NANT NEWYDD QUARRY

HYDROGELOGICAL RISK ASSESSMENT

November 2008

CONTENTS

1 INTRODUCTION 2
2 SITE DESCRIPTION 3
2.1 Site location and surrounding land use 3
2.2 Site history and development 3
2.3 Monitoring records 4
3 ENVIRONMENTAL SETTING 7
3.1 HYDROLOGY 7
3.1.1 Rainfall 7
3.1.2 Surface water features around the site 7
3.1.3 Surface water quality 9
3.2 GEOLOGY 14
3.2.1 Regional geology 14
3.2.2 Local geology (quarry face mapping) 14
3.2.3 Local geology (boreholes) 15
3.3 HYDROGEOLOGY 17
3.3.1 Regional hydrogeology 17
3.3.2 Local hydrogeology 17
3.3.3 Groundwater levels and direction of groundwater flow 18
3.3.4 Aquifer properties 21
3.3.5 Groundwater quality 23
4 PROPOSED DEVELOPMENT 30
4.1 Quarrying activities 30
4.2 Landfilling activities 30
5 POTENTIAL IMPACTS AND MITIGATION MEASURES 32
5.1 Groundwater flow direction 32
5.2 Groundwater and surface water quality 32
5.3 Groundwater and surface water quality 32
6 CONCLUSIONS 35

Drawing 3131.HRA.01 – Site Location Plan
Drawing 3131.HRA.02 – Site Layout (site survey)
Drawing 3131.HRA.03 – Contour plots of groundwater at the site
Drawing 3131.HRA.04 – Cross sections of the site (map)
Drawing 3131.HRA.05 – Cross sections of the site

Appendix 1 – Waste Acceptance Criteria test results and evaluation of the results
Appendix 2a – Correspondence with the EA justifying the use of springs and existing water supply wells for groundwater monitoring in the absence of groundwater boreholes
Appendix 2b – Correspondence with the EA justifying monitoring for a reduced monitoring suite during the time when the site is not accepting waste until the pre-operational conditions are met
Appendix 3 – Groundwater monitoring borehole logs
Appendix 4 – Rainfall and groundwater hydrographs
Appendix 5 – Surface water quality monitoring graphs
Appendix 6 – Slug test methodology and slug test results
Appendix 7 – Groundwater quality monitoring graphs
Appendix 8 - Raw monitoring data

1 INTRODUCTION

1.1 Egniol Consulting Ltd (Egniol) was instructed by W.J.Owen and Sons to submit a Planning Application for extension of the time allowed for quarrying operations at the site and subsequently restoring the levels using inert waste fill (landfilling activities are currently licensed under PPC Permit number RP3337SE). This report details the hydrogeological risk assessment for the proposed activities at Nant Neywdd Quarry ('the site') and suggests mitigation measures where required. The location of the site is shown on Drawing 3131.HRA.01.

1.2 The scoping opinion indicated that regulators at the site are particularly concerned with the hydrogeological regime for the site, and in particular changes to the quantity and quality of groundwater and surface water, which might impact the nearby site of special scientific interest(SSSI), special area of conservation (SAC) and a Ramsar site, Cors Erddreiniog.

1.3 This report compiles observations made during monitoring of the site as part of compliance with landfilling requirements, information obtained during the installation of four groundwater monitoring boreholes, and monitoring data collected over the last 3 years to evaluate the potential impacts, which the proposed developments at the site might have on the identified sensitive receptors.

2 SITE DESCRIPTION

2.1 Site location and surrounding land use

2.1.1 Nant Newydd Quarry is situated on the B5110 road, approximately 2km south-west of Brynteg on the isle of Anglesey at National Grid Reference SH 490 800 (see Drawing 3131.HRA.01).

2.1.2 The site is situated in a rural area, surrounded by agricultural fields to the west, north and east, and bound to the south by the B5110 road. Bodgynda Farm lies approximately 150m west of the site, Nant Uchaf is 300m to the north, Nant Newydd farm and caravan park lie 250m east of the site. Tyn Y Lon lies approximately 200m south of the site, across the B5110 road from it.

