
phosphate	-	all results less than the MAC;
sulphate	-	all results less than the MAC; and
ammoniacal nitrogen	-	the MAC of 0.39 mg/l is only exceeded at spring N (0.6 mg/l).

3.16 As with the borehole water the spring samples were analysed to lower limits of detection for heavy metals in 1998 compared with 1997. In 1997, excepting lead and zinc at Spring I, no heavy metals were detected at concentrations greater than the limit of detection. However, in 1998 this was not the case with a number of heavy metals present at slightly elevated concentrations as follows:

Results *continued*

- arsenic at 0.19 and 0.24 mg/l at springs B and M respectively. The MAC for potable water is 0.05 mg/l;
- chromium at 0.19 mg/l at spring M (MAC = 0.05 mg/l);
- lead at 0.11, 0.09 and 0.18 mg/l at springs A, B and M respectively (MAC = 0.05 mg/l); and
- selenium at 0.007 mg/l at spring I (MAC = 0.01 mg/l).

The majority of the cases where water quality standards for heavy metals were exceeded were at spring M.

Organic Analysis

3.17 The indicator analyses undertaken include those for mineral oil, non-volatile aromatics, NSO, solvent extractable matter, COD, BOD and TOC. All, except TOC and COD at spring N were at or very close to the limit of detection. The COD at spring N was slightly elevated, but none of the TOC concentrations were elevated, although those at springs L and R2 had increased significantly since 1997 (TOC has also increased slightly at three other locations).

3.18 The specific organic analyses for petrol range organics, BTEX and phenols, as with the borehole samples, all indicate concentrations less than the limit of detection and also less than the MAC for potable water (where specified). The diesel range organics analysis indicates these compounds to be present at all locations, albeit at low concentrations, except at springs I and N where weathered diesel and diesel respectively were identified. These are discussed further below.

Discussion

3.19 The results of the 1998 sampling exercise indicate that the groundwater beneath and around the site is generally of good quality with little change from 1997 to 1998. The main exceptions are the increase in ammoniacal nitrogen in the boreholes and phosphate at several boreholes and springs. In addition to these, diesel range organics were identified at all locations.

3.20 The increase in ammoniacal nitrogen and phosphate suggests fertiliser as a source. Its increase on site but not in the springs suggests that it is being applied by at least one of the farmers utilising the airfield for grazing. The North Oxfordshire Consortium contacted the farmers, at least two of whom are using nitrogen, phosphorous, potassium (NPK) fertilisers. The farmers also confirmed that although the application of these involves "relatively" small amounts of fertiliser, they were applied prior to a particularly wet period. The result of this is that much of the nitrogen and to a lesser extent the phosphorous moved into solution and entered the groundwater. Of interest is the fact that the lowest

Results *continued*

increase in ammoniacal nitrogen was at borehole 3B which is separated from 3A by a thin mudstone band. However, at boreholes 1A and 1B the lower completion, which is separated by much thicker bands of mudstone than at 3A/3B, both exhibited large increases in ammoniacal nitrogen concentration. This indicates that not all of the mudstone bands beneath the site act as low permeability barriers.

3.21 Although the diesel range organics analysis has indicated that compounds are present with carbon chains which are also found in diesel the results only indicate that diesel fuel oil (*sensu stricto*) is present at two locations - spring I (as weathered diesel - possibly from POL21, which is known to be contaminated with fuels) and spring N. At other locations the compounds present and their source materials could not be identified, but could include substances such as "naturally" occurring hydrocarbons, detergents, surfactants and plasticisers. Values less than 50 µg/l should be treated essentially as "background". Locations where this background concentration have been exceeded are springs I and N (see above) and boreholes 3A, 3B and 4 (see below).

3.22 The UK drinking water standards do not cite a MAC for diesel range organics. However, the EC directive relating to potable water (Reference 3) cites the guide level for substances extractable in chloroform (similar to the extraction used by Geochem Laboratory for diesel range organics) as 100 µg/l. All analyses were less than this except boreholes 3A, 3B, 4, spring I & spring N, the latter two of which were the locations where diesel was positively identified. Although not strictly comparable to diesel range organics, the Dutch intervention Value for Mineral Oil is 600 µg/l. The diesel range organics detected in boreholes 3A, 3B and 4 are all less than this value. Thus, although the results may indicate some hydrocarbon contamination the concentrations are not thought to be significant.

3.23 The 1997 results for diesel range organics were greater than the limit of detection at only five locations compared to all locations in 1998. No compounds could be positively identified at any of the five locations in 1997. The laboratory confirmed that this could be due to the volume of sample analysed and may have been prompted by our more detailed requests for the 1998 analyses.

3.24 The diesel which has been positively identified cannot be unequivocally attributed to Upper Heyford, especially that from spring N. This spring is dry for part of the year and when flowing rises at an elevation greater than the water level in the nearest on site borehole (borehole 2). Furthermore, given that all fuel storage on the northern side of the airfield ceased at least four years ago any diesel resurging at spring N would be more likely to be weathered rather than the unweathered diesel detected. It is therefore postulated that the diesel is from a local, more recent source.

3.25 The elevated heavy metals detected at some of the springs may be due to "local" sources outwith RAF Upper Heyford, or they may be due to contaminants moving

through the aquifer. With further monitoring it will be possible to better determine the source of these variations.

3.26 It is not possible to determine any trends with only two years of monitoring data. Only by undertaking long term monitoring would such trends be identifiable. Of particular concern are diesel range organics, heavy metals, phosphate and ammoniacal nitrogen. Given than the site is no longer an operational airbase and that MOD POL storage and transfer facilities have been drained of fuel then decreasing trends in diesel range organics and heavy metals would be expected, assuming of course, that any existing contamination is not disturbed.

Conclusions and Recommendations

3.27 In conclusion the monitoring data confirm that the groundwater beneath the site:

- is not contaminated with hydrocarbon based fuels, although hydrocarbon containing compounds are present at low concentrations;
- with a very limited number of exceptions, is not contaminated with heavy metals;
- is not contaminated with gasoline range organics, phenols or volatile organic compounds; and
- is sensitive to land use, such as agriculture, which involves the direct addition of soluble substances to the land surface.

3.28 Excepting fertiliser derived compounds, the very limited exceedence of potable water quality standards of a small number of determinands does not require any groundwater remediation. Furthermore, it confirms that there are no water quality issues which should limit the redevelopment of the site for housing. However, it is recommended that the groundwater be regularly monitored during any demolition or redevelopment of the site to determine if this remains the case.

References

4

1. Aspinwall & Company Ltd, June 1997, RAF Upper Heyford Land Quality Assessment - Factual Report, Interpretive Report and Appendices, Report Reference MD3333A.

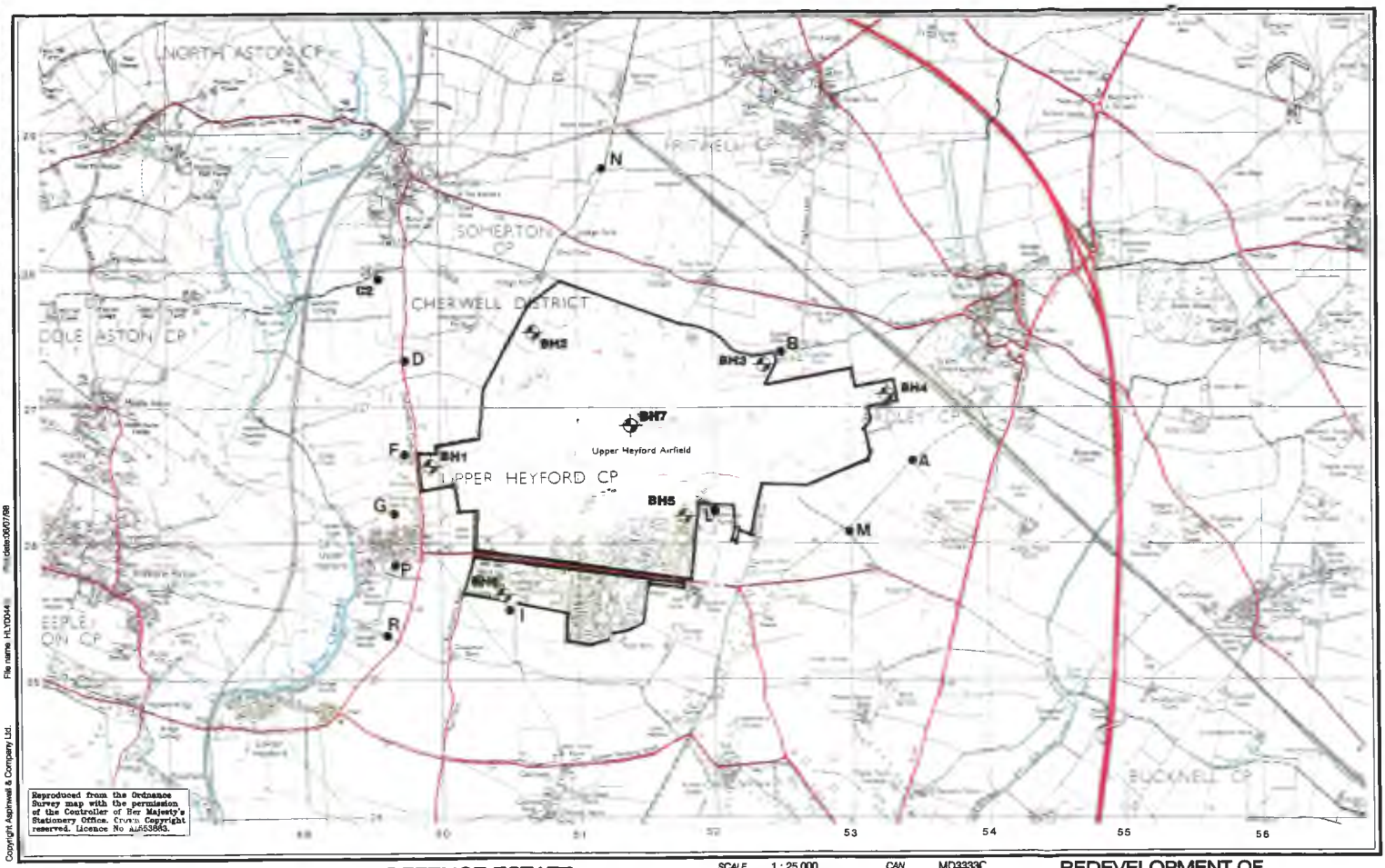
2. DoE/Welsh Office, 1989, The Water Supply (Water Quality) Regulations 1989, Statutory Instruments No. 1147, Water, England and Wales.

3. Department of the Environment/Welsh Office, 1982, EC Directive Relating To The Quality of Water Intended For Human Consumption, Ref. 80/778/EEC.

Figures

Figure 1

Groundwater and Surface Water Sampling Locations



KEY

- Borehole locations
- Surface water sampling locations

NOTES

G is downstream of springs G1, G2, & G3

T is downstream of springs / outfalls K & L

P is downstream of springs P1 & P2

A, F & N will only be sampled if flowing (dry during April 1997)

Boreholes as referred to in the investigation completed for DEO

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SCALE 1 : 25,000

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CAN MD3333C

DRAWN HLY

DATE JULY 1998

REDEVELOPMENT OF UPPER HEYFORD

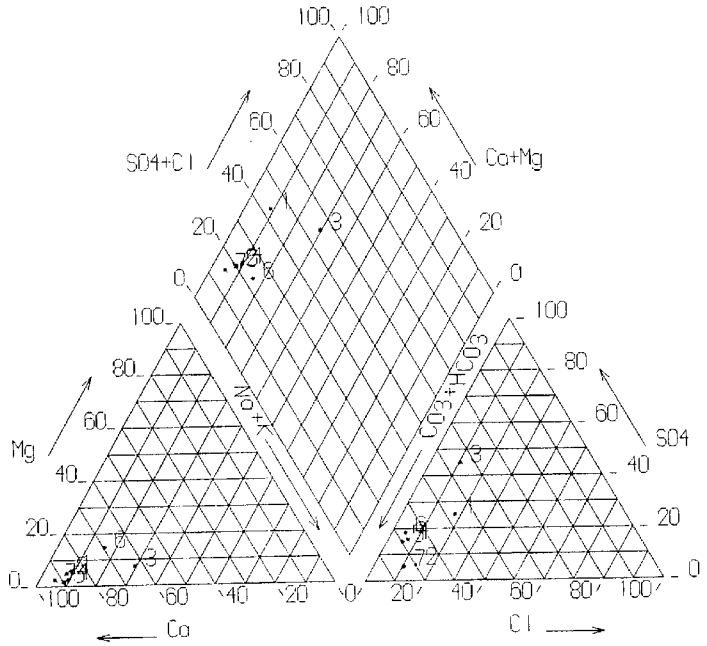
FIGURE 1

GROUNDWATER AND SURFACE WATER SAMPLING LOCATIONS

Figure 2

Groundwater Quality - Boreholes

#	Date YYMMDD	Zone	Well I.D.
1	980512	1,3,5	BH1A
2	980512	1,3,5	BH1B
3	980512	1,4,9	BH2
4	980512	1,3,5	BH3A
5	980512	1,3,5	BH3B
6	980512	1,3,5	BH4
7	980512	1,3,5	BH7



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Plot date:06/07/98

KEY:

SCALE CAN MD3333C

CONTENT DRAWN HLY

CHECKED DATE JULY 1998

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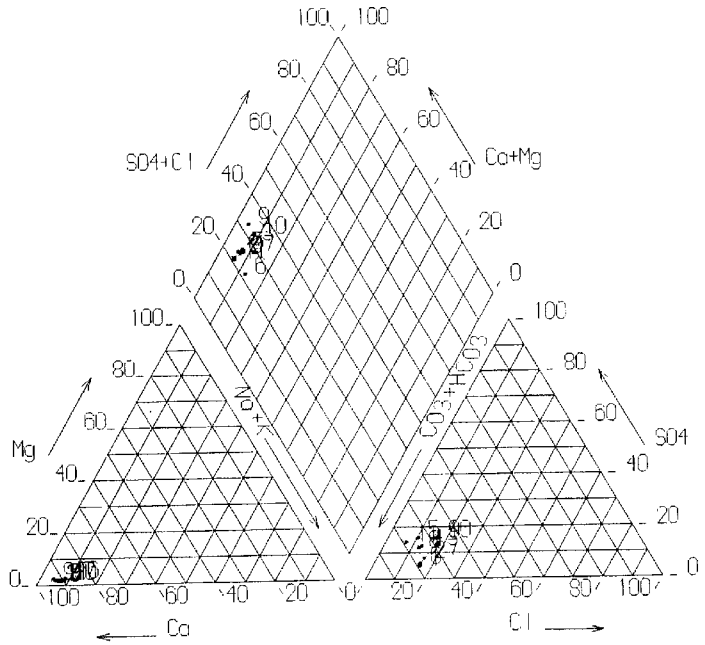
REDEVELOPMENT OF UPPER HEYFORD

FIGURE 2
GROUNDWATER QUALITY - BOREHOLES

Figure 3

Groundwater Quality - Springs

#	Date YYMMDD	Zone	Well I.D.
1	980512	1,3,5	SPRING A
2	980512	1,3,5	SPRING B
3	980512	1,3,5	SPRING D
4	980512	1,3,5	SPRING F
5	980512	1,3,5	SPRING G1
6	980512	1,3,5	SPRING I
7	980512	1,3,5	SPRING L
8	980512	1,3,5	SPRING M
9	980512	1,3,5	SPRING N
10	980512	1,3,5	SPRING P1
11	980512	1,3,5	SPRING R2



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DATE JULY 1998

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REDEVELOPMENT OF UPPER HEYFORD

FIGURE 3
GROUNDWATER QUALITY - SPRINGS

File name:HLY
Plot date:06/07/98

Appendices

Appendix 1

Consultants Directive

Ministry of Defence
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Shropshire SY4 2HH

Your Reference: MD3333C

Our Reference: D/DEO/27/104/4/07686

Date: 8 May 1998

fao [redacted]

Dear [redacted]

RAF UPPER HEYFORD: Groundwater Quality Monitoring

References

A. Phase Two LQA report, MD3333B, dated June 1997
B. Minutes of Meeting at Upper Heyford, G381, dated 26 February 1998
C. Letter, A&Co to EA, TA2501A, dated 27 February 1998
D. Letter, EA to A&Co, SD/G/CL/OX, dated 17 April 1998
E. Letter, A&Co to EA, TA2502A, dated 27 April 1998
F. Letter, MD3333C/SLH, dated 28 April 1998
G. C2 Order No. 114, dated 8 May 1998

1. Sampling and analysis of groundwater at RAF Upper Heyford was recommended by the Phase Two LQA (ref. A) and requested by the Environment Agency (EA) at a meeting held on 26 February 1998 (ref. B). With reference to your letter (ref. F) and your Term Commission WS13/1982/2, enclosed is a C2 Order (ref. G) for sampling and analysis of groundwater from boreholes and springs on and around RAF Upper Heyford. Please sign and return the original C2 Order to me indicating your acceptance of this task. Please notify me of the start date for sampling and of progress to issue of the draft report.

2. The scope of work is as presented in the Interpretive Report (ref. A) with additions and clarifications by the EA and Aspinwall & Co (refs B, C, D and E). The resulting scope for this single round groundwater sampling exercise is set out below. This Order is placed on the basis of the following scope of works and is intended to augment the information provided in the LQA. The following scope of works represents an accumulation of intentions expressed by Aspinwall & Co and the EA in documents referred to above. The scope of works is accepted as suitable based on advice given to DEO by those parties. Any subsequent works to assess or monitor the land quality of the site will be the responsibility of the joint venture consortium for development of this site.

3. The groundwater quality monitoring exercise will comprise collection of one sample of groundwater from each nominated spring and borehole on and around the site. Each borehole will be purged sufficiently to ensure that the sample collected is representative of formation water. The assessment of adequate purging should be determined preferably by measurement of appropriate properties or alternatively by the calculated borehole volume method. Measures must be taken to ensure that there is no cross-contamination between samples. Samples for VOC analysis are to collected and transferred to the laboratory in a manner which minimises loss of volatiles. All samples must be collected and stored in an appropriate manner which minimises sample degradation. The details of sample collection must be recorded and presented with the other data from this exercise. A water level must be recorded for each borehole in a manner which allows calculation of depth below ground level and elevation above

Ordnance Datum. All sample locations are shown on Figure 4 of the Phase Two LQA Factual Report; an annotated copy of this map is enclosed.

4. Locations to be sampled are as follows:

- Boreholes: 1A, 1B, 2, 3A, 3B, 4, 5, 6 and 7.
- Springs: B, C2, D, G1, P1, R2, I, L, M and (if flowing) A, F and N.

5. The analytical suite for each sample is to be as follows with detection limits :

- Major Ions: Ca, Mg, K, Na, HCO_3, SO_4, NO_3, Cl and Ammoniacal Nitrogen.
- Metals: As, Cd, Cr, Pb, Hg, Cu, Ni, Zn (limit of detection appropriate to drinking water MACs)
- Others: pH (*in situ* and lab), Electrical Conductivity (*in situ* and lab), Solvent Extractable Matter (SEM), Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD), Total Organic Carbon (TOC), Total Petroleum Hydrocarbons (diesel and petrol range), Total Alkalinity and phosphate.
- Additional EA requested determinands: phenol (all samples) and Volatile Organic Compounds by GCMS (VOCs) (borehole samples only). The VOC suite as agreed with the Environment Agency (Ref. D) is to be as follows:

Benzene	Dichloromethane (DCM)
Toluene	Trichloroethene (TCE)
Ethylbenzene	Tetrachloroethene (TeCE)
Xylene	1,1,1-trichloroethane (TCA)
Carbon Tetrachloride	Vinyl Chloride

6. Analytical data and interpretation will be presented in a single volume report which will be issued initially in draft form. The final report will be issued after receipt of comments. The report will include tabulation of analytical data in a manner which allows comparison with previous data. As for the LQA report, 4 copies of the draft report and 8 copies of the Final report will be required. Following issue of the report, a meeting will be held with the Environment Agency to discuss the conclusions of this monitoring exercise. That meeting is not included in this commission and will be funded from the development budget through NOC.

7. Please contact me if I can be of further assistance.

Yours sincerely,

[redacted]

[redacted]
Environmental Engineer
SC 4e, DEO HQ
SB19 2453SB

cc. DEO[redacted]
RAFIO, Infra Pol 3b

encl.. Figure 4 Site Plan with annotations

Appendix 2

Water Level Measurements

Water Levels at Upper Heyford

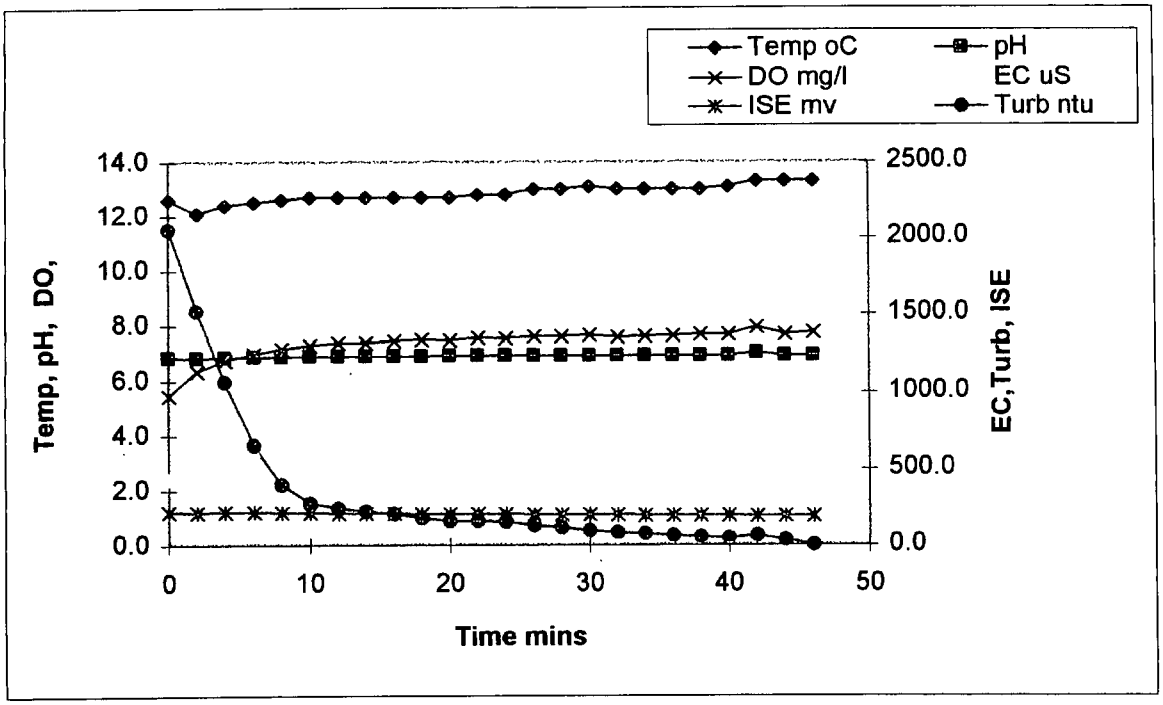
Location	Ground Elevation m AOD	Water level 09-May-97 m AOD	Water level 11-May-98 m AOD
1A	116.42	81.4	81.46
1B	116.42	103.57	105.51
2	137.98	113.67	116.7
3A	121.71	120.04	120.12
3B	121.71	120.03	120.09
4	121.88	109.72	111.63
5	120.2	118.92	118.97
6	121.56	112.88	116.86
7	131.01	129.07	128.38

Appendix 3

Details of Purging

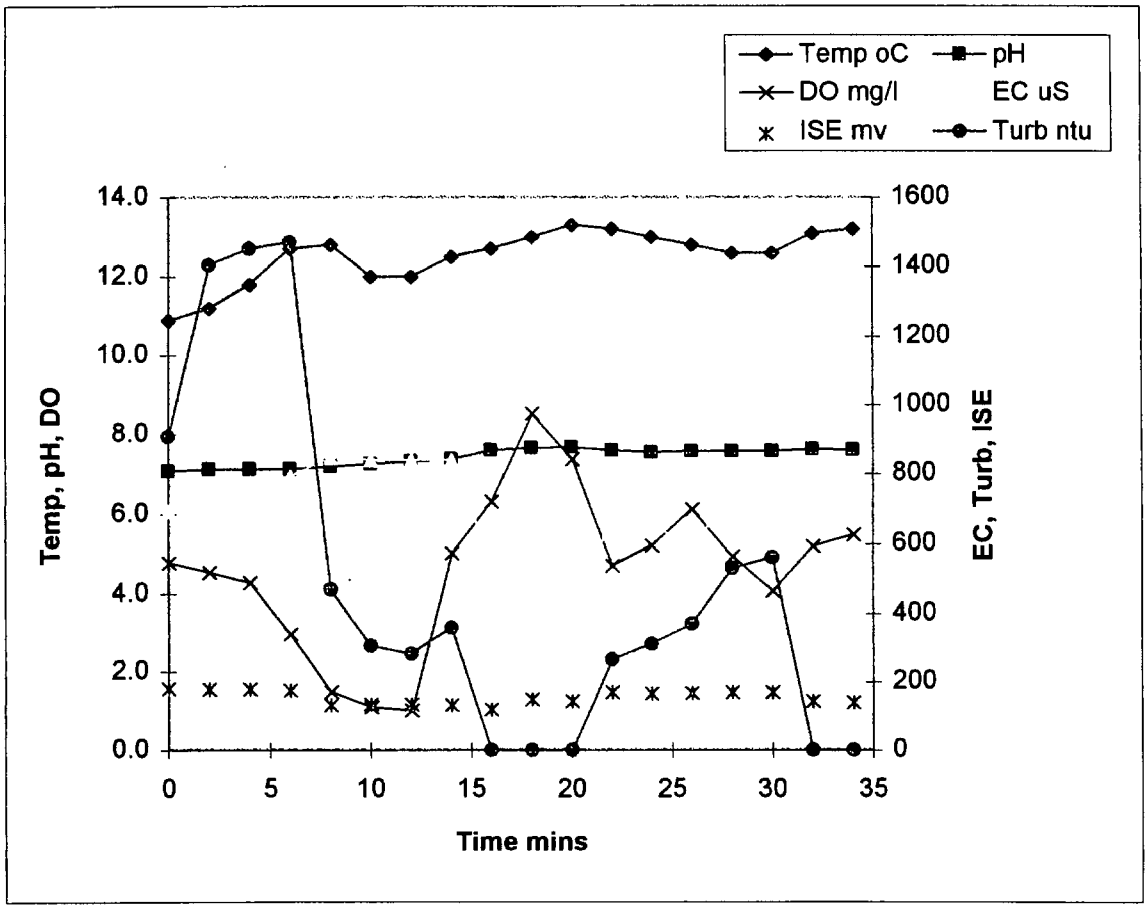
Borehole 1B

Time		Pt100 øC Temp oC	pH/mV pH pH	conduct uS EC uS	DO Salin mg/l DO mg/l	ISE mid mV ISE mv	turbid NTU Turb ntu
13/05/98 11:12	0	12.6	6.85	432.3	5.48	214.7	2050
13/05/98 11:14	2	12.1	6.83	563.2	6.36	214.2	1518
13/05/98 11:16	4	12.4	6.86	594.3	6.76	214.6	1063
13/05/98 11:18	6	12.5	6.87	620.0	7.00	214.6	652
13/05/98 11:20	8	12.6	6.88	627.2	7.18	213.0	397
13/05/98 11:22	10	12.7	6.89	631.8	7.30	211.6	276
13/05/98 11:24	12	12.7	6.89	636.6	7.39	210.0	243
13/05/98 11:26	14	12.7	6.90	637.1	7.38	208.5	221
13/05/98 11:28	16	12.7	6.90	639.3	7.45	207.1	205
13/05/98 11:30	18	12.7	6.90	640.5	7.51	205.9	178
13/05/98 11:32	20	12.7	6.91	639.9	7.48	204.7	159
13/05/98 11:34	22	12.8	6.91	640.4	7.56	203.2	157
13/05/98 11:36	24	12.8	6.91	640.2	7.54	201.8	152
13/05/98 11:38	26	13.0	6.91	640.7	7.62	200.2	129
13/05/98 11:40	28	13.0	6.92	642.4	7.61	199.6	115
13/05/98 11:42	30	13.1	6.92	644.2	7.66	199.1	95
13/05/98 11:44	32	13.0	6.92	643.0	7.60	198.3	84
13/05/98 11:46	34	13.0	6.92	643.8	7.61	197.5	75
13/05/98 11:48	36	13.0	6.92	642.4	7.64	196.7	61
13/05/98 11:50	38	13.0	6.92	643.6	7.68	195.7	56
13/05/98 11:52	40	13.1	6.92	643.4	7.68	194.7	44
13/05/98 11:54	42	13.3	7.02	635.2	7.94	193.0	62
13/05/98 11:56	44	13.3	6.93	642.5	7.69	192.4	32
13/05/98 11:58	46	13.3	6.93	644.4	7.76	192.0	0



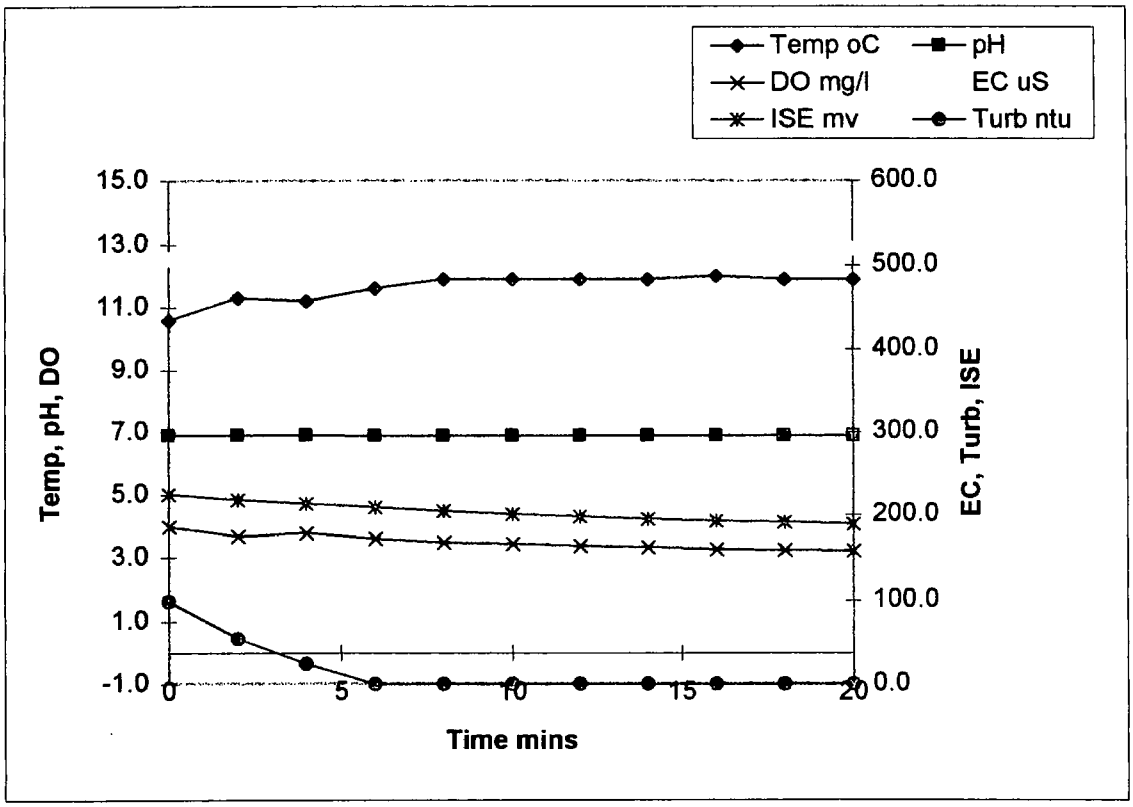
Borehole 2

Time		Pt100 øC Temp oC	pH/mV pH pH	conduct uS EC uS	DO Salin mg/l DO mg/l	ISE mid mV ISE mv	turbid NTU Turb ntu
13/05/98 08:44	0	10.9	7.07	694.4	4.79	180.6	908
13/05/98 08:46	2	11.2	7.11	716.6	4.54	179.8	1405
13/05/98 08:48	4	11.8	7.12	742.9	4.29	179.8	1452
13/05/98 08:50	6	12.7	7.11	792.4	2.98	175.9	1471
13/05/98 08:52	8	12.8	7.17	845.5	1.51	133.4	469
13/05/98 08:54	10	12.0	7.25	838.6	1.12	134.9	305
13/05/98 08:56	12	12.0	7.31	838.1	1.03	135.3	281
13/05/98 08:58	14	12.5	7.36	839.4	5.02	133.6	359
13/05/98 09:00	16	12.7	7.58	547.1	6.32	119.4	0
13/05/98 09:02	18	13.0	7.65	423.9	8.53	149.1	0
13/05/98 09:04	20	13.3	7.66	384.7	7.37	144.5	0
13/05/98 09:06	22	13.2	7.58	685.7	4.70	170.0	265
13/05/98 09:08	24	13.0	7.54	648.2	5.22	167.1	311
13/05/98 09:10	26	12.8	7.57	609.3	6.12	168.1	370
13/05/98 09:12	28	12.6	7.56	714.7	4.95	170.2	530
13/05/98 09:14	30	12.6	7.56	761.6	4.07	169.8	562
13/05/98 09:16	32	13.1	7.62	714.6	5.20	143.8	0
13/05/98 09:18	34	13.2	7.60	702.8	5.50	140.0	0



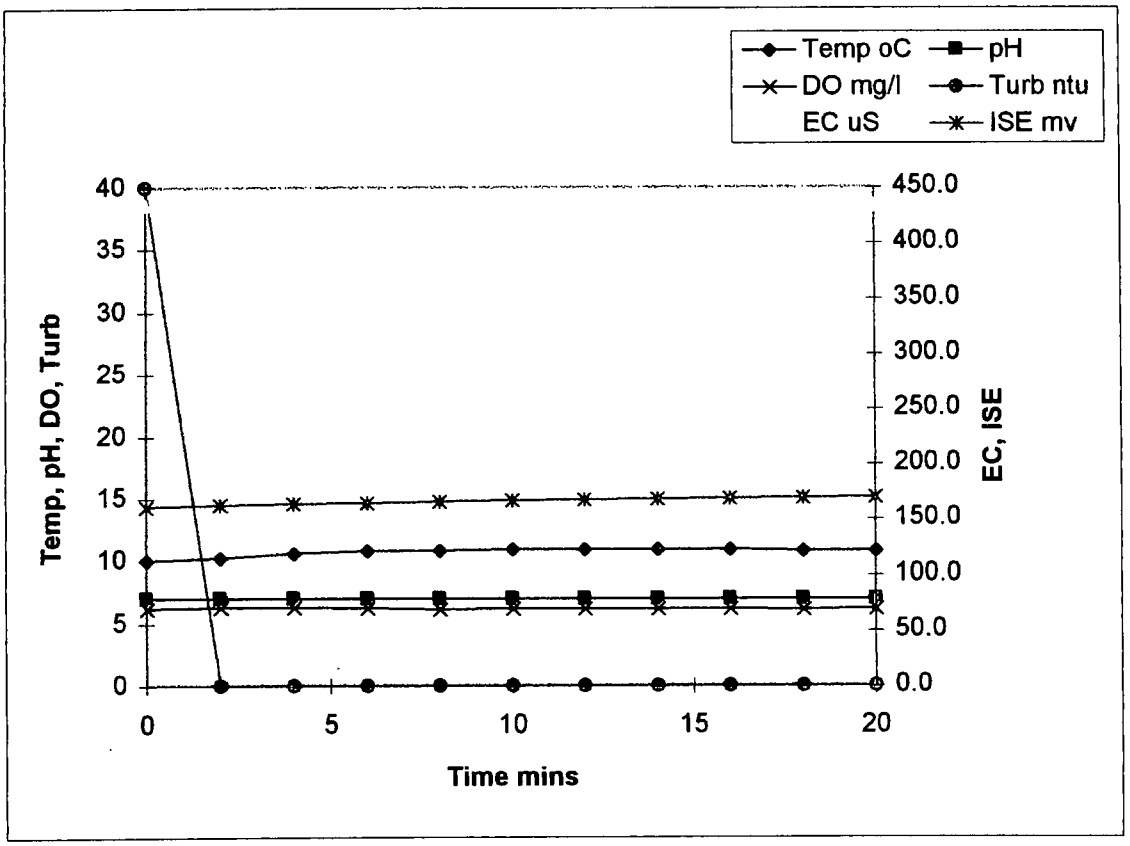
Borehole 3A

Time		Pt100 øC Temp oC	pH/mV pH pH	conduct uS EC uS	DO Salin mg/l DO mg/l	ISE mid mV ISE mv	turbid NTU Turb ntu
11/05/98 11:51	0	10.6	6.89	507.8	3.97	225.1	98
11/05/98 11:53	2	11.3	6.89	510.0	3.66	218.7	54
11/05/98 11:55	4	11.2	6.89	509.2	3.78	213.8	24
11/05/98 11:57	6	11.6	6.88	525.7	3.58	209.5	0
11/05/98 11:59	8	11.9	6.88	525.6	3.47	204.9	0
11/05/98 12:01	10	11.9	6.88	525.6	3.42	201.2	0
11/05/98 12:03	12	11.9	6.88	524.9	3.36	198.1	0
11/05/98 12:05	14	11.9	6.88	522.8	3.33	195.3	0
11/05/98 12:07	16	12.0	6.88	523.8	3.26	192.8	0
11/05/98 12:09	18	11.9	6.88	522.1	3.24	190.8	0
11/05/98 12:11	20	11.9	6.88	520.2	3.22	189.1	0



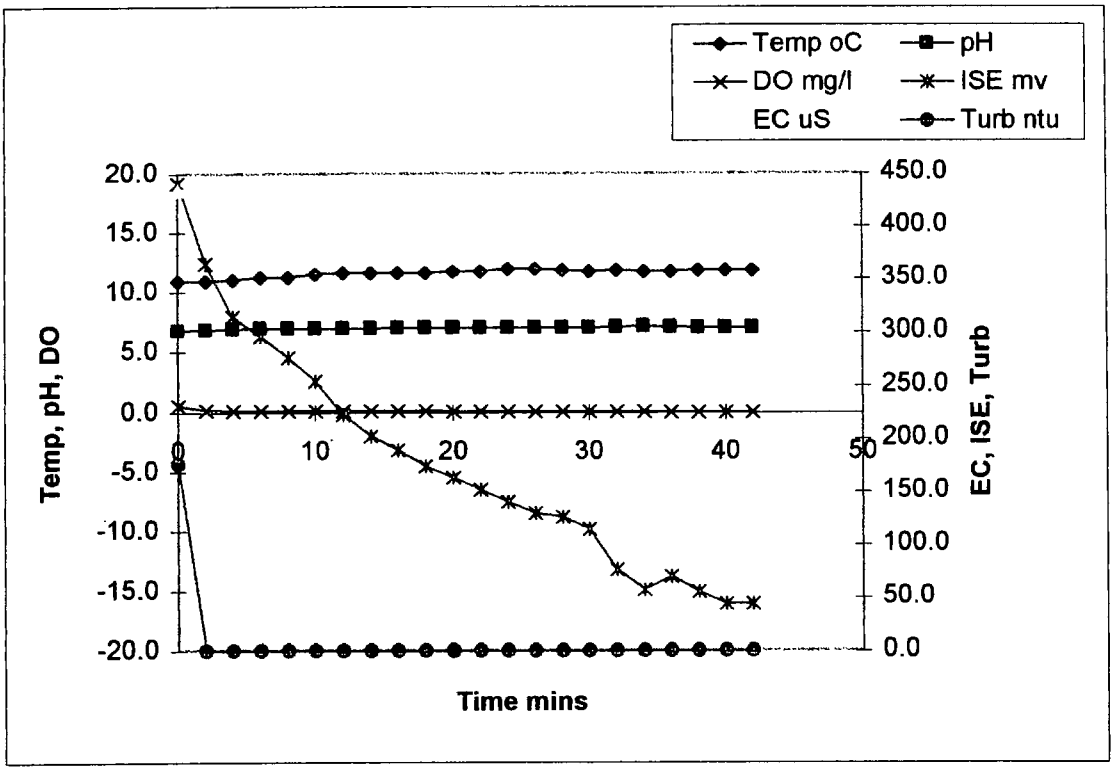
Borehole 3B

Time		Pt100 øC Temp oC	pH/mV pH pH	conduct uS EC uS	DO Salin mg/l DO mg/l	ISE mid mV ISE mv	turbid NTU Turb ntu
11/05/98 11:13	0	10	6.98	434.2	6.23	161.2	40
11/05/98 11:15	2	10.2	6.99	433.0	6.30	163.0	0
11/05/98 11:17	4	10.6	6.99	431.8	6.31	164.0	0
11/05/98 11:19	6	10.8	6.99	432.9	6.25	164.7	0
11/05/98 11:21	8	10.8	6.99	432.9	6.18	165.7	0
11/05/98 11:23	10	10.9	6.99	434.2	6.23	166.7	0
11/05/98 11:25	12	10.9	6.99	433.5	6.19	167.5	0
11/05/98 11:27	14	10.9	6.99	433.5	6.23	168.1	0
11/05/98 11:29	16	10.9	6.99	432.9	6.23	168.9	0
11/05/98 11:31	18	10.8	6.99	434.2	6.18	169.5	0
11/05/98 11:33	20	10.8	6.99	433.6	6.22	170.0	0



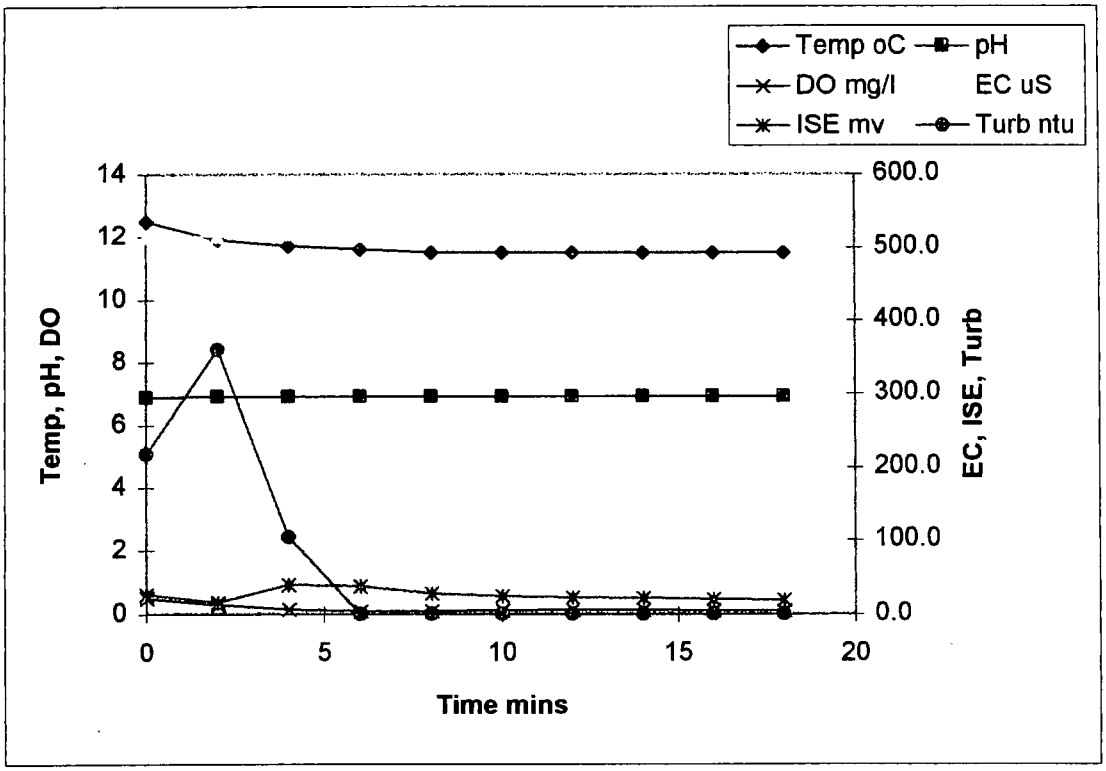
Borehole 4

Time		Pt100 øC Temp oC	pH/mV pH pH	conduct uS EC uS	DO Salin mg/l DO mg/l	ISE mid mV ISE mv	turbid NTU Turb ntu
11/05/98 09:35	0	10.9	6.77	434.2	0.57	19.2	176
11/05/98 09:37	2	10.9	6.85	437.7	0.18	12.4	0
11/05/98 09:39	4	11.0	6.88	438.9	0.12	7.9	0
11/05/98 09:41	6	11.2	6.92	439.3	0.16	6.3	0
11/05/98 09:43	8	11.2	6.93	439.2	0.13	4.5	0
11/05/98 09:45	10	11.5	6.95	441.4	0.13	2.6	0
11/05/98 09:47	12	11.6	6.95	441.5	0.12	-0.2	0
11/05/98 09:49	14	11.6	6.96	443.2	0.12	-2.0	0
11/05/98 09:51	16	11.6	6.97	442.7	0.11	-3.2	0
11/05/98 09:53	18	11.6	6.98	443.1	0.11	-4.5	0
11/05/98 09:55	20	11.7	6.98	443.0	0.10	-5.5	0
11/05/98 09:57	22	11.7	6.99	443.5	0.10	-6.5	0
11/05/98 09:59	24	11.9	6.99	443.9	0.09	-7.5	0
11/05/98 10:01	26	11.9	6.99	443.4	0.09	-8.5	0
11/05/98 10:03	28	11.8	7.00	443.5	0.08	-8.8	0
11/05/98 10:05	30	11.7	7.00	444.2	0.06	-9.8	0
11/05/98 10:07	32	11.8	7.02	433.0	0.06	-13.2	0
11/05/98 10:09	34	11.7	7.11	436.0	0.06	-14.9	0
11/05/98 10:11	36	11.7	7.02	443.0	0.03	-13.8	0
11/05/98 10:13	38	11.8	7.01	444.7	0.03	-15.1	0
11/05/98 10:15	40	11.8	7.01	445.2	0.03	-16.1	0
11/05/98 10:17	42	11.8	7.01	443.9	0.03	-16.1	0



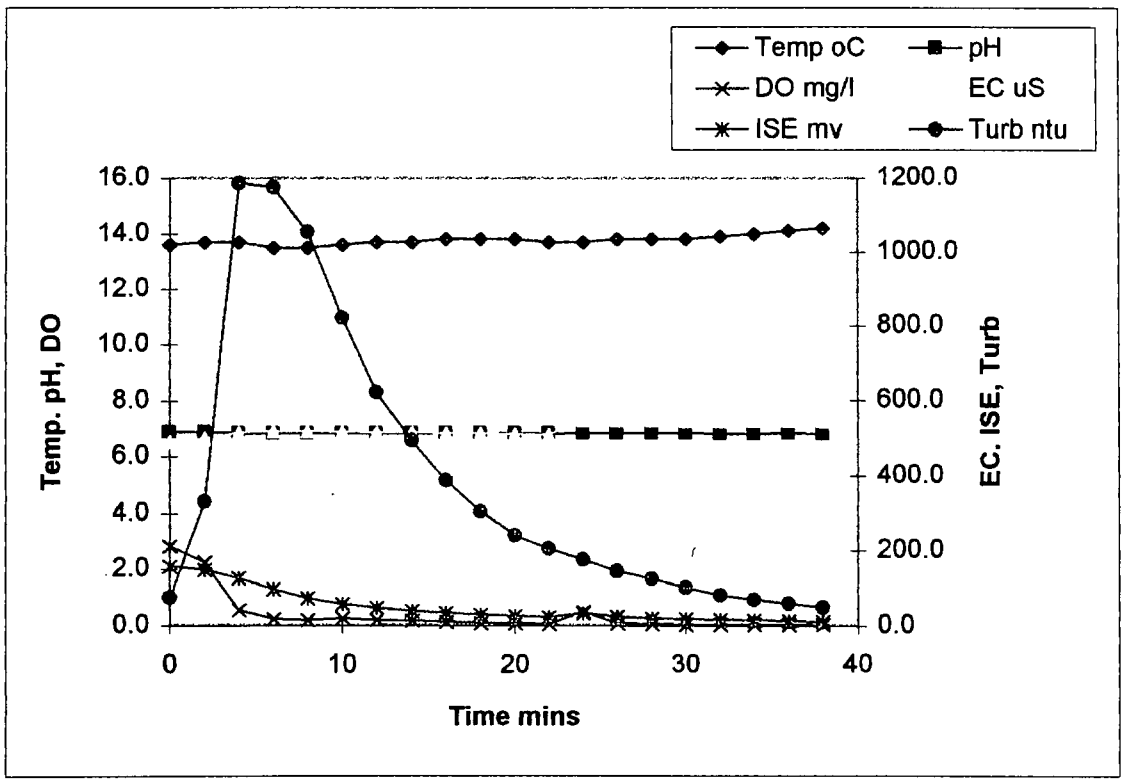
Borehole 5

Time		Pt100 øC Temp oC	pH/mV pH pH	conduct uS EC uS	DO Salin mg/l DO mg/l	ISE mid mV ISE mv	turbid NTU Turb ntu
11/05/98 13:19	0	12.5	6.88	514.8	0.50	26.1	217
11/05/98 13:21	2	11.9	6.89	515.1	0.30	15.7	360
11/05/98 13:23	4	11.7	6.90	517.6	0.16	39.2	104
11/05/98 13:25	6	11.6	6.89	516.2	0.11	37.3	0
11/05/98 13:27	8	11.5	6.89	517.0	0.10	27.7	0
11/05/98 13:29	10	11.5	6.89	516.4	0.12	24.3	0
11/05/98 13:31	12	11.5	6.89	517.0	0.14	22.6	0
11/05/98 13:33	14	11.5	6.89	516.4	0.15	21.6	0
11/05/98 13:35	16	11.5	6.89	516.4	0.13	20.4	0
11/05/98 13:37	18	11.5	6.89	517.0	0.12	19.0	0



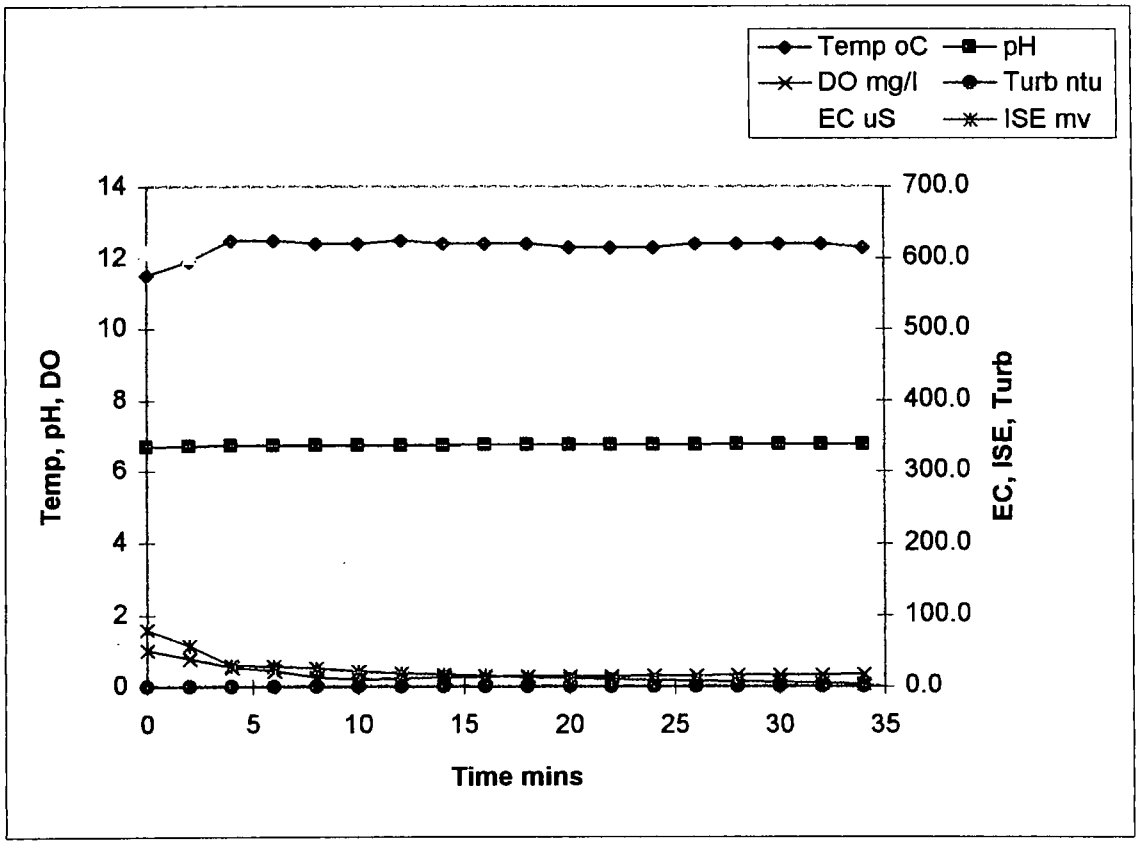
Borehole 6

Time		Pt100 øC Temp oC	pH/mV pH pH	conduct uS EC uS	DO Salin mg/l DO mg/l	ISE mid mV ISE mv	turbid NTU Turb ntu
11/05/98 15:01	0	13.6	6.88	489.8	2.83	157.9	75
11/05/98 15:03	2	13.7	6.87	498.4	2.26	149.6	332
11/05/98 15:05	4	13.7	6.83	514.2	0.58	126.9	1186
11/05/98 15:07	6	13.5	6.82	517.0	0.25	97.3	1176
11/05/98 15:09	8	13.5	6.82	516.5	0.20	74.1	1054
11/05/98 15:11	10	13.6	6.82	515.9	0.28	58.1	821
11/05/98 15:13	12	13.7	6.82	514.2	0.21	47.5	623
11/05/98 15:15	14	13.7	6.82	514.2	0.18	40.0	493
11/05/98 15:17	16	13.8	6.82	512.0	0.13	34.1	389
11/05/98 15:19	18	13.8	6.82	511.4	0.10	29.4	304
11/05/98 15:21	20	13.8	6.82	509.8	0.09	25.3	240
11/05/98 15:23	22	13.7	6.82	509.0	0.07	22.4	205
11/05/98 15:25	24	13.7	6.85	547.7	0.50	32.4	176
11/05/98 15:27	26	13.8	6.84	548.1	0.09	23.6	145
11/05/98 15:29	28	13.8	6.84	547.2	0.06	19.6	125
11/05/98 15:31	30	13.8	6.84	545.9	0.05	16.9	101
11/05/98 15:33	32	13.9	6.83	546.5	0.05	14.7	81
11/05/98 15:35	34	14.0	6.83	547.0	0.04	13.0	69
11/05/98 15:37	36	14.1	6.84	547.3	0.04	11.2	58
11/05/98 15:39	38	14.2	6.83	546.2	0.04	9.8	48



Borehole 7

Time		Pt100 øC Temp oC	pH/mV pH pH	conduct uS EC uS	DO Salin mg/l DO mg/l	ISE mid mV ISE mv	turbid NTU Turb ntu
13/05/98 14:00	0	11.5	6.69	607.5	1.03	79.6	0
13/05/98 14:02	2	11.9	6.71	601.1	0.79	57.5	0
13/05/98 14:04	4	12.5	6.72	587.3	0.56	30.0	0
13/05/98 14:06	6	12.5	6.73	589.2	0.44	29.0	0
13/05/98 14:08	8	12.4	6.73	588.2	0.27	25.7	0
13/05/98 14:10	10	12.4	6.73	587.1	0.22	21.8	0
13/05/98 14:12	12	12.5	6.73	586.3	0.24	19.0	0
13/05/98 14:14	14	12.4	6.73	586.0	0.26	16.9	0
13/05/98 14:16	16	12.4	6.74	585.3	0.28	15.1	0
13/05/98 14:18	18	12.4	6.74	583.6	0.30	13.6	0
13/05/98 14:20	20	12.3	6.74	583.6	0.31	12.0	0
13/05/98 14:22	22	12.3	6.74	581.9	0.31	10.8	0
13/05/98 14:24	24	12.3	6.74	580.1	0.32	9.4	0
13/05/98 14:26	26	12.4	6.74	580.7	0.33	8.3	0
13/05/98 14:28	28	12.4	6.75	579.0	0.34	7.1	0
13/05/98 14:30	30	12.4	6.75	578.3	0.34	6.1	0
13/05/98 14:32	32	12.4	6.75	577.8	0.34	4.7	0
13/05/98 14:34	34	12.3	6.75	576.6	0.35	3.8	0



Appendix 4

Details of Samples Collected

GEOCHEM

GEOCHEM ANALYTICAL SERVICES
TEST SCHEDULE

NAMAS TESTING No. 1291

JOB NUMBER	98/01468/02/01	**BATCH NUMBER**	1
CLIENT	Aspinwall & Company	**CLIENT REF/CODE**	
CONTACT	[redacted]	**ORDER NUMBER**	
DATE OF RECEIPT	12/5/1998	**TURNAROUND**	12 Days
LOCATION	RAF UPPER HEYFORD		

Nonhazardous ☐
Hazardous ☐
Type .....

Numeric values indicate additional scheduling

** Indicates test subcontracted*

Sample No.	Sample Identity	P / V	Depth (m)	Sample Type	Arsenic	Hg Low Dutch T	Nickel	Cd low level	Lead	Chromium	Se low level	Copper	Zinc	Boron	Phenol by HS	Solv. Ext. W	Diesel rng orgs	Petrol rng orgs	BTEX by GC	MTBE	Conductivity	pH (water)	Sodium	Potassium
1	BH3A	1lglass	3.50	WATER												✔	✔							
2	BH3A	1lglass	3.50	WATER											✔									
3	BH3A	1lplastic	3.50	WATER	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔							✔	✔	✔	✔
4	BH3A	H2SO4	3.50	WATER																				
5	BH3A	Vial	3.50	WATER														✔	✔	✔				
6	BH3A	Vial	3.50	WATER																				
7	BH3B	1lglass	2.00	WATER												✔	✔							
8	BH3B	1lglass	2.00	WATER											✔									
9	BH3B	1lplastic	2.00	WATER	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔							✔	✔	✔	✔
10	BH3B	H2SO4	2.00	WATER																				
11	BH3B	Vial	2.00	WATER														✔	✔	✔				
12	BH3B	Vial	2.00	WATER																				
13	BH4	1lglass	15.00	WATER												✔	✔							
14	BH4	1lglass	15.00	WATER											✔									
15	BH4	1lplastic	15.00	WATER	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔							✔	✔	✔	✔
16	BH4	H2SO4	15.00	WATER																				
17	BH4	Vial	15.00	WATER														✔	✔	✔				
18	BH4	Vial	15.00	WATER																				
19	BH5 [redacted]	1lglass	2.00	WATER												✔	✔							

Checked by ..... [redacted] Name: [redacted]

GEOCHEM

GEOCHEM ANALYTICAL SERVICES
TEST SCHEDULE

NAMAS TESTING No. 1291

Nonhazardous	☐
Hazardous	☐
Type	_ _ _ _ _ _ _ _ _ _ _ _

JOB NUMBER	98/01468/02/01	**BATCH NUMBER**	1
CLIENT	Aspinwall & Company	**CLIENT REF/CODE**	
CONTACT	[redacted]	**ORDER NUMBER**	
DATE OF RECEIPT	12/5/1998	**TURNAROUND**	12 Days
LOCATION	RAF UPPER HEYFORD		

Numeric values indicate additional scheduling

** Indicates test subcontracted*

Sample No.	Sample Identity	P / V	Depth (m)	Sample Type	Calcium	Magnesium	Chloride Kone	Nitrate Kone	Phosphate Kone	Sulphate Kone	Amm. N2 (W)	Alkalinity Total	Bicarbonate	COD (unfiltered)	BOD (unfiltered)	T.O.C. In water	Thin-layer chro.	H/space (MSD)						
1	BH3A	1lglass	3.50	WATER												✔	✔							
2	BH3A	1lglass	3.50	WATER																				
3	BH3A	1lplastic	3.50	WATER	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔									
4	BH3A	H2SO4	3.50	WATER							✔													
5	BH3A	Vial	3.50	WATER																				
6	BH3A	Vial	3.50	WATER														✔						
7	BH3B	1lglass	2.00	WATER												✔	✔							
8	BH3B	1lglass	2.00	WATER																				
9	BH3B	1lplastic	2.00	WATER	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔									
10	BH3B	H2SO4	2.00	WATER							✔													
11	BH3B	Vial	2.00	WATER																				
12	BH3B	Vial	2.00	WATER														✔						
13	BH4	1lglass	15.00	WATER												✔	✔							
14	BH4	1lglass	15.00	WATER																				
15	BH4	1lplastic	15.00	WATER	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔									
16	BH4	H2SO4	15.00	WATER							✔													
17	BH4	Vial	15.00	WATER																				
18	BH4	Vial	15.00	WATER														✔						
19	BH5 [redacted]	1lglass	2.00	WATER												✔	✔							

Checked by .... [redacted] ..   Name: [redacted]

NAMAS Accredited

GEOCHEM ANALYTICAL SERVICES
TEST SCHEDULE

NAMAS TESTING No. 1291

Nonhazardous ☐
Hazardous ☐
Type _____

JOB NUMBER	98/01468/02/01	**BATCH NUMBER**	1
CLIENT	Aspinwall & Company	**CLIENT REF/CODE**	
CONTACT	[redacted]	**ORDER NUMBER**	
DATE OF RECEIPT	12/5/1998	**TURNAROUND**	12 Days
LOCATION	RAF UPPER HEYFORD		

Numeric values indicate additional scheduling

** Indicates test subcontracted*

Sample No.	Sample Identity	P / V	Depth (m)	Sample Type	Arsenic	Hg Low Dutch T	Nickel	Cd low level	Lead	Chromium	Se low level	Copper	Zinc	Boron	Phenol by HS	Solv. EXT. W	Diesel mg orgs	Petrol mg orgs	BTEX by GC	MTBE	Conductivity	pH (water)	Sodium	Potassium
20	BH5	1lglass	2.00	WATER											✓									
21	BH5	1lplastic	2.00	WATER	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓							✓	✓	✓	✓
22	BH5	H2SO4	2.00	WATER																				
23	BH5	Vial	2.00	WATER														✓	✓	✓				
24	BH5	Vial	2.00	WATER																				
Total [redacted] of tests					4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4

Checked by [redacted] Name: [redacted]

GEOCHEM ANALYTICAL SERVICES
TEST SCHEDULE

GEOCHEM

JOB NUMBER	98/01468/02/01	**BATCH NUMBER**	1
CLIENT	Aspinwall & Company	**CLIENT REF/CODE**	
CONTACT	[redacted]	**ORDER NUMBER**	
DATE OF RECEIPT	12/5/1998	**TURNAROUND**	12 Days
LOCATION	RAF UPPER HEYFORD		

Nonhazardous ☐
Hazardous ☐
Type ....

NAMAS TESTING No. 1291

Numeric values indicate additional scheduling
** Indicates test subcontracted*

Sample No.	Sample Identity	P / V	Depth (m)	Sample Type	Calcium	Magnesium	Chloride Kone	Nitrate Kone	Phosphate Kone	Sulphate Kone	Amm N2 (W)	Alkalinity Total	Bicarbonate	COD (unfiltered)	BOD (unfiltered)	T.O.C. in water	Thin-layer chro	H'space (MSD)						
20	BH5	1lglass	2.00	WATER																				
21	BH5	1lplastic	2.00	WATER	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔									
22	BH5	H2SO4	2.00	WATER							✔													
23	BH5	Vial	2.00	WATER																				
24	BH5	Vial	2.00	WATER														✔						
	Total [redacted] ests				4	4	4	4	4	4	4	4	4	4	4	4	4	4						

Checked by ....[redacted]... Name: [redacted]

GEOCHEM

GEOCHEM ANALYTICAL SERVICES
TEST SCHEDULE

NAMAS TESTING No. 1291

JOB NUMBER	98/01468/02/01	**BATCH NUMBER**	2
CLIENT	Aspinwall & Company	**CLIENT REF/CODE**	TA2502A
CONTACT	[redacted]	**ORDER NUMBER**	17011
DATE OF RECEIPT	13/5/1998	**TURNAROUND**	12 Days
LOCATION	RAF Upper Heyford		

Nonhazardous ☐
Hazardous ☐
Type .....

Numeric values indicate additional scheduling

** Indicates test subcontracted*

Sample No.	Sample Identity	P / V	Depth (m)	Sample Type	Arsenic	Hg Low Dutch T	Nickel	Cd low level	Lead	Chromium	Se low level	Copper	Zinc	Boron	Phenol by HS	Solv. Ext. W	Diesel rng orgs	Petrol rng orgs	BTEX by GC	MTBE	Conductivity	pH (water)	Sodium	Potassium
25	BH6	1lglass	14.00	WATER		✔										✔	✔							
26	BH6	1lglass	14.00	WATER											✔									
27	BH6	1lplastic	14.00	WATER	✔		✔	✔	✔	✔	✔	✔	✔	✔							✔	✔	✔	✔
28	BH6	H2SO4	14.00	WATER																				
29	BH6	Vial	14.00	WATER														✔	✔	✔				
30	BH6	Vial	14.00	WATER																				
31	D	1lglass	SURFACE	WATER		✔										✔	✔							
32	D	1lglass	SURFACE	WATER											✔									
33	D	1lplastic	SURFACE	WATER	✔		✔	✔	✔	✔	✔	✔	✔	✔							✔	✔	✔	✔
34	D	H2SO4	SURFACE	WATER																				
35	D	Vial	SURFACE	WATER														✔	✔	✔				
36	F	1lglass	SURFACE	WATER		✔										✔	✔							
37	F	1lglass	SURFACE	WATER											✔									
38	F	1lplastic	SURFACE	WATER	✔		✔	✔	✔	✔	✔	✔	✔	✔							✔	✔	✔	✔
39	F	H2SO4	SURFACE	WATER																				
40	F	Vial	SURFACE	WATER														✔	✔	✔				
41	G1 STREAM	1lglass	SURFACE	WATER		✔										✔	✔							
42	G1 STREAM	1lglass	SURFACE	WATER											✔									
43	G1 STREAM	1lplastic	SURFACE	WATER	✔		✔	✔	✔	✔	✔	✔	✔	✔							✔	✔	✔	✔

Checked by .....[redacted]... Name: [redacted]

NAMAS Accredited

GEOCHEM ANALYTICAL SERVICES
TEST SCHEDULE

NAMAS TESTING No. 1291

Nonhazardous ☐
Hazardous ☐
Type .....

JOB NUMBER	98/01468/02/01	**BATCH NUMBER**	2
CLIENT	Aspinwall & Company	**CLIENT REF/CODE**	TA2502A
CONTACT	[redacted]	**ORDER NUMBER**	17011
DATE OF RECEIPT	13/5/1998	**TURNAROUND**	12 Days
LOCATION	RAF Upper Heyford		

Numeric values indicate additional scheduling

** Indicates test subcontracted*

Sample No.	Sample Identity	P / V	Depth (m)	Sample Type	Calcium	Magnesium	Chloride Kone	Nitrate Kone	Phosphate Kone	Sulphate Kone	Ammn N2 (W)	Alkalinity Total	Bicarbonate	COD (unfiltered)	BOD (unfiltered)	T.O.C. in water	Thin-layer chro.	H'space (MSD)						
25	BH6	1lglass	14.00	WATER												✓	✓							
26	BH6	1lglass	14.00	WATER																				
27	BH6	1lplastic	14.00	WATER	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓									
28	BH6	H2SO4	14.00	WATER							✓													
29	BH6	Vial	14.00	WATER																				
30	BH6	Vial	14.00	WATER														✓						
31	D	1lglass	SURFACE	WATER												✓	✓							
32	D	1lglass	SURFACE	WATER																				
33	D	1lplastic	SURFACE	WATER	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓									
34	D	H2SO4	SURFACE	WATER							✓													
35	D	Vial	SURFACE	WATER																				
36	F	1lglass	SURFACE	WATER												✓	✓							
37	F	1lglass	SURFACE	WATER																				
38	F	1lplastic	SURFACE	WATER	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓									
39	F	H2SO4	SURFACE	WATER							✓													
40	F	Vial	SURFACE	WATER																				
41	G1 STREAM	1lglass	SURFACE	WATER												✓	✓							
42	G1 STREAM	1lglass	SURFACE	WATER																				
43	G1 STREAM	1lplastic	SURFACE	WATER	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓									

Checked by [redacted] Name: [redacted]

NAMAS Accredited

GEOCHEM ANALYTICAL SERVICES
TEST SCHEDULE

NAMAS TESTING No. 1291

Nonhazardous ☐
Hazardous ☐
Type .....

Numeric values indicate additional scheduling

** Indicates test subcontracted*

JOB NUMBER	98/01468/02/01	**BATCH NUMBER**	2
CLIENT	Aspinwall & Company	**CLIENT REF/CODE**	TA2502A
CONTACT	[redacted]	**ORDER NUMBER**	17011
DATE OF RECEIPT	13/5/1998	**TURNAROUND**	12 Days
LOCATION	RAF Upper Heyford		

Sample No.	Sample Identity	P / V	Depth (m)	Sample Type	Arsenic	Hg Low Dutch T	Nickel	Cd low level	Lead	Chromium	Se low level	Copper	Zinc	Boron	Phenol by HS	Solv. Ext. W	Diesel rng orgs	Petrol rng orgs	BTEX by GC	MTBE	Conductivity	pH (water)	Sodium	Potassium
44	G1 STREAM	H2SO4	SURFACE	WATER														✔	✔	✔				
45	G1 STREAM	Vial	SURFACE	WATER																				
46	N	1lglass	SURFACE	WATER		✔										✔	✔							
47	N	1lglass	SURFACE	WATER											✔									
48	N	1lplastic	SURFACE	WATER	✔		✔	✔	✔	✔	✔	✔	✔	✔							✔	✔	✔	✔
49	N	H2SO4	SURFACE	WATER																				
50	N	Vial	SURFACE	WATER														✔	✔	✔				
51	P1 SPRING	1lglass	SURFACE	WATER		✔										✔	✔							
52	P1 SPRING	1lglass	SURFACE	WATER											✔									
53	P1 SPRING	1lplastic	SURFACE	WATER	✔		✔	✔	✔	✔	✔	✔	✔	✔							✔	✔	✔	✔
54	P1 SPRING	H2SO4	SURFACE	WATER																				
55	P1 SPRING	Vial	SURFACE	WATER														✔	✔	✔				
56	R2 STREAM	1lglass	SURFACE	WATER		✔										✔	✔							
57	R2 STREAM	1lglass	SURFACE	WATER											✔									
58	R2 STREAM	1lplastic	SURFACE	WATER	✔		✔	✔	✔	✔	✔	✔	✔	✔							✔	✔	✔	✔
59	R2 STREAM	H2SO4	SURFACE	WATER																				
60	R2 STREAM	Vial	SURFACE	WATER														✔	✔	✔				
Total number of tests					7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7

Checked by ..... [redacted] . Name: [redacted]

NAMAS Accredited

GEOCHEM ANALYTICAL SERVICES
TEST SCHEDULE

NAMAS TESTING No. 1291

Nonhazardous ☐
Hazardous ☐
Type .....

JOB NUMBER	98/01468/02/01	**BATCH NUMBER**	2
CLIENT	Aspinwall & Company	**CLIENT REF/CODE**	TA2502A
CONTACT	[redacted]	**ORDER NUMBER**	17011
DATE OF RECEIPT	13/5/1998	**TURNAROUND**	12 Days
LOCATION	RAF Upper Heyford		

Numeric values indicate additional scheduling

** Indicates test subcontracted*

Sample No.	Sample Identity	P / V	Depth (m)	Sample Type	Calcium	Magnesium	Chloride Kone	Nitrate Kone	Phosphate Kone	Sulphate Kone	Amm. N2 (M)	Alkalinity Total	Bicarbonate	COD (undiluted)	BOD (undiluted)	T.O.C. in water	Thin-layer chro.	H'space (HSD)						
44	G1 STREAM	H2SO4	SURFACE	WATER							✓													
45	G1 STREAM	Vial	SURFACE	WATER																				
46	N	1lglass	SURFACE	WATER												✓	✓							
47	N	1lglass	SURFACE	WATER																				
48	N	1lplastic	SURFACE	WATER	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓									
49	N	H2SO4	SURFACE	WATER							✓													
50	N	Vial	SURFACE	WATER																				
51	P1 SPRING	1lglass	SURFACE	WATER												✓	✓							
52	P1 SPRING	1lglass	SURFACE	WATER																				
53	P1 SPRING	1lplastic	SURFACE	WATER	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓									
54	P1 SPRING	H2SO4	SURFACE	WATER							✓													
55	P1 SPRING	Vial	SURFACE	WATER																				
56	R2 STREAM	1lglass	SURFACE	WATER												✓	✓							
57	R2 STREAM	1lglass	SURFACE	WATER																				
58	R2 STREAM	1lplastic	SURFACE	WATER	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓									
59	R2 STREAM	H2SO4	SURFACE	WATER							✓													
60	R2 STREAM	Vial	SURFACE	WATER																				
Total number of tests					7	7	7	7	7	7	7	7	7	7	7	7	7	1						

Checked by .... [redacted] ..... Name: [redacted]

NAMAS Accredited

GEOCHEM ANALYTICAL SERVICES
TEST SCHEDULE

NAMAS TESTING No. 1291

JOB NUMBER	98/01468/02/01	**BATCH NUMBER**	3
CLIENT	Aspinwall & Company	**CLIENT REF/CODE**	TA 2502A
CONTACT	[redacted]	**ORDER NUMBER**	17011
DATE OF RECEIPT	14/5/1998	**TURNAROUND**	12 Days
LOCATION	RAF UPPER HEYFORD		

Nonhazardous ☐
Hazardous ☐
Type .....

Numeric values indicate additional scheduling

** Indicates test subcontracted*

Sample No.	Sample Identity	P / V	Depth (m)	Sample Type	Arsenic	Hg Low Dutch T	Nickel	Cd low level	Lead	Chromium	Se low level	Copper	Zinc	Boron	Phenol by HS	Solv. Ext. W	Diesel mg orgs	Petrol mg orgs	BTEX by GC	MTBE	Conductivity	pH [water]	Sodium	Potassium
61	BH1 A	1lglass	35.00	WATER												✓	✓							
62	BH1 A	1lglass	35.00	WATER											✓									
63	BH1 A	1lplastic	35.00	WATER	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓							✓	✓	✓	✓
64	BH1 A	H2SO4	35.00	WATER																				
65	BH1 A	Vial	35.00	WATER														✓	✓	✓				
66	BH1 A	Vial	35.00	WATER																				
67	BH1 B	1lglass	14.00	WATER												✓	✓							
68	BH1 B	1lglass	14.00	WATER											✓									
69	BH1 B	1lplastic	14.00	WATER	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓							✓	✓	✓	✓
70	BH1 B	H2SO4	14.00	WATER																				
71	BH1 B	Vial	14.00	WATER														✓	✓	✓				
72	BH1 B	Vial	14.00	WATER																				
73	BH 2	1lglass	23.00	WATER												✓	✓							
74	BH 2	1lglass	23.00	WATER											✓									
75	BH 2	1lplastic	23.00	WATER	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓							✓	✓	✓	✓
76	BH 2	H2SO4	23.00	WATER																				
77	BH 2	Vial	23.00	WATER														✓	✓	✓				
78	BH 2	Vial	23.00	WATER																				
	Tot[redacted]ests				3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Checked by .....[redacted].. Name: [redacted]

GEOCHEM ANALYTICAL SERVICES
TEST SCHEDULE

NAMAS TESTING No. 1291

Nonhazardous ☐
Hazardous ☐
Type .....

JOB NUMBER	98/01468/02/01	**BATCH NUMBER**	3
CLIENT	Aspinwall & Company	**CLIENT REF/CODE**	TA 2502A
CONTACT	[redacted]	**ORDER NUMBER**	17011
DATE OF RECEIPT	14/5/1998	**TURNAROUND**	12 Days
LOCATION	RAF UPPER HEYFORD		

Numeric values indicate additional scheduling

** Indicates test subcontracted*

Sample No.	Sample Identity	P / V	Depth (m)	Sample Type	Calcium	Magnesium	Chloride Kone	Nitrate Kone	Phosphate Kone	Sulphate Kone	Ammn. N2 (PF)	Alkalinity Total	Bicarbonate	COD (unfiltered)	BOD (unfiltered)	T.O.C. in water	Thin-layer chro.	Hspace (MSD)						
61	BH1 A	1lglass	35.00	WATER												✓	✓							
62	BH1 A	1lglass	35.00	WATER																				
63	BH1 A	1lplastic	35.00	WATER	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓									
64	BH1 A	H2SO4	35.00	WATER							✓													
65	BH1 A	Vial	35.00	WATER																				
66	BH1 A	Vial	35.00	WATER														✓						
67	BH1 B	1lglass	14.00	WATER												✓	✓							
68	BH1 B	1lglass	14.00	WATER																				
69	BH1 B	1lplastic	14.00	WATER	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓									
70	BH1 B	H2SO4	14.00	WATER							✓													
71	BH1 B	Vial	14.00	WATER																				
72	BH1 B	Vial	14.00	WATER														✓						
73	BH 2	1lglass	23.00	WATER												✓	✓							
74	BH 2	1lglass	23.00	WATER																				
75	BH 2	1lplastic	23.00	WATER	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓									
76	BH 2	H2SO4	23.00	WATER							✓													
77	BH 2	Vial	23.00	WATER																				
78	BH 2	Vial	23.00	WATER														✓						
Total number of tests					3	3	3	3	3	3	3	3	3	3	3	3	3	3						

Checked by ..... [redacted] ... Name: [redacted]

NAMAS Accredited

GEOCHEM ANALYTICAL SERVICES
TEST SCHEDULE

JOB NUMBER	98/01468/02/01	**BATCH NUMBER**	4
CLIENT	Aspinwall & Company	**CLIENT REF/CODE**	TA 2502A
CONTACT	[redacted]	**ORDER NUMBER**	17011
DATE OF RECEIPT	15/5/1998	**TURNAROUND**	12 Days
LOCATION	RAF UPPER HEYFORD		

Nonhazardous ☐
Hazardous ☐
Type .....

NAMAS TESTING No. 1291

Numeric values indicate additional scheduling

** Indicates test subcontracted*

Sample No.	Sample Identity	P / V	Depth (m)	Sample Type	Arsenic	Hg Low Dutch T	Nickel	Cd low level	Lead	Chromium	Se low level	Copper	Zinc	Boron	Phenol by HS	Solv. Ext. of	Diesel rng orgs	Petroleum orgs	BTEX by GC	MTBE	Conductivity	pH (water)	Sodium	Potassium
79	BH7	1lglass	4.00	WATER											✔	✔	✔							
80	BH7	1lglass	4.00	WATER											✔									
81	BH7	1lplastic	4.00	WATER	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔							✔	✔	✔	✔
82	BH7	H2SO4	4.00	WATER																				
83	BH7	Vial	4.00	WATER														✔	✔	✔				
84	BH7	Vial	4.00	WATER																				
85	SPRING I	1lglass	SURFACE	WATER												✔	✔							
86	SPRING I	1lglass	SURFACE	WATER											✔									
87	SPRING I	1lplastic	SURFACE	WATER	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔							✔	✔	✔	✔
88	SPRING I	H2SO4	SURFACE	WATER																				
89	SPRING I	Vial	SURFACE	WATER														✔	✔	✔				
90	SPRING A	1lglass	SURFACE	WATER												✔	✔							
91	SPRING A	1lglass	SURFACE	WATER											✔									
92	SPRING A	1lplastic	SURFACE	WATER	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔							✔	✔	✔	✔
93	SPRING A	H2SO4	SURFACE	WATER																				
94	SPRING A	Vial	SURFACE	WATER														✔	✔	✔				
95	SPRING B	1lglass	SURFACE	WATER												✔	✔							
96	SPRING B	1lglass	SURFACE	WATER											✔									
97	SPRING B	1lplastic	SURFACE	WATER	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔							✔	✔	✔	✔

Checked by [redacted] Name: [redacted]

GEOCHEM ANALYTICAL SERVICES
TEST SCHEDULE

NAMAS TESTING No. 1291

Nonhazardous ☐
Hazardous ☐
Type .....

JOB NUMBER	98/01468/02/01	**BATCH NUMBER**	4
CLIENT	Aspinwall & Company	**CLIENT REF/CODE**	TA 2502A
CONTACT	[redacted]	**ORDER NUMBER**	17011
DATE OF RECEIPT	15/5/1998	**TURNAROUND**	12 Days
LOCATION	RAF UPPER HEYFORD		

Numeric values indicate additional scheduling

** Indicates test subcontracted*

Sample No.	Sample Identity	P / V	Depth (m)	Sample Type	Calcium	Magnesium	Chloride Kone	Nitrate Kone	Phosphate Kone	Sulphate Kone	Acid. N2 (W)	Alkalinity Total	Bicarbonate	COD (unfiltered)	BOD (unfiltered)	T.O.C. in water	Thin-layer chro	Hspace (H2S)						
79	BH7	1lglass	4.00	WATER												✓	✓							
80	BH7	1lglass	4.00	WATER																				
81	BH7	1lplastic	4.00	WATER	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓									
82	BH7	H2SO4	4.00	WATER							✓													
83	BH7	Vial	4.00	WATER																				
84	BH7	Vial	4.00	WATER														✓						
85	SPRING I	1lglass	SURFACE	WATER												✓	✓							
86	SPRING I	1lglass	SURFACE	WATER																				
87	SPRING I	1lplastic	SURFACE	WATER	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓									
88	SPRING I	H2SO4	SURFACE	WATER							✓													
89	SPRING I	Vial	SURFACE	WATER																				
90	SPRING A	1lglass	SURFACE	WATER												✓	✓							
91	SPRING A	1lglass	SURFACE	WATER																				
92	SPRING A	1lplastic	SURFACE	WATER	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓									
93	SPRING A	H2SO4	SURFACE	WATER							✓													
94	SPRING A	Vial	SURFACE	WATER																				
95	SPRING B	1lglass	SURFACE	WATER												✓	✓							
96	SPRING B	1lglass	SURFACE	WATER																				
97	SPRING B	1lplastic	SURFACE	WATER	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓									

Checked by [redacted] Name: [redacted]

NAMAS Accredited

GEOCHEM

GEOCHEM ANALYTICAL SERVICES
TEST SCHEDULE

NAMAS TESTING No. 1291

JOB NUMBER	98/01468/02/01	**BATCH NUMBER**	4
CLIENT	Aspinwall & Company	**CLIENT REF/CODE**	TA 2502A
CONTACT	[redacted]	**ORDER NUMBER**	17011
DATE OF RECEIPT	15/5/1998	**TURNAROUND**	12 Days
LOCATION	RAF UPPER HEYFORD		

Nonhazardous ☐
Hazardous ☐
Type .....

Numeric values indicate additional scheduling

** Indicates test subcontracted*

Sample No.	Sample Identity	P / V	Depth (m)	Sample Type	Arsenic	Hg Low Dutch T	Nickel	Cd low level	Lead	Chromium	Se low level	Copper	Zinc	Boron	Phenol by HS	Solv. Ext. W	Diesel rng orgs	Petrol rng orgs	BTEX by GC	MTBE	Conductivity	pH (water)	Sodium	Potassium
98	SPRING B	H2SO4	SURFACE	WATER														✔	✔	✔				
99	SPRING B	Vial	SURFACE	WATER																				
100	SPRING L	1lglass	SURFACE	WATER												✔	✔							
101	SPRING L	1lglass	SURFACE	WATER											✔									
102	SPRING L	1lplastic	SURFACE	WATER	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔							✔	✔	✔	✔
103	SPRING L	H2SO4	SURFACE	WATER																				
104	SPRING L	Vial	SURFACE	WATER														✔	✔	✔				
105	SPRING M	1lglass	SURFACE	WATER												✔	✔							
106	SPRING M	1lglass	SURFACE	WATER											✔									
107	SPRING M	1lplastic	SURFACE	WATER	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔							✔	✔	✔	✔
108	SPRING M	H2SO4	SURFACE	WATER																				
109	SPRING M	Vial	SURFACE	WATER														✔	✔	✔				
[redacted] r of tests					6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6

Checked by ... [redacted] ..... Name: [redacted]

NAMAS Accredited

GEOCHEM ANALYTICAL SERVICES
TEST SCHEDULE

GEOCHEM

NAMAS TESTING No. 1291

Nonhazardous	☐
Hazardous	☐
Type	- - - - - - - - - - - - -

JOB NUMBER	98/01468/02/01	**BATCH NUMBER**	4
CLIENT	Aspinwall & Company	**CLIENT REF/CODE**	TA 2502A
CONTACT	[redacted]	**ORDER NUMBER**	17011
DATE OF RECEIPT	15/5/1998	**TURNAROUND**	12 Days
LOCATION	RAF UPPER HEYFORD		

Numeric values indicate additional scheduling

** Indicates test subcontracted*

Sample No.	Sample Identity	P / V	Depth (m)	Sample Type	Calcium	Magnesium	Chloride Kone	Nitrate Kone	Phosphate Kone	Sulphate Kone	Amm. N2 (W)	Alkalinity Total	Bicarbonate	COD (unfiltered)	BOD (unfiltered)	T.O.C in Water	Thin-layer chro	H'space (MSD)						
98	SPRING B	H2SO4	SURFACE	WATER							✔													
99	SPRING B	Vial	SURFACE	WATER																				
100	SPRING L	1lglass	SURFACE	WATER												✔	✔							
101	SPRING L	1lglass	SURFACE	WATER																				
102	SPRING L	1lplastic	SURFACE	WATER	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔									
103	SPRING L	H2SO4	SURFACE	WATER							✔													
104	SPRING L	Vial	SURFACE	WATER																				
105	SPRING M	1lglass	SURFACE	WATER												✔	✔							
106	SPRING M	1lglass	SURFACE	WATER																				
107	SPRING M	1lplastic	SURFACE	WATER	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔									
108	SPRING M	H2SO4	SURFACE	WATER							✔													
109	SPRING M	Vial	SURFACE	WATER																				
Tota[redacted]					6	6	6	6	6	6	6	6	6	6	6	6	6	1						

Checked by ...... [redacted] Name: [redacted]

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Appendix 5

In situ Water Quality Measurements at Spring Sampling Locations

In Situ Chemistry at Springs/Outfalls around Upper Heyford

Date/time	Spring	Parameters					
		Temperature	pH	Electrical Conductivity	Dissolved Oxygen	Redox	Turbidity
		oC		uS/cm	mg/l	mv	ntu
14/05/98 10:00	A *	14	7.28	490	6.93	224	0
14/05/98 11:40	B	11.1	7.01	508	7.02	217	0
12/05/98 12:00	C1 & C2	DRY					
12/05/98 11:30	D	10.5	7	728	8.96	205	0
12/05/98 11:10	F	10.8	6.89	648	7.98	224	0
12/05/98 10:00	G1	11	7.04	660	8.19	209	0
14/05/98 08:40	I *	14.2	7.62	543	8.39	220	0
14/05/98 09:20	L	11.9	6.98	552	6.96	198	0
14/05/98 10:30	M	11.8	7.05	486	8.76	228	0
12/05/98 12:30	N	11.3	7.39	635	7.42	195	0
12/05/98 12:30	P1	10.8	7.18	640	9.12	209	0
12/05/98 12:00	R2	10.2	6.99	626	8.65	187	0

Notes: * parameters not measured at source

Appendix 6

Laboratory Results

Appendix 6a

Miscellaneous Data

Laboratory Analysis Notes

Geochem were unable to determine a chloride or nitrate determination for borehole 6 as all of the sample had been used when these came to be tested (even though Geochem specified the sample volume requirements).

Geochem have quoted bicarbonate as being equal to alkalinity (only alkalinity is analysed for). At neutral pH the bicarbonate is approximately equal to the alkalinity multiplied by 1.22. Ion balance errors have been computed for both sets of figures. The piper plots have been drawn up using the data supplied by Geochem.

The ion balance errors (IBE) for the data have been calculated as detailed below. It is normally expected that the IBE will be in the range -10 % to + 10 %.

Location	IBE (%) - HCO_3 = Alk	IBE (%) HCO_3 = Alk x 1.2	Comments
BH1A	3	-3	
BH1B	-2	-10	
BH2	-7	-11	
BH3A	0	-8	
BH3B	16	8	
BH4	2	-5	
BH5	2	-5	
BH6	19	10	Chloride and nitrate not determined
BH7	16	8	
Spring A	16	8	
Spring B	13	6	
Spring D	27	20	
Spring F	20	13	
Spring G1	28	21	
Spring I	6	-1	
Spring L	15	8	
Spring M	13	5	
Spring N	21	14	
Spring P1	27	20	
Spring R2	21	13	

The ion balance is improved when alkalinity is converted to bicarbonate using standard methods such that the IBE for borehole samples are within a reasonable error band. However, the spring waters generally have higher errors, especially springs D, G1 and P1. The error in all cases is positive indicating an underestimate of anions or an overestimate of cations.

GEOCHEM

GEOCHEM ANALYTICAL SERVICES
TABLE OF RESULTS

NAMAS TESTING No. 1291

Job Number : 98/01468/02/01
Client : ASPINWALL & COMPANY
Date of Receipt : 12/05/98
(of first sample)

Sample Type : WATER
Location : RAF UPPER HEYFORD
Client Contact : [redacted]
Client Ref. No. : TA 2502A

☐ Preliminary
☑ Validated
☐ NAMAS Accredited

Sample Number	Sample Identity	Depth (m)	Arsenic	Boron	Calcium	Chromium	Copper	Magnesium	Nickel	Lead	Zinc	Min. Oil / Paraffin by TLC	Total Non-Volatile Aromatics	NSO / Resins	COD On Unfiltered Sample	BOD in unfiltered water	Mercury Low Dutch Target	Ammoniacal Nitrogen In Water
Units			ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppb	ppm
Detection Method			ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	TLC	TLC	TLC	Spectro	ATU	CVAAS	Colour
Detection Limits			<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<1	<1	<1	<10	<1	<0.05	<0.01
1	BH3A	3.50	-	-	-	-	-	-	-	-	-	<1	<1	1	-	-	-	-
2	BH3A	3.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	BH3A	3.50	<0.05	<0.05	109.1	<0.05	<0.05	1.94	<0.05	<0.05	<0.05	-	-	-	<10	<1	<0.05	-
4	BH3A	3.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.10
5	BH3A	3.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	BH3A	3.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	BH3B	2.00	-	-	-	-	-	-	-	-	-	<1	<1	1	-	-	-	-
8	BH3B	2.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	BH3B	2.00	<0.05	<0.05	127.0	<0.05	<0.05	1.78	<0.05	<0.05	<0.05	-	-	-	22	<1	<0.05	-
10	BH3B	2.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.09
11	BH3B	2.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	BH3B	2.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	BH4	15.00	-	-	-	-	-	-	-	-	-	<1	<1	1	-	-	-	-
14	BH4	15.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	BH4	15.00	<0.05	0.08	83.7	<0.05	<0.05	11.0	<0.05	<0.05	<0.05	-	-	-	73	2	<0.05	-
16	BH4	15.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.60
17	BH4	15.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18	BH4	15.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19	BH5	2.00	-	-	-	-	-	-	-	-	-	<1	<1	<1	-	-	-	-
20	BH5	2.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Printed on 15 June 1998

Checked by ..... [redacted] ..... [redacted]

GEOCHEM

GEOCHEM ANALYTICAL SERVICES
TABLE OF RESULTS

Job Number : 98/01468/02/01
Client : ASPINWALL & COMPANY
Date of Receipt : 12/05/98
(of first sample)

Sample Type : WATER
Location : RAF UPPER HEYFORD
Client Contact : [redacted]
Client Ref. No. : TA 2502A

NAMAS TESTING No. 1291

☐ Preliminary
☑ Validated
☐ NAMAS Accredited

Sample Number	Sample Identity	Depth (m)	Arsenic	Boron	Calcium	Chromium	Copper	Magnesium	Nickel	Lead	Zinc	Min. Oil / Paraffin by TLC	Total Non-Volatile Aromatics	NSO / Resins	COD On Unfiltered Sample	BOD in unfiltered water	Mercury Low Dutch Target	Ammoniacal Nitrogen In Water
Units			ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppb	ppm
Detection Method			ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	TLC	TLC	TLC	Spectro	ATU	CVAAS	Colour
Detection Limits			<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<1	<1	<1	<10	<1	<0.05	<0.01
21	BH5	2.00	<0.05	<0.05	127.0	<0.05	<0.05	2.01	<0.05	<0.05	<0.05	-	-	-	16	<1	<0.05	-
22	BH5	2.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.36
23	BH5	2.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24	BH5	2.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25	BH6	14.00	-	-	-	-	-	-	-	-	-	<1	<1	<1	-	-	<0.05	-
26	BH6	14.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27	BH6	14.00	<0.05	<0.05	156.0	<0.05	<0.05	7.30	<0.05	<0.05	<0.05	-	-	-	18	<1	-	-
28	BH6	14.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.09
29	BH6	14.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30	BH6	14.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31	D	SURFACE	-	-	-	-	-	-	-	-	-	<1	<1	<1	-	-	<0.05	-
32	D	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
33	D	SURFACE	<0.05	<0.05	219.0	<0.05	<0.05	3.91	<0.05	<0.05	<0.05	-	-	-	<10	<1	-	-
34	D	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.20
35	D	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
36	F	SURFACE	-	-	-	-	-	-	-	-	-	<1	<1	<1	-	-	<0.05	-
37	F	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
38	F	SURFACE	<0.05	<0.05	187.0	<0.05	<0.05	2.76	<0.05	<0.05	<0.05	-	-	-	<10	<1	-	-
39	F	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.10
40	F	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Printed on 15 June 1998

Checked by ..... [redacted] .....

GEOCHEM

GEOCHEM ANALYTICAL SERVICES
TABLE OF RESULTS

NAMAS TESTING No. 1291

Job Number : 98/01468/02/01
Client : ASPINWALL & COMPANY
Date of Receipt : 12/05/98 (of first sample)

Sample Type : WATER
Location : RAF UPPER HEYFORD
Client Contact : [redacted]
Client Ref. No. : TA 2502A

☐ Preliminary
☑ Validated
☐ NAMAS Accredited

Sample Number	Sample Identity	Depth (m)	Arsenic	Boron	Calcium	Chromium	Copper	Magnesium	Nickel	Lead	Zinc	Min. Oil / Paraffin by TLC	Total Non-Volatile Aromatics	NSO / Resins	COD On Unfiltered Sample	BOD in unfiltered water	Mercury Low Dutch Target	Ammoniacal Nitrogen In Water
Units			ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppb	ppm
Detection Method			ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	TLC	TLC	TLC	Spectro	ATU	CVAAS	Colour
Detection Limits			<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<1	<1	<1	<10	<1	<0.05	<0.01
41	G1 STREAM	SURFACE	-	-	-	-	-	-	-	-	-	<1	<1	<1	-	-	<0.05	-
42	G1 STREAM	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
43	G1 STREAM	SURFACE	<0.05	<0.05	234.0	<0.05	<0.05	3.88	<0.05	<0.05	<0.05	-	-	-	<10	<1	-	-
44	G1 STREAM	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.05
45	G1 STREAM	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
46	N	SURFACE	-	-	-	-	-	-	-	-	-	1	<1	1	-	-	<0.05	-
47	N	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
48	N	SURFACE	<0.05	<0.05	216.0	<0.05	<0.05	2.36	<0.05	<0.05	0.14	-	-	-	71	<1	-	-
49	N	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.62
50	N	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
51	P1 SPRING	SURFACE	-	-	-	-	-	-	-	-	-	<1	<1	<1	-	-	<0.05	-
52	P1 SPRING	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
53	P1 SPRING	SURFACE	<0.05	<0.05	193.0	<0.05	<0.05	3.84	<0.05	<0.05	<0.05	-	-	-	14	<1	-	-
54	P1 SPRING	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.08
55	P1 SPRING	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
56	R2 STREAM	SURFACE	-	-	-	-	-	-	-	-	-	<1	<1	<1	-	-	<0.05	-
57	R2 STREAM	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
58	R2 STREAM	SURFACE	<0.05	<0.05	207.0	<0.05	<0.05	3.28	<0.05	<0.05	<0.05	-	-	-	<10	<1	-	-
59	R2 STREAM	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.12
60	R2 STREAM	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Printed on 15 June 1998

Checked by ..... [redacted] ..... [redacted]

GEOCHEM

GEOCHEM ANALYTICAL SERVICES
TABLE OF RESULTS

NAMAS TESTING No. 1291

Job Number : 98/01468/02/01
Client : ASPINWALL & COMPANY
Date of Receipt : 15/05/98
(of first sample)

Sample Type : WATER
Location : RAF UPPER HEYFORD
Client Contact : [redacted]
Client Ref. No. : TA 2502A

☐ Preliminary
☐ Validated
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Sample Number	Sample Identity	Depth (m)	Arsenic	Boron	Calcium	Chromium	Copper	Magnesium	Nickel	Lead	Zinc	Min. Oil / Paraffin by TLC	Total Non-Volatile Aromatics	NSO / Resins	COD On Unfiltered Sample	BOD in unfiltered water	Mercury Low Dutch Target	Ammoniacal Nitrogen In Water
Units			ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppb	ppm
Detection Method			ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	TLC	TLC	TLC	Spectro	ATU	CVAAS	Colour
Detection Limits			<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<1	<1	<1	<10	<1	<0.05	<0.01
61	BH1 A	35.00	-	-	-	-	-	-	-	-	-	<1	<1	<1	-	-	-	-
62	BH1 A	35.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
63	BH1 A	35.00	0.05	0.05	210.0	<0.05	<0.05	8.96	<0.05	<0.05	0.05	-	-	-	124	11	<0.05	-
64	BH1 A	35.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.09
65	BH1 A	35.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
66	BH1 A	35.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
67	BH1 B	14.00	-	-	-	-	-	-	-	-	-	<1	<1	<1	-	-	-	-
68	BH1 B	14.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
69	BH1 B	14.00	0.05	<0.05	145.00	<0.05	<0.05	5.22	<0.05	<0.05	<0.05	-	-	-	47	2	<0.05	-
70	BH1 B	14.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.60
71	BH1 B	14.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
72	BH1 B	14.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
73	BH 2	23.00	-	-	-	-	-	-	-	-	-	<1	<1	<1	-	-	-	-
74	BH 2	23.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
75	BH 2	23.00	<0.05	0.49	138.00	<0.05	<0.05	10.00	<0.05	<0.05	<0.05	-	-	-	89	6	<0.05	-
76	BH 2	23.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.67
77	BH 2	23.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
78	BH 2	23.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
79	BH7	4.00	-	-	-	-	-	-	-	-	-	<1	<1	<1	-	-	-	-
80	BH7	4.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

GEOCHEM

GEOCHEM ANALYTICAL SERVICES
TABLE OF RESULTS

NAMAS TESTING No. 1291

Job Number : 98/01468/02/01
Client : ASPINWALL & COMPANY
Date of Receipt : 12/05/98
(of first sample)

Sample Type : WATER
Location : RAF UPPER HEYFORD
Client Contact : [redacted]
Client Ref. No. : TA 2502A

☐ Preliminary
☑ Validated
☐ NAMAS Accredited

Sample Number	Sample Identity	Depth (m)	Arsenic	Boron	Calcium	Chromium	Copper	Magnesium	Nickel	Lead	Zinc	Min. Oil / Paraffin by TLC	Total Non-Volatile Aromatics	NSO / Resins	COD On Unfiltered Sample	BOD in unfiltered water	Mercury Low Dutch Target	Ammoniacal Nitrogen in Water
Units			ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppb	ppm
Detection Method			ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	TLC	TLC	TLC	Spectro	ATU	CVAAS	Colour
Detection Limits			<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<1	<1	<1	<10	<1	<0.05	<0.01
81	BH7	4.00	0.44	<0.05	191.0	<0.05	<0.05	3.31	<0.05	<0.05	<0.05	-	-	-	<10	<1	<0.05	-
82	BH7	4.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.11
83	BH7	4.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
84	BH7	4.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
85	SPRING I	SURFACE	-	-	-	-	-	-	-	-	-	<1	<1	<1	-	-	-	-
86	SPRING I	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
87	SPRING I	SURFACE	<0.05	<0.05	129.0	<0.05	<0.05	2.94	<0.05	0.05	<0.05	-	-	-	<10	<1	<0.05	-
88	SPRING I	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.07
89	SPRING I	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
90	SPRING A	SURFACE	-	-	-	-	-	-	-	-	-	<1	<1	1	-	-	-	-
91	SPRING A	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
92	SPRING A	SURFACE	<0.05	<0.05	137.0	<0.05	<0.05	1.89	<0.05	0.11	<0.05	-	-	-	<10	<1	<0.05	-
93	SPRING A	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.05
94	SPRING A	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
95	SPRING B	SURFACE	-	-	-	-	-	-	-	-	-	<1	<1	1	-	-	-	-
96	SPRING B	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
97	SPRING B	SURFACE	0.19	<0.05	156.0	<0.05	<0.05	2.46	<0.05	0.09	<0.05	-	-	-	<10	<1	<0.05	-
98	SPRING B	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01
99	SPRING B	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
100	SPRING L	SURFACE	-	-	-	-	-	-	-	-	-	<1	<1	1	-	-	-	-

Printed on 15 June 1998

Checked by ..... [redacted] ..... [redacted]

GEOCHEM

GEOCHEM ANALYTICAL SERVICES
TABLE OF RESULTS

Job Number : 98/01468/02/01
Client : ASPINWALL & COMPANY
Date of Receipt : 12/05/98
(of first sample)

Sample Type : WATER
Location : RAF UPPER HEYFORD
Client Contact : [redacted]
Client Ref. No. : TA 2502A

NAMAS TESTING No. 1291

☐ Preliminary
☑ Validated
☐ NAMAS Accredited

Sample Number	Sample Identity	Depth (m)	Arsenic	Boron	Calcium	Chromium	Copper	Magnesium	Nickel	Lead	Zinc	Min. Oil / Paraffin by TLC	Total Non-Volatile Aromatics	NSO / Resins	COD On Unfiltered Sample	BOD in unfiltered water	Mercury Low Dutch Target	Ammoniacal Nitrogen In Water
Units			ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppb	ppm
Detection Method			ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	TLC	TLC	TLC	Spectro	ATU	CVAAS	Colour
Detection Limits			<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<1	<1	<1	<10	<1	<0.05	<0.01
101	SPRING L	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
102	SPRING L	SURFACE	<0.05	<0.05	150.0	<0.05	<0.05	2.79	<0.05	<0.05	<0.05	-	-	-	<10	<1	<0.05	-
103	SPRING L	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.10
104	SPRING L	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
105	SPRING M	SURFACE	-	-	-	-	-	-	-	-	-	<1	<1	<1	-	-	-	-
106	SPRING M	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
107	SPRING M	SURFACE	0.24	<0.05	144.0	0.19	<0.05	1.80	<0.05	0.18	0.06	-	-	-	<10	<1	<0.05	-
108	SPRING M	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01
109	SPRING M	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Printed on 15 June 1998

Checked by ..... [redacted] ..... [redacted]

GEOCHEM

GEOCHEM ANALYTICAL SERVICES
TABLE OF RESULTS

NAMAS TESTING No. 1291

Job Number : 98/01468/02/01
Client : ASPINWALL & COMPANY
Date of Receipt : 12/05/98
(of first sample)

Sample Type : WATER
Location : RAF UPPER HEYFORD
Client Contact : [redacted]
Client Ref. No. : TA 2502A

☐ Preliminary
☑ Validated
☐ NAMAS Accredited

Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	mS/cm		ppm	ppm		
Detection Method	Flame P	Flame P	GFAAS	GFAAS	Grav	IR	KONE	KONE	KONE	KONE	Meter	Meter	Titrat	Titre		
Detection Limits	<0.2	<0.2	<0.0004	<0.005	<1	<1	<5	<0.5	<0.01	<3	<0.001	<0.01	<1	<1		

Sample Number	Sample Identity	Depth (m)	Potassium	Sodium	Cadmium Low Level	Selenium Low Level	Solvent Ext. Matter Water	Tot. Org. Carbon in Water	Chloride (soluble)	Nitrate (soluble)	Phosphate (soluble)	Sulphate (soluble)	Electrical Conductivity	pH Value in Water	Alkalinity Total as CaCO3	Bicarbonate		
1	BH3A	3.50	-	-	-	-	1	3	-	-	-	-	-	-	-	-		
2	BH3A	3.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
3	BH3A	3.50	1.6	12.5	<0.0004	<0.005	-	-	15	32.7	0.94	48	0.679	7.21	290	290		
4	BH3A	3.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
5	BH3A	3.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
6	BH3A	3.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
7	BH3B	2.00	-	-	-	-	1	3	-	-	-	-	-	-	-	-		
8	BH3B	2.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
9	BH3B	2.00	1.1	13.1	<0.0004	<0.005	-	-	10	23.3	1.67	38	0.594	7.28	250	250		
10	BH3B	2.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
11	BH3B	2.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
12	BH3B	2.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
13	BH4	15.00	-	-	-	-	1	3	-	-	-	-	-	-	-	-		
14	BH4	15.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
15	BH4	15.00	4.1	20.0	<0.0004	<0.005	-	-	10	<0.5	0.07	51	0.585	7.38	270	270		
16	BH4	15.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
17	BH4	15.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
18	BH4	15.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
19	BH5	2.00	-	-	-	-	<1	3	-	-	-	-	-	-	-	-		
20	BH5	2.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-		

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GEOCHEM

GEOCHEM ANALYTICAL SERVICES
TABLE OF RESULTS

NAMAS TESTING No. 1291

Job Number : 98/01468/02/01
Client : ASPINWALL & COMPANY
Date of Receipt : 12/05/98
(of first sample)

Sample Type : WATER
Location : RAF UPPER HEYFORD
Client Contact : [redacted]
Client Ref. No. : TA 2502A

☐ Preliminary
☑ Validated
☐ NAMAS Accredited

Sample Number	Sample Identity	Depth (m)	Potassium	Sodium	Cadmium Low Level	Selenium Low Level	Solvent Ext. Matter Water	Tot. Org. Carbon in Water	Chloride (soluble)	Nitrate (soluble)	Phosphate (soluble)	Sulphate (soluble)	Electrical Conductivity	pH Value in Water	Alkalinity Total as CaCO3	Bicarbonate		
Units			ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	mS/cm		ppm	ppm		
Detection Method			Flame P	Flame P	GFAAS	GFAAS	Grav	IR	KONE	KONE	KONE	KONE	Meter	Meter	Titrat	Titre		
Detection Limits			<0.2	<0.2	<0.0004	<0.005	<1	<1	<5	<0.5	<0.01	<3	<0.001	<0.01	<1	<1		
21	BH5	2.00	1.7	19.0	<0.0004	0.016	-	-	29	1.5	1.40	54	0.671	7.21	310	310		
22	BH5	2.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
23	BH5	2.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
24	BH5	2.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
25	BH6	14.00	-	-	-	-	<1	2	-	-	-	-	-	-	-	-		
26	BH6	14.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
27	BH6	14.00	3.6	12.5	<0.0004	<0.005	-	-	NDP	NDP	0.03	45	0.433	7.59	320	320		
28	BH6	14.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
29	BH6	14.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
30	BH6	14.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
31	D	SURFACE	-	-	-	-	<1	4	-	-	-	-	-	-	-	-		
32	D	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
33	D	SURFACE	10.6	18.5	<0.0004	<0.005	-	-	45	79.4	0.02	45	0.921	7.14	300	300		
34	D	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
35	D	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
36	F	SURFACE	-	-	-	-	<1	3	-	-	-	-	-	-	-	-		
37	F	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
38	F	SURFACE	1.8	18.0	<0.0004	<0.005	-	-	32	60.5	0.02	42	0.830	7.12	310	310		
39	F	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
40	F	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-		

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GEOCH

GEOCHEM ANALYTICAL SERVICES
TABLE OF RESULTS

Job Number : 98/01468/02/01
Client : ASPINWALL & COMPANY
Date of Receipt : 12/05/98
(of first sample)

Sample Type : WATER
Location : RAF UPPER HEYFORD
Client Contact : [redacted]
Client Ref. No. : TA 2502A

NAMAS TESTING No. 1291

☐ Preliminary
☑ Validated
☐ NAMAS Accredited

Sample Number	Sample Identity	Depth (m)	Potassium	Sodium	Cadmium Low Level	Selenium Low Level	Solvent Ext. Matter Water	Tot. Org. Carbon In Water	Chloride (soluble)	Nitrate (soluble)	Phosphate (soluble)	Sulphate (soluble)	Electrical Conductivity	pH Value In Water	Alkalinity Total as CaCO3	Bicarbonate		
Units			ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	mS/cm		ppm	ppm		
Detection Method			Flame P	Flame P	GFAAS	GFAAS	Grav	IR	KONE	KONE	KONE	KONE	Meter	Meter	Titrat	Titre		
Detection Limits			<0.2	<0.2	<0.0004	<0.005	<1	<1	<5	<0.5	<0.01	<3	<0.001	<0.01	<1	<1		
41	G1 STREAM	SURFACE	-	-	-	-	<1	3	-	-	-	-	-	-	-	-		
42	G1 STREAM	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
43	G1 STREAM	SURFACE	2.6	20.0	<0.0004	<0.005	-	-	27	27.4	0.02	56	0.811	7.45	330	330		
44	G1 STREAM	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
45	G1 STREAM	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
46	N	SURFACE	-	-	-	-	2	6	-	-	-	-	-	-	-	-		
47	N	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
48	N	SURFACE	0.9	13.0	<0.0004	<0.005	-	-	34	52.3	0.08	33	0.809	7.63	350	350		
49	N	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
50	N	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
51	P1 SPRING	SURFACE	-	-	-	-	<1	3	-	-	-	-	-	-	-	-		
52	P1 SPRING	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
53	P1 SPRING	SURFACE	6.2	21.5	<0.0004	<0.005	-	-	46	45.5	0.01	58	0.815	7.06	310	310		
54	P1 SPRING	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
55	P1 SPRING	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
56	R2 STREAM	SURFACE	-	-	-	-	<1	2	-	-	-	-	-	-	-	-		
57	R2 STREAM	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
58	R2 STREAM	SURFACE	1.5	14.0	<0.0004	<0.005	-	-	19	23.8	0.02	50	0.793	7.37	350	350		
59	R2 STREAM	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
60	R2 STREAM	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-		

GEOCHEM

GEOCHEM ANALYTICAL SERVICES
TABLE OF RESULTS

Job Number : 98/01468/02/01
Client : ASPINWALL & COMPANY
Date of Receipt : 12/05/98
(of first sample)

Sample Type : WATER
Location : RAF UPPER HEYFORD
Client Contact : [redacted]
Client Ref. No. : TA 2502A

NAMAS TESTING No. 1291

☐ Preliminary
☑ Validated
☐ NAMAS Accredited

Sample Number	Sample Identity	Depth (m)	Potassium	Sodium	Cadmium Low Level	Selenium Low Level	Solvent Ext. Matter Water	Tot. Org. Carbon In Water	Chloride (soluble)	Nitrate (soluble)	Phosphate (soluble)	Sulphate (soluble)	Electrical Conductivity	pH Value In Water	Alkalinity Total as CaCO3	Bicarbonate		
Units			ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	mS/cm		ppm	ppm		
Detection Method			Flame P	Flame P	GFAAS	GFAAS	Grav	IR	KONE	KONE	KONE	KONE	Meter	Meter	Titrat	Titre		
Detection Limits			<0.2	<0.2	<0.0004	<0.005	<1	<1	<5	<0.5	<0.01	<3	<0.001	<0.01	<1	<1		
61	BH1 A	35.00	-	-	-	-	1	3	-	-	-	-	-	-	-	-		
62	BH1 A	35.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
63	BH1 A	35.00	2.5	23.8	<0.0004	<0.005	-	-	74	28.3	0.10	142	0.996	7.36	400	400		
64	BH1 A	35.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
65	BH1 A	35.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
66	BH1 A	35.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
67	BH1 B	14.00	-	-	-	-	1	6	-	-	-	-	-	-	-	-		
68	BH1 B	14.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
69	BH1 B	14.00	2.0	13.8	<0.0004	<0.005	-	-	43	54.0	0.10	27	0.744	7.49	420	420		
70	BH1 B	14.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
71	BH1 B	14.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
72	BH1 B	14.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
73	BH 2	23.00	-	-	-	-	<1	5	-	-	-	-	-	-	-	-		
74	BH 2	23.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
75	BH 2	23.00	5.4	71.3	<0.0004	0.005	-	-	46	7.1	0.08	271	0.992	7.90	340	340		
76	BH 2	23.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
77	BH 2	23.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
78	BH 2	23.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
79	BH7	4.00	-	-	-	-	1	4	-	-	-	-	-	-	-	-		
80	BH7	4.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-		

Printed on 15 June 1998

Checked by ..... [redacted] ..... [redacted]

GEOCHEM ANALYTICAL SERVICES
TABLE OF RESULTS

Job Number : 98/01468/02/01
Client : ASPINWALL & COMPANY
Date of Receipt : 12/05/98
(of first sample)

Sample Type : WATER
Location : RAF UPPER HEYFORD
Client Contact : [redacted]
Client Ref. No. : TA 2502A

NAMAS TESTING No. 1291

☐ Preliminary
☑ Validated
☐ NAMAS Accredited

Sample Number	Sample Identity	Depth (m)	Potassium	Sodium	Cadmium Low Level	Selenium Low Level	Solvent Ext. Matter Water	Tot. Org. Carbon In Water	Chloride (soluble)	Nitrate (soluble)	Phosphate (soluble)	Sulphate (soluble)	Electrical Conductivity	pH Value In Water	Alkalinity Total as CaCO3	Bicarbonate		
Units			ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	mS/cm		ppm	ppm		
Detection Method			Flame P	Flame P	GFAAS	GFAAS	Grav	IR	KONE	KONE	KONE	KONE	Meter	Meter	Titrat	Titre		
Detection Limits			<0.2	<0.2	<0.0004	<0.005	<1	<1	<5	<0.5	<0.01	<3	<0.001	<0.01	<1	<1		
81	BH7	4.00	0.8	11.8	<0.0004	<0.005	-	-	28	3.1	0.02	20	0.375	7.38	380	380		
82	BH7	4.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
83	BH7	4.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
84	BH7	4.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
85	SPRING I	SURFACE	-	-	-	-	1	5	-	-	-	-	-	-	-	-		
86	SPRING I	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
87	SPRING I	SURFACE	4.9	19.3	<0.0004	0.007	-	-	38	7.6	0.01	19	0.594	7.48	320	320		
88	SPRING I	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
89	SPRING I	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
90	SPRING A	SURFACE	-	-	-	-	1	1	-	-	-	-	-	-	-	-		
91	SPRING A	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
92	SPRING A	SURFACE	0.8	10.3	<0.0004	<0.005	-	-	31	24.7	0.02	14	0.604	7.70	260	260		
93	SPRING A	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
94	SPRING A	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
95	SPRING B	SURFACE	-	-	-	-	1	3	-	-	-	-	-	-	-	-		
96	SPRING B	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
97	SPRING B	SURFACE	1.4	11.0	<0.0004	<0.005	-	-	37	30.7	0.03	25	0.653	7.43	300	300		
98	SPRING B	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
99	SPRING B	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
100	SPRING L	SURFACE	-	-	-	-	1	7	-	-	-	-	-	-	-	-		

Checked by ..... [redacted] ..... [redacted]

GEOCHEM ANALYTICAL SERVICES
TABLE OF RESULTS

Job Number : 98/01468/02/01
Client : ASPINWALL & COMPANY
Date of Receipt : 12/05/98
(of first sample)

Sample Type : WATER
Location : RAF UPPER HEYFORD
Client Contact : [redacted]
Client Ref. No. : TA 2502A

NAMAS TESTING No. 1291

☐ Preliminary
☑ Validated
☐ NAMAS Accredited

Sample Number	Sample Identity	Depth (m)	Potassium	Sodium	Cadmium Low Level	Selenium Low Level	Solvent Ext. Matter Water	Tot. Org. Carbon in Water	Chloride (soluble)	Nitrate (soluble)	Phosphate (soluble)	Sulphate (soluble)	Electrical Conductivity	pH Value in Water	Alkalinity Total as CaCO3	Bicarbonate		
Units			ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	mS/cm		ppm	ppm		
Detection Method			Flame P	Flame P	GFAAS	GFAAS	Grav	IR	KONE	KONE	KONE	KONE	Meter	Meter	Titrat	Titre		
Detection Limits			<0.2	<0.2	<0.0004	<0.005	<1	<1	<5	<0.5	<0.01	<3	<0.001	<0.01	<1	<1		
101	SPRING L	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
102	SPRING L	SURFACE	2.0	21.4	<0.0004	<0.005	-	-	46	7.1	0.55	28	0.565	7.68	280	280		
103	SPRING L	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
104	SPRING L	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
105	SPRING M	SURFACE	-	-	-	-	1	3	-	-	-	-	-	-	-	-		
106	SPRING M	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
107	SPRING M	SURFACE	0.9	12.3	<0.0004	<0.005	-	-	26	32.3	0.51	36	0.606	7.62	280	280		
108	SPRING M	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
109	SPRING M	SURFACE	-	-	-	-	-	-	-	-	-	-	-	-	-	-		

Printed on 15 June 1998

Checked by ..... [redacted] ..... [redacted]

Appendix 6b

Hydrocarbon Analyses

[redacted]

Geochem Analytical Services

Diesel Range Organics

by

G.C.

Client Ref:= -
Sample Matrix= Water
Job Number:= 98/01468/02/01

Date Sample Received:= 12/5/98
Date Extracted/Prepared:= 20/5/98
Date Analysed:= 20/5/98

Separatory Funnel Ext:= Yes
Soxtec Extraction:= No
Column Extraction:= Yes

Internal Standard:= A :- 2,2,4,4,6,8,8, HEPTAMETHYLNONANE B :- 1-CHLOROOCTADECANE C :- SQUALANE

Sample number	Sample Identity	Depth	Total Soluble Extract (mg/litre)	Diesel Range Hydrocarbons (µg/litre)	Interpretation
001	BH3A	3.50	1	204	No Identification Possible
007	BH3B	2.00	1	217	No Identification Possible
013	BH4	15.00	1	501	No Identification Possible
019	BH5	2.00	<1	14	No Identification Possible

Checked by [redacted]

Geochem Analytical Services

Diesel Range Organics
by
G.C.

Client Ref:= TA2502A
Sample Matrix= Water
Job Number:= 98/1468/02/01

Date Sample Received:= 13/05/98
Date Extracted/Prepared:= 26/05/98
Date Analysed:= 26/05/98

Separatory Funnel Ext:= Yes
Soxtec Extraction:= No
Column Extraction:= Yes

Internal Standard:= A :- 2,2,4,4,6,8,8, HEPTAMETHYLNONANE B :- 1-CHLOROOCTADECANE C :- SQUALANE

Sample number	Sample Identity	Depth	Total Soluble Extract (mg/litre)	Diesel Range Hydrocarbons (µg/litre)	Interpretation
025	BH6	14.00	<1	45	No Identification Possible
031	D	SURFACE	<1	38	No Identification Possible
036	F	SURFACE	<1	42	No Identification Possible
041	G 1 STREAM	SURFACE	<1	29	No Identification Possible
046	N	SURFACE	2	2489	Diesel
051	P 1 SPRING	SURFACE	<1	40	No Identification Possible
056	R2 STREAM	SURFACE	<1	44	No Identification Possible

Checked by [redacted]

Geochem Analytical Services

Diesel Range Organics
by
G.C.

Client Ref:= TA 2502A
Sample Matrix= Water
Job Number:= 98/1468/02/01

Date Sample Received:= 14/5/98
Date Extracted/Prepared:= 21/5/98
Date Analysed:= 21/5/98

Separatory Funnel Ext:= Yes
Soxtec Extraction:= No
Column Extraction:= Yes

Internal Standard:= A :- 2,2,4,4,6,8,8, HEPTAMETHYLNONANE B :- 1-CHLOROOCTADECANE C :- SQUALANE

Sample number	Sample Identity	Depth	Total Soluble Extract (mg/litre)	Diesel Range Hydrocarbons (µg/litre)	Interpretation
061	BH1 A	35.00	1	37	No Identification Possible
067	BH1 B	14.00	1	36	No Identification Possible
073	BH 2	23.00	<1	33	No Identification Possible

Checked by [redacted]

Geochem Analytical Services

Diesel Range Organics
by
G.C.

Client Ref:= TA 2502A
Sample Matrix= Water
Job Number:= 98/1468/02/01

Date Sample Received:= 15/05/98
Date Extracted/Prepared:= 00/01/00
Date Analysed:= 27/05/98

Separatory Funnel Ext:= Yes
Soxtec Extraction:= No
Column Extraction:= Yes

Internal Standard:= A :- 2,2,4,4,6,8,8, HEPTAMETHYLNONANE B :- 1-CHLOROOCTADECANE C :- SQUALANE

Sample number	Sample Identity	Depth	Total Soluble Extract (mg/litre)	Diesel Range Hydrocarbons (µg/litre)	Interpretation
079	BH7	4.00	1	22	No Identification Possible
085	SPRING I	SURFACE	1	783	Weathered Diesel
090	SPRING A	SURFACE	1	27	No Identification Possible
095	SPRING B	SURFACE	1	28	No Identification Possible
100	SPRING L	SURFACE	1	33	No Identification Possible
105	SPRING M	SURFACE	1	26	No Identification Possible

Checked by [redacted]

Geochem Analytical Services

Gasoline Range Organics

By

GC

Job No: 98/1468/02/01

Client: Aspinwall & Company

Matrix: Water

Units: µg/l

Sample No	Sample Ref	Depth m/ft	Total Volatiles
005	BH 3A	3.5	<10
011	BH 3B	2.0	<10
017	BH 4	15.0	<10
023	BH 5	2.0	<10

Checked by.....

Geochem Analytical Services

Gasoline Range Organics

By

GC

Job No: 98/1468/02/01

Client: Aspinwall & Company

Matrix: Water

Units: µg/l

Sample No	Sample Ref	Depth m/ft	Total Volatiles
029	BH 6	14.0	<10
035	D	SURF	<10
040	F	SURF	<10
045	G1 STREAM	SURF	<10
050	N	SURF	<10
055	P1 SPRING	SURF	<10
060	R2 STREAM	SURF	<10

Checked by.....

Geochem Analytical Services

Gasoline Range Organics

By

GC

Job No: 98/1468/02/01

Client: Aspinwall & Company

Matrix: Water

Units: µg/l

Sample No	Sample Ref	Depth m/ft	Total Volatiles
065	BH 1A	35.0	<10
071	BH 1B	14.0	<10
077	BH 2	23.0	<10

Checked by.....

Geochem Analytical Services

Gasoline Range Organics

By

GC

Job No: 98/1468/02/01

Client: Aspinwall & Company

Matrix: Water

Units: µg/l

Sample No	Sample Ref	Depth m/ft	Total Volatiles
083	BH 7	4.0	<10
089	SPRING I	SURF	<10
094	SPRING A	SURF	<10
099	SPRING B	SURF	<10
104	SPRING L	SURF	<10
109	SPRING M	SURF	<10

Checked by [redacted]

Geochem Analytical Services

BTEX Analysis

By

G.C.

Job No: 98/1468/02/01

Client: Aspinwall & Company

Matrix: Water

Units: µg/l

Sample No	Sample Ref	Depth m/ft	Benzene	Toluene	Ethyl Benzene	Total Xylene
005	BH 3A	3.5	<10	<10	<10	<10
011	BH 3B	2.0	<10	<10	<10	<10
017	BH 4	15.0	<10	<10	<10	<10
023	BH 5	2.0	<10	<10	<10	<10

Checked by.....

Geochem Analytical Services

BTEX (MTBE) Analysis

By

G.C.

Job No: 98/1468/02/01

Client: Aspinwall & Company

Matrix: Water

Units: µg/l

Smpl No	Sample Ref	Depth m/ft	MTBE	Benzene	Toluene	Ethyl Benzene	Total Xylene
029	BH 6	14.0	<10	<10	<10	<10	<10
035	D	SURF	<10	<10	<10	<10	<10
040	F	SURF	<10	<10	<10	<10	<10
045	G1 STREAM	SURF	<10	<10	<10	<10	<10
050	N	SURF	<10	<10	<10	<10	<10
055	P1 SPRING	SURF	<10	<10	<10	<10	<10
060	R2 STREAM	SURF	<10	<10	<10	<10	<10

Checked by.....

Geochem Analytical Services

BTEX (MTBE) Analysis

By

G.C.

Job No: 98/1468/02/01

Client: Aspinwall & Company

Matrix: Water

Units: µg/l

Smpl No	Sample Ref	Depth m/ft	MTBE	Benzene	Toluene	Ethyl Benzene	Total Xylene
065	BH 1A	35.0	<10	<10	<10	<10	<10
071	BH 1B	14.0	<10	<10	<10	<10	<10
077	BH 2	23.0	<10	<10	<10	<10	<10

Checked by.....

Geochem Analytical Services

BTEX (MTBE) Analysis

By

G.C.

Job No: 98/1468/02/01

Client: Aspinwall & Company

Matrix: Water

Units: µg/l

Smpl No	Sample Ref	Depth m/ft	MTBE	Benzene	Toluene	Ethyl Benzene	Total Xylene
083	BH 7	4.0	<10	<10	<10	<10	<10
089	SPRING I	SURF	<10	<10	<10	<10	<10
094	SPRING A	SURF	<10	<10	<10	<10	<10
099	SPRING B	SURF	<10	<10	<10	<10	<10
104	SPRING L	SURF	<10	<10	<10	<10	<10
109	SPRING M	SURF	<10	<10	<10	<10	<10

Checked by. [redacted]

Appendix 6c

Phenol Analyses

Geochem Analytical Services

Phenols
By
G.C.M.S.

Sample Matrix :	Water
Our Reference:	98/1468/02/01
Date Sample Received:	12/05/98
Date Extracted/Prepared:	20/05/98
Separatory Funnel Ext:	No
Soxtec Extraction:	No
Column Extraction:	Yes
Date Analysed:	22/05/98
GC-MS Mode:	SIM
Internal Standard:	External

CAS Number	Sample No.	002	008	014	020	
	Client Ref.	BH3A	BH3B	H4 15.	BH5 2.0	
	P.Q.L.	001	001	001	001	
	Units	µg/l	µg/l	µg/l	µg/l	
108-95-2	Phenol	<0.5	<0.5	<0.5	<0.5	
95-57-8	2-Chlorophenol	<0.5	<0.5	<0.5	<0.5	
88-75-5	2-Nitrophenol	<0.5	<0.5	<0.5	<0.5	
105-67-9	2,4-Dimethylphenol	<0.5	<0.5	<0.5	<0.5	
120-83-2	2,4-Dichlorophenol	<0.5	<0.5	<0.5	<0.5	
59-50-7	4-Chloro-3-methylphenol	<0.5	<0.5	<0.5	<0.5	
88-06-2	2,4,6-Trichlorophenol	<0.5	<0.5	<0.5	<0.5	
100-02-7	4-Nitrophenol	<0.5	<0.5	<0.5	<0.5	
87-86-5	Pentachlorophenol	<0.5	<0.5	<0.5	<0.5	

Approved by [redacted].....

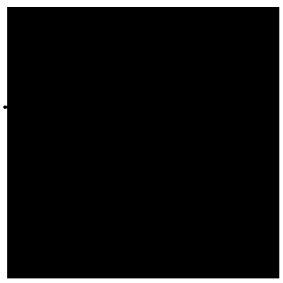
Geochem Analytical Services

Phenols
By
G.C.M.S.

Sample Matrix :	Water
Our Reference:	98/1468/02/02
Date Sample Received:	13/05/98
Date Extracted/Prepared:	26/05/98
Separatory Funnel Ext:	No
Soxtec Extraction:	No
Column Extraction:	Yes
Date Analysed:	26/05/98
GC-MS Mode:	SIM
Internal Standard:	External

	Sample No.	026	032	037	042	047
	Client Ref.	BH6 14	D Surfac	F Surfac	1strea	N Surfac
	P.Q.L.	001	001	001	001	001
CAS Number	Units	µg/l	µg/l	µg/l	µg/l	µg/l
108-95-2	Phenol	<0.5	<0.5	<0.5	<0.5	<0.5
95-57-8	2-Chlorophenol	<0.5	<0.5	<0.5	<0.5	<0.5
88-75-5	2-Nitrophenol	<0.5	<0.5	<0.5	<0.5	<0.5
105-67-9	2,4-Dimethylphenol	<0.5	<0.5	<0.5	<0.5	<0.5
120-83-2	2,4-Dichlorophenol	<0.5	<0.5	<0.5	<0.5	<0.5
59-50-7	4-Chloro-3-methylphenol	<0.5	<0.5	<0.5	<0.5	<0.5
88-06-2	2,4,6-Trichlorophenol	<0.5	<0.5	<0.5	<0.5	<0.5
100-02-7	4-Nitrophenol	<0.5	<0.5	<0.5	<0.5	<0.5
87-86-5	Pentachlorophenol	<0.5	<0.5	<0.5	<0.5	<0.5

Approved by :.....



Geochem Analytical Services

Phenols
By
G.C.M.S.

Sample Matrix :	Water
Our Reference:	98/1468/02/02
Date Sample Received:	13/05/98
Date Extracted/Prepared:	26/05/98
Separatory Funnel Ext:	No
Soxtec Extraction:	No
Column Extraction:	Yes
Date Analysed:	26/05/98
GC-MS Mode:	SIM
Internal Standard:	External

	Sample No.	052	057			
	Client Ref.	P1spring	R2strea			
	P.Q.L.	001	001			
CAS Number	Units	µg/l	µg/l			
108-95-2	Phenol	<0.5	<0.5			
95-57-8	2-Chlorophenol	<0.5	<0.5			
88-75-5	2-Nitrophenol	<0.5	<0.5			
105-67-9	2,4-Dimethylphenol	<0.5	<0.5			
120-83-2	2,4-Dichlorophenol	<0.5	<0.5			
59-50-7	4-Chloro-3-methylphenol	<0.5	<0.5			
88-06-2	2,4,6-Trichlorophenol	<0.5	<0.5			
100-02-7	4-Nitrophenol	<0.5	<0.5			
87-86-5	Pentachlorophenol	<0.5	<0.5			

Approved by :.....

Geochem Analytical Services

Phenols
By
G.C.M.S.

Sample Matrix :	Water
Our Reference:	98/1468/02/03
Date Sample Received:	14/05/98
Date Extracted/Prepared:	22/05/98
Separatory Funnel Ext:	No
Soxtec Extraction:	No
Column Extraction:	Yes
Date Analysed:	23/05/98
GC-MS Mode:	SIM
Internal Standard:	External

	Sample No.	062	068	074		
	Client Ref.	BH1A 3	BH1B 1	BH2 23		
	P.Q.L.	001	001	001		
CAS Number	Units	µg/l	µg/l	µg/l		
108-95-2	Phenol	<0.5	<0.5	<0.5		
95-57-8	2-Chlorophenol	<0.5	<0.5	<0.5		
88-75-5	2-Nitrophenol	<0.5	<0.5	<0.5		
105-67-9	2,4-Dimethylphenol	<0.5	<0.5	<0.5		
120-83-2	2,4-Dichlorophenol	<0.5	<0.5	<0.5		
59-50-7	4-Chloro-3-methylphenol	<0.5	<0.5	<0.5		
88-06-2	2,4,6-Trichlorophenol	<0.5	<0.5	<0.5		
100-02-7	4-Nitrophenol	<0.5	<0.5	<0.5		
87-86-5	Pentachlorophenol	<0.5	<0.5	<0.5		

Approved by :....[redacted]

Geochem Analytical Services

Phenols
By
G.C.M.S.

Sample Matrix :	Water
Our Reference:	98/01468/02/01
Date Sample Received:	15/05/98
Date Extracted/Prepared:	27/05/98
Separatory Funnel Ext:	No
Soxtec Extraction:	Yes
Column Extraction:	No
Date Analysed:	01/06/98
GC-MS Mode:	SIM
Internal Standard:	External

	Sample No.	080	086	091	096	101
	Client Ref.	BH7	Spring I	Spring A	Spring B.	Spring L
	P.Q.L.	0.5	0.5	0.5	0.5	0.5
CAS Number	Units	µg/l	µg/l	µg/l	µg/l	µg/l
108-95-2	Phenol	<0.5	<0.5	<0.5	<0.5	<0.5
95-57-8	2-Chlorophenol	<0.5	<0.5	<0.5	<0.5	<0.5
88-75-5	2-Nitrophenol	<0.5	<0.5	<0.5	<0.5	<0.5
105-67-9	2,4-Dimethylphenol	<0.5	<0.5	<0.5	<0.5	<0.5
120-83-2	2,4-Dichlorophenol	<0.5	<0.5	<0.5	<0.5	<0.5
59-50-7	4-Chloro-3-methylphenol	<0.5	<0.5	<0.5	<0.5	<0.5
88-06-2	2,4,6-Trichlorophenol	<0.5	<0.5	<0.5	<0.5	<0.5
100-02-7	4-Nitrophenol	<0.5	<0.5	<0.5	<0.5	<0.5
87-86-5	Pentachlorophenol	<0.5	<0.5	<0.5	<0.5	<0.5

Approved by :.....

Geochem Analytical Services

Phenols
By
G.C.M.S.

Sample Matrix :	Water
Our Reference:	98/01468/02/01
Date Sample Received:	15/05/98
Date Extracted/Prepared:	27/05/98
Separatory Funnel Ext:	No
Soxtec Extraction:	Yes
Column Extraction:	No
Date Analysed:	01/06/98
GC-MS Mode:	SIM
Internal Standard:	External

	Sample No.	106				
	Client Ref.	Spring M				
	P.Q.L.	0.5				
CAS Number	Units	µg/l				
108-95-2	Phenol	<0.5				
95-57-8	2-Chlorophenol	<0.5				
88-75-5	2-Nitrophenol	<0.5				
105-67-9	2,4-Dimethylphenol	<0.5				
120-83-2	2,4-Dichlorophenol	<0.5				
59-50-7	4-Chloro-3-methylphenol	<0.5				
88-06-2	2,4,6-Trichlorophenol	<0.5				
100-02-7	4-Nitrophenol	<0.5				
87-86-5	Pentachlorophenol	<0.5				

Approved by : [redacted]

Appendix 6d

Volatile Organic Compounds

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Geochem Analytical Services

Volatile Organic Compounds (EPA 624/8260)

NAMAS TESTING No. 1291

Sample Identity - 1468-006 BH3A 3.50m
Client / Sample matrix - Aspinwall & Company/Water
Date Acquired - 05/16/98 02:57
Instrument Name - MSD Vols5
Units - ppb

CAS No.	Compound	Conc.	CAS No.	Compound	Conc.
75-71-8	Dichlorodifluoromethane	< 1	127-18-4	Tetrachloroethene	< 1
74-87-3	Chloromethane	< 1	630-20-6	1,1,1,2-Tetrachloroethane	< 1
75-01-4	Vinyl chloride	< 1	108-90-7	Chlorobenzene	< 1
74-83-9	Bromomethane	< 1	100-41-4	Ethylbenzene	< 1
75-00-3	Chloroethane	< 1	108-38-3*	p/m-Xylene	< 1
75-69-4	Trichlorofluoromethane	< 1	75-25-2	Bromoform	< 1
156-60-5	trans-1,2-Dichloroethene	< 1	100-42-5	Styrene	< 1
75-09-2	Dichloromethane	< 1	79-34-5	1,1,2,2-Tetrachloroethane	< 1
75-35-4	1,1-Dichloroethene	< 1	95-47-6	o-Xylene	< 1
75-34-3	1,1-Dichloroethane	< 1	96-18-4	1,2,3-Trichloropropane	< 1
156-59-2	cis-1,2-Dichloroethene	< 1	98-82-8	Isopropylbenzene	< 1
74-97-5	Bromochloromethane	< 1	108-86-1	Bromobenzene	< 1
67-66-3	Chloroform	< 1	95-49-8	2-Chlorotoluene	< 1
594-20-7	2,2-Dichloropropane	< 1	103-65-1	Propylbenzene	< 1
107-06-2	1,2-Dichloroethane	< 1	106-43-4	4-Chlorotoluene	< 1
71-55-6	1,1,1-Trichloroethane	< 1	95-63-6	1,2,4-Trimethylbenzene	< 1
563-58-6	1,1-Dichloropropene	< 1	99-87-6	4-Isopropyltoluene	< 1
71-43-2	Benzene	< 1	108-67-6	1,3,5-Trimethylbenzene	< 1
56-23-5	Carbontetrachloride	< 1	95-50-1	1,2-Dichlorobenzene	< 1
74-95-3	Dibromomethane	< 1	106-46-7	1,4-Dichlorobenzene	< 1
78-87-5	1,2-Dichloropropane	< 1	135-98-8	sec-Butylbenzene	< 1
75-27-4	Bromodichloromethane	< 1	98-06-6	tert-Butylbenzene	< 1
79-01-6	Trichloroethene	< 1	541-73-1	1,3-Dichlorobenzene	< 1
10061-01-5	cis-1,3-Dichloropropene	< 1	104-51-8	n-Butylbenzene	< 1
10061-02-6	trans-1,3-Dichloropropene	< 1	96-12-8	1,2-Dibromo-3-chloropropane	< 1
79-00-5	1,1,2-Trichloroethane	< 1	120-82-1	1,2,4-Trichlorobenzene	< 1
108-88-3	Toluene	< 1	91-20-3	Naphthalene	< 1
142-28-9	1,3-Dichloropropane	< 1	87-61-6	1,2,3-Trichlorobenzene	< 1
124-48-1	Dibromochloromethane	< 1	87-68-3	Hexachlorobutadiene	< 1
106-93-4	1,2-Dibromoethane	< 1			

N.B. * also CAS No. 106-42-3 **

Approved by - [redacted]

GEOCHEM

Geochem Analytical Services

Volatile Organic Compounds (EPA 624/8260)

NAMAS TESTING No. 1291

Sample Identity - 1468-012 BH3B 2.00m
Client / Sample matrix - Aspinwall & Company/Water
Date Acquired - 05/16/98 03:31
Instrument Name - MSD Vols5
Units - ppb

CAS No.	Compound	Conc.	CAS No.	Compound	Conc.
75-71-8	Dichlorodifluoromethane	< 1	127-18-4	Tetrachloroethene	< 1
74-87-3	Chloromethane	< 1	630-20-6	1,1,1,2-Tetrachloroethane	< 1
75-01-4	Vinyl chloride	< 1	108-90-7	Chlorobenzene	< 1
74-83-9	Bromomethane	< 1	100-41-4	Ethylbenzene	< 1
75-00-3	Chloroethane	< 1	108-38-3*	p/m-Xylene	< 1
75-69-4	Trichlorofluoromethane	< 1	75-25-2	Bromoform	< 1
156-60-5	trans-1,2-Dichloroethene	< 1	100-42-5	Styrene	< 1
75-09-2	Dichloromethane	< 1	79-34-5	1,1,2,2-Tetrachloroethane	< 1
75-35-4	1,1-Dichloroethene	< 1	95-47-6	o-Xylene	< 1
75-34-3	1,1-Dichloroethane	< 1	96-18-4	1,2,3-Trichloropropane	< 1
156-59-2	cis-1,2-Dichloroethene	< 1	98-82-8	Isopropylbenzene	< 1
74-97-5	Bromochloromethane	< 1	108-86-1	Bromobenzene	< 1
67-66-3	Chloroform	< 1	95-49-8	2-Chlorotoluene	< 1
594-20-7	2,2-Dichloropropane	< 1	103-65-1	Propylbenzene	< 1
107-06-2	1,2-Dichloroethane	< 1	106-43-4	4-Chlorotoluene	< 1
71-55-6	1,1,1-Trichloroethane	< 1	95-63-6	1,2,4-Trimethylbenzene	< 1
563-58-6	1,1-Dichloropropene	< 1	99-87-6	4-Isopropyltoluene	< 1
71-43-2	Benzene	< 1	108-67-6	1,3,5-Trimethylbenzene	< 1
56-23-5	Carbontetrachloride	< 1	95-50-1	1,2-Dichlorobenzene	< 1
74-95-3	Dibromomethane	< 1	106-46-7	1,4-Dichlorobenzene	< 1
78-87-5	1,2-Dichloropropane	< 1	135-98-8	sec-Butylbenzene	< 1
75-27-4	Bromodichloromethane	< 1	98-06-6	tert-Butylbenzene	< 1
79-01-6	Trichloroethene	< 1	541-73-1	1,3-Dichlorobenzene	< 1
10061-01-5	cis-1,3-Dichloropropene	< 1	104-51-8	n-Butylbenzene	< 1
10061-02-6	trans-1,3-Dichloropropene	< 1	96-12-8	1,2-Dibromo-3-chloropropane	< 1
79-00-5	1,1,2-Trichloroethane	< 1	120-82-1	1,2,4-Trichlorobenzene	< 1
108-88-3	Toluene	< 1	91-20-3	Naphthalene	< 1
142-28-9	1,3-Dichloropropane	< 1	87-61-6	1,2,3-Trichlorobenzene	< 1
124-48-1	Dibromochloromethane	< 1	87-68-3	Hexachlorobutadiene	< 1
106-93-4	1,2-Dibromoethane	< 1			

N.B. * also CAS No. 106-42-3

Approved by - [redacted]

Geochem Analytical Services

Volatile Organic Compounds (EPA 624/8260)

NAMAS TESTING No. 1291

Sample Identity - 1468-018 BH4 15.00m
Client / Sample matrix - Aspinwall & Company/Water
Date Acquired - 05/16/98 04:05
Instrument Name - MSD Vols5
Units - ppb

CAS No.	Compound	Conc.	CAS No.	Compound	Conc.
75-71-8	Dichlorodifluoromethane	< 1	127-18-4	Tetrachloroethene	< 1
74-87-3	Chloromethane	< 1	630-20-6	1,1,1,2-Tetrachloroethane	< 1
75-01-4	Vinyl chloride	< 1	108-90-7	Chlorobenzene	< 1
74-83-9	Bromomethane	< 1	100-41-4	Ethylbenzene	< 1
75-00-3	Chloroethane	< 1	108-38-3*	p/m-Xylene	< 1
75-69-4	Trichlorofluoromethane	< 1	75-25-2	Bromoform	< 1
156-60-5	trans-1,2-Dichloroethene	< 1	100-42-5	Styrene	< 1
75-09-2	Dichloromethane	< 1	79-34-5	1,1,2,2-Tetrachloroethane	< 1
75-35-4	1,1-Dichloroethene	< 1	95-47-6	o-Xylene	< 1
75-34-3	1,1-Dichloroethane	< 1	96-18-4	1,2,3-Trichloropropane	< 1
156-59-2	cis-1,2-Dichloroethene	< 1	98-82-8	Isopropylbenzene	< 1
74-97-5	Bromochloromethane	< 1	108-86-1	Bromobenzene	< 1
67-66-3	Chloroform	< 1	95-49-8	2-Chlorotoluene	< 1
594-20-7	2,2-Dichloropropane	< 1	103-65-1	Propylbenzene	< 1
107-06-2	1,2-Dichloroethane	< 1	106-43-4	4-Chlorotoluene	< 1
71-55-6	1,1,1-Trichloroethane	< 1	95-63-6	1,2,4-Trimethylbenzene	< 1
563-58-6	1,1-Dichloropropene	< 1	99-87-6	4-Isopropyltoluene	< 1
71-43-2	Benzene	< 1	108-67-6	1,3,5-Trimethylbenzene	< 1
56-23-5	Carbontetrachloride	< 1	95-50-1	1,2-Dichlorobenzene	< 1
74-95-3	Dibromomethane	< 1	106-46-7	1,4-Dichlorobenzene	< 1
78-87-5	1,2-Dichloropropane	< 1	135-98-8	sec-Butylbenzene	< 1
75-27-4	Bromodichloromethane	< 1	98-06-6	tert-Butylbenzene	< 1
79-01-6	Trichloroethene	< 1	541-73-1	1,3-Dichlorobenzene	< 1
10061-01-5	cis-1,3-Dichloropropene	< 1	104-51-8	n-Butylbenzene	< 1
10061-02-6	trans-1,3-Dichloropropene	< 1	96-12-8	1,2-Dibromo-3-chloropropane	< 1
79-00-5	1,1,2-Trichloroethane	< 1	120-82-1	1,2,4-Trichlorobenzene	< 1
108-88-3	Toluene	< 1	91-20-3	Naphthalene	< 1
142-28-9	1,3-Dichloropropane	< 1	87-61-6	1,2,3-Trichlorobenzene	< 1
124-48-1	Dibromochloromethane	< 1	87-68-3	Hexachlorobutadiene	< 1
106-93-4	1,2-Dibromoethane	< 1			

N.B. * also CAS No. 106-42-3

** [redacted]

Approved by - ....[redacted]

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Volatile Organic Compounds (EPA 624/8260)

NAMAS TESTING No. 1291

Sample Identity - 1468-024 BH5 2.00m
Client / Sample matrix - Aspinwall & Company/Water
Date Acquired - 05/16/98 04:40
Instrument Name - MSD Vols5
Units - ppb

CAS No.	Compound	Conc.	CAS No.	Compound	Conc.
75-71-8	Dichlorodifluoromethane	< 1	127-18-4	Tetrachloroethene	< 1
74-87-3	Chloromethane	< 1	630-20-6	1,1,1,2-Tetrachloroethane	< 1
75-01-4	Vinyl chloride	< 1	108-90-7	Chlorobenzene	< 1
74-83-9	Bromomethane	< 1	100-41-4	Ethylbenzene	< 1
75-00-3	Chloroethane	< 1	108-38-3*	p/m-Xylene	< 1
75-69-4	Trichlorofluoromethane	< 1	75-25-2	Bromoform	< 1
156-60-5	trans-1,2-Dichloroethene	< 1	100-42-5	Styrene	< 1
75-09-2	Dichloromethane	< 1	79-34-5	1,1,2,2-Tetrachloroethane	< 1
75-35-4	1,1-Dichloroethene	< 1	95-47-6	o-Xylene	< 1
75-34-3	1,1-Dichloroethane	< 1	96-18-4	1,2,3-Trichloropropane	< 1
156-59-2	cis-1,2-Dichloroethene	< 1	98-82-8	Isopropylbenzene	< 1
74-97-5	Bromochloromethane	< 1	108-86-1	Bromobenzene	< 1
67-66-3	Chloroform	< 1	95-49-8	2-Chlorotoluene	< 1
594-20-7	2,2-Dichloropropane	< 1	103-65-1	Propylbenzene	< 1
107-06-2	1,2-Dichloroethane	< 1	106-43-4	4-Chlorotoluene	< 1
71-55-6	1,1,1-Trichloroethane	< 1	95-63-6	1,2,4-Trimethylbenzene	< 1
563-58-6	1,1-Dichloropropene	< 1	99-87-6	4-Isopropyltoluene	< 1
71-43-2	Benzene	< 1	108-67-6	1,3,5-Trimethylbenzene	< 1
56-23-5	Carbontetrachloride	< 1	95-50-1	1,2-Dichlorobenzene	< 1
74-95-3	Dibromomethane	< 1	106-46-7	1,4-Dichlorobenzene	< 1
78-87-5	1,2-Dichloropropane	< 1	135-98-8	sec-Butylbenzene	< 1
75-27-4	Bromodichloromethane	< 1	98-06-6	tert-Butylbenzene	< 1
79-01-6	Trichloroethene	< 1	541-73-1	1,3-Dichlorobenzene	< 1
10061-01-5	cis-1,3-Dichloropropene	< 1	104-51-8	n-Butylbenzene	< 1
10061-02-6	trans-1,3-Dichloropropene	< 1	96-12-8	1,2-Dibromo-3-chloropropane	< 1
79-00-5	1,1,2-Trichloroethane	< 1	120-82-1	1,2,4-Trichlorobenzene	< 1
108-88-3	Toluene	< 1	91-20-3	Naphthalene	< 1
142-28-9	1,3-Dichloropropane	< 1	87-61-6	1,2,3-Trichlorobenzene	< 1
124-48-1	Dibromochloromethane	< 1	87-68-3	Hexachlorobutadiene	< 1
106-93-4	1,2-Dibromoethane	< 1			

N.B. * also CAS No. 106-42-3 **

Approved by - ...

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Geochem Analytical Services

Volatile Organic Compounds (EPA 624/8260)

NAMAS TESTING No. 1291

Sample Identity - 1468-030 BH6 14.00m
Client / Sample matrix - Aspinwall & Company/Water
Date Acquired - 05/16/98 05:14
Instrument Name - MSD Vols5
Units - ppb

CAS No.	Compound	Conc.	CAS No.	Compound	Conc.
75-71-8	Dichlorodifluoromethane	< 1	127-18-4	Tetrachloroethene	< 1
74-87-3	Chloromethane	< 1	630-20-6	1,1,1,2-Tetrachloroethane	< 1
75-01-4	Vinyl chloride	< 1	108-90-7	Chlorobenzene	< 1
74-83-9	Bromomethane	< 1	100-41-4	Ethylbenzene	< 1
75-00-3	Chloroethane	< 1	108-38-3*	p/m-Xylene	< 1
75-69-4	Trichlorofluoromethane	< 1	75-25-2	Bromoform	< 1
156-60-5	trans-1,2-Dichloroethene	< 1	100-42-5	Styrene	< 1
75-09-2	Dichloromethane	< 1	79-34-5	1,1,2,2-Tetrachloroethane	< 1
75-35-4	1,1-Dichloroethene	< 1	95-47-6	o-Xylene	< 1
75-34-3	1,1-Dichloroethane	< 1	96-18-4	1,2,3-Trichloropropane	< 1
156-59-2	cis-1,2-Dichloroethene	< 1	98-82-8	Isopropylbenzene	< 1
74-97-5	Bromochloromethane	< 1	108-86-1	Bromobenzene	< 1
67-66-3	Chloroform	< 1	95-49-8	2-Chlorotoluene	< 1
594-20-7	2,2-Dichloropropane	< 1	103-65-1	Propylbenzene	< 1
107-06-2	1,2-Dichloroethane	< 1	106-43-4	4-Chlorotoluene	< 1
71-55-6	1,1,1-Trichloroethane	< 1	95-63-6	1,2,4-Trimethylbenzene	< 1
563-58-6	1,1-Dichloropropene	< 1	99-87-6	4-Isopropyltoluene	< 1
71-43-2	Benzene	< 1	108-67-6	1,3,5-Trimethylbenzene	< 1
56-23-5	Carbontetrachloride	< 1	95-50-1	1,2-Dichlorobenzene	< 1
74-95-3	Dibromomethane	< 1	106-46-7	1,4-Dichlorobenzene	< 1
78-87-5	1,2-Dichloropropane	< 1	135-98-8	sec-Butylbenzene	< 1
75-27-4	Bromodichloromethane	< 1	98-06-6	tert-Butylbenzene	< 1
79-01-6	Trichloroethene	< 1	541-73-1	1,3-Dichlorobenzene	< 1
10061-01-5	cis-1,3-Dichloropropene	< 1	104-51-8	n-Butylbenzene	< 1
10061-02-6	trans-1,3-Dichloropropene	< 1	96-12-8	1,2-Dibromo-3-chloropropane	< 1
79-00-5	1,1,2-Trichloroethane	< 1	120-82-1	1,2,4-Trichlorobenzene	< 1
108-88-3	Toluene	< 1	91-20-3	Naphthalene	< 1
142-28-9	1,3-Dichloropropane	< 1	87-61-6	1,2,3-Trichlorobenzene	< 1
124-48-1	Dibromochloromethane	< 1	87-68-3	Hexachlorobutadiene	< 1
106-93-4	1,2-Dibromoethane	< 1			

N.B. * also CAS No. 106-42-3 *

Approved by - [redacted]

Geochem Analytical Services

Volatile Organic Compounds (EPA 624/8260)

NAMAS TESTING No. 1291

Sample Identity - 1468-066 BH1A 35.00m
Client / Sample matrix - Aspinwall & Company/Water
Date Acquired - 05/16/98 05:48
Instrument Name - MSD Vols5
Units - ppb

CAS No.	Compound	Conc.	CAS No.	Compound	Conc.
75-71-8	Dichlorodifluoromethane	< 1	127-18-4	Tetrachloroethene	< 1
74-87-3	Chloromethane	< 1	630-20-6	1,1,1,2-Tetrachloroethane	< 1
75-01-4	Vinyl chloride	< 1	108-90-7	Chlorobenzene	< 1
74-83-9	Bromomethane	< 1	100-41-4	Ethylbenzene	< 1
75-00-3	Chloroethane	< 1	108-38-3*	p/m-Xylene	< 1
75-69-4	Trichlorofluoromethane	< 1	75-25-2	Bromoform	< 1
156-60-5	trans-1,2-Dichloroethene	< 1	100-42-5	Styrene	< 1
75-09-2	Dichloromethane	< 1	79-34-5	1,1,2,2-Tetrachloroethane	< 1
75-35-4	1,1-Dichloroethene	< 1	95-47-6	o-Xylene	< 1
75-34-3	1,1-Dichloroethane	< 1	96-18-4	1,2,3-Trichloropropane	< 1
156-59-2	cis-1,2-Dichloroethene	< 1	98-82-8	Isopropylbenzene	< 1
74-97-5	Bromochloromethane	< 1	108-86-1	Bromobenzene	< 1
67-66-3	Chloroform	< 1	95-49-8	2-Chlorotoluene	< 1
594-20-7	2,2-Dichloropropane	< 1	103-65-1	Propylbenzene	< 1
107-06-2	1,2-Dichloroethane	< 1	106-43-4	4-Chlorotoluene	< 1
71-55-6	1,1,1-Trichloroethane	< 1	95-63-6	1,2,4-Trimethylbenzene	< 1
563-58-6	1,1-Dichloropropene	< 1	99-87-6	4-Isopropyltoluene	< 1
71-43-2	Benzene	< 1	108-67-6	1,3,5-Trimethylbenzene	< 1
56-23-5	Carbontetrachloride	< 1	95-50-1	1,2-Dichlorobenzene	< 1
74-95-3	Dibromomethane	< 1	106-46-7	1,4-Dichlorobenzene	< 1
78-87-5	1,2-Dichloropropane	< 1	135-98-8	sec-Butylbenzene	< 1
75-27-4	Bromodichloromethane	< 1	98-06-6	tert-Butylbenzene	< 1
79-01-6	Trichloroethene	< 1	541-73-1	1,3-Dichlorobenzene	< 1
10061-01-5	cis-1,3-Dichloropropene	< 1	104-51-8	n-Butylbenzene	< 1
10061-02-6	trans-1,3-Dichloropropene	< 1	96-12-8	1,2-Dibromo-3-chloropropane	< 1
79-00-5	1,1,2-Trichloroethane	< 1	120-82-1	1,2,4-Trichlorobenzene	< 1
108-88-3	Toluene	< 1	91-20-3	Naphthalene	< 1
142-28-9	1,3-Dichloropropane	< 1	87-61-6	1,2,3-Trichlorobenzene	< 1
124-48-1	Dibromochloromethane	< 1	87-68-3	Hexachlorobutadiene	< 1
106-93-4	1,2-Dibromoethane	< 1			

N.B. * also CAS No. 106-42-3 **

Approved by - .....

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Geochem Analytical Services

Volatile Organic Compounds (EPA 624/8260)

NAMAS TESTING No. 1291

Sample Identity - 1468-072 BH1B 14.00m
Client / Sample matrix - Aspinwall & Company/Water
Date Acquired - 05/16/98 06:23
Instrument Name - MSD Vols5
Units - ppb

CAS No.	Compound	Conc.	CAS No.	Compound	Conc.
75-71-8	Dichlorodifluoromethane	< 1	127-18-4	Tetrachloroethene	< 1
74-87-3	Chloromethane	< 1	630-20-6	1,1,1,2-Tetrachloroethane	< 1
75-01-4	Vinyl chloride	< 1	108-90-7	Chlorobenzene	< 1
74-83-9	Bromomethane	< 1	100-41-4	Ethylbenzene	< 1
75-00-3	Chloroethane	< 1	108-38-3*	p/m-Xylene	< 1
75-69-4	Trichlorofluoromethane	< 1	75-25-2	Bromoform	< 1
156-60-5	trans-1,2-Dichloroethene	< 1	100-42-5	Styrene	< 1
75-09-2	Dichloromethane	< 1	79-34-5	1,1,2,2-Tetrachloroethane	< 1
75-35-4	1,1-Dichloroethene	< 1	95-47-6	o-Xylene	< 1
75-34-3	1,1-Dichloroethane	< 1	96-18-4	1,2,3-Trichloropropane	< 1
156-59-2	cis-1,2-Dichloroethene	< 1	98-82-8	Isopropylbenzene	< 1
74-97-5	Bromochloromethane	< 1	108-86-1	Bromobenzene	< 1
67-66-3	Chloroform	< 1	95-49-8	2-Chlorotoluene	< 1
594-20-7	2,2-Dichloropropane	< 1	103-65-1	Propylbenzene	< 1
107-06-2	1,2-Dichloroethane	< 1	106-43-4	4-Chlorotoluene	< 1
71-55-6	1,1,1-Trichloroethane	< 1	95-63-6	1,2,4-Trimethylbenzene	< 1
563-58-6	1,1-Dichloropropene	< 1	99-87-6	4-Isopropyltoluene	< 1
71-43-2	Benzene	< 1	108-67-6	1,3,5-Trimethylbenzene	< 1
56-23-5	Carbontetrachloride	< 1	95-50-1	1,2-Dichlorobenzene	< 1
74-95-3	Dibromomethane	< 1	106-46-7	1,4-Dichlorobenzene	< 1
78-87-5	1,2-Dichloropropane	< 1	135-98-8	sec-Butylbenzene	< 1
75-27-4	Bromodichloromethane	< 1	98-06-6	tert-Butylbenzene	< 1
79-01-6	Trichloroethene	< 1	541-73-1	1,3-Dichlorobenzene	< 1
10061-01-5	cis-1,3-Dichloropropene	< 1	104-51-8	n-Butylbenzene	< 1
10061-02-6	trans-1,3-Dichloropropene	< 1	96-12-8	1,2-Dibromo-3-chloropropane	< 1
79-00-5	1,1,2-Trichloroethane	< 1	120-82-1	1,2,4-Trichlorobenzene	< 1
108-88-3	Toluene	< 1	91-20-3	Naphthalene	< 1
142-28-9	1,3-Dichloropropane	< 1	87-61-6	1,2,3-Trichlorobenzene	< 1
124-48-1	Dibromochloromethane	< 1	87-68-3	Hexachlorobutadiene	< 1
106-93-4	1,2-Dibromoethane	< 1			

N.B. * also CAS No. 106-42-3 ** V[redacted]

Approved by - .....[redacted]

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Geochem Analytical Services

Volatile Organic Compounds (EPA 624/8260)

NAMAS TESTING No. 1291

Sample Identity - 1468-078 BH2 23.00m
Client / Sample matrix - Aspinwall & Company/Water
Date Acquired - 05/16/98 06:57
Instrument Name - MSD Vols5
Units - ppb

CAS No.	Compound	Conc.	CAS No.	Compound	Conc.
75-71-8	Dichlorodifluoromethane	< 1	127-18-4	Tetrachloroethene	< 1
74-87-3	Chloromethane	< 1	630-20-6	1,1,1,2-Tetrachloroethane	< 1
75-01-4	Vinyl chloride	< 1	108-90-7	Chlorobenzene	< 1
74-83-9	Bromomethane	< 1	100-41-4	Ethylbenzene	< 1
75-00-3	Chloroethane	< 1	108-38-3*	p/m-Xylene	< 1
75-69-4	Trichlorofluoromethane	< 1	75-25-2	Bromoform	< 1
156-60-5	trans-1,2-Dichloroethene	< 1	100-42-5	Styrene	< 1
75-09-2	Dichloromethane	< 1	79-34-5	1,1,2,2-Tetrachloroethane	< 1
75-35-4	1,1-Dichloroethene	< 1	95-47-6	o-Xylene	< 1
75-34-3	1,1-Dichloroethane	< 1	96-18-4	1,2,3-Trichloropropane	< 1
156-59-2	cis-1,2-Dichloroethene	< 1	98-82-8	Isopropylbenzene	< 1
74-97-5	Bromochloromethane	< 1	108-86-1	Bromobenzene	< 1
67-66-3	Chloroform	< 1	95-49-8	2-Chlorotoluene	< 1
594-20-7	2,2-Dichloropropane	< 1	103-65-1	Propylbenzene	< 1
107-06-2	1,2-Dichloroethane	< 1	106-43-4	4-Chlorotoluene	< 1
71-55-6	1,1,1-Trichloroethane	< 1	95-63-6	1,2,4-Trimethylbenzene	< 1
563-58-6	1,1-Dichloropropene	< 1	99-87-6	4-Isopropyltoluene	< 1
71-43-2	Benzene	< 1	108-67-6	1,3,5-Trimethylbenzene	< 1
56-23-5	Carbontetrachloride	< 1	95-50-1	1,2-Dichlorobenzene	< 1
74-95-3	Dibromomethane	< 1	106-46-7	1,4-Dichlorobenzene	< 1
78-87-5	1,2-Dichloropropane	< 1	135-98-8	sec-Butylbenzene	< 1
75-27-4	Bromodichloromethane	< 1	98-06-6	tert-Butylbenzene	< 1
79-01-6	Trichloroethene	< 1	541-73-1	1,3-Dichlorobenzene	< 1
10061-01-5	cis-1,3-Dichloropropene	< 1	104-51-8	n-Butylbenzene	< 1
10061-02-6	trans-1,3-Dichloropropene	< 1	96-12-8	1,2-Dibromo-3-chloropropane	< 1
79-00-5	1,1,2-Trichloroethane	< 1	120-82-1	1,2,4-Trichlorobenzene	< 1
108-88-3	Toluene	< 1	91-20-3	Naphthalene	< 1
142-28-9	1,3-Dichloropropane	< 1	87-61-6	1,2,3-Trichlorobenzene	< 1
124-48-1	Dibromochloromethane	< 1	87-68-3	Hexachlorobutadiene	< 1
106-93-4	1,2-Dibromoethane	< 1			

N.B. * also CAS No. 106-42-3

** Water blank subtracted

Approved by - [redacted]

Geochem Analytical Services

Volatile Organic Compounds (EPA 624/8260)

NAMAS TESTING No. 1231

Sample Identity - 1468-084 SPRING
Client / Sample matrix - Aspinwall & Company / Water
Date Acquired - 05/28/98 03:37
Instrument Name - MSD Vols5
Units - ppb

CAS No.	Compound	Conc.	CAS No.	Compound	Conc.
75-71-8	Dichlorodifluoromethane	< 1	127-18-4	Tetrachloroethene	< 1
74-87-3	Chloromethane	< 1	630-20-6	1,1,1,2-Tetrachloroethane	< 1
75-01-4	Vinyl chloride	< 1	108-90-7	Chlorobenzene	< 1
74-83-9	Bromomethane	< 1	100-41-4	Ethylbenzene	< 1
75-00-3	Chloroethane	< 1	108-38-3*	p/m-Xylene	< 1
75-69-4	Trichlorofluoromethane	< 1	75-25-2	Bromoform	< 1
156-60-5	trans-1,2-Dichloroethene	< 1	100-42-5	Styrene	< 1
75-09-2	Dichloromethane	< 1	79-34-5	1,1,2,2-Tetrachloroethane	< 1
75-35-4	1,1-Dichloroethene	< 1	95-47-6	o-Xylene	< 1
75-34-3	1,1-Dichloroethane	< 1	96-18-4	1,2,3-Trichloropropane	< 1
156-59-2	cis-1,2-Dichloroethene	< 1	98-82-8	Isopropylbenzene	< 1
74-97-5	Bromochloromethane	< 1	108-86-1	Bromobenzene	< 1
67-66-3	Chloroform	< 1	95-49-8	2-Chlorotoluene	< 1
594-20-7	2,2-Dichloropropane	< 1	103-65-1	Propylbenzene	< 1
107-06-2	1,2-Dichloroethane	< 1	106-43-4	4-Chlorotoluene	< 1
71-55-6	1,1,1-Trichloroethane	< 1	95-63-6	1,2,4-Trimethylbenzene	< 1
563-58-6	1,1-Dichloropropene	< 1	99-87-6	4-Isopropyltoluene	< 1
71-43-2	Benzene	< 1	108-67-6	1,3,5-Trimethylbenzene	< 1
56-23-5	Carbontetrachloride	< 1	95-50-1	1,2-Dichlorobenzene	< 1
74-95-3	Dibromomethane	< 1	106-46-7	1,4-Dichlorobenzene	< 1
78-87-5	1,2-Dichloropropane	< 1	135-98-8	sec-Butylbenzene	< 1
75-27-4	Bromodichloromethane	< 1	98-06-6	tert-Butylbenzene	< 1
79-01-6	Trichloroethene	< 1	541-73-1	1,3-Dichlorobenzene	< 1
10061-01-5	cis-1,3-Dichloropropene	< 1	104-51-8	n-Butylbenzene	< 1
10061-02-6	trans-1,3-Dichloropropene	< 1	96-12-8	1,2-Dibromo-3-chloropropane	< 1
79-00-5	1,1,2-Trichloroethane	< 1	120-82-1	1,2,4-Trichlorobenzene	< 1
108-88-3	Toluene	< 1	91-20-3	Naphthalene	< 1
142-28-9	1,3-Dichloropropane	< 1	87-61-6	1,2,3-Trichlorobenzene	< 1
124-48-1	Dibromochloromethane	< 1	87-68-3	Hexachlorobutadiene	< 1
106-93-4	1,2-Dibromoethane	< 1			

N.B. * also CAS No. 106-42-3 ** Water blank subtracted

Approved by - .....[redacted].....

Appendix 7

Discussion of Groundwater Chemistry (copied from Reference 1)

Appendix *continued* 7

Results of Chemical Analysis of Groundwater from Boreholes

Table 2.7 indicates that the groundwater beneath the site is generally of good quality. It is of neutral to slightly alkaline pH with slightly elevated electrical conductivity (EC), indicative of a high total dissolved solids. This is not unusual given the nature of the geology beneath the site. However, excepting nitrate in Borehole 1B and sulphate in Borehole 2 none of the major ions exceed the EC maximum admissible concentration (MAC) in drinking water (where a value is given - Ref 4). The elevated nitrate may be due to local agricultural use, whilst the sulphate may be naturally derived from mudstone strata. Bicarbonate at Borehole 6 is also elevated, although the reason for this is unclear.

The major ions have been plotted as a piper diagram (Appendix 2) and indicate the similarity between the groundwater at all locations except borehole 2. The determinands are dominated by calcium and bicarbonate ions typical of limestone groundwaters. Borehole 2 is the exception as although calcium in the groundwater at this location is high, bicarbonate is low, whilst sodium, sulphate, phosphate and ammoniacal nitrogen are elevated compared to the other locations. This may be a facet of the nature of the borehole as much as the aquifer - limited water was encountered at this location, permeability was low and borehole purging/ development was not extensive. Of the metals for which analysis was undertaken, the majority were present at concentrations less than the limit of detection. The exceptions are discussed below.

Arsenic can be found naturally in groundwaters at concentrations in excess of 50 µg/l, although the norm is less than 1 µg/l (Ref 6). The concentration of 710 µg/l measured in Borehole 2 is therefore elevated in comparison, whilst the 2280 µg/l in Borehole 3B is greatly elevated. It can be much higher in geothermal waters, values of 40 mg/l being recorded in the US (Ref 7). No trial pits were dug in the close vicinity of Borehole 3 to indicate local soil concentrations.

Boron is greater than the limit of detection in Boreholes 1A, 2, 5 and 6, however, it was nowhere detected at a concentration greater than the EC guide level. Cadmium was only detected in Boreholes 5 and 6, at 0.1 and 0.2 mg/l respectively, only just greater than the limit of detection of 0.05 mg/l. The natural background concentration is around 1 µg/l (Ref 6). Chromium was not significantly greater than the limit of detection at any location.

Copper was only present at greater than the limit of detection at Borehole 3B and then not significantly greater than the EC GL. Mercury concentrations detected in Boreholes 1B, 4 and 6 are elevated compared to the EC MAC, but are less than twice the limit of detection and must therefore be interpreted with caution. The concentration of 140 µg/l measured at Borehole 1A is elevated compared to the

Appendix *continued* 7

MAC of 1 µg/l. No natural sources can be suggested for its origin, whilst analysis of shallow soils near Borehole 1 do not indicate elevated concentrations.

Nickel was only detected at greater than the limit of detection (and the EC MAC) in Borehole 3B. However, the concentration was only four times the limit of detection. Nickel can be found naturally occurring in groundwaters in the UK at over 0.1 mg/l, although typically concentrations are less than 0.01 mg/l (Ref 6). Nickel concentrations in soil across the site are very low.

Lead was detected at a concentration slightly greater than the limit of detection (and the EC MAC) at four locations, although only at one of these was the concentration slightly greater than four times the limit of detection. Natural concentrations of lead in groundwater are generally below 1 µg/l (Ref 6). Selenium was not detected at any location greater than the limit of detection.

Zinc was present at a concentration greater than the limit of detection at four locations, but only at Borehole 3B was the concentration significantly greater than the limit. There is no EC MAC for zinc, although the concentration exceeds the EC GL, but not the Dutch Intervention value.

Although at the majority of locations the metal concentrations in groundwater do not exceed the limit of detection there are a number of instances where this does occur. In general the concentrations are not significant being only up to four times the limit of detection. Furthermore comparison has been made to guideline concentrations for potable water which are not necessarily applicable to contaminated land assessments such as this. The only exception is in Borehole 3B where arsenic appears to be anomalously high.

Organic Determinands

A number of screening tests were undertaken in order to identify, in broad terms, if organic contaminants were present in the groundwater. These included COD, BOD, TOC, Mineral Oil, TPH and NSO/resins. In addition, analysis for diesel range organics (DRO) was carried out to improve the detection limits for hydrocarbons.

COD was only elevated in Borehole 1A at 478 mg/l and slightly elevated in Borehole 6 at 77 mg/l. The cause of the very high concentrations in Borehole 1A could not be determined by the laboratory and was not paralleled by elevated concentrations of any other "indicator" tests, including TOC and BOD. COD is generally used as an indicator of the presence of "polluting" material, although in this instance such material could not be identified.

BOD was slightly elevated in Borehole 1B, although not to an extent to cause any great concern. Of the remaining "indicators" used, all were less than, at, or close

Appendix *continued* 7

to, the limit of detection, indicating that the groundwaters are not significantly contaminated by organic material. The analysis for diesel range organics also indicates no significant contamination.

The DRO analysis indicates that the groundwater sampled from the boreholes is not contaminated by hydrocarbons. The slightly elevated concentration measured in Borehole 2 is not significant, especially given that it was not possible to effectively purge the borehole due to the slow groundwater inflow rate.

Results of Chemical Analysis of Spring Water

Inorganic Determinands

The spring water chemistry is detailed in Table 2.8. This indicates good quality water with a neutral pH and slightly elevated EC typical of groundwater from oolite strata. As with the borehole waters the major ion concentrations are generally less than the MAC for potable water (where a value is given). The exceptions are from springs C2 and D where nitrate concentrations of 119 and 97 mg/l respectively were measured. These are probably associated with inputs from agricultural sources.

The piper plot (Appendix 2) indicates that the springs are all of a similar chemical type, as with the borehole waters, being dominated by calcium and bicarbonate ions. Only spring I appears to have a slightly different chemistry with calcium, chloride and sulphate being generally lower. This is likely to be a reflection of the conditions under which spring I was sampled (i.e. following heavy overnight rain) compared to all other locations (stable conditions).

There are slight differences in the chemistry of the borehole and spring waters. The spring waters tend to have higher calcium, potassium, chloride, and ammoniacal nitrogen concentrations and lower magnesium and sodium. This may be a reflection of bedrock quality variations, groundwater residence times in the aquifer, and equilibration of dominant ionic species.

Of the metals, all except lead and zinc at Spring I are less than the limit of detection. The concentrations at spring I are less than or equal to twice the limit of detection and should therefore be treated with caution. In both instances, if the values are true, they are not significant in terms of environmental contamination.

Organic Determinands

All of the indicators of organic contamination are either less than the limit of detection, or close to it, suggesting that there is not significant pollution of spring

Appendix *continued*

water. Although DRO was detected at greater than the limit of detection at three locations these concentrations are not considered to be significant.