

TROSTRE LANDFILL SITE, LLANELLI

MONITORING REPORT

OCTOBER 2011

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TROSTRE LANDFILL SITE, LLANELLI

MONITORING REPORT

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1.0 INTRODUCTION

Previous work undertaken by ExCAL Limited on behalf of Carmarthenshire County Council (CCC) at a former inert landfill site in Trostre, Llanelli; *Land off Trostre Works Link Road*, NGR: 252799 199700 indicated elevated levels of contaminants potentially harmful to human health and the presence of non-inert materials.

No baseline or operational data exists for the site and consequently CCC commissioned ExCAL Limited to carry out a 12 month period of monthly monitoring at the site.

This report presents the information obtained over the monitoring period.

This report should be read in conjunction with the following: -

- Preliminary Risk Assessment (PRA) (October 2009). ExCAL Limited;
- Site Investigation Report (August 2010). ExCAL Limited.

2.0 METHODOLOGY

The monitoring comprised a single additional phase of soil sampling and monthly monitoring of groundwater, surface water and ground gas between September 2010 and August 2011.

2.1 Soil

Additional soil samples were obtained on 10th September 2010 and analysed for the following suite of chemicals;

- Cyanide (total)
- Arsenic
- Barium
- Beryllium
- Cadmium
- Chromium
- Copper
- Lead
- Mercury
- Nickel
- Selenium
- Vanadium
- Zinc.

2.2 Water

Monthly monitoring of groundwater and surface water was undertaken between September 2010 and August 2011.

The ground water samples were taken from BH3.

The surface water monitoring points have been selected to provide background concentrations as well as to allow identification of the potential landfill contribution to surface waters (see Drawing No. 44-05-02.D02): -

- SW1 – surface waters that are likely to have originated onsite;
- SW2 – background concentrations from the River Dafen / Afon Dafen;
- SW3 – background concentrations for the unnamed tributary of the River Dafen / Afon Dafen.

The soil and surface water samples were analysed for the suite of determinands listed in Table 1 below: -

Table 1 – Suite of Determinands

• pH	• Anthracene
• Biological Oxygen Demand	• Fluoranthene
• Chemical Oxygen Demand	• Pyrene
• Electrical Conductivity	• Benzo[a]anthracene
• Alkalinity	• Chrysene
• Chloride	• Benzo[b]fluoranthene
• Ammoniacal Nitrogen	• Benzo[k]fluoranthene
• Cyanide (total)	• Benzo[a]pyrene
• Iron (dissolved)	• Dibenzo[a,h]anthracene
• Iron (total)	• Indeno[1,2,3-cd]pyrene
• Sulphide	• Benzo[g,h,i]perylene
• Total Organic Carbon	• PCBs as Aroclor
• Sulphate	• Catechols
• Arsenic (dissolved)	• Phenol
• Arsenic	• Cresols
• Barium	• Xylenols
• Beryllium	• Naphthols
• Boron	• Trimethyl phenols
• Cadmium	• 2-sec-Butyl-4-6-dinitrophenol
• Chromium (dissolved)	• 4-Chloro-3-methylphenol
• Chromium (total)	• 2-Chlorophenol
• Copper (dissolved)	• 2,4-Dichlorophenol
• Copper	• 2,6-Dichlorophenol
• Lead (dissolved)	• 2,4-Dimethylphenol
• Lead	• 2,4-Dinitrophenol
• Mercury	• 2-Methyl-4-6-dinitrophenol
• Nickel (dissolved)	• 2-Methylphenol
• Nickel	• 3-Methylphenol
• Selenium	• 4-Methylphenol
• Antimony (dissolved)	• 2-Nitrophenol
• Antimony	• 4-Nitrophenol
• Vanadium (dissolved)	• Pentachlorophenol
• Vanadium	• Phenol
• Zinc (dissolved)	• 2,3,4,5-Tetrachlorophenol
• Zinc	• 2,3,4,6-Tetrachlorophenol
• TPH (Aqueous Phase)	• 2,3,5,6-Tetrachlorophenol
• PAH (total EPA 16)	• 2,3,4-Trichlorophenol
• Naphthalene	• 2,3,5-Trichlorophenol
• Acenaphthylene	• 2,3,6-Trichlorophenol
• Acenaphthene	• 2,4,5-Trichlorophenol
• Fluorene	• 2,4,6-Trichlorophenol
• Phenanthrene	• 3,4,5-Trichlorophenol

2.3 Gas

Monthly monitoring of gas was undertaken between September 2010 and August 2011 for methane (CH₄), carbon dioxide (CO₂) and oxygen (O₂).

3.0 RESULTS

3.1 Soil

The results of the soil sample analyses are given in table 3 and were compared to available CLEA Soil Guideline Values (SGV's) and LQM & CIEH Generic Assessment Criteria (GAC) (Table 2). Where no guideline values are available or analysis results are below chemical detection limits only the raw data is reported.

Table 2 – SGV's and GAC's for Soil

Contaminant	SGV / GAC
Cyanide (total) (mg/kg)	3.7 ^{*4}
Sulphide (mg/kg)	-
Organic matter (%)	-
Boron (hot water soluble) (mg/kg)	-
Sulphate (2:1 water soluble) as SO ₄ (g/L)	-
Sulphate (total) by BS1377 (HCl extract) (%)	-
Arsenic (mg/kg)	32 ^{*1}
Barium (mg/kg)	230 ^{*2}
Beryllium (mg/kg)	N/A
Cadmium (mg/kg)	1.8 ^{*3}
Chromium (mg/kg)	130 ^{*1}
Copper (mg/kg)	2,300 ^{*4}
Lead (mg/kg)	450 ^{*1}
Mercury (mg/kg)	8.0 ^{*3}
Nickel (mg/kg)	130 ^{*1}
Selenium (mg/kg)	120 ^{*3}
Vanadium (mg/kg)	-
Zinc (mg/kg)	3,800 ^{*3}
TPH (mg/kg)	-
pH	-
*1 CLEA Soil Guideline Value (SGV) – residential	
*2 CLEA SGV – commercial	
*3 CLEA SGV – allotments	
*4 LQM & CIEH. 2009. <i>The LQM/CIEH Generic Assessment Criteria for Human Health Risk Assessment</i> (2 nd Ed.)	

Table 3 – Soil analysis results

Soil - 10 September 2010								
Contaminant	SGV / GAC	TP1 1.50m	TP2 1.50m	TP3 0.50m	TP3 2.50m	TP4 2.50m	TP5 1.50m	TP6 3.50m
Cyanide (total) (mg/kg)	3.7 ^{*4}	0.11	<0.05	<0.05	0.05	<0.05	<0.05	<0.05
Arsenic (mg/kg)	32 ^{*1}	5.7	<1	3.9	7.7	1.1	5.6	1.1
Barium (mg/kg)	230 ^{*2}	32	16	82	23	50	50	<5.0
Beryllium (mg/kg)	N/A	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Cadmium (mg/kg)	1.8 ^{*3}	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Chromium (mg/kg)	130 ^{*1}	2.2	3.7	2.6	3.4	2.9	5.1	3.4
Copper (mg/kg)	2,300 ^{*4}	4	3.2	8	43	2.3	3.8	<1
Lead (mg/kg)	450 ^{*1}	<1	<1	<1	12	1.4	<1	<1
Mercury (mg/kg)	8.0 ^{*3}	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Nickel (mg/kg)	130 ^{*1}	2.4	11	2.5	3.4	2.1	3.5	2
Selenium (mg/kg)	120 ^{*3}	3.2	<1	1.9	2.3	<1	1.4	<1
Vanadium (mg/kg)	-	2.2	<1	2.8	12	<1	12	<1
Zinc (mg/kg)	3,800 ^{*3}	<1	<1	<1	1.9	3.4	3.3	<1

All measurements in metres represent metres below ground level.
^{*1} CLEA Soil Guideline Value (SGV) – residential
^{*2} CLEA SGV – commercial
^{*3} CLEA SGV – allotments
^{*4} LQM & CIEH. 2009. *The LQM/CIEH Generic Assessment Criteria for Human Health Risk Assessment (2nd Ed.)*

None of the samples indicated elevated levels of contaminants when compared to the appropriate guidelines. Notwithstanding this, the Barium concentrations are anomalous for Inert waste

3.2 Water

The water samples have been analysed and graphs have been generated of the variation in concentrations of contaminants in SW1, SW2, SW3 and BH3 for all determinands. These results have been compared to their relevant EQS / GAC (determinands without EQS's are listed as 'None') listed in Table 4.

Table 4 – EQS and GAC's for Water Samples

Determinand	EQS / GAC	Determinand	EQS / GAC
pH	6.5 – 10 ^{*2}	Anthracene	0.021 mg/l ^{*5}
Biological Oxygen Demand	<5 mg/l ^{*3}	Fluoranthene	0.23 mg/l ^{*5}
Chemical Oxygen Demand	30 mg/l ^{*3}	Pyrene	0.13 mg/l ^{*5}
Electrical Conductivity	N/A	Benzo[a]anthracene	0.0038 mg/l ^{*5}
Alkalinity	None	Chrysene	0.0020 mg/l ^{*5}
Chloride	250 mg/l ^{*2}	Benzo[b]fluoranthene	0.0020 mg/l ^{*5}
Ammoniacal Nitrogen	0.5 mg NH ₄ /l ^{*2}	Benzo[k]fluoranthene	0.0008 mg/l ^{*5}
Cyanide (total)	0.05 mg/l ^{*1}	Benzo[a]pyrene	0.0038 mg/l ^{*5}

Determinand	EQS / GAC	Determinand	EQS / GAC
Iron (dissolved)	2,000 µg/l ^{*1}	Dibenzo[a,h]anthracene	0.0006 mg/l ^{*5}
Iron (total)	2,000 µg/l ^{*1}	Indeno[1,2,3-cd]pyrene	0.0002 mg/l ^{*5}
Sulphide	N/A	Benzo[g,h,i]perylene	0.00026 mg/l ^{*5}
Total Organic Carbon	None	PCBs as Aroclor	None
Sulphate	250 mg/l ^{*1}	Catechols	None
Antimony	5 µg/l ^{*2}	Phenol	None
Arsenic (dissolved)	10 µg/l ^{*2}	Cresols	None
Arsenic	10 µg/l ^{*2}	Xylenols	None
Barium	100 µg/l ^{*1}	Naphthols	None
Beryllium	None	Trimethyl phenols	None
Boron	1,000 µg/l ^{*2}	2-sec-Butyl-4-6-dinitrophenol	None
Cadmium	5 µg/l ^{*1}	4-Chloro-3-methylphenol	None
Chromium (dissolved)	50 µg/l ^{*1}	2-Chlorophenol	None
Chromium (total)	50 µg/l ^{*1}	2,4-Dichlorophenol	None
Copper (dissolved)	50 µg/l ^{*1}	2,6-Dichlorophenol	None
Copper	50 µg/l ^{*1}	2,4-Dimethylphenol	None
Lead (dissolved)	50 µg/l ^{*1}	2,4-Dinitrophenol	None
Lead	50 µg/l ^{*1}	2-Methyl-4-6-dinitrophenol	None
Mercury	1 µg/l ^{*2}	2-Methylphenol	None
Nickel (dissolved)	20 µg/l ^{*2}	3-Methylphenol	None
Nickel	20 µg/l ^{*2}	4-Methylphenol	None
Selenium	10 µg/l ^{*1}	2-Nitrophenol	None
Antimony (dissolved)	5 µg/l ^{*2}	4-Nitrophenol	None
Antimony	5 µg/l ^{*2}	Pentachlorophenol	None
Vanadium (dissolved)	20 µg/l ^{*4}	Phenol	None
Vanadium	20 µg/l ^{*4}	2,3,4,5-Tetrachlorophenol	None
Zinc (dissolved)	3,000 µg/l ^{*1}	2,3,4,6-Tetrachlorophenol	None
Zinc	3,000 µg/l ^{*1}	2,3,5,6-Tetrachlorophenol	None
TPH (Aqueous Phase)	50 µg/l ^{*1}	2,3,4-Trichlorophenol	None
PAH (total EPA 16)	None	2,3,5-Trichlorophenol	None
Naphthalene	19 mg/l ^{*5}	2,3,6-Trichlorophenol	None
Acenaphthylene	4.2 mg/l ^{*5}	2,4,5-Trichlorophenol	None
Acenaphthene	3.2 mg/l ^{*5}	2,4,6-Trichlorophenol	None
Fluorene	1.9 mg/l ^{*5}	3,4,5-Trichlorophenol	None
Phenanthrene	0.53 mg/l ^{*5}		

*1 Surface Waters (Abstraction for Drinking Water) (Classification) Regulations 1996

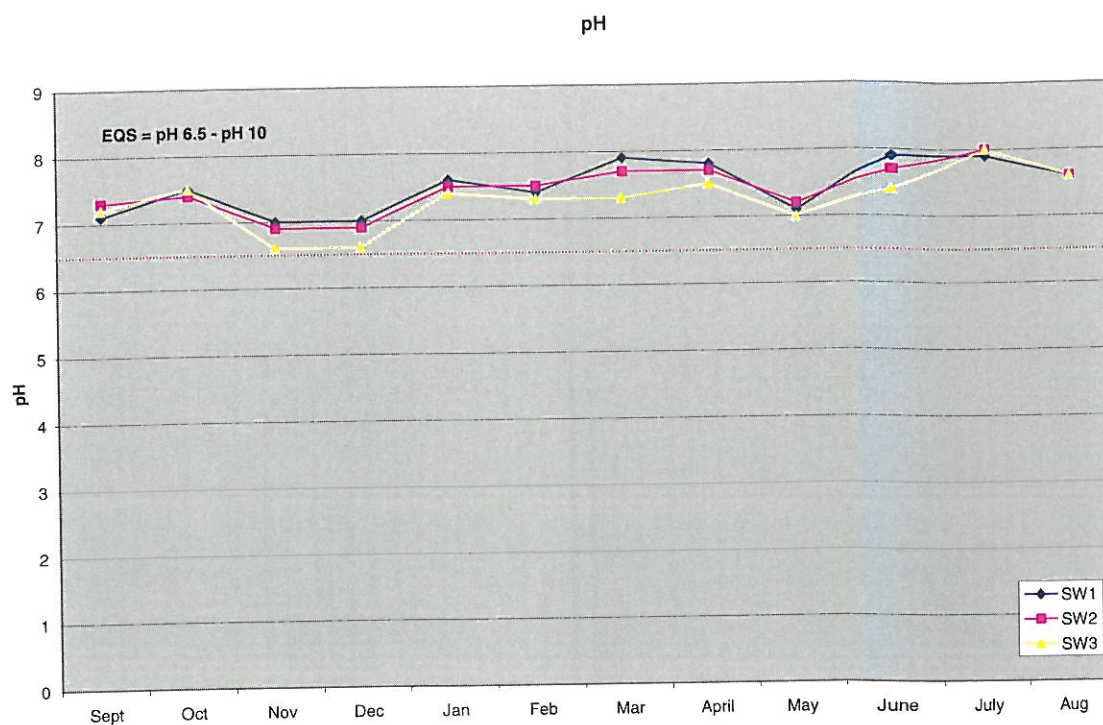
*2 Water Supply (Water Quality) Regulations 2000

*3 Council Directive concerning the quality required of surface water intended for the abstraction of drinking water in the Member States (Surface Water Directive) (Repealed)

*4 Water Research Council (WRC). 1984. *Determination of pollutants in effluents: Proposed*

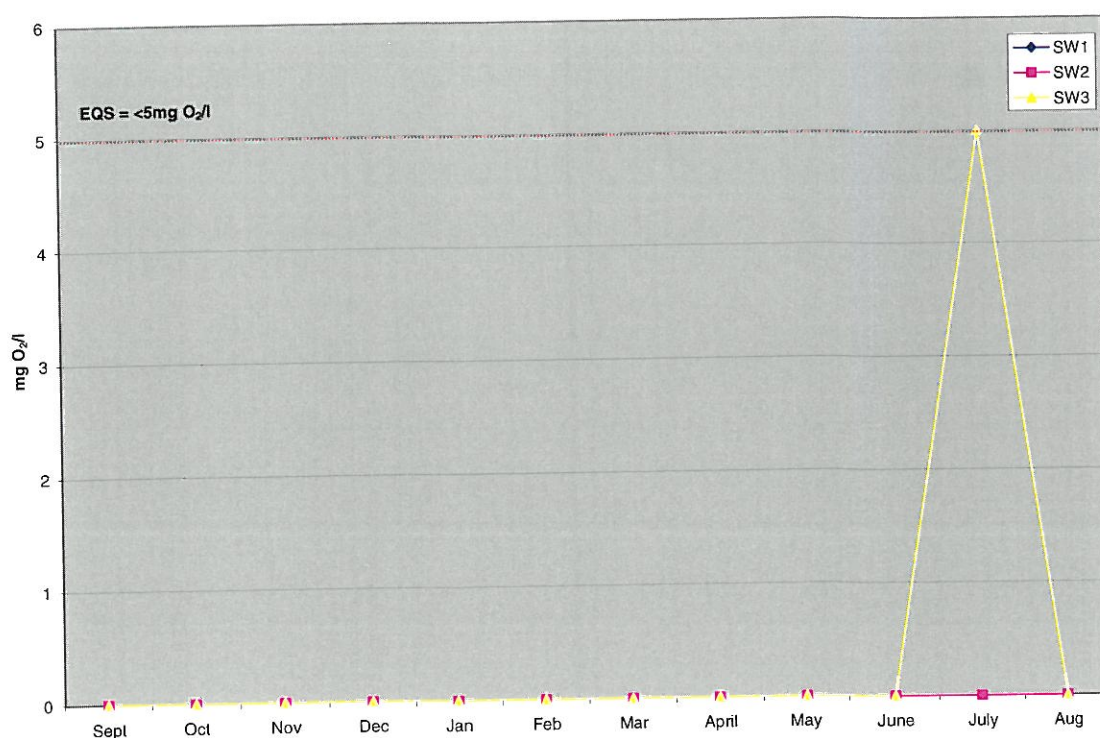
Determinand	EQS / GAC	Determinand	EQS / GAC
<i>environmental quality standards for vanadium in water and associated materials.</i> <i>*5 LQM & CIEH. 2009. The LQM/CIEH Generic Assessment Criteria for Human Health Risk Assessment (2nd Ed.)</i>			

Surface Water Results: SW1, SW2, SW3



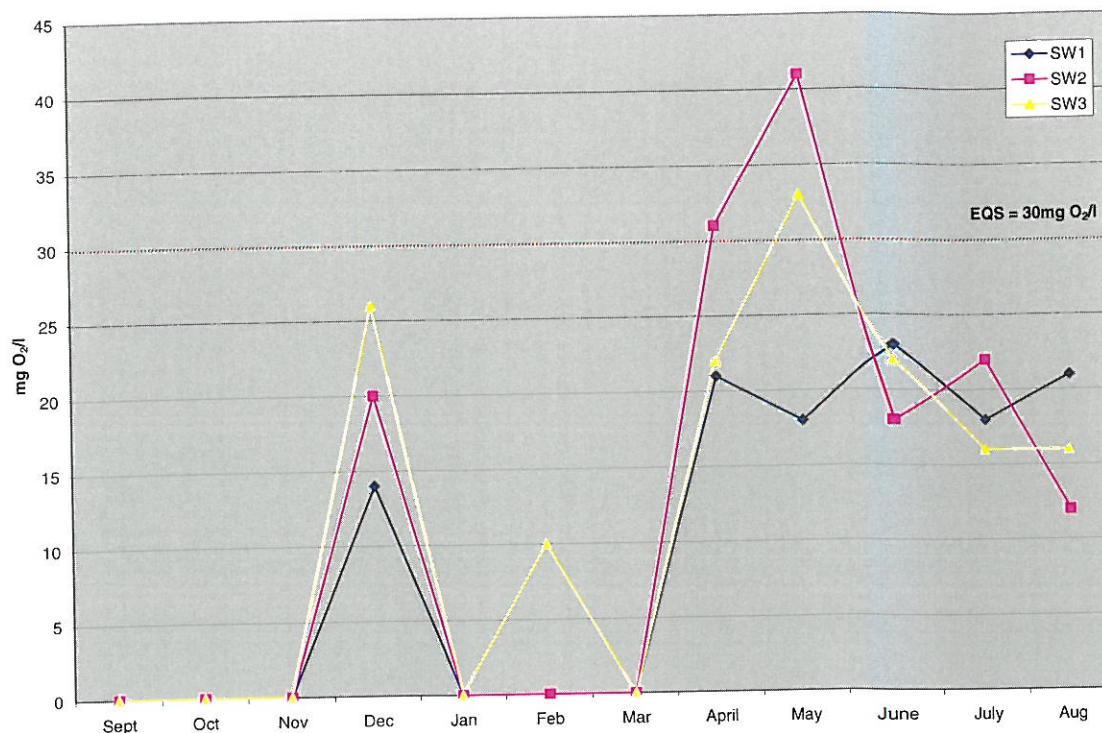
The results indicate that the pH of surface water SW3 was at or below the recommended limits (pH6.5 to pH10) in November and December. All other surface water samples were within the recommended limits.

Biological Oxygen Demand (BOD)



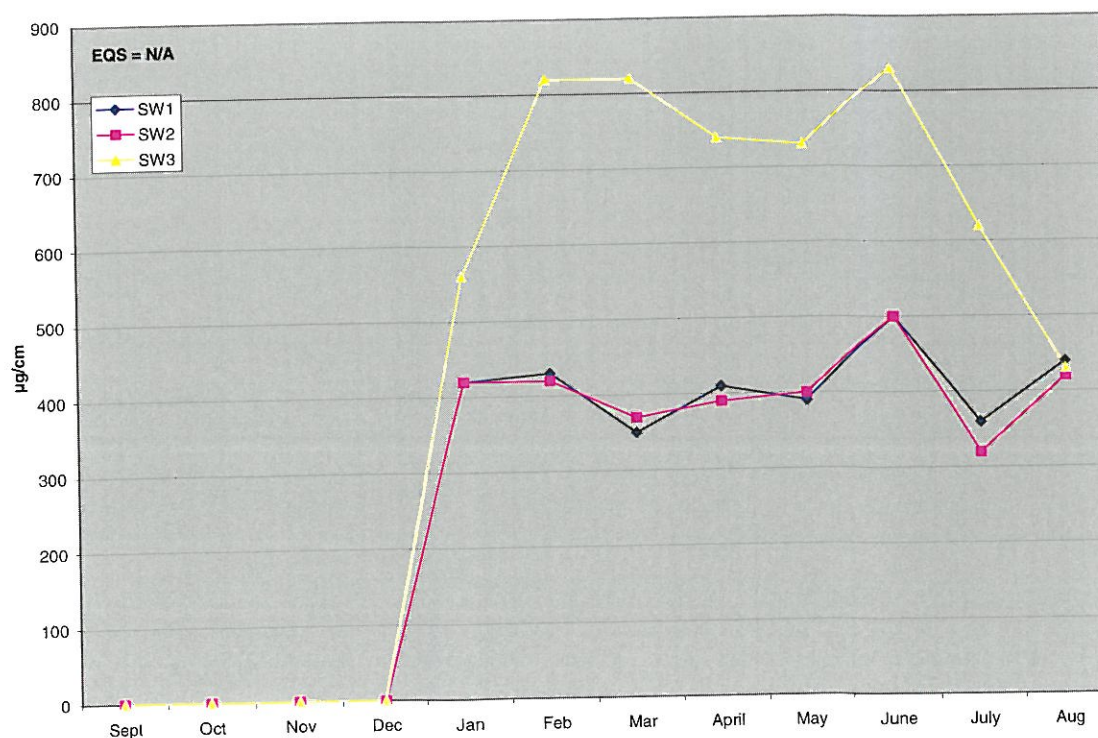
The results indicate that the BOD of surface water SW3 was at or above the recommended limits (5mg/l) in July. All other surface water samples were within the recommended limits.

Chemical Oxygen Deman (COD)

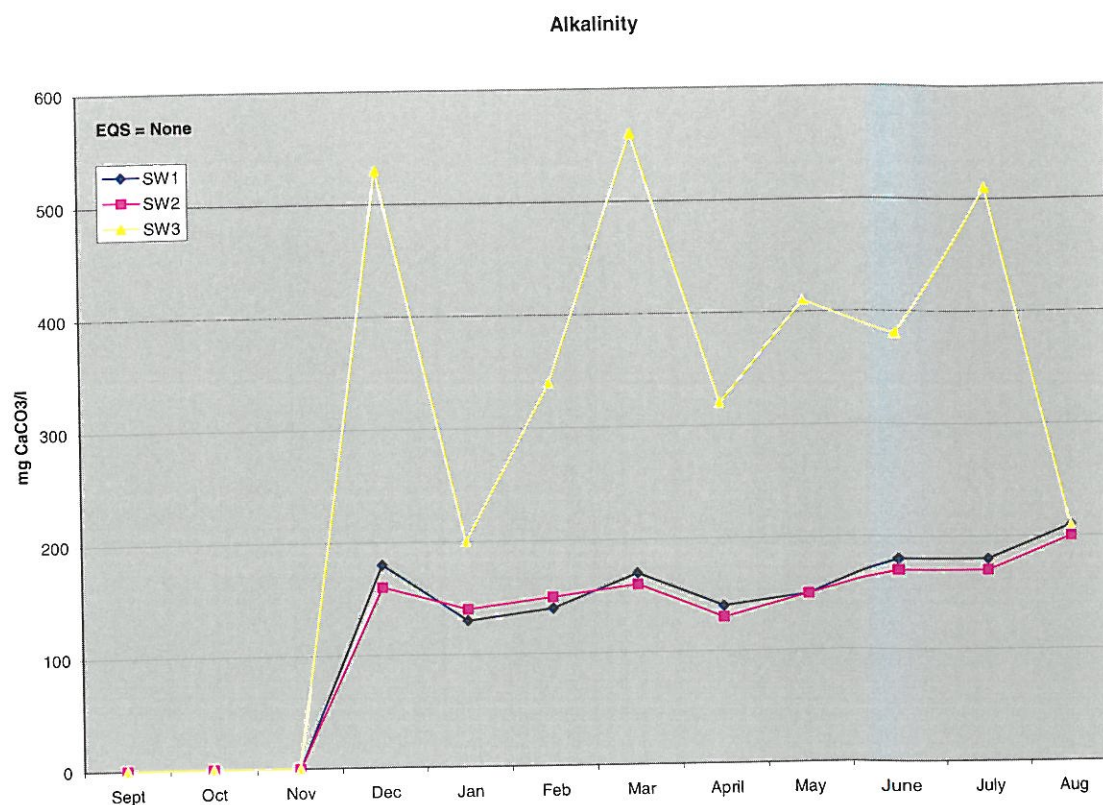


The results indicate that the COD of surface water SW2 was above the recommended limits (30mg/l) in April and May, SW3 was above the limit in May also. All other surface water samples were within the recommended limits.

Electrical Conductivity

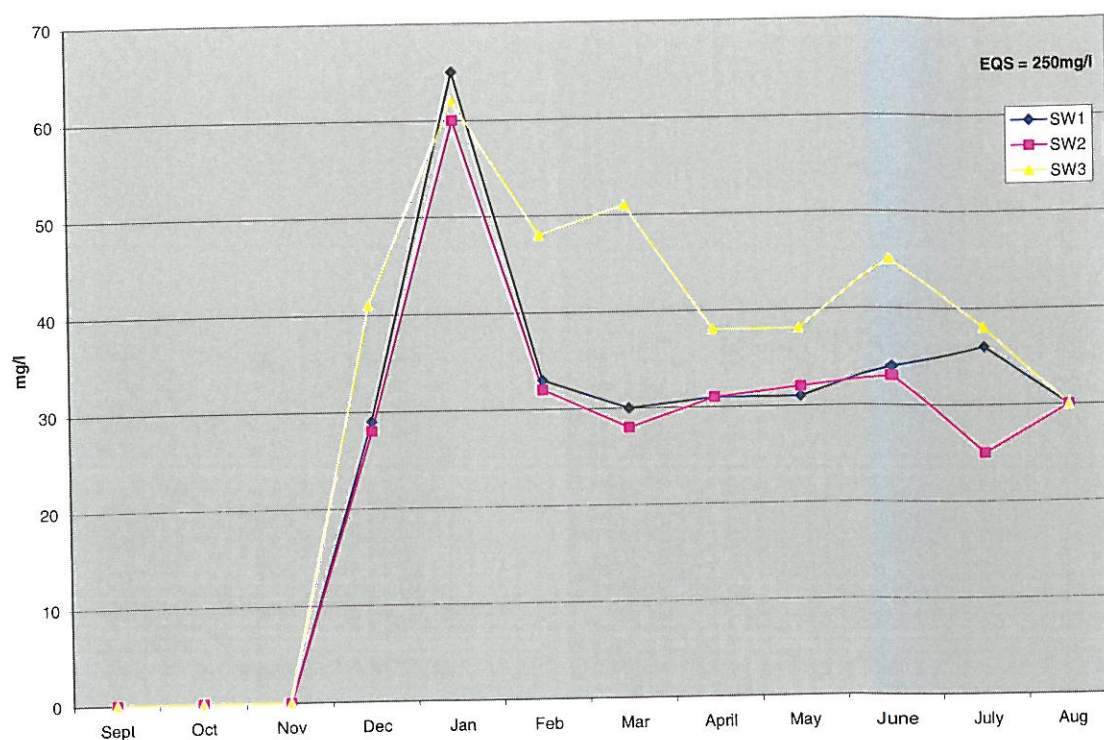


There is no recommended limit for Electrical conductivity which is directly related to the concentration of dissolved solid, but it can be noted that the conductivity and hence dissolved solid concentration were rising for most of the monitoring period.



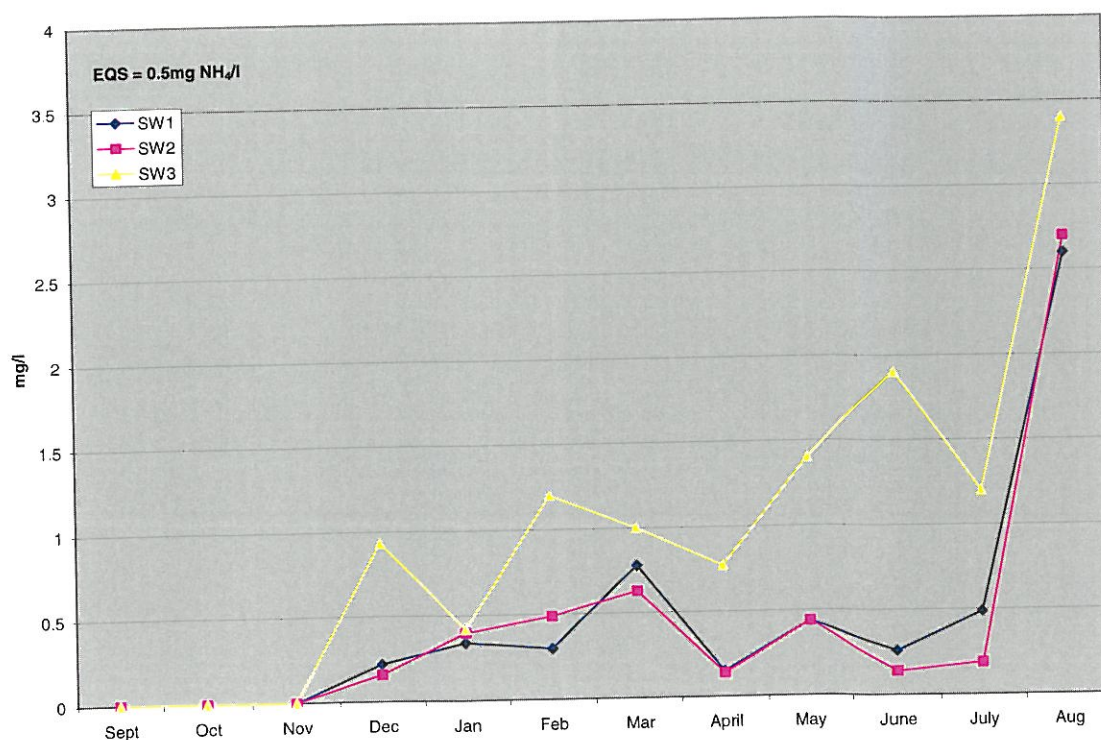
There is no recommended limit for Alkalinity but it should be noted that the concentration was rising for all samples for but particularly with regards to SW3, for most of the monitoring period. This indicates that the alkalinity is being brought into the site by the incoming surface water.

Chloride



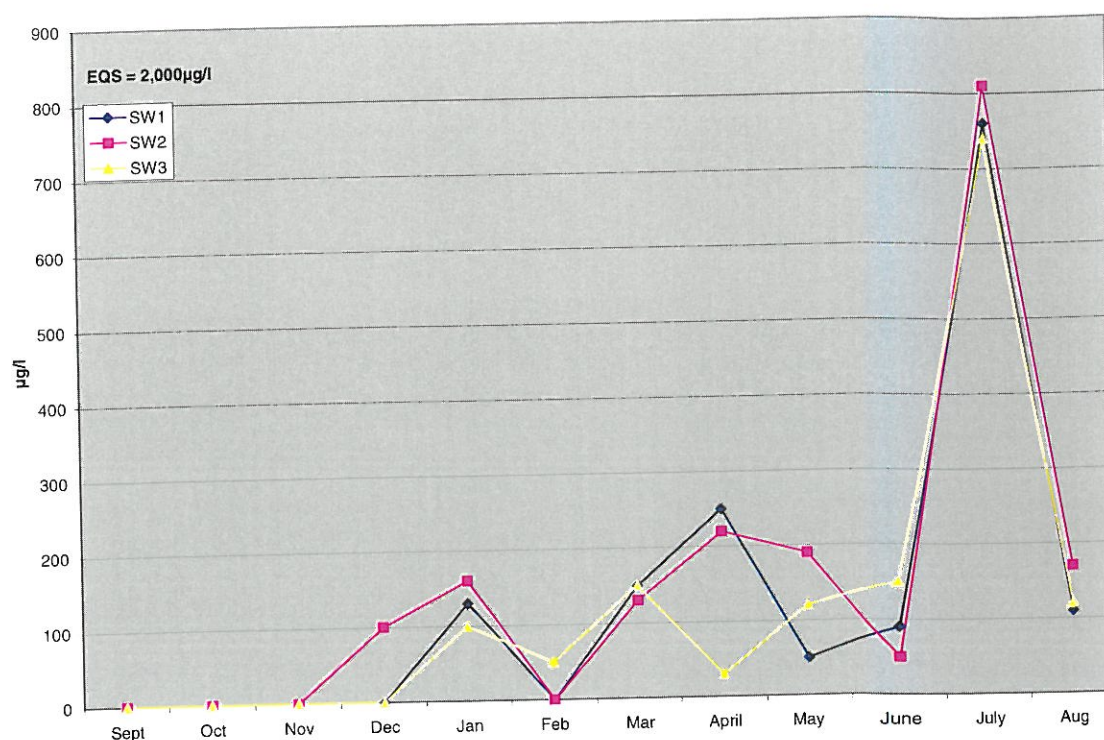
The results indicate that the chloride in all surface water samples over the monitoring period are below recommended thresholds (250 mg/l).

Ammoniacal Nitrogen

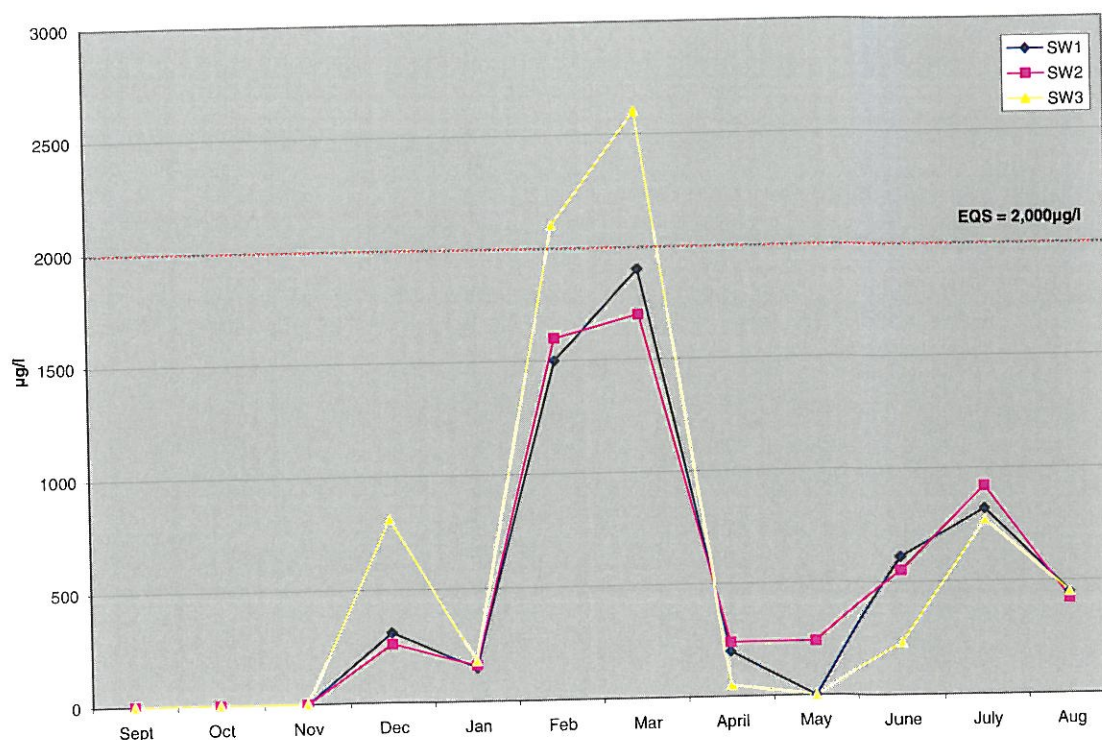


The results indicate that the ammoniacal nitrogen (as NH₄) in all surface water samples over the monitoring period were on average above recommended limits (0.5 mg/l). Results for SW3 indicate surface water entering the site was above the EQS.

Iron (dissolved)



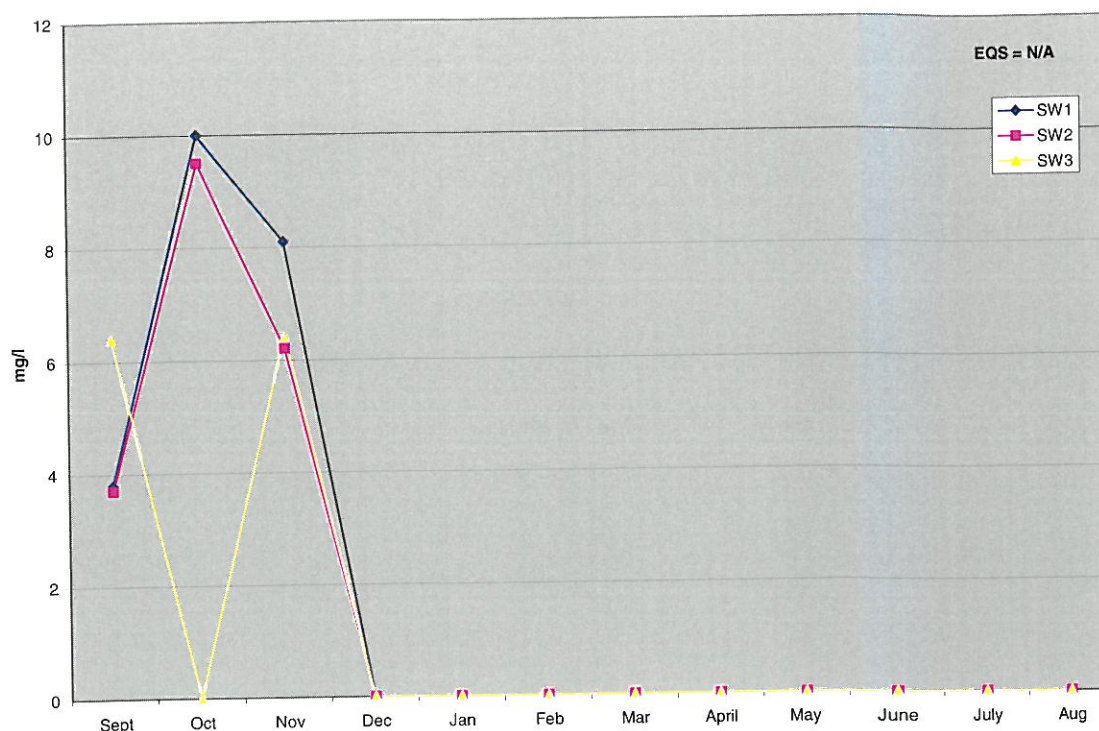
Iron (total)



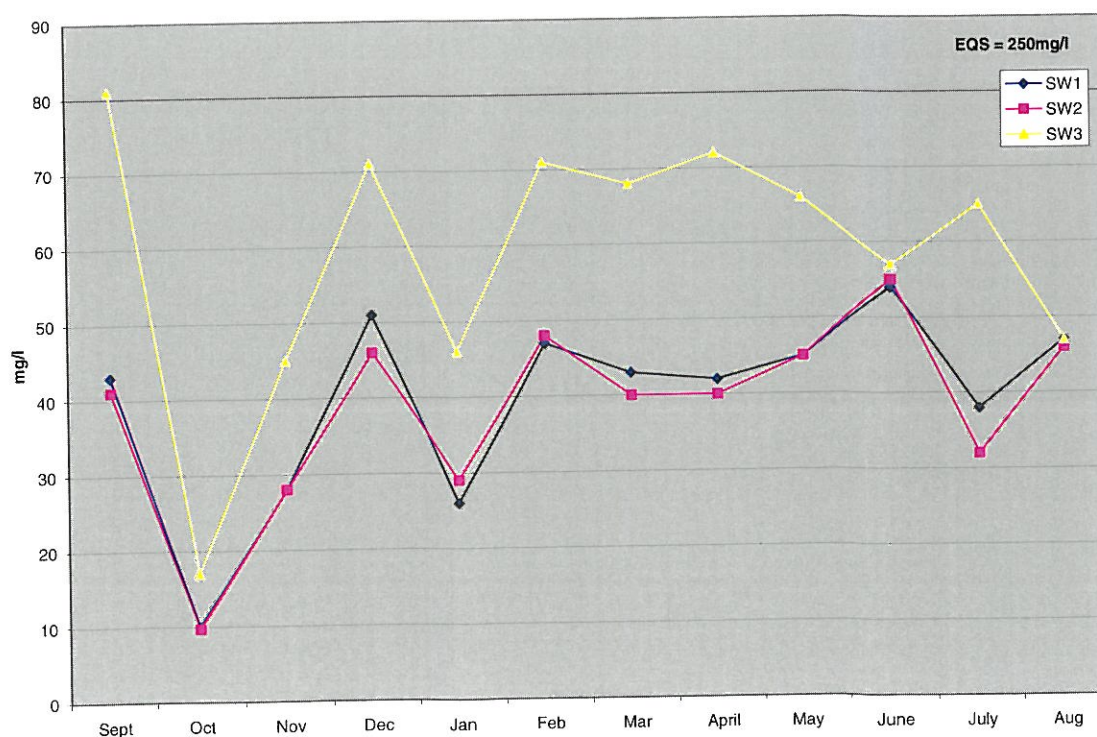
The results indicate that the iron (total and dissolved) in surface water samples over the monitoring period are on average within recommended limits according to the Surface Waters (Abstraction for Drinking Water) (Classification) Regulations 1996 (2,000 µg/l). Lower limits stipulated in the Water Supply (Water Quality) Regulations

2000 (200 µg/l) indicate that all surface waters are significantly above the recommended EQS. Concentrations of iron in SW2 and SW3, representing background concentrations from the River Dafen and the unnamed tributary of the River Dafen, are above concentrations found in SW1.

Total Organic Carbon (TOC)

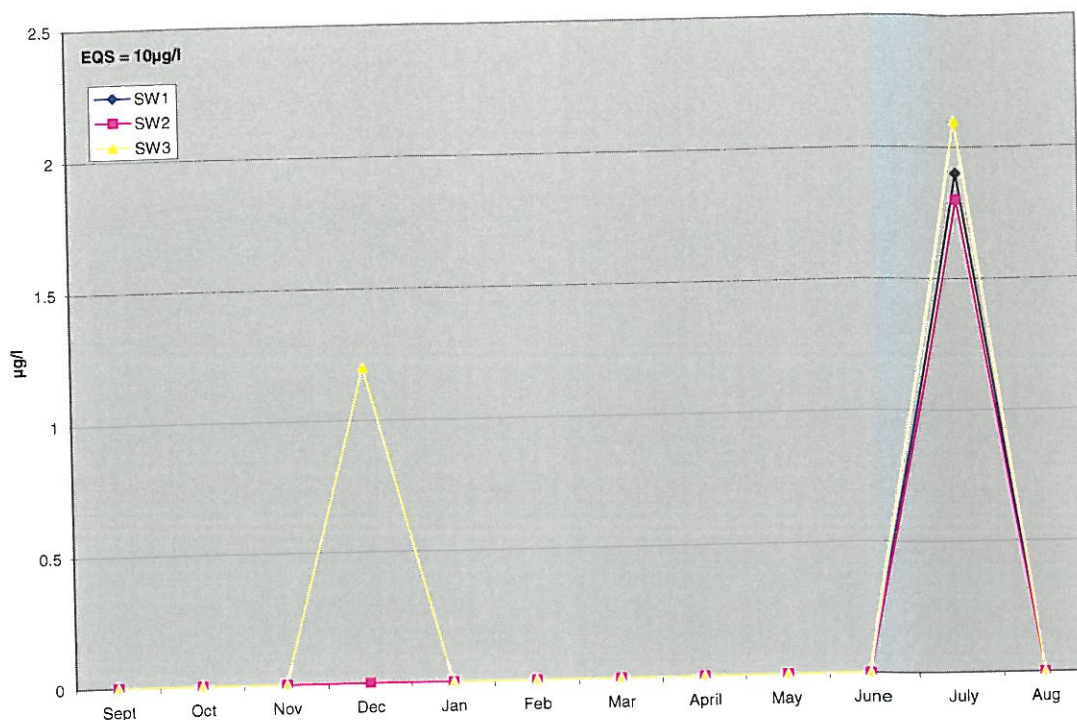


Sulphate

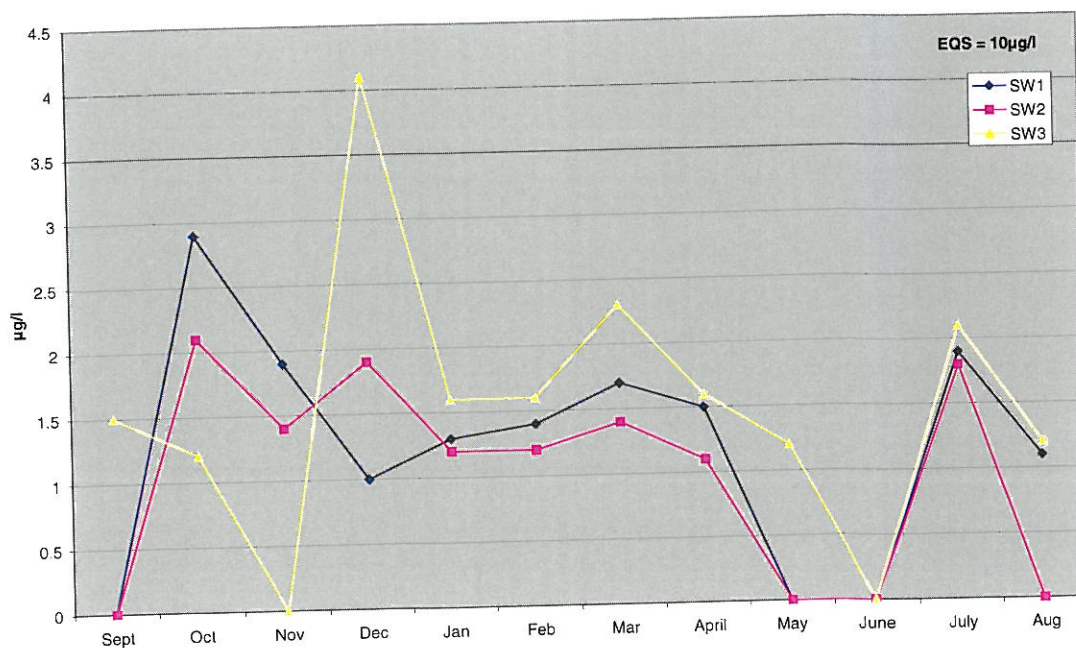


The results indicate that the sulphate in all surface water samples over the monitoring period are within recommended limits (250 mg/l).

Arsenic (dissolved)

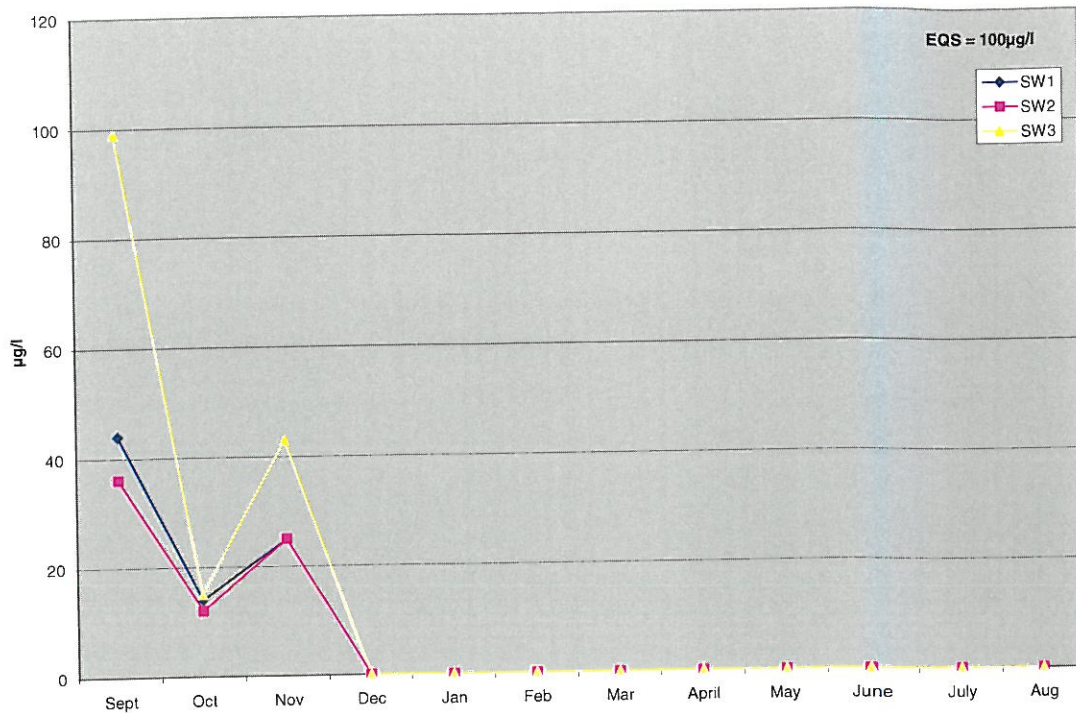


Arsenic (total)



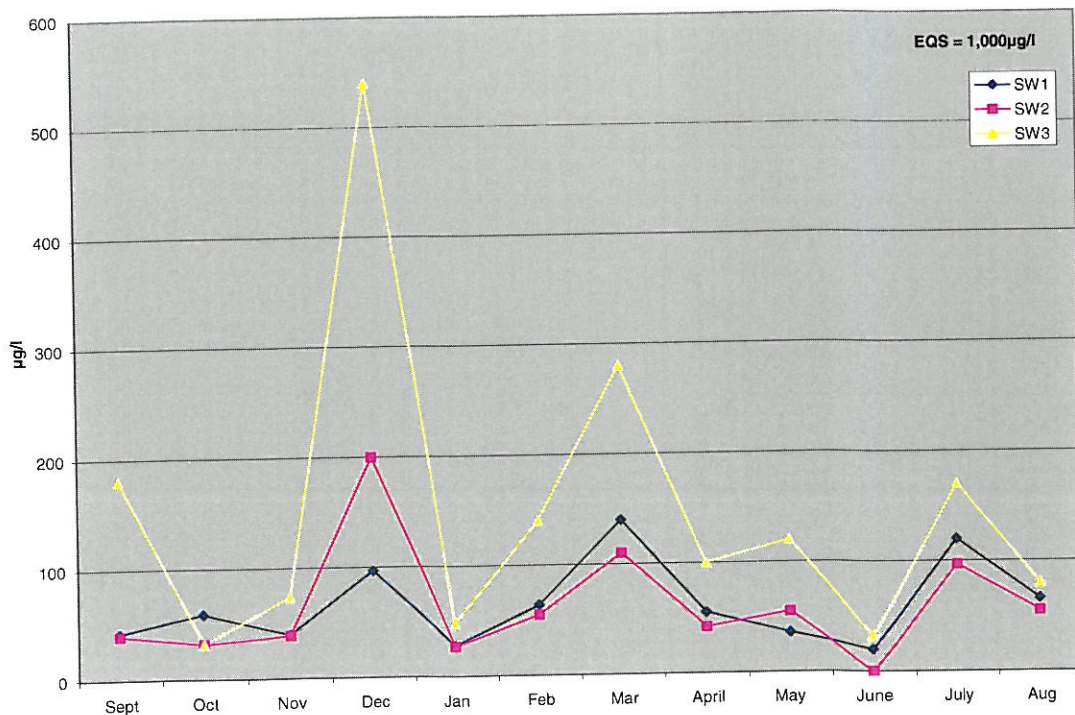
The results indicate that the total and dissolved arsenic in all surface water samples over the monitoring period are within recommended limits (10 µg/l).

Barium



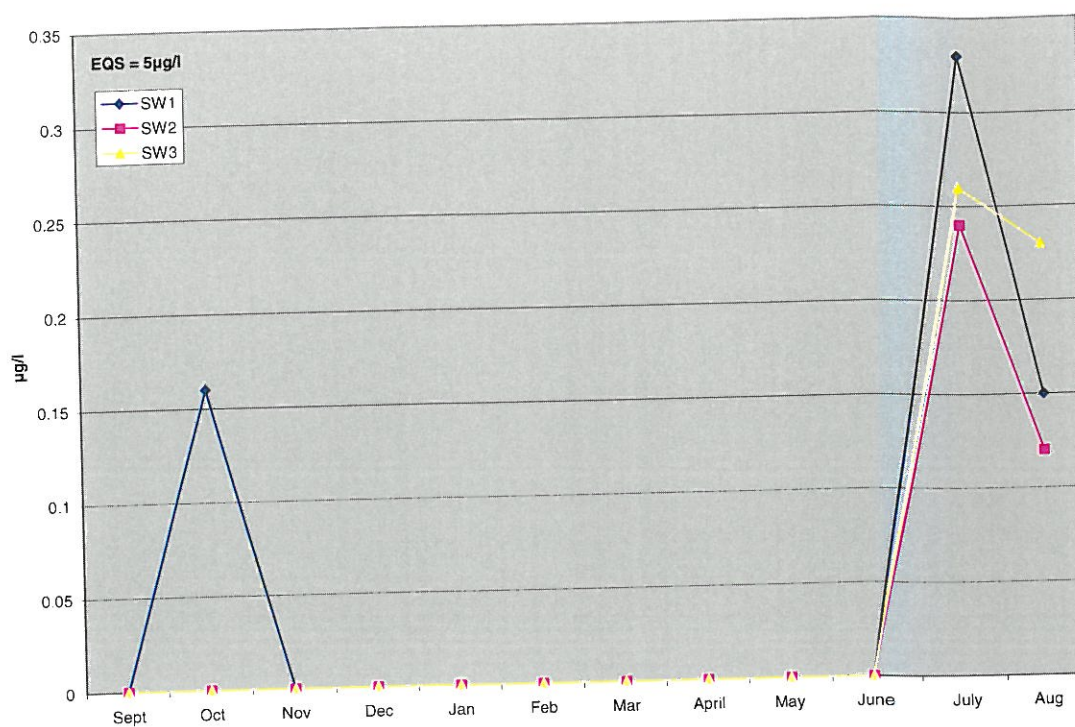
The results indicate that the Barium concentration of surface water SW3 was above the recommended limits (100µg/l) in September. All other surface water samples were within the recommended limits.

Boron



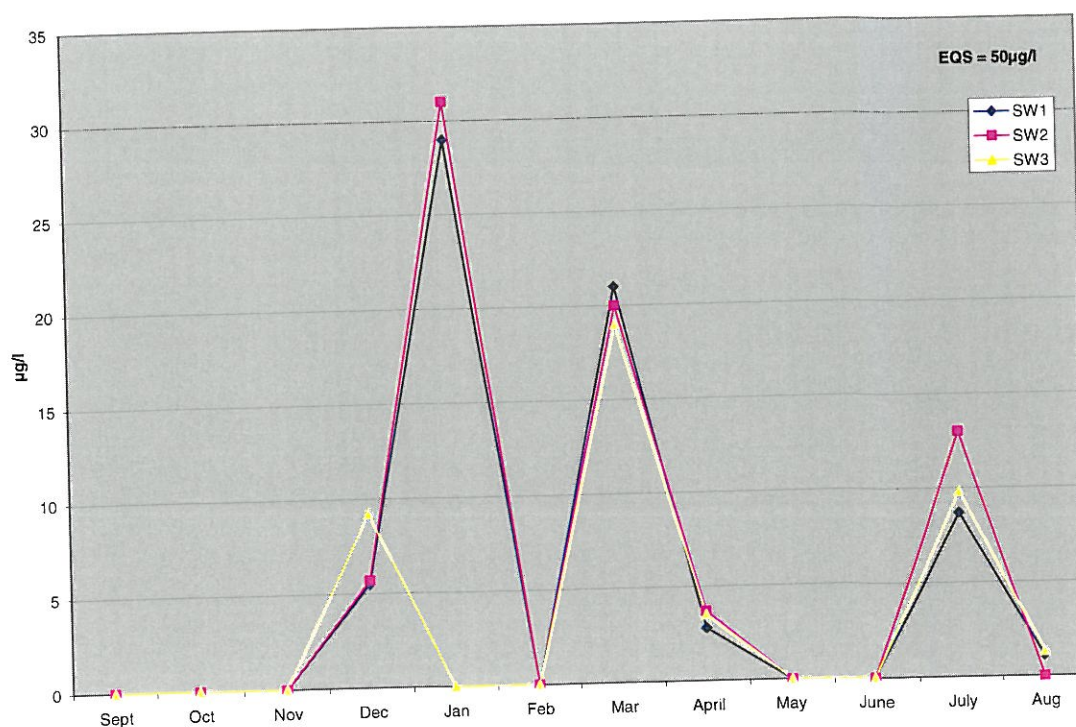
The results indicate that the total and dissolved Boron in all surface water samples over the monitoring period are within recommended limits (1,000 µg/l).

Cadmium

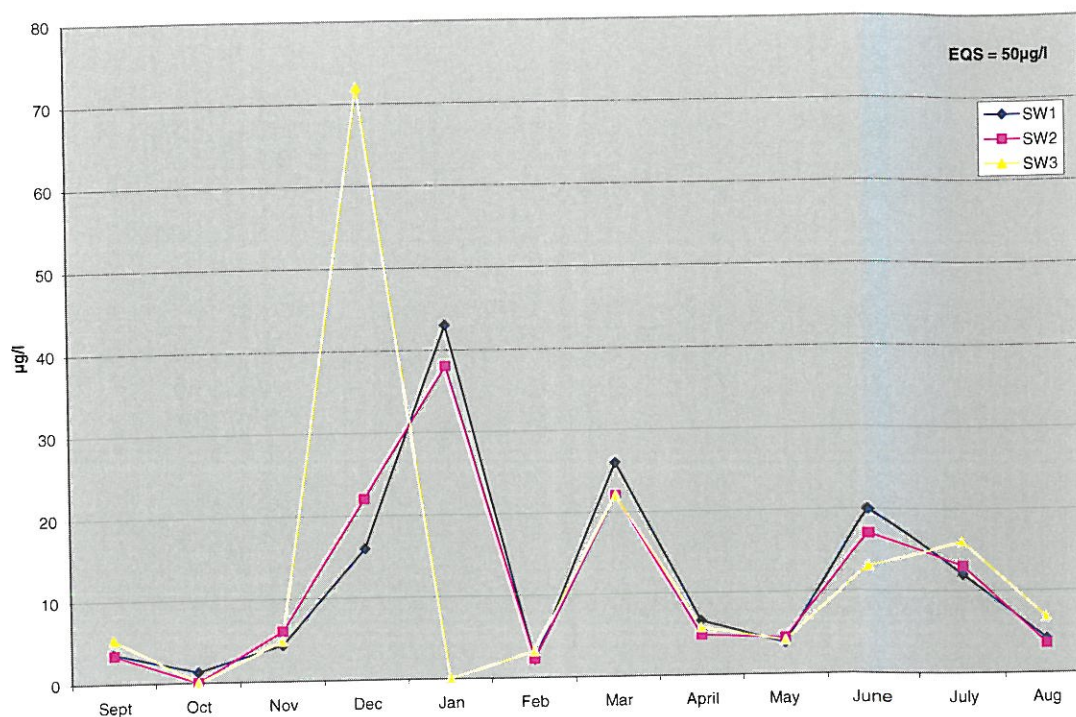


The results indicate that the cadmium in all surface water samples over the monitoring period are within recommended limits (5 µg/l).

Chromium (dissolved)

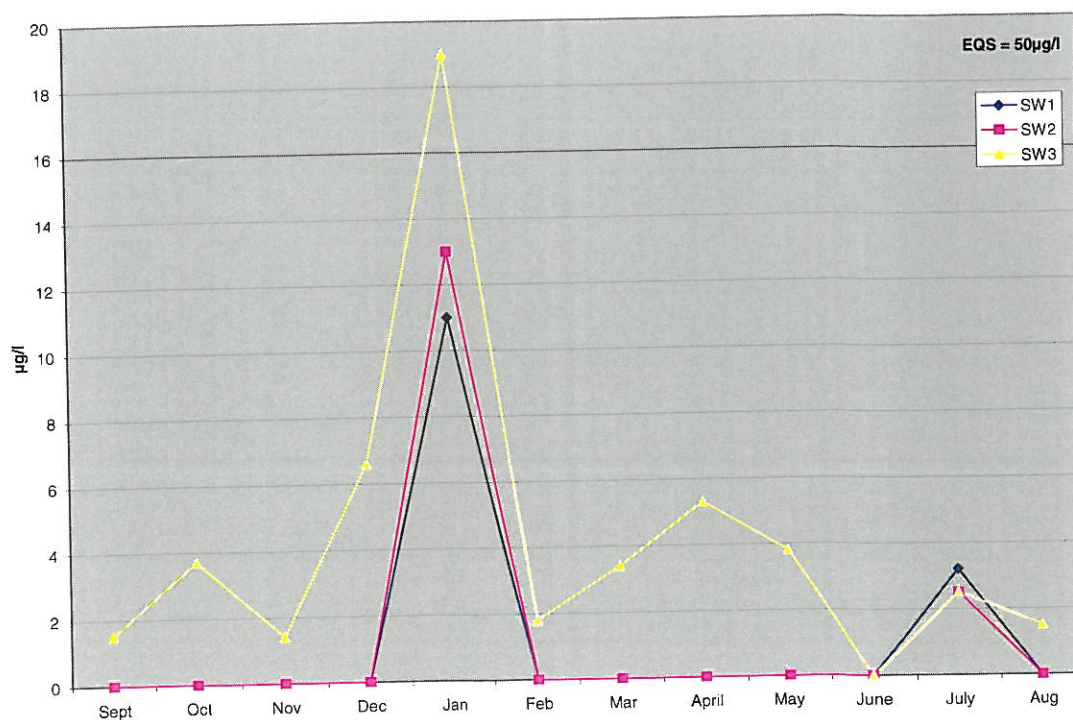


Chromium (total)

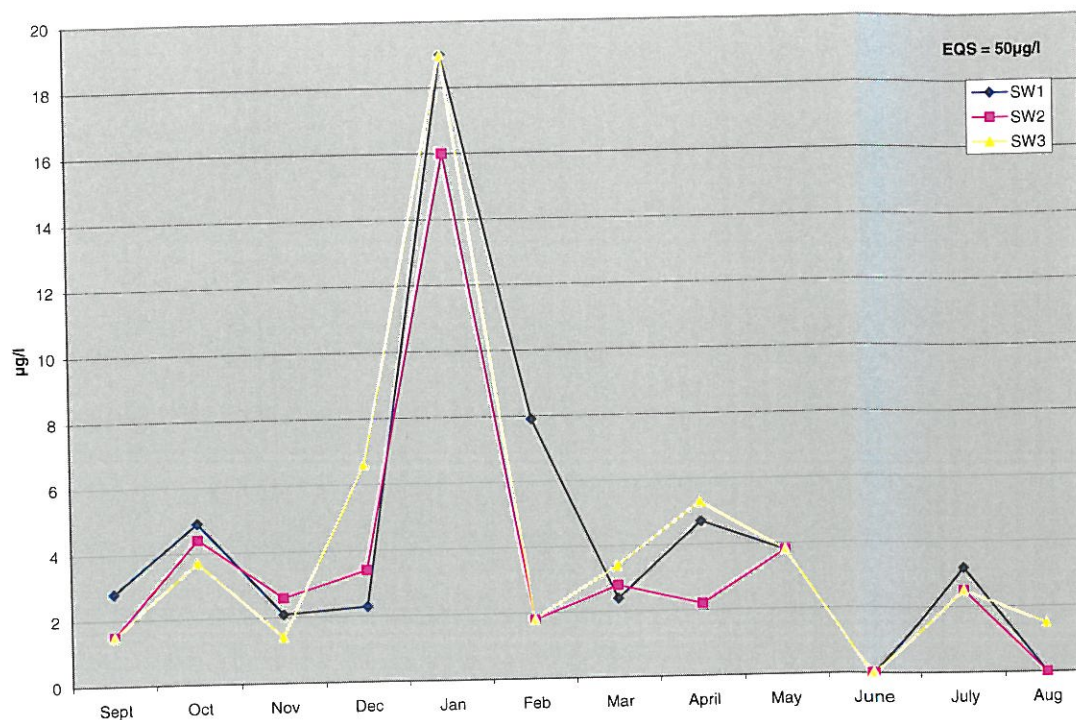


The results indicate that the total and dissolved chromium in all surface water samples over the monitoring period are within recommended limits (50 µg/l) with the exception of the sample from SW3 in December 2010.

Copper (dissolved)

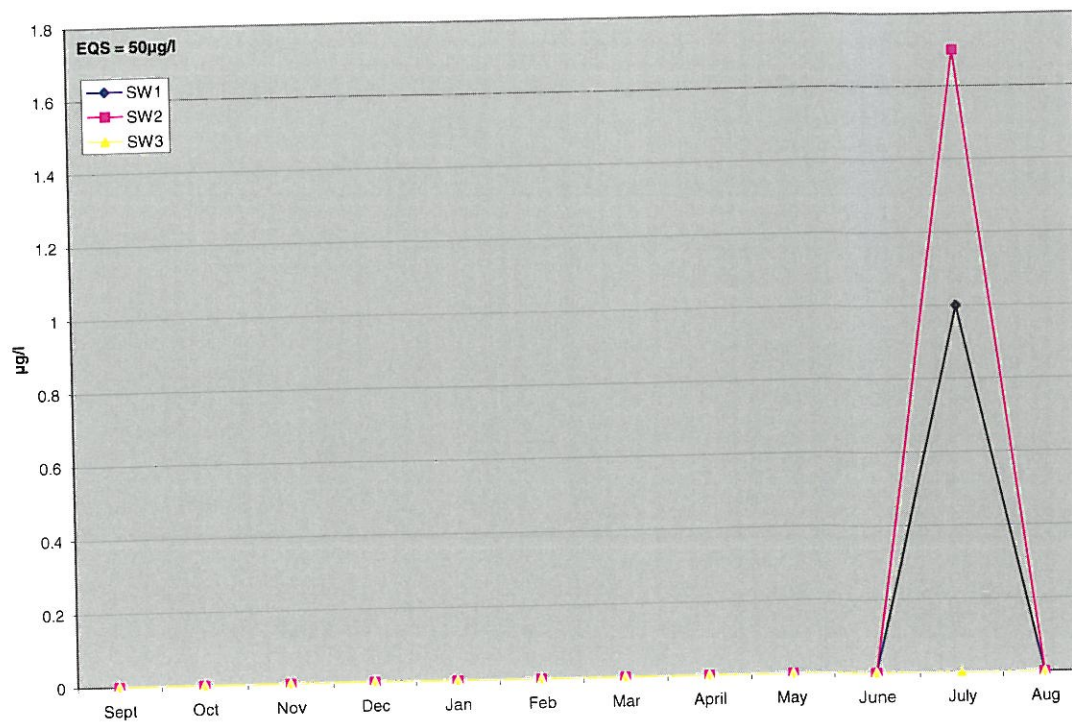


Copper (total)

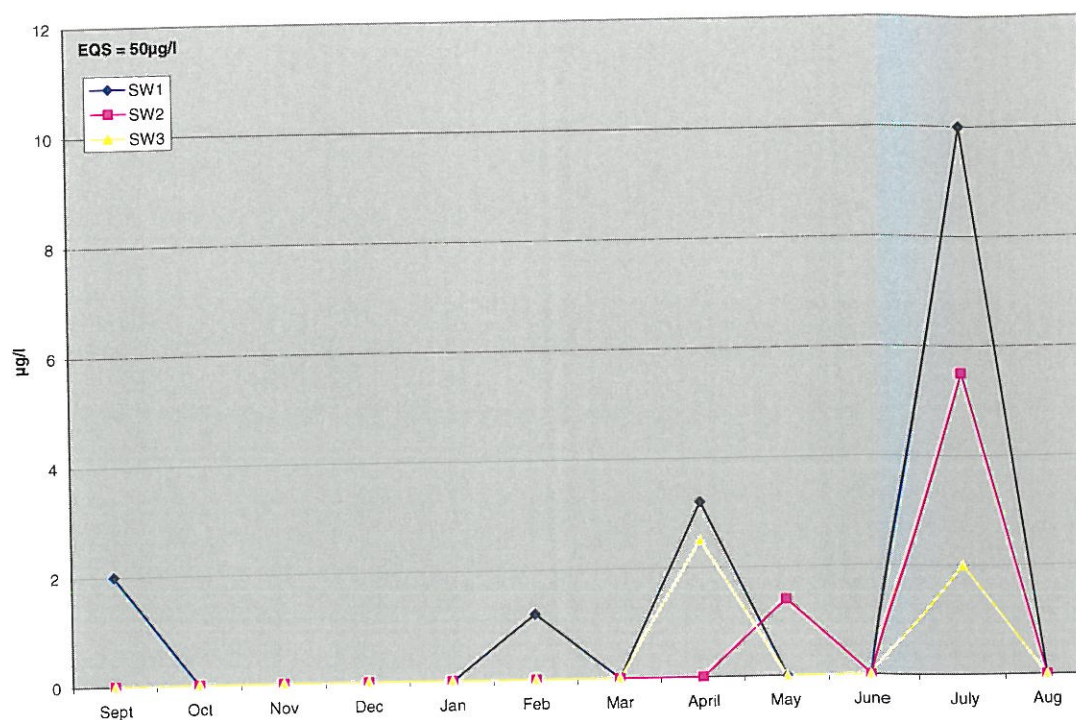


The results indicate that the total and dissolved copper in all surface water samples over the monitoring period are within recommended limits (50 µg/l).

Lead (dissolved)

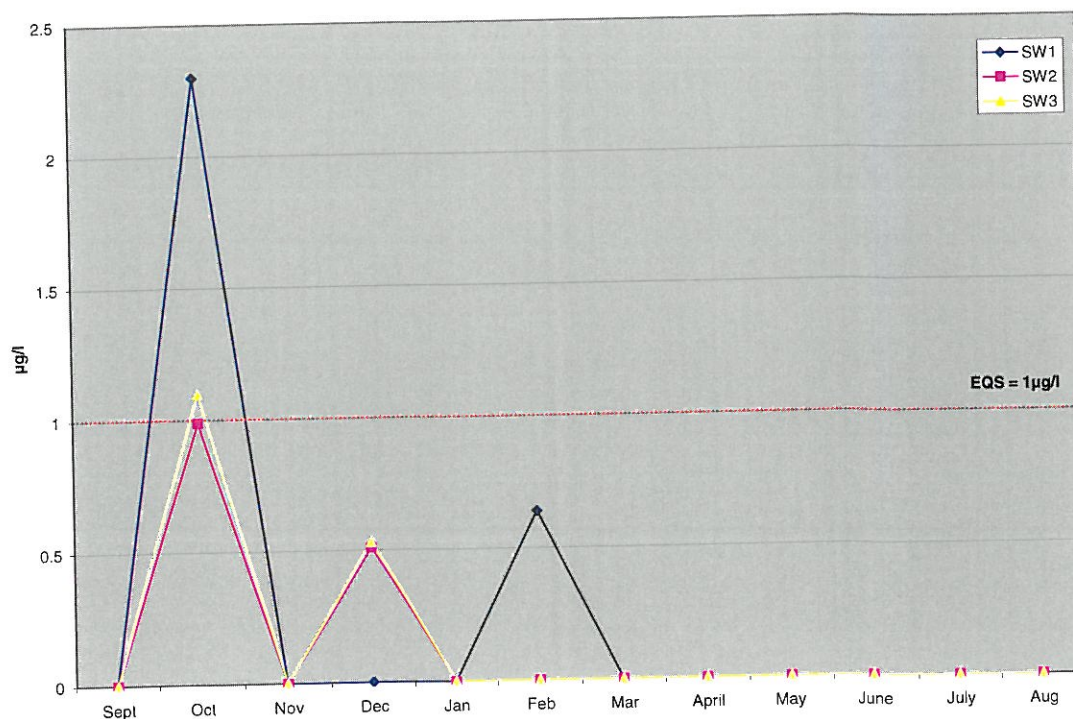


Lead (total)

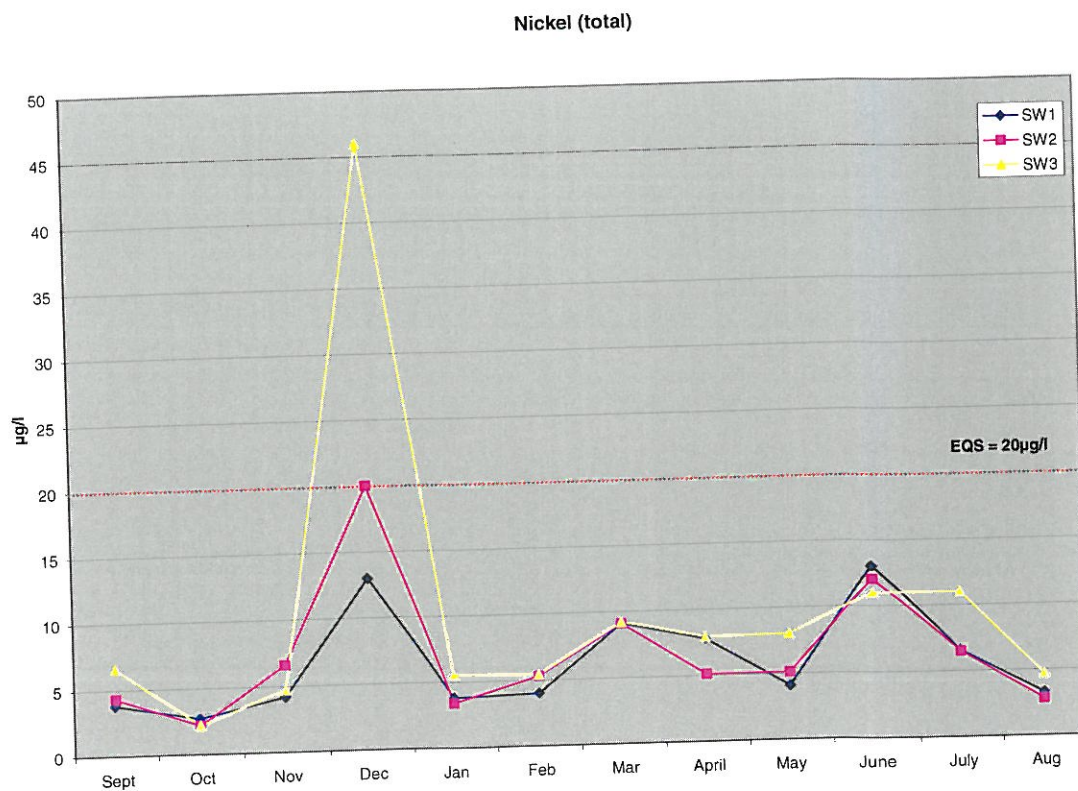
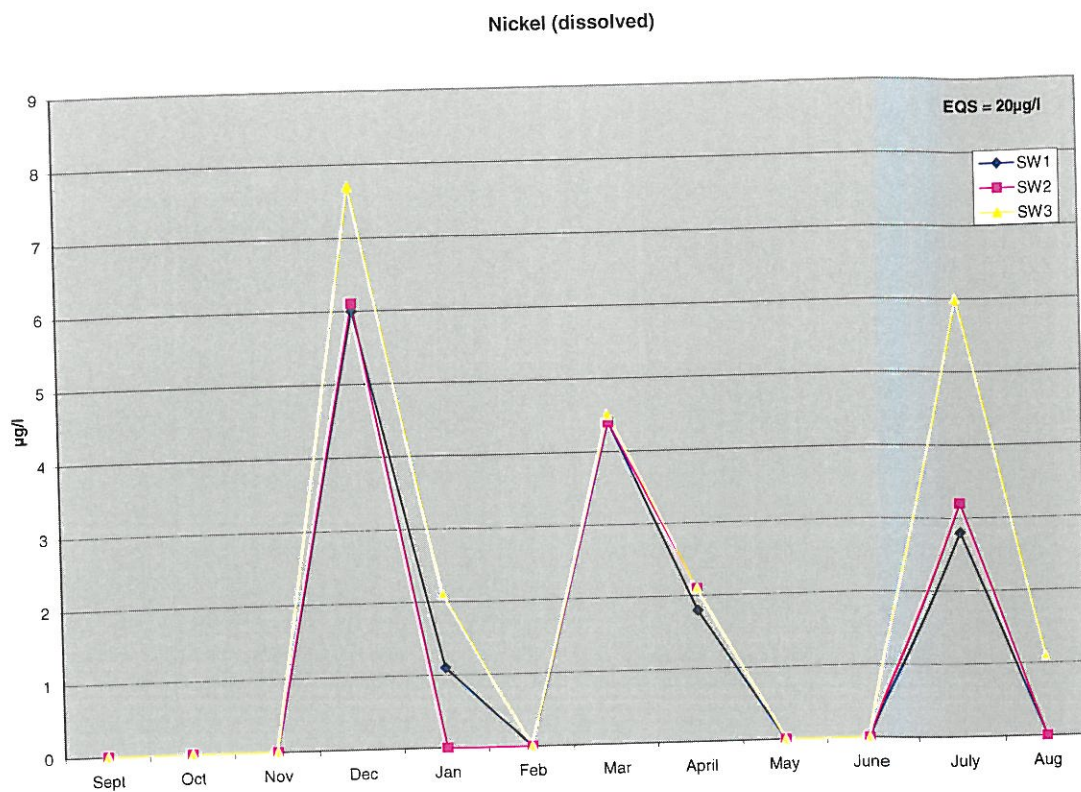


The results indicate that the total and dissolved lead in all surface water samples over the monitoring period are within recommended limits (50 µg/l).

Mercury

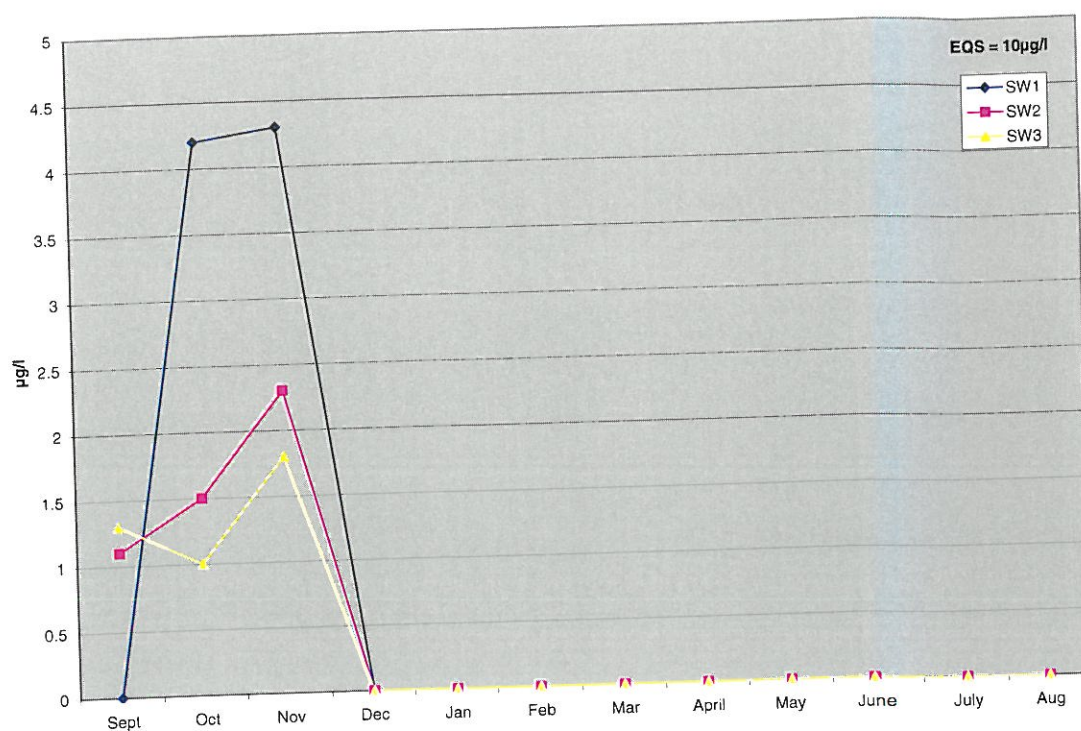


The results indicate that the Mercury concentration of surface water SW1 was above the recommended limits (1 µg/l) in October. All other surface water samples were within the recommended limits.



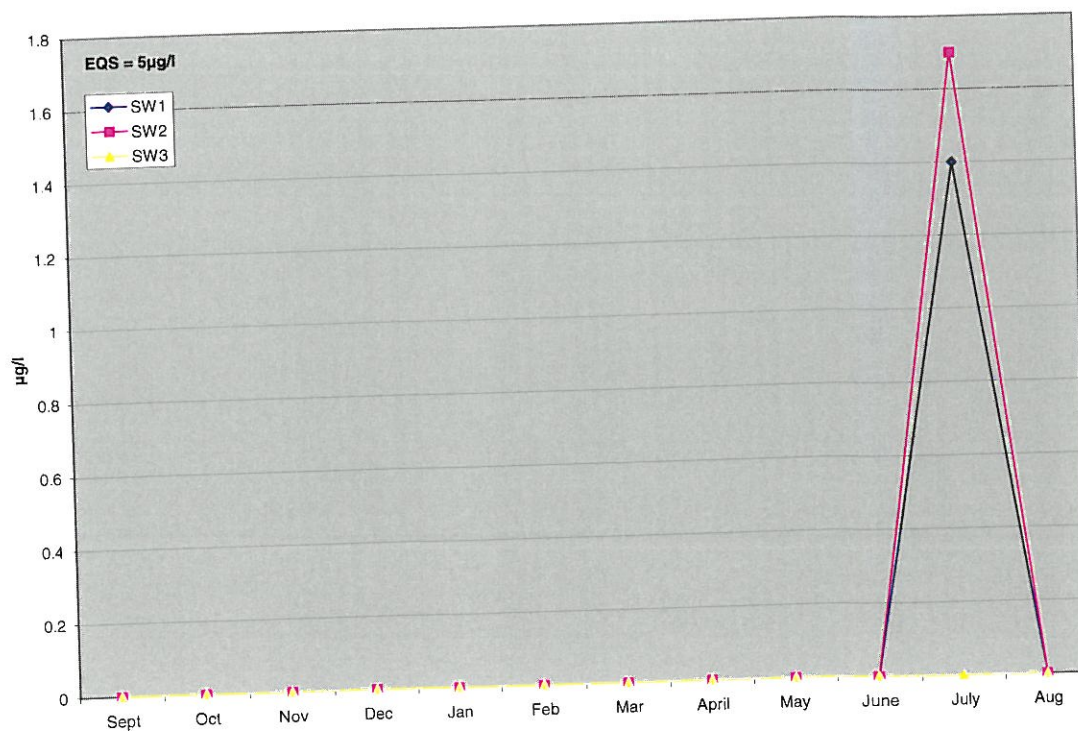
The results indicate that the Nickel total concentration of surface water SW3 was above the recommended limits (20µg/l) in December, All other surface water samples were within the recommended limits.

Selenium

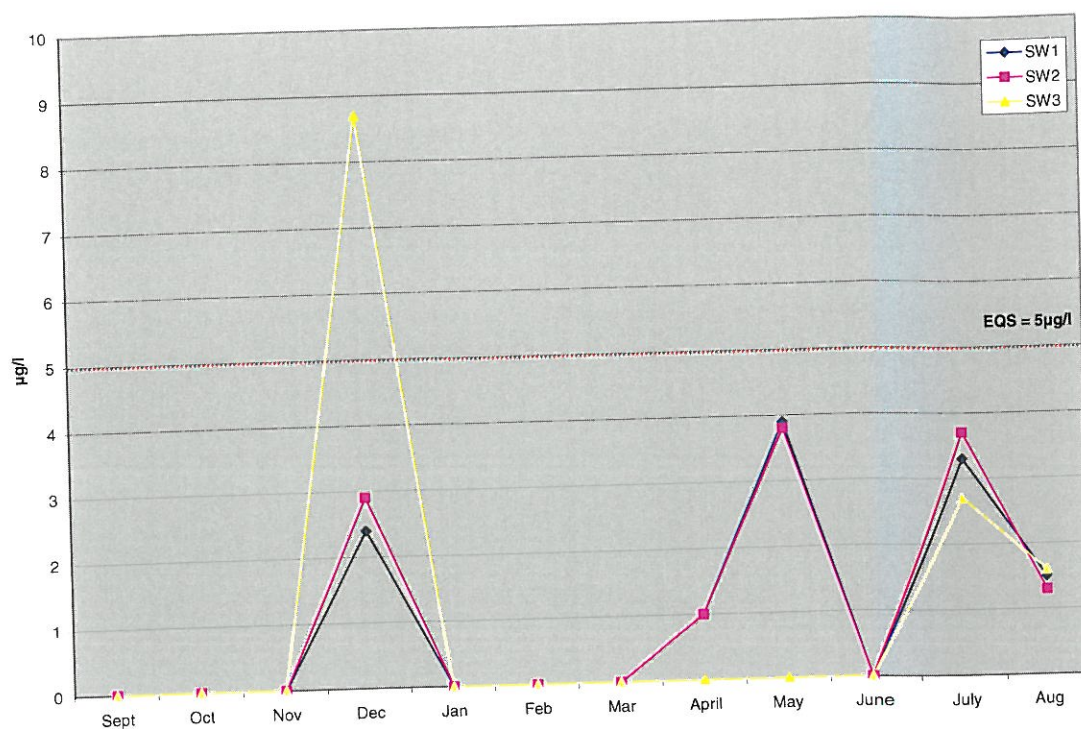


The results indicate that the selenium in all surface water samples over the monitoring period are within recommended limits (10 µg/l).

Antimony (dissolved)

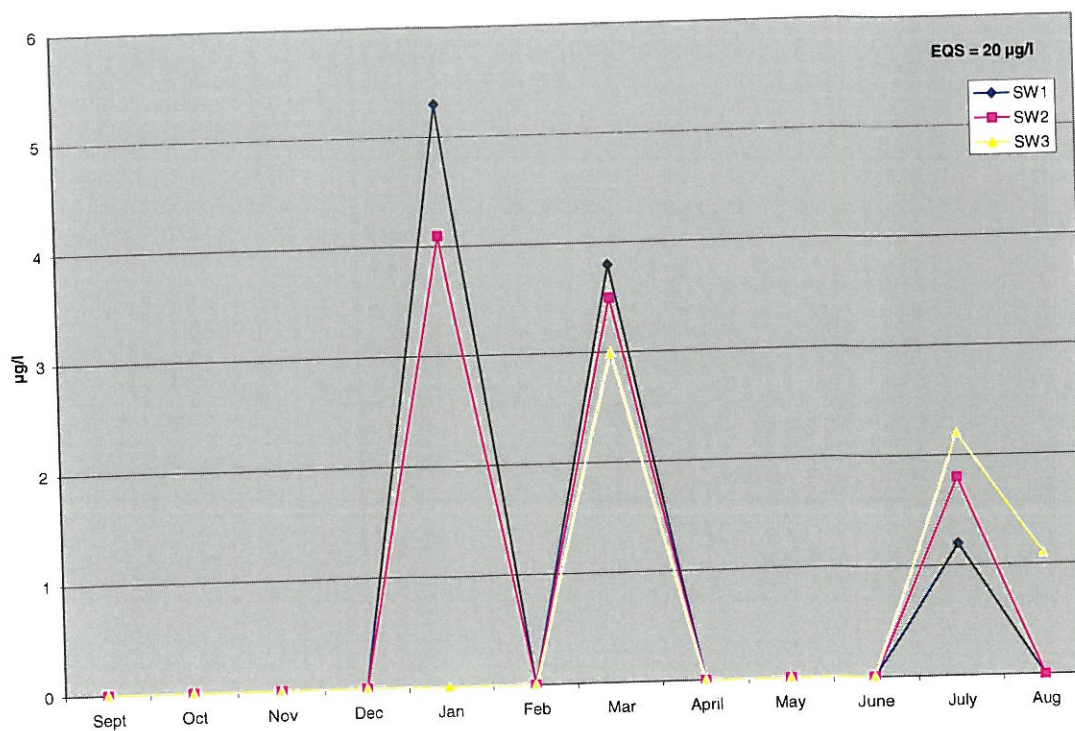


Antimony (total)

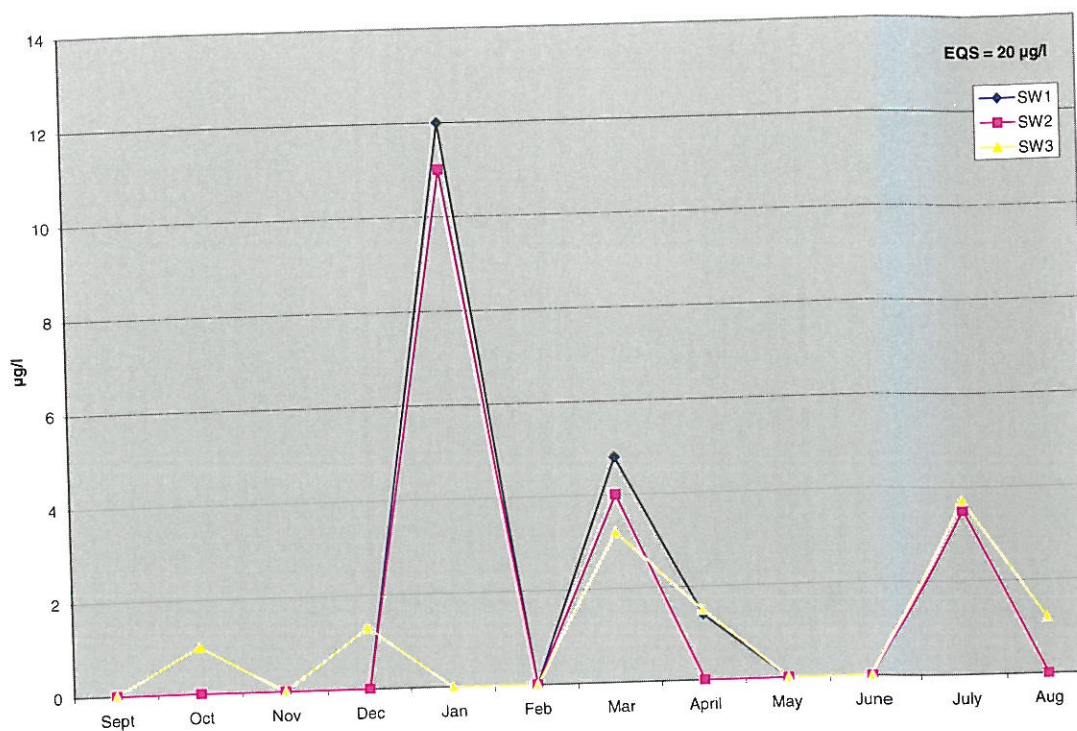


The results indicate that the Antimony Total concentration of surface water SW3 was above the recommended limits (5 $\mu\text{g/l}$) in December. All other surface water samples were within the recommended limits.

Vanadium (dissolved)

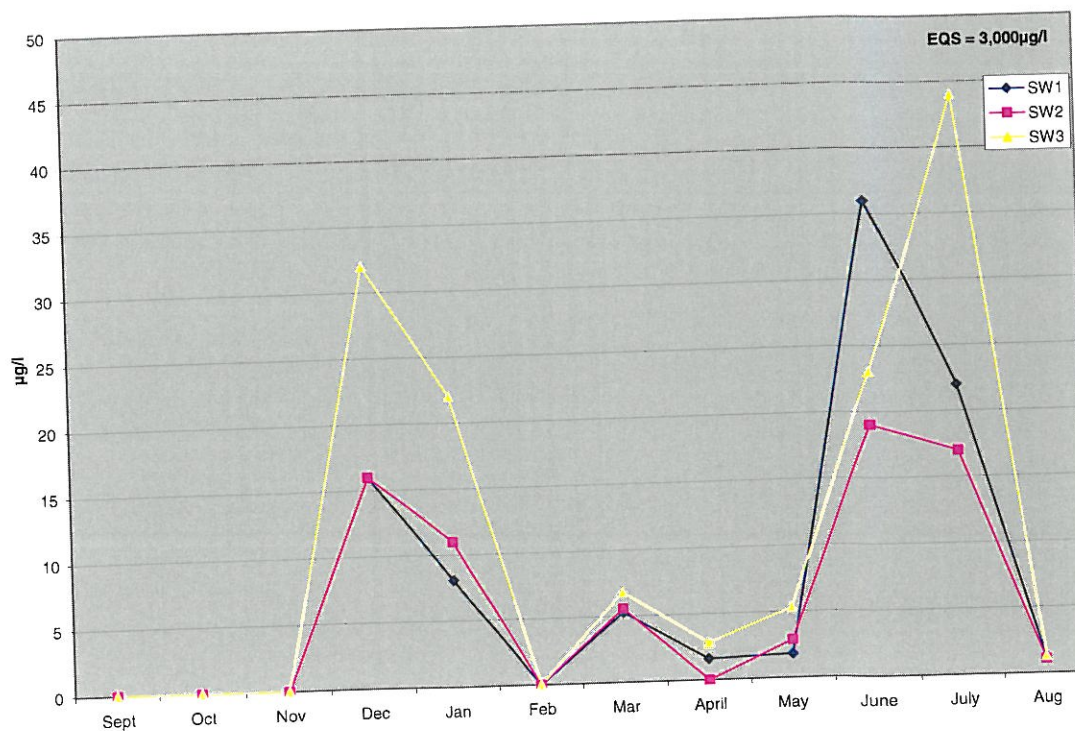


Vanadium (total)

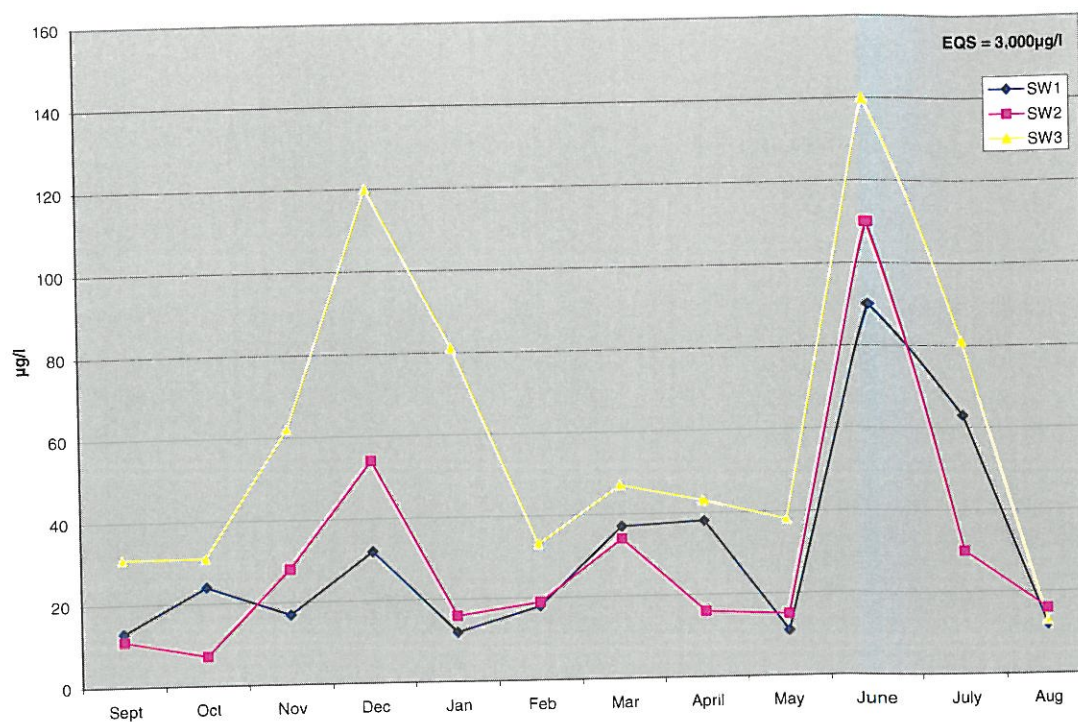


The results indicate that the total and dissolved vanadium in all surface water samples over the monitoring period are within recommended limits (20 µg/l).

Zinc (dissolved)

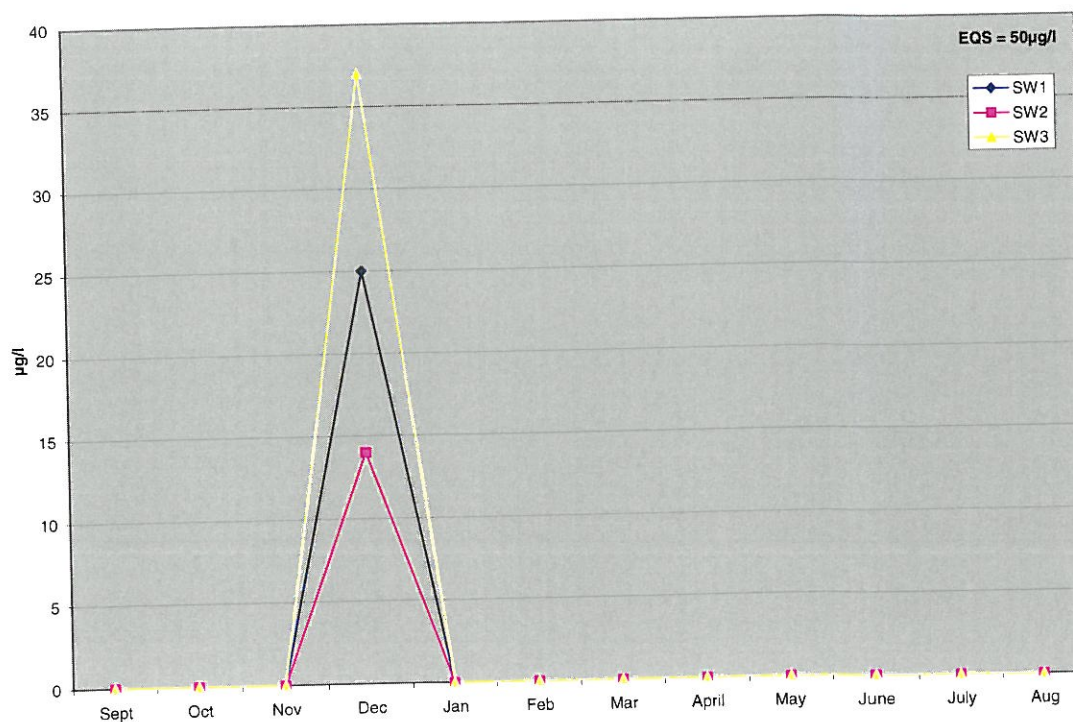


Zinc (total)



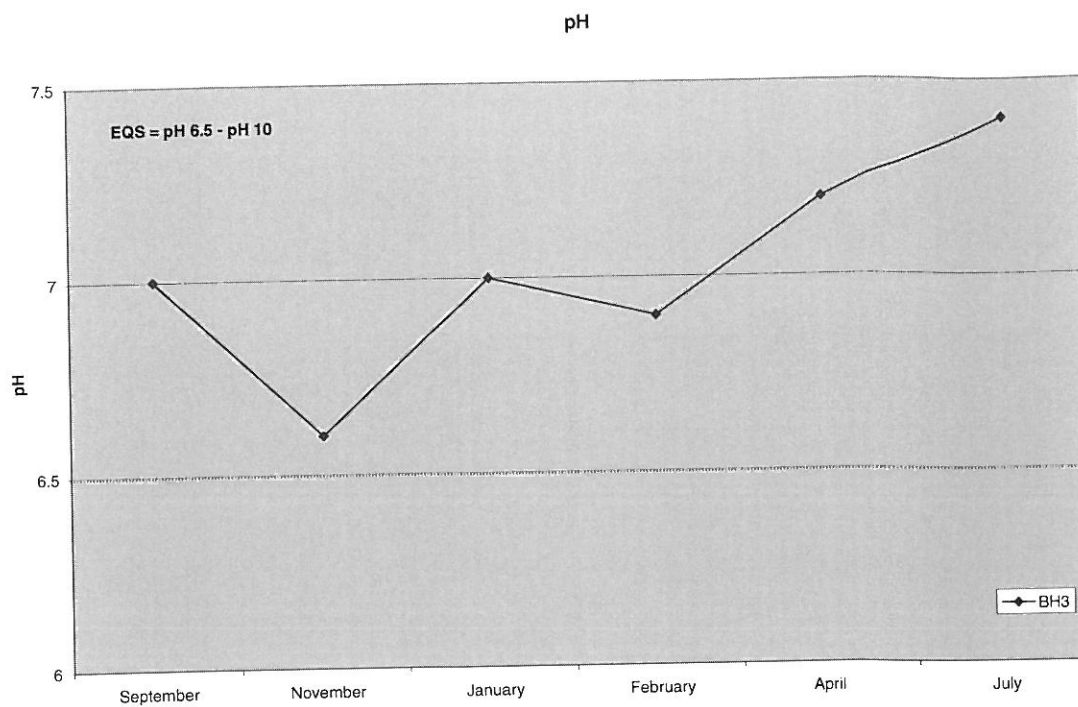
The results indicate that the total and dissolved zinc in all surface water samples over the monitoring period are within recommended limits (3,000 µg/l).

Total Petroleum Hydrocarbons (TPH) (Aqueous Phase)

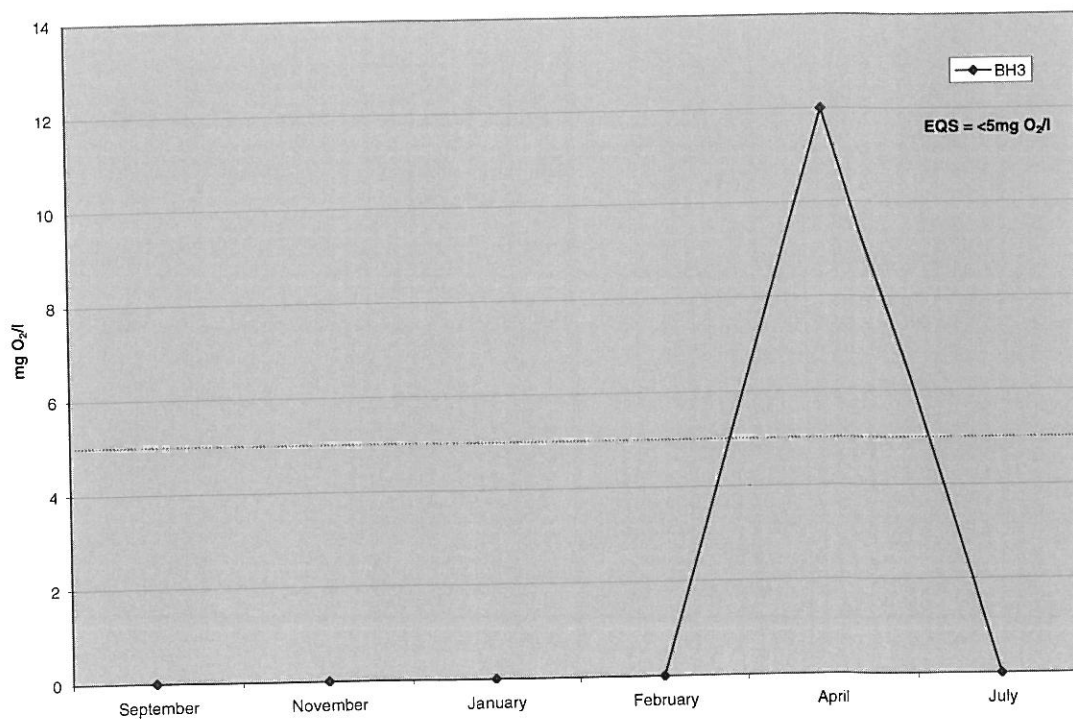


The results indicate that the TPH in all surface water samples over the monitoring period are within recommended limits (50 µg/l).

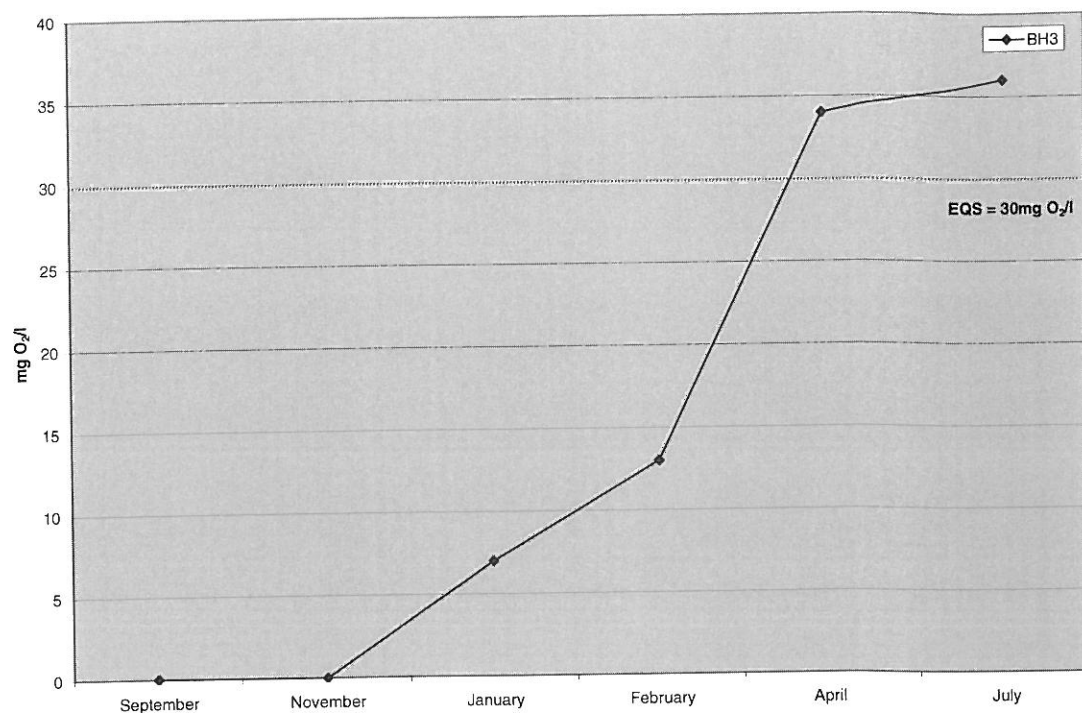
Groundwater Results: BH3



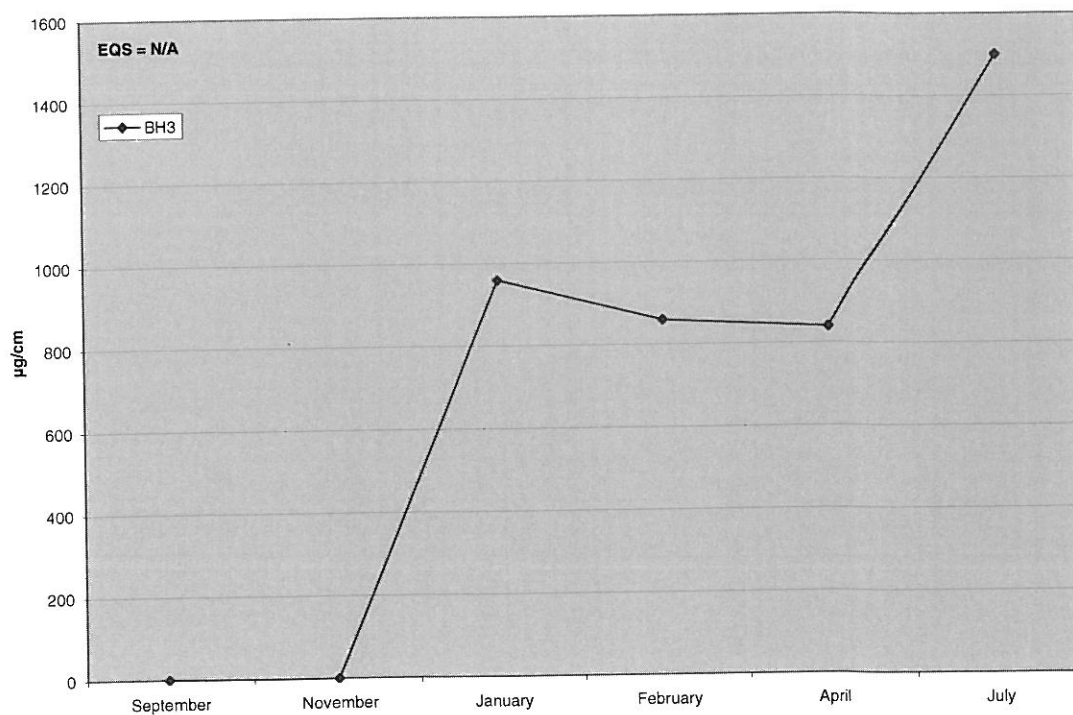
Biological Oxygen Demand (BOD)



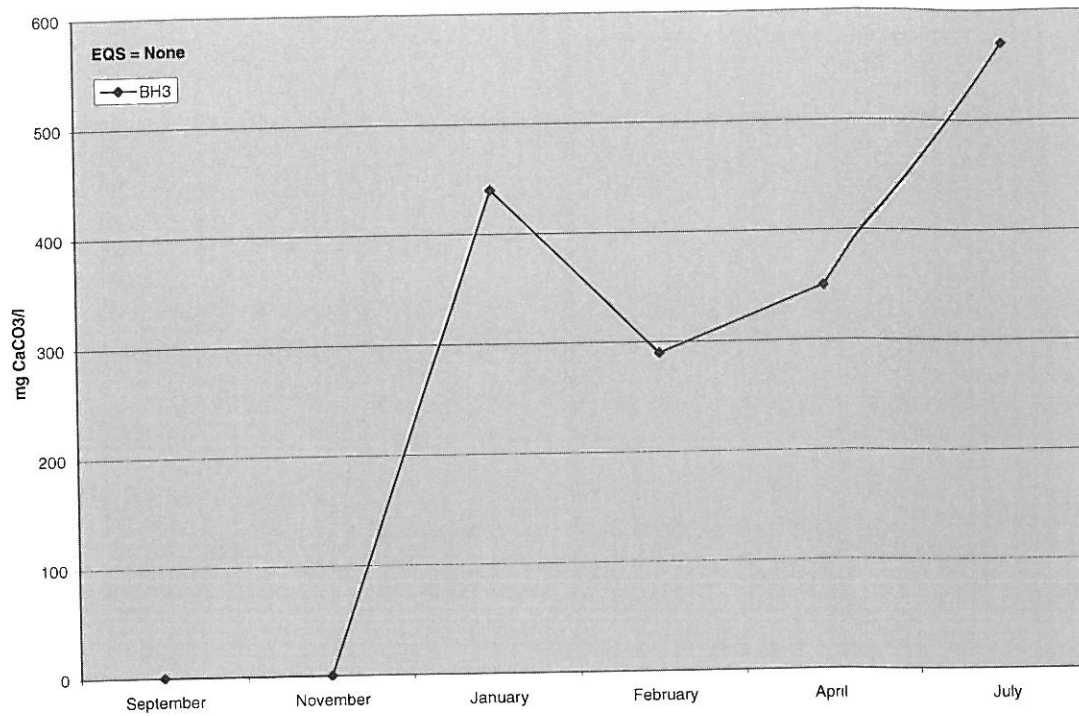
Chemical Oxygen Deman (COD)



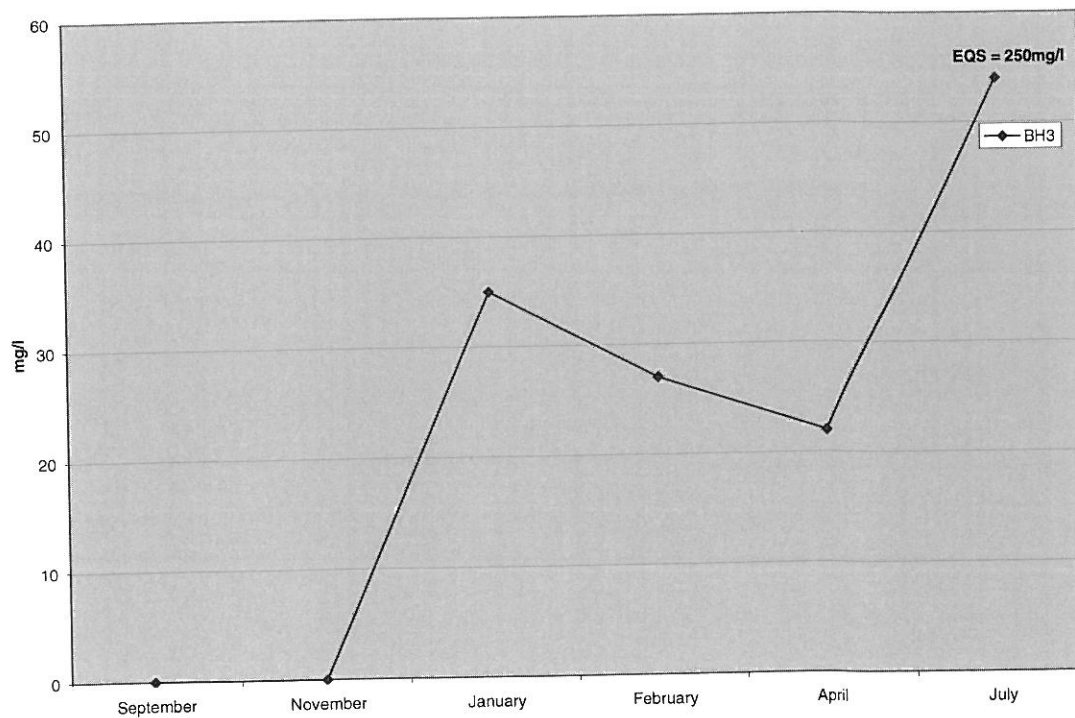
Eletrical Conductivity



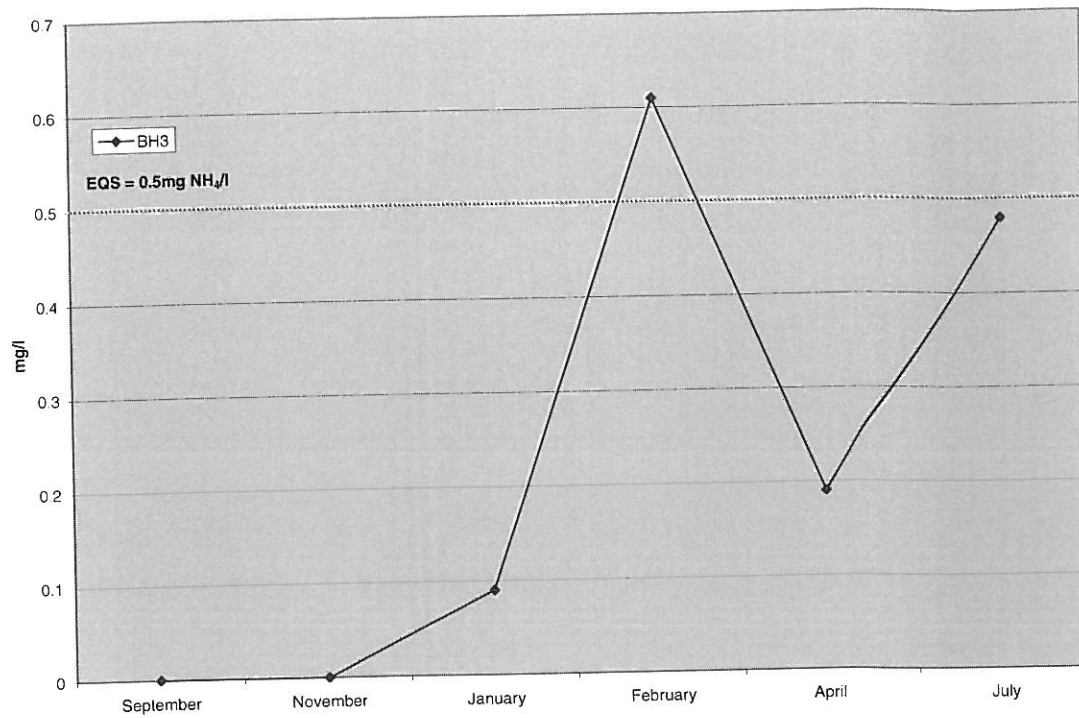
Alkalinity



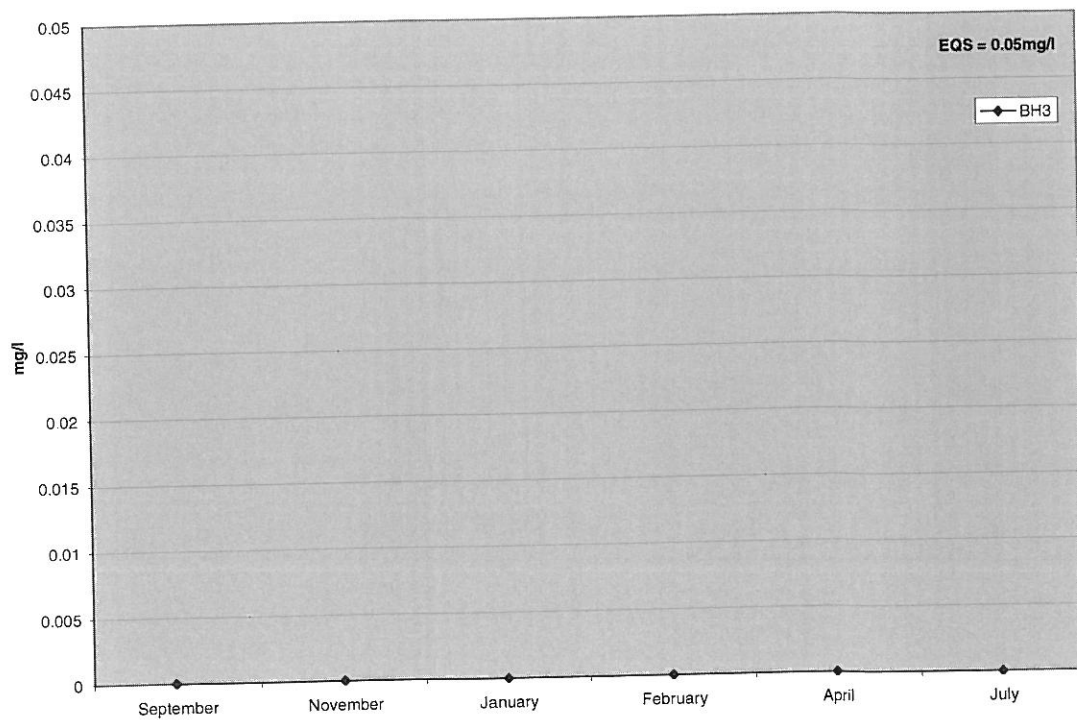
Chloride



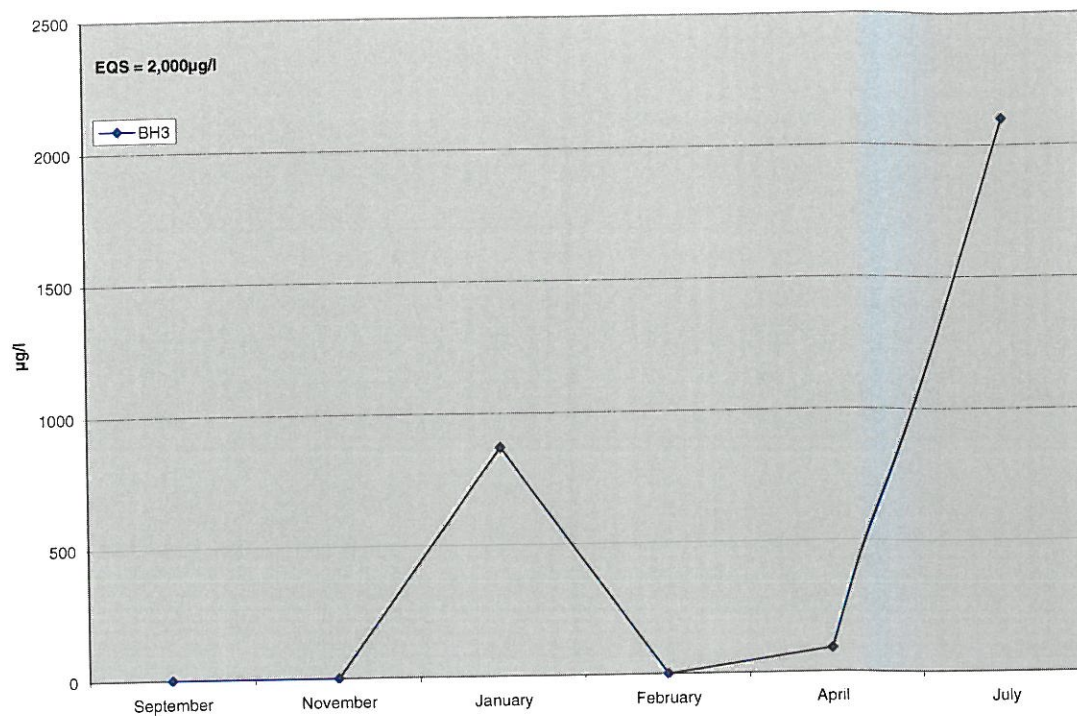
Ammoniacal Nitrogen



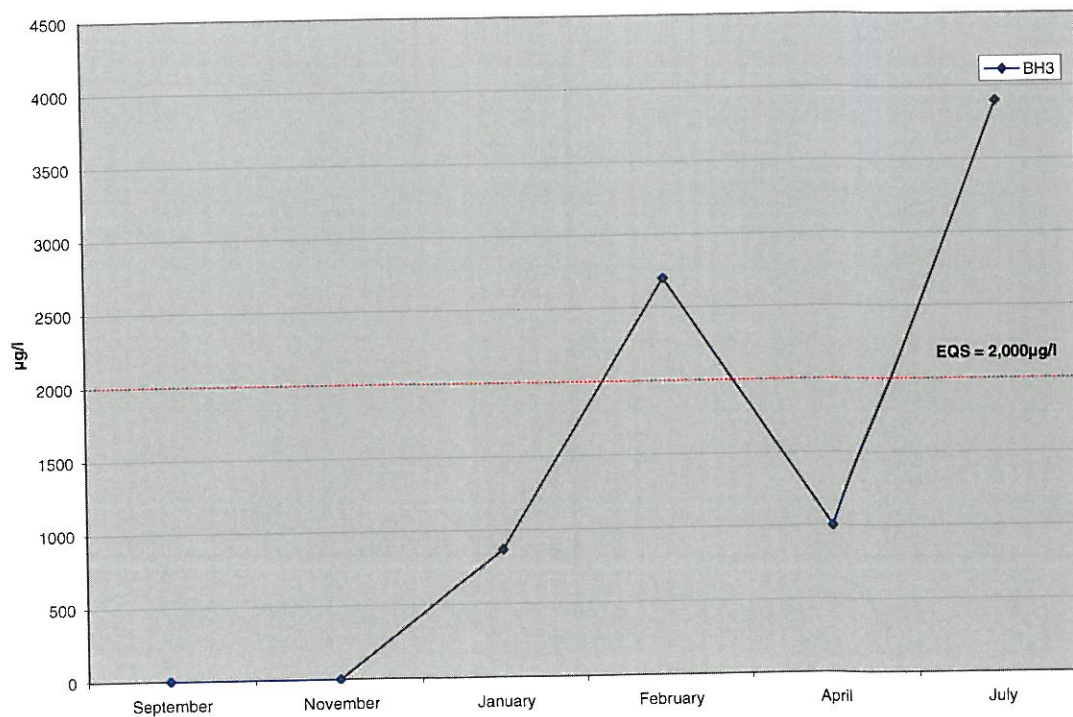
Cyanide (total)



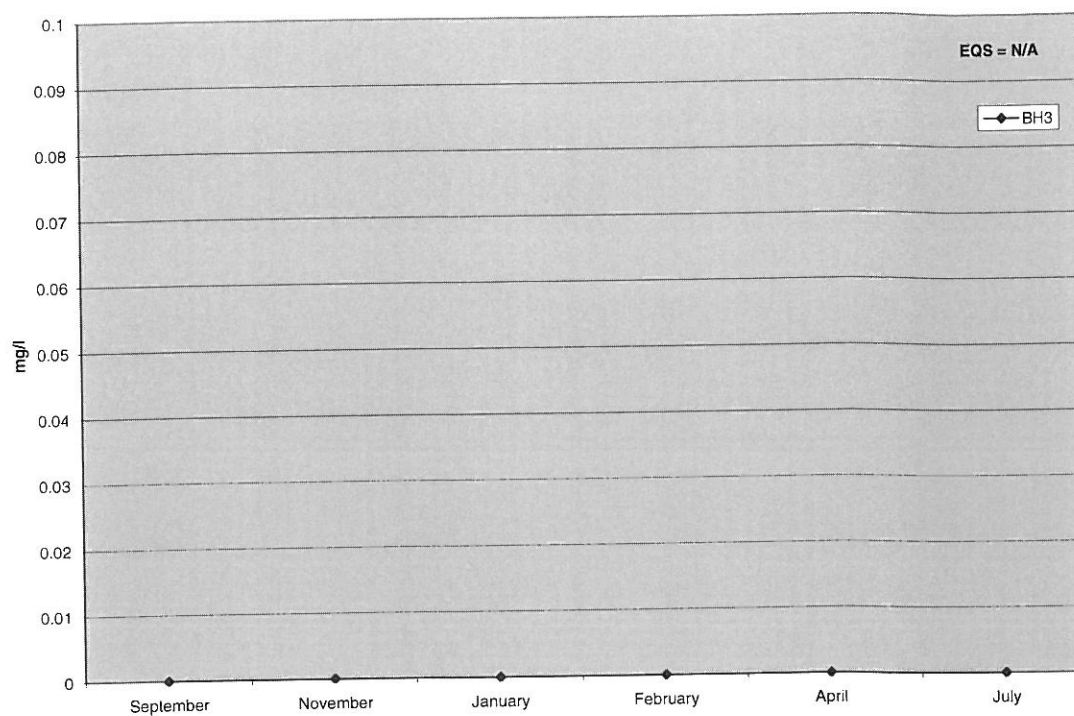
Iron (dissolved)



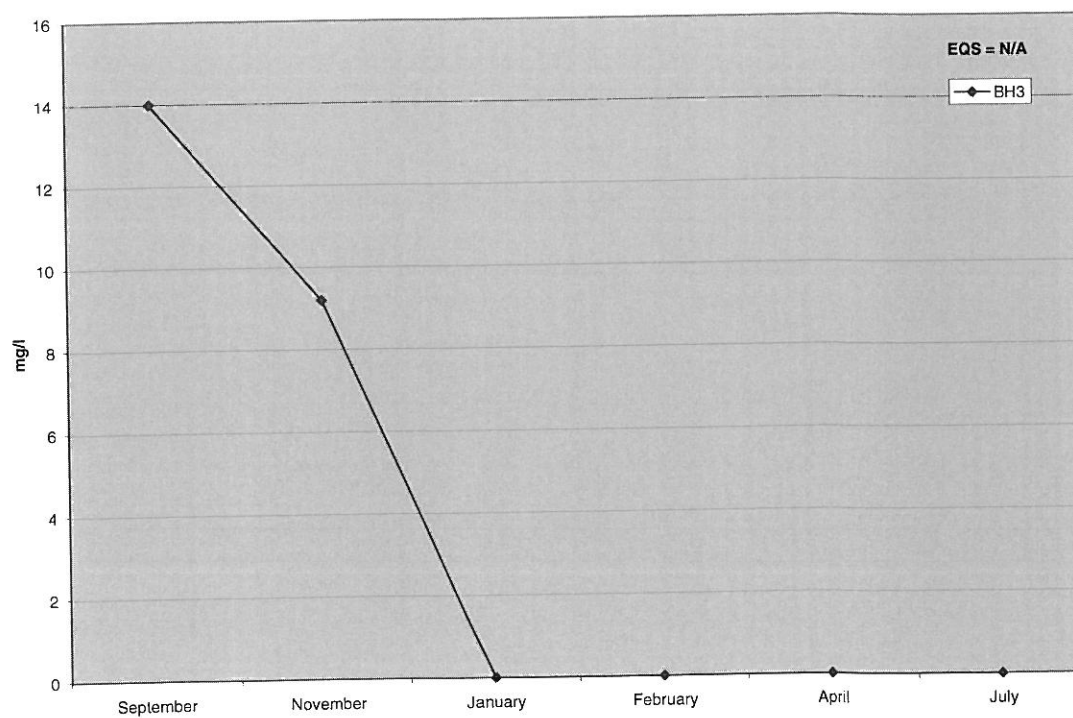
Iron (total)



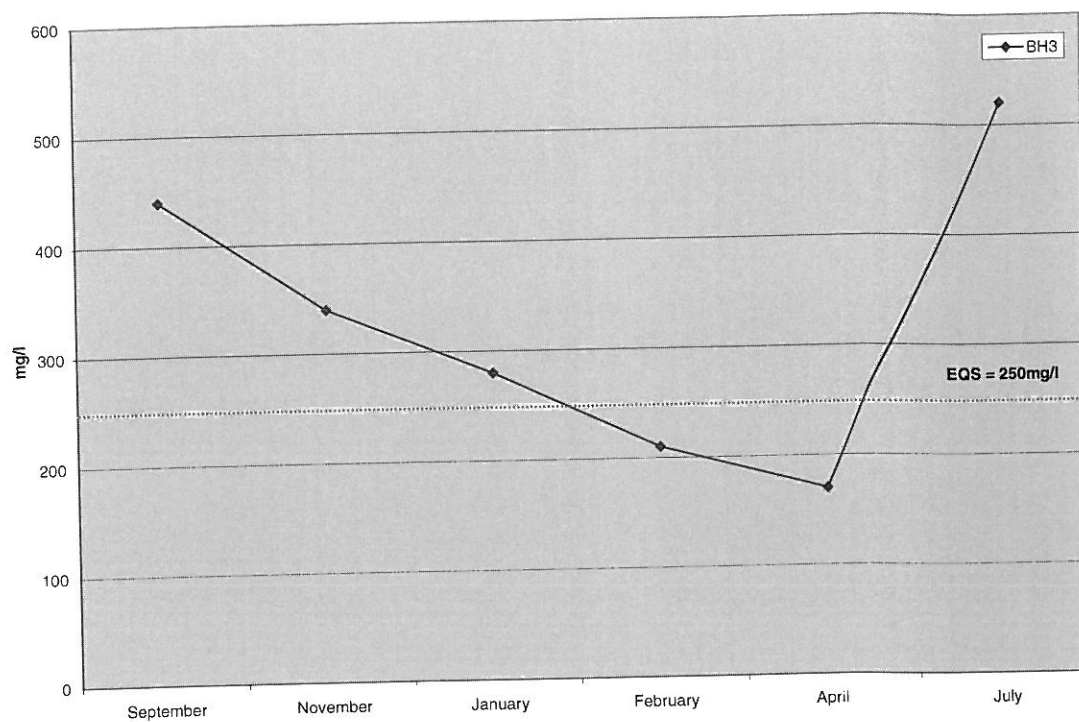
Sulphide



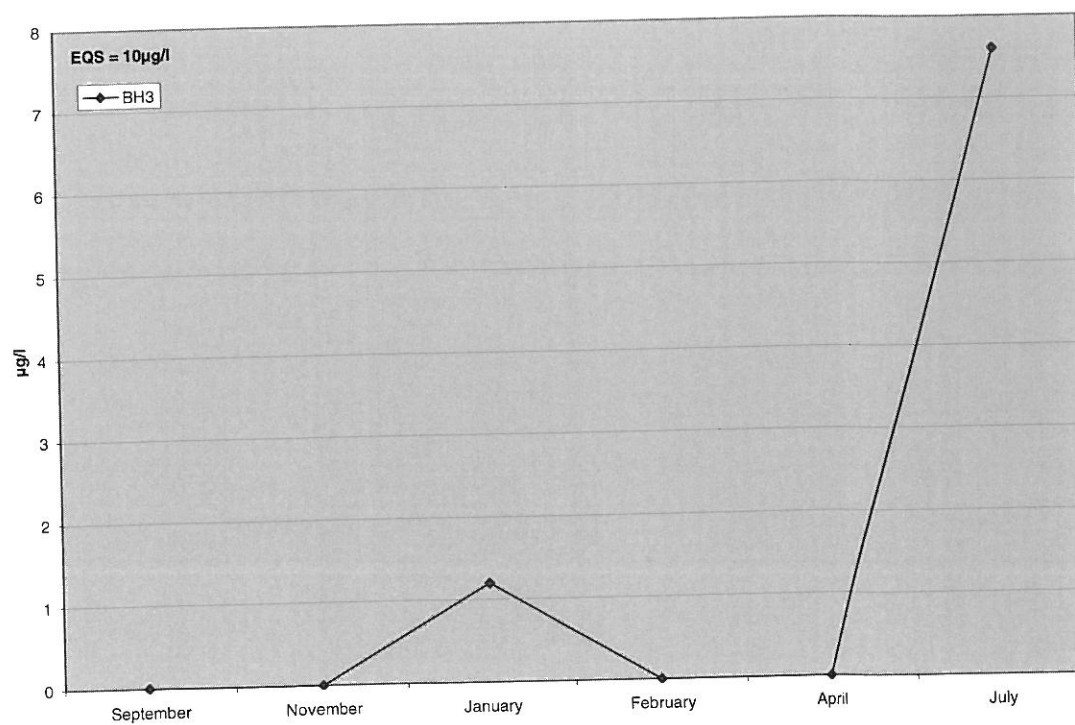
Total Organic Carbon (TOC)



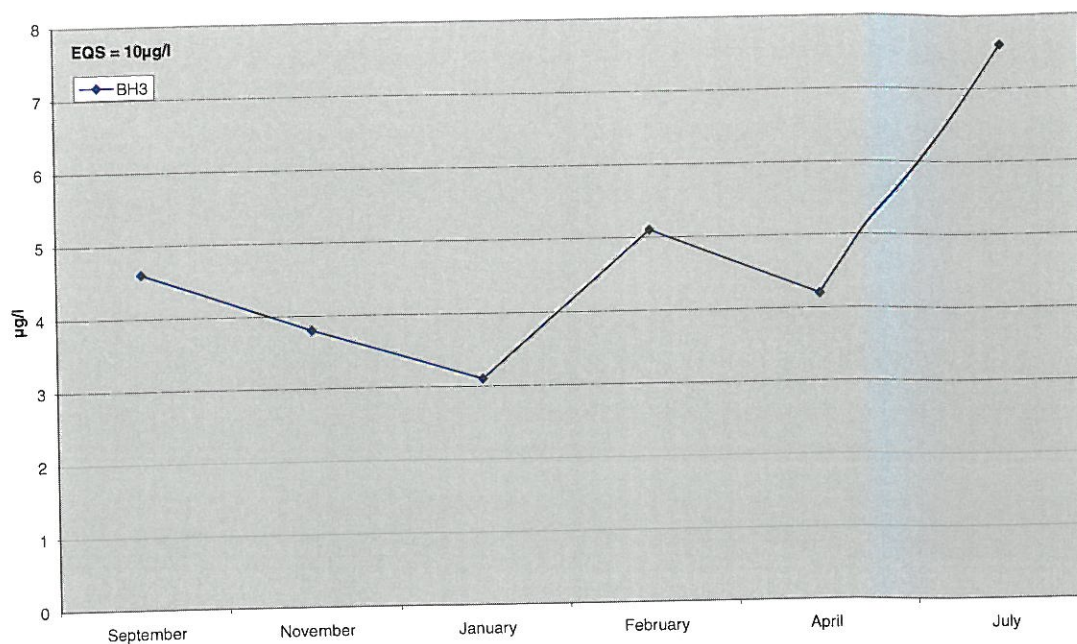
Sulphate



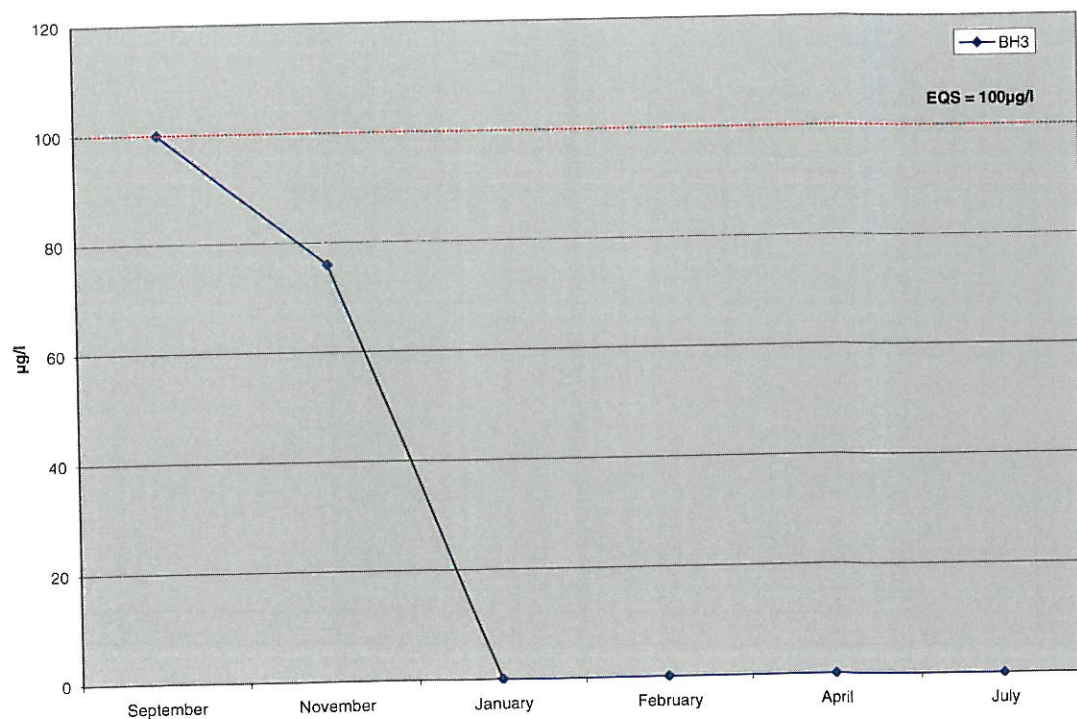
Arsenic (dissolved)



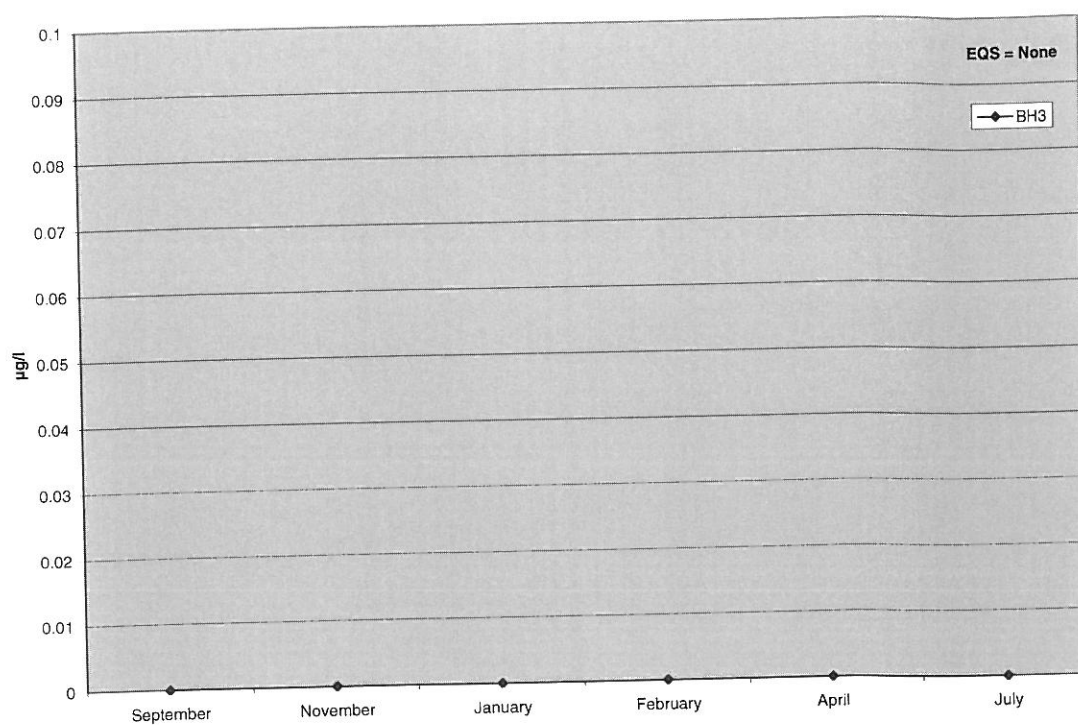
Arsenic (total)



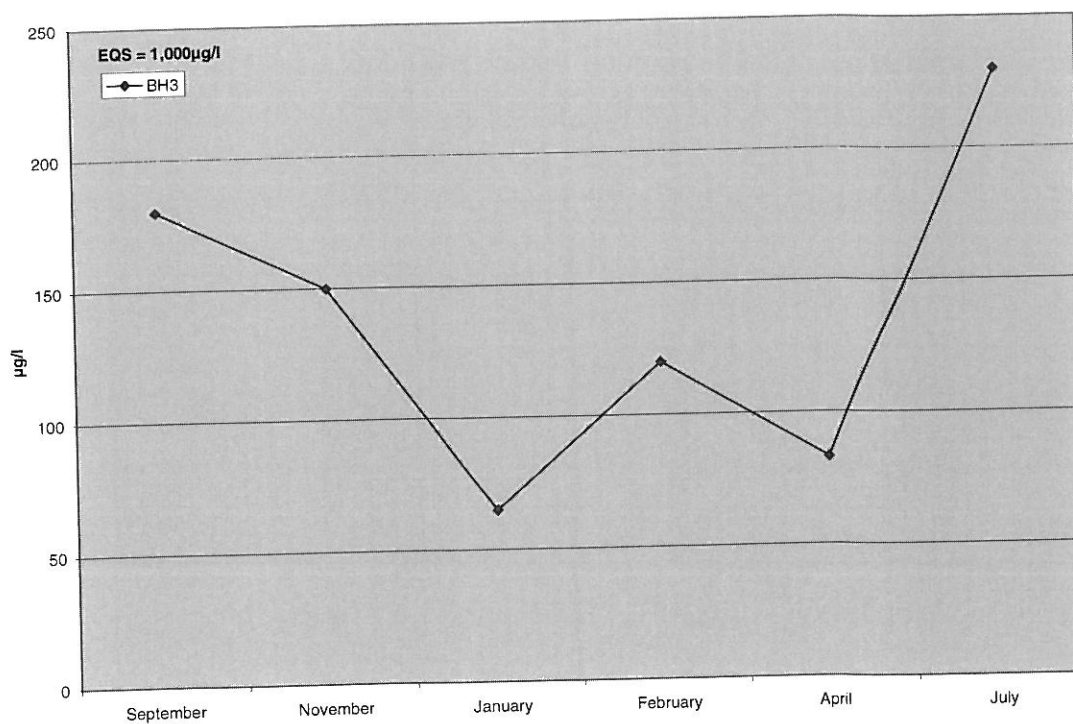
Barium



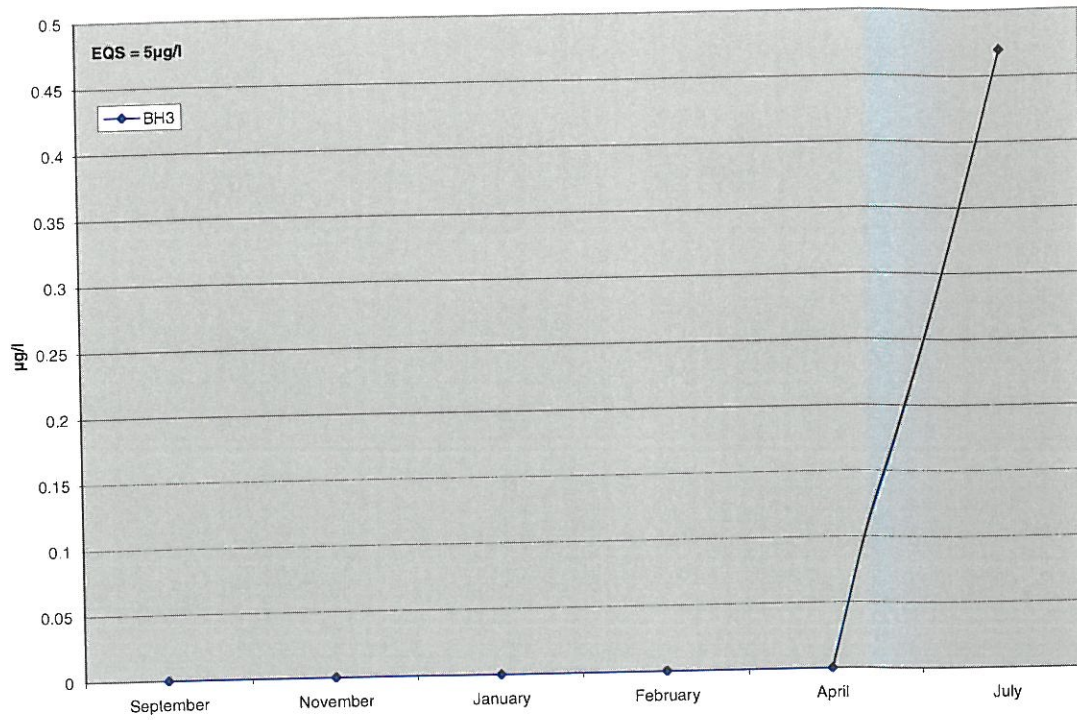
Beryllium



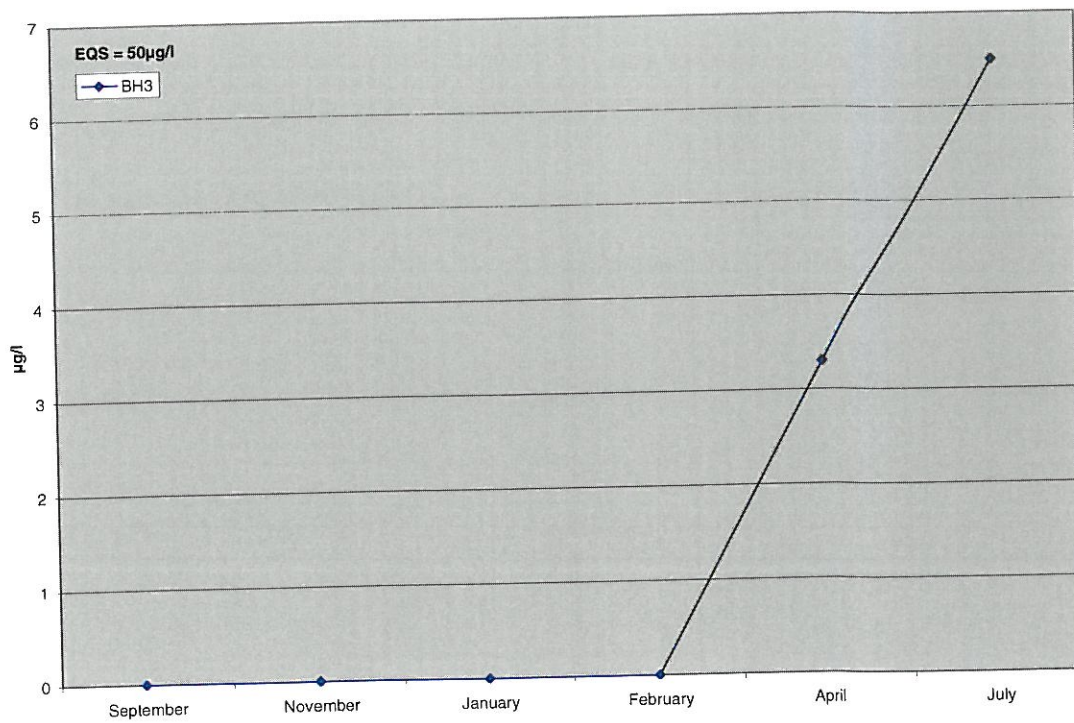
Boron



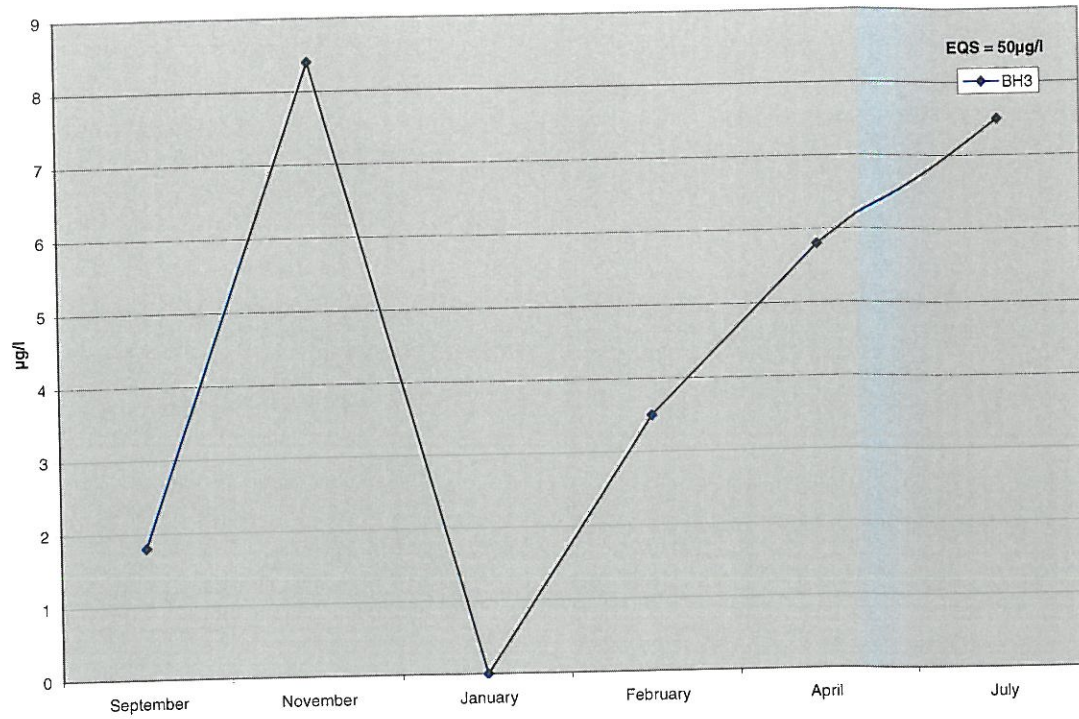
Cadmium



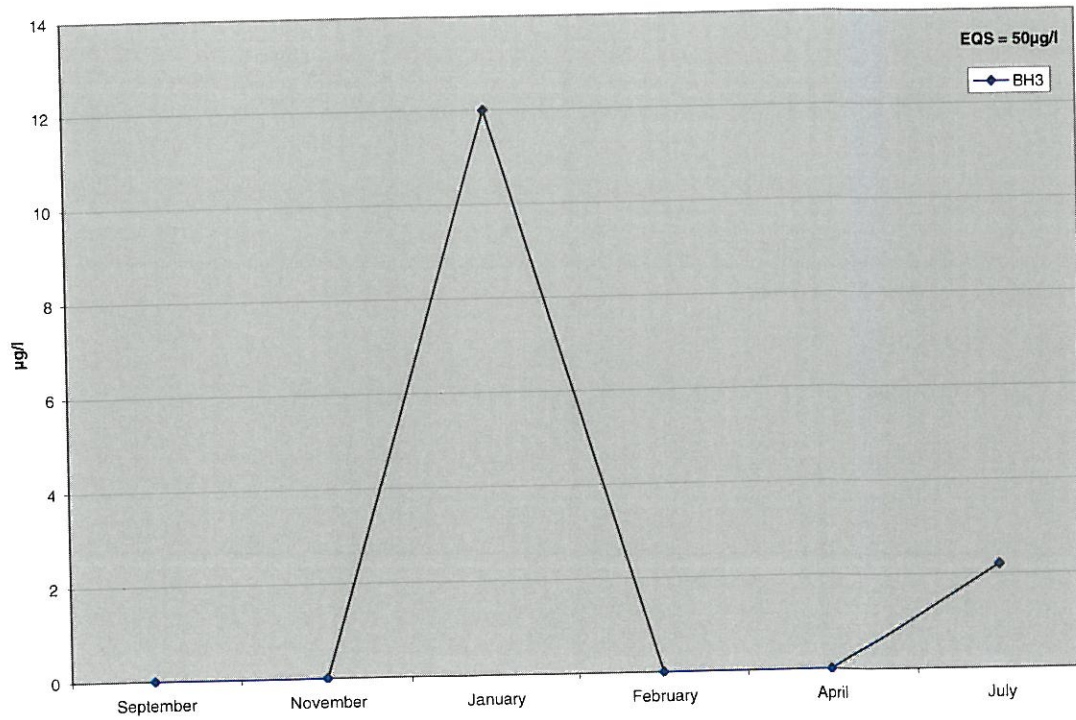
Chromium (dissolved)



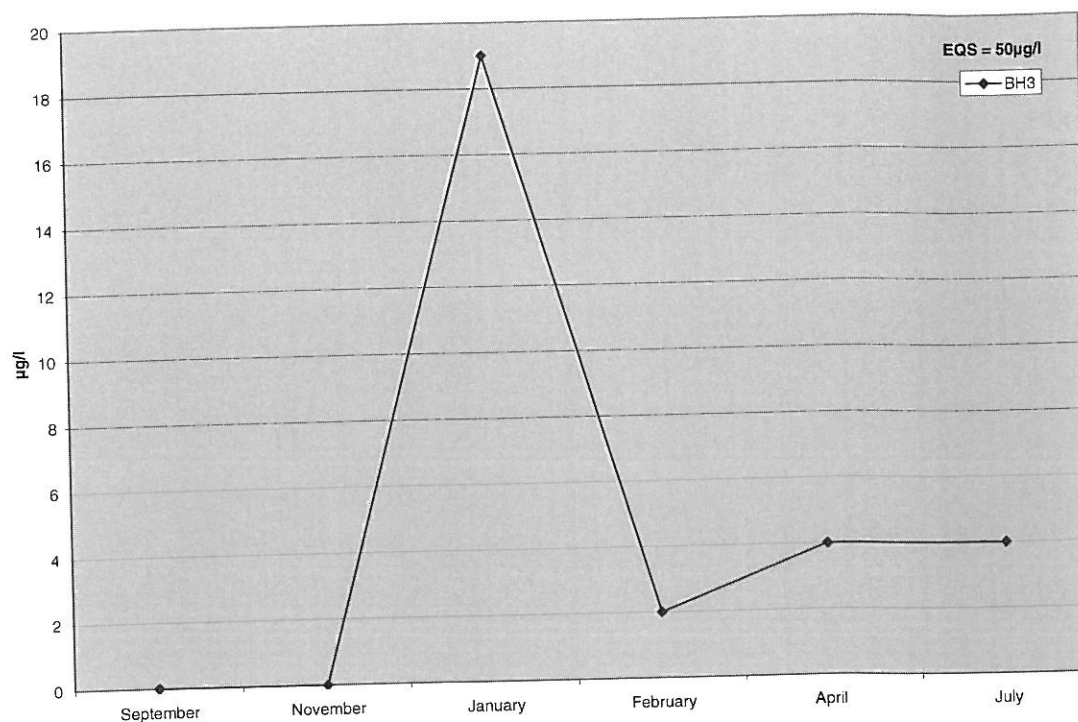
Chromium (total)



Copper (dissolved)



Copper (total)



Lead (dissolved)