2.1.3 A private water supply has been noted as being located within 150m of the site at SH247908 381138 (EA letter 11th August 2008, Scoping Opinion). The grid reference locates the well at Bodgynda Farm, Brynteg, Anglesey LL78 7JJ. The owner of the farm was contacted regarding this water supply. The owner of the farm confirmed, that the installation is in fact located just south of their other farm, Nant Uchaf, which is situated North of Nant Newydd Quarry, at approximate NGR SH 248060 381790. This location was sampled as WELL during part of the monitoring at the site (see Table 1) and is thought to be representative of background groundwater quality, as it is up hydraulic gradient of the site. As such, it is not considered to represent a receptor in relation to activities at Nant Newydd Quarry.

2.1.3 Cors Erddreiniog lies to the west of the site, approximately 200m away at its closest point. This area has been designated Site of Special Scientific Interest (SSSI), Special Area of Conservation (SAC) and a Ramsar site, as part of the Anglesey Fens, and as such is particularly sensitive to changes in the amounts and quality of groundwater flowing through the underlying rock and draining to it. This SSSI/SAC represents a particularly sensitive receptor with regards to activities at Nant Neywdd Quarry.

2.1.4 The original ground elevations around the quarry fall from 93mAOD at the north-eastern corner of the site to approximately 80mAOD at the south-western corner. The topography of the area around the site falls southwards and westwards from 108mAOD to the north of the site to below 65mAOD at Cors Erddreiniog. The topographic elevation of the area in relation to the position of the site and Cors Erddreiniog is shown on Drawing 3131.HRA.01.

2.2 Site history and development

2.2.1 The site constitutes a limestone quarry, where Carboniferous Limestone is extracted and sold as building and cladding material. Quarrying was enabled by the use of a pecker, grab and digger onsite. Stone has been extracted in the southern and eastern parts of the site. The lowest level within the quarry has been recorded as 72m AOD, at the end of the existing waste mass, and the southern-most exposed part of the quarry floor. The levels then increase in steps to the northern part of the excavations where most recent working has been at an elevation of 83m AOD. Excavation to the west of

the site has been minimal to date. The most recent topographic survey of the site showing the site layout is shown on Drawing 3131.HRA.02.

2.2.2 The site currently holds a PPC Permit number RP3337SE for the acceptance of inert wastes to restore the ground levels at the site in line with the pre-existing ground elevations in the area. Acceptance of inert waste was previously managed under waste management license number EAWML/37144.

2.2.3 A historic waste mass, accepted prior to the granting of the PPC Permit, exists in the southern part of the site to the north of the site entrance, weighbridge and wheel-wash and site offices. Further stockpiles of waste from segregated sources, which may be used as engineering materials, are situated in the northern part of the site, towards the northern boundary. No engineering has been undertaken at the site to date, the existing wastes being placed immediately over the quarry floor.

2.2.4 The potential risks associated with the chemistry of the existing waste masses and any future wastes, which will be accepted at the site have been assessed as part of the PPC Permitting process for the site. The wastes within the existing waste masses were shown to the satisfaction of the regulating authority to be inert and therefore not to pose a significant threat to the surrounding environment. The obtained waste acceptance criteria (WAC) and chemical results, including interpretation of the potential risks they pose and correspondence with the EA regarding the matter, are included in Appendix 1.

2.2.5 Surface water management is currently carried out onsite by allowing rainwater to collect in the base of the quarry to the lowest point, in the south of the site next to the existing waste mass (the sump). There water is allowed to pond until it reaches levels, which would be preventative to quarrying. The water is then pumped through a settlement lagoon to the west of the main haul road and from there drains under gravity through a further settlement and treatment ditch to where it joins the unnamed stream which runs along the southern boundary of the site.

2.2.6 A workshop is present onsite, where vehicles are maintained and serviced. A fuel storage facility is also kept onsite, as well as some scrap metal material used for servicing the site plant. These additional potential sources of contamination have been investigated as part of the PPC Permitting process for the site to ensure that they do not pose a risk to the surrounding environment. The provided documentation confirmed to the satisfaction of the regulating authority that these potential sources were unlikely to give rise to any potentially harmful pollution events.

2.3 Monitoring records

2.3.1 A summary of this monitoring regime in relation to the subsequent requirements for monitoring is included in Table 1 below.

Table 1. Summary of the monitoring regimes at the site

Time period	Monitoring locations	Monitoring suite	Frequency	Regime	Analytical lab
May 2005 to March 2007	W1, W2, W3	Ammoniacal nitrogen, nitrate, phosphate, chloride, sulphate, sulphide, total suspended solids, total extractable matter (TEM), pH, Electrical conductivity	monthly	WML	ECOS
April 2007- August 2007	W1, W2, W3 and W4	pH, oil and grease (visual), temperature, electrical conductivity, ammoniacal nitrogen, chloride, dissolved oxygen, biological oxygen demand (BOD), chemical oxygen demand (COD), total suspended solids, total organic carbon (TOC), iron, chromium, manganese, nickel, lead, phosphate, sulphate, nitrate and nitrite	monthly	PPC Permit	ALcontrol
		Total oxidised nitrogen (TON), calcium, cadmium, mercury, magnesium, sodium, potassium, alkalinity, copper, zinc, mineral oil (C8-C40) PAH and MTBE	quarterly		
		Full List I screening including cadmium, mercury, mineral oils and PAH	annually		
September 2007 - May 2008	W1, W2, W3, W4, W5 and Well	pH, oil and grease (visual), temperature, electrical conductivity, ammoniacal nitrogen, chloride, dissolved oxygen, biological oxygen demand (BOD), chemical oxygen demand (COD), total suspended soilds, total organic carbon (TOC), iron, chromium, manganese, nickel, lead, phosphate, sulphate, nitrate and nitrite	monthly	PPC Permit	ALcontrol
		Total oxidised nitrogen (TON), calcium, cadmium, mercury, magnesium, sodium, potassium, alkalinity, copper, zinc, mineral oil (C8-C40) PAH and MTBE	quarterly		
		Full List I screening including cadmium, mercury, mineral oils and PAH	annually		
June 2008 - present	W1, W2, W3	pH, oil and grease (visual), temperature, electrical conductivity, ammoniacal nitrogen, chloride, sulphate, dissolved oxygen, total suspended solids, TOC	monthly	PPC Permit reduced as site is not operational	ALcontrol
		Alkalinity, BOD, COD, calcium, chromium, copper, iron, magnesium, manganese, nickel, sodium, potassium, zinc, lead, nitrate, nitrite	quarterly		
		Full List I screening including cadmium, mercury, mineral oils and PAH	annually		
	GW1, GW2, GW3A	Water level, temperature, pH, electrical conductivity, dissolved oxygen, chloride, sulphate, cadmium, nickel, zinc, ammoniacal nitrogen	monthly		
		Alkalinity, COD, arsenic, selenium, phosphate, calcium, chromium copper, iron, magnesium, manganese, lead, potassium, sodium, nitrate, nitrite, phenols	quarterly		
		Full List I screening including cadmium, mercury, mineral oils and PAH	annually		

2.3.2 Monitoring at the site was carried out as required under the Waste Management License (WML) since May 2005. Only three surface water monitoring locations were monitored as part of this regime, one within the ditch, which allows water to be discharged to the stream (W1) and two within the stream bordering the southern part of the site, upstream of the site (W2), downstream of the site (W3). The monitoring suite was limited to nutrients and toluene extractable matter (TEM), as well as sulphate and pH and EC.

2.3.3 After granting of the PPC Permit for the site 30th March 2007, water monitoring was required to include a wider range of parameters, and to be carried out in a number of surface water and groundwater monitoring locations. A pre-operational condition was imposed on the site, that no further waste would be accepted until suitable groundwater monitoring infrastructure was installed in appropriate locations.

2.3.4 After discussion with the PPC compliance officer for the site, prior to installation of groundwater boreholes, the quality of groundwater down-gradient of the site was monitored by sampling appropriate springs on the boundary of the SSSI (initially W4 and subsequently including W5). A well belonging to Bodogynda farm was used as up-gradient monitoring location (WELL). Correspondence justifying the used points and a map indicating the locations is included in Appendix 2a.

2.3.5 Groundwater monitoring infrastructure in accordance with the pre-operational conditions for the site was installed in May-June 2008, and groundwater monitoring has been undertaken at these boreholes, GW1, GW2 and GW3A, since then (borehole logs are included in Appendix 3). No monitoring of the springs at the boundary of the SSSI was undertaken after the installation of the groundwater monitoring boreholes.

2.3.6 The monitoring suite varied during the different stages of site development. The monitoring regime was reduced after the issue of the PPC Permit, in accordance with the EA. The reduced suite was agreed for interim period only, before waste acceptance commences, and is based on the interpretation that the existing waste mass has been shown to be inert to the satisfaction of the EA. Correspondence presenting the justification and subsequent acceptance by the EA is included in Appendix 2b.

2.3.7 It is considered, that upon resuming of landfilling operations, the monitoring suite will be returned to that stipulated in the PPC Permit. A monitoring suite, appropriate for monitoring any impacts of the proposed developments for the site with regards to quarrying and landfilling is suggested in Section 6 of this report.

3 ENVIRONMENTAL SETTING

3.1 HYDROLOGY

3.1.1 Rainfall

3.1.1.1 The average annual rainfall at Nant Newydd Quarry has been assessed using data from rain gauges available in the near-by area. Historic records are available for a rain monitoring gauge in Benllech (NGR SH 519 822), approximately 2.5km north-east of the site, for 1999-2005[1]. More recent rainfall data from Cors Bodeilio has been provided to Egniol Consulting Limited by Dr P.Jones of the Countryside Council for Wales (CCW) and covers the period of September 2006-July 2008. The rain gauge is located at a NGR SH 550509 77357, approximately 8km south-east of the site. The available rainfall data is summarised in Table 2 below, and daily rainfall data obtained from the Cors Bodeilio monitoring location is presented on graph GW1 in Appendix 4.

Table 2. Monthly and annual rainfall (mm).

Year	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
1999	184.5	66.6	85.6	81.1	50.9	79.3	20.9	111.6	171.5	90	92.2	157.4	1191.6
2000	129.5	134.3	46.5	90.3	57.1	37.7	68.5	77.8	139.9	232.9	293.4	152.4	1460.3
2001	48.2	105	46	105.9	39.3	28.9	36.4	94.1	93.9	83.1	87.9	68.2	836.9
2002	103.5	158.7	39.7	88.9	73.7	79.8	53.3	95.2	22.5	153.7	198.7	116.4	1184.1
2003	83.1	51.4	51.9	54.6	147.4	72.9	69.5	6	0	64.6	15.3	107	723.7
2004								121.1	145.6	205.4	85.4	115.6	
2005	77	61	48.2										
2006									48.3*	8.2*	132.1	210.4	
2007	143.4	61.6	78.9	32.1	82.1	127.9	125.1	98.8	121.4	61.8	104.8	128	1166.2
2008	177.9	65.9	93.2	103.6	29.1	129.3	77.3						
											Average		1093.8

Key

Benllech rainfall data
Cors Bodeilio rainfall data
* Incomplete data

3.1.1.2 Groundwater monitoring infrastructure was installed in May-June 2008. Rainfall monitoring records are currently available prior to this date, and up to July 2008. Therefore no assessment of the behaviour of groundwater around the site in relation to rainfall could be made prior to summer 2008. For the time period after installation of the boreholes, the rainfall data and groundwater levels recorded at the site are plotted together on graph GR3 in Appendix 4.

3.1.2 Surface water features around the site

3.1.2.1 Nant Newydd quarry is situated with the catchment of Cors Erddreiniog, one of the Corsydd Mon/Anglesey Fens special area of conservation. An unnamed surface water course runs along the southern boundary of the site. This water course originates from issues situated to the north-east of the site, and then runs though lands owned by

[1] Data is reproduced from records presented in an investigation of the water environment in the vicinity of Rhuddlan Bach Quarry, Anglesey, and an assessment of the potential impact on Cors Goch SAC, Consultation Draft Version 1, October 2005, provided by Anglesey County Council planning department

Nant Newydd Caravan parks before reaching the site. Surface water runoff from the area to the south of the B5110 road joins the stream before it flows past Nant Newydd Quarry. Surface water runoff from the road would fun off into the stream along the southern boundary at the site.

3.1.2.2 The stream then flows adjacent to the southern boundary of Nant Newydd Quarry, with the outflow of the site's surface water management system joining it via a system of settlement lagoons before the stream reaches the western site boundary. This stream subsequently flows southwards and westwards, and flows into the SSSI from the south, eventually draining to the principal receiving surface water body in the area Llyn Yr Wyth Eidion.

3.1.2.3 The flow path of the stream from where it moves away from Nant Newydd Quarry to where it flows past the boundary of the SSSI is approximately 800m. This stream would collect surface water runoff from the fields to the south of the site, which border the main road, and forms the principal surface water flow feature in the catchment leading into Cors Erddreiniog. Throughout the period when monitoring has been carried out at the site by Egniol, this feature always contained water. In a number of periods of reduced rainfall, the flow was very minimal between small pools of water in the stream bed. The continuous flow observed in the stream indicates that it is partially fed by groundwater from the underlying rock.

3.1.2.4 In the last few months the water level in the stream was observed to be significantly above the base of the stream, with as much as 300mm -500mm of water at W2 location where the stream bed is deeper. Vegetation on the border of the stream, previously above the line of the water was found to be submerged during visits in October and November 2008.

3.1.2.5 Three springs have been located within 500m of the site and are indicated on Drawing 3131.HRA.01. One is located to the north of the site, approximately at NGR SH 4828 8144, at an elevation of between 90 and 95mAOD. This spring has been reported as flowing continuously throughout the time since the site was owned by Nant Newydd Caravans, in excess of 50 years. The issue has been reported to be situated between in-situ rocks in the corner of a field. These observations suggest that the feature represents an issue from the groundwater within the main aquifer in the area, rather than from subsurface flow or perched groundwater within the superficial drift deposits overlying the bedrock. No access to this feature was granted during any of the visits to the site.

3.1.2.6 Two springs are located to the west of the site, where the ground falls steeply towards Llyn Yr Wyth Eidion. The northern issue (denoted as W4 when monitored, located at approximately NGR SH 4764 8169) has been elevated within a concrete construction to allow the water to escape in a more controlled manner, forming a small stream/ditch towards the lake. The southern spring (denoted as W5 when monitored, located at approximately NGR SH 4759 8156) flows out form the corner of a field and a ditch is denoted as running away from it. Throughout the time period when samples were recovered from these two locations, the springs were reported as present (they were not found to be dry on any of the visits). This indicates that similarly to the spring

in the north/east of the site, these two springs are likely to be fed by groundwater flow from the main aquifer in the area rather than perched groundwater bodies.

3.1.2.7 Cors Goch, another of the Anglesey Fens, lies within 1km of the site, to the south-east. The topography of the surrounding area indicates that it lies within a hydrologically separate catchment to Nant Newydd and therefore does not constitute a receptor with regards to any potential hydrological impacts from Nant Newydd Quarry.

3.1.3 Surface water quality

3.1.3.1 The quality of the surface water around the site was monitored routinely as part of the WML and PPC requirements as summarised in Table 1 section 2.3 of this report. The results of the monitoring undertaken at different surface water monitoring locations are presented in graphs included in Appendix 4 and as summary statistics in Table 3 below.

3.1.3.2 In the context of the site and its surroundings W1 is representative of the loading of surface water due to quarrying and landfilling activities at the site, while W2 is indicative of the off-site, up-stream inputs into the surface water system. W3 gives an indication of the surface water quality downstream of the site.

3.1.3.3 The elevated concentrations of calcium and magnesium recorded in all surface water monitoring locations, and the alkaline pH recorded are likely to result from the environmental setting of the site within Carboniferous Limestone. The value of pH within the site is typically slightly more neutral than that from upstream of the site. This is likely to reflect the fact that a significant proportion of the discharge from the site constitutes rainfall runoff, rather than groundwater only.

3.1.3.4 Concentrations of ammoniacal nitrogen being discharged from the site have been below the detection limit in all occasions except one when a concentration of 2.2mg/l was recorded (February 2007). This did not result in increase of the concentration of ammoniacal nitrogen in the downstream monitoring location W3. Three incidents of elevated concentrations of ammoniacal nitrogen (as high as 55.4mg/l) were noted in W2, upstream of the site. During all three incidents, ammoniacal nitrogen concentrations in the downstream monitoring point were found to be elevated.

3.1.3.5 The concentrations of chloride recorded at W1 have remained relatively stable between 11mg/l and 55mg/l and typically below 45mg/l, with an average of 33.3mg/l throughout the monitored period. Concentrations in W2 upstream of the site tend to be somewhat lower with an average of 27.95mg/l, however are recorded at concentrations above those in W1. All of the recorded concentrations are significantly below the freshwater EQS of 250mg/l.

3.1.3.6 Electrical conductivity recorded in W1 was relatively stable, on average 990µS/cm, slightly above that recorded in W2 (620µS/cm).

Table 3a. Summary statistics for surface water monitoring in W1, W2 and W3

Location		W1				W2				W3			
Parameter		**Min**	**Mean**	**Max**	**count**	**Min**	**Mean**	**Max**	**count**	**Min**	**Mean**	**Max**	**count**
Ammoniacal Nitrogen as N	mg/l	<0.1	0.26	2.2	33	<0.10	4.04	55.10	25	<0.10	3.54	42.60	24
Arsenic Dissolved (ICP MS)	ug/l	2	6.00	10	2	<1.00	5.50	10.00	2	2.00	126.00	250.00	2
BOD	mg/l	<1	2.09	4	11	<1.00	1.45	2.00	11	<1.00	1.64	4.60	11
Boron Dissolved (ICP MS)	ug/l	<0.02	6.51	13	2	<0.02	5.01	10	2	<10	<10	<10	1
Cadmium Dissolved (ICP MS)	ug/l	<0.22	0.31	<0.4	6	<0.10	-	<0.40	6	<0.10	-	<0.40	6
Calcium Dissolved (ICP MS)	ug/l	180000	206000	230000	5	110000	120000	130000	5	120000	162000	200000	5
Chloride	mg/l	11	33.30	55	33	13.20	27.95	70.00	24	12.50	31.04	67.00	24
Chromium Dissolved (ICP MS)	ug/l	<1	3.23	22	13	<1	3.08	150	13	<1	1.54	3.00	13
COD	mg/l	10	58.33	370	12	6.00	12.75	23.00	12	9.00	19.08	60.00	12
Conductivity (at 25 deg.C)	mS/cm	0.69	0.99	1.11	23	0.25	0.62	0.73	19	0.58	0.77	1.10	19
Copper Dissolved (ICP MS)	ug/l	<1.6	1.76	3.6	5	<1.00	2.16	4.2	5	<1	1.36	1.6	5
Dissolved Oxygen	mg/l	9	10.18	13	17	6.00	8.47	11.00	17	9.00	9.53	11.00	17
Iron Dissolved (ICP MS)	ug/l	5	59.54	120	13	<5.00	40	80.00	13	<5.00	48	87.00	13
Lead Dissolved (ICP MS)	ug/l	<0.4	0.90	2	13	<0.40	0.92	1.1	13	<0.40	0.9	1.5	13
Magnesium Dissolved (ICP MS)	ug/l	14000	15000	16000	2	4100	4350	4750	2	10000	14000	18000	2
Manganese Dissolved (ICP MS)	ug/l	2	180.15	390	13	<1.00	14.69	130.00	13	<3.00	37.62	210.00	13
Mercury Dissolved (CVAF)	ug/l	<0.01	0.03	<0.05	5	<0.01	<0.03	<0.05	5	<0.01	<0.03	<0.05	5
Mineral Oil Aqueous	ug/l	<10	<10	<10	4	<10.00	100.00	370.00	4	<10.00	<10.00	<10.00	1
Nickel Dissolved (ICP MS)	ug/l	2.7	31.28	57	13	<1.00	2.14	4.6	13	<2.00	13.85	32.00	13
Nitrate as NO3	mg/l	<0.3	10.97	34	29	<0.30	11.63	26.00	20	<0.30	11.26	27.00	20
Nitrite as NO2	mg/l	<0.05	0.07	0.12	13	<0.05	0.15	0.50	13	<0.05	0.13	0.80	13
PAH 16 Total Aqueous	ng/l	27	108.80	290	5	<27.00	70.80	100.00	5	<27.00	79.00	100.00	5
pH Value	pH Units	7.5	8.00	8.22	22	8	8.33	8.65	19	7.96	8.22	8.56	19
Phenols Monohydric	mg/l	<0.01	0.01	<0.01	1	<0.01	<0.01	<0.01	1	<0.01	<0.01	<0.01	1
Phosphate (Ortho as PO4)	mg/l	<0.08	0.12	1	24	<0.01	1.44	14.10	19	<0.01	1.27	10.60	19
Potassium Dissolved	mg/l	4.8	6.50	7.4	5	<0.50	2.86	6.3	6	2	4.28	6.00	5
Selenium Dissolved (ICP MS)	ug/l	4	4.00	4	1	<2.00	<2.00	<2.00	1	<3.00	<3.00	<3.00	1
Sodium Dissolved	mg/l	15	38.60	100	5	11	19.4	33.00	5	11.00	18.80	26.00	5
Sulphate (soluble)	mg/l	68	252.39	440	33	18.00	25.67	37.00	24	18.00	100.92	300.00	24
Sulphide	mg/l	<0.1	0.10	<0.1	15	<0.10	0.10	0.10	5	<0.10	0.10	0.10	6
TEM	mg/l	<10	18.19	138	16	<10	24	106	7	10	27.71	134	7
Total Alkalinity as CaCO3	mg/l	140	222.50	290	4	220	255	290.00	5	180	240	310	4
Total Organic Carbon	mg/l	4	5.94	9	17	<3.00	4.88	7.00	17	<3.00	5.53	8.00	17
Total Oxidised Nitrogen as N	mg/l	<0.3	0.76	1.8	7	<0.30	2.11	4.10	7	<0.30	2.86	9.80	7
Total Suspended Solids	mg/l	5	282.78	4100	32	<5.00	14.74	55.00	23	<6.00	59.22	430.00	23
TPH	mg/l	<1	1.80	4	5	<1	1.80	4.00	5	<0.01	2.60	6.00	5
Zinc Dissolved (ICP MS)	ug/l	<3	27.67	71	6	<3.00	9.67	24.00	6	<3.00	11.67	22.00	6

3.1.3.7 Levels of biological oxygen demand (BOD) were recorded typically below 4.6mg/l in all surface water monitoring locations. Levels recorded in W1 remained stable throughout the monitoring period with an average of 2.09mg/l. Levels of chemical oxygen demand (COD) were found to be typically below 50mg/l in all monitoring locations except two peak concentrations in W1 recorded in November 2007 and February 2008. On both of those occasions elevated concentrations of suspended solids were recorded in W1 (4100mg/l and 580mg/l respectively), but no concentrations of other determinants were observed to be elevated. This suggests that elevated COD could be associated with high sediment loading of the sample, and therefore the two high levels recorded may not be fully representative of the typical COD loading of the water discharge from the site. This interpretation is supported by the results collected in W3, where in November 2007 elevated concentrations of suspended solids coincided with slightly elevated concentrations of COD. The elevated concentration of suspended solids withinW1 is likely to result from disturbing bottom sediment while obtaining the sample. It is considered unlikely that any sediment from the site would be carried a significant distance along the stream.

3.1.3.8 It has been highlighted, that the SSSI receptor could be sensitive to input of nutrients. No EQS values for fresh water are available for nitrate, nitrite, TON, or phosphate therefore the potential impact of the site with regards to these nutrients has been assessed in relation to background concentrations.

3.1.3.9 Concentrations of nitrate were relatively similar in W1, W2 and W3, (10.97mg/l, 11.63mg/l and 11.26mg/l respectively). Greater concentrations in all three surface water monitoring locations were recorded during winter months (between November and March). The perceived seasonality could result from application of fertilisers to agricultural fields in the surrounding area. Nitrite concentrations in W1 were below 0.12mg/l throughout the reviewed period, with slightly more elevated concentrations being recorded in W2 and W3 (up to 0.5mg/l and 0.8mg/l respectively). The concentrations of total oxidised nitrogen (TON) remained below 10mg/l in all locations and had a similar distribution to that of nitrites.

3.1.3.10 Concentrations of phosphate in W1 were below the detection limit of 0.08mg/l throughout the reviewed period except on one occasion in February 2007 when a value of 1mg/l was recorded at this location. Two peaks of phosphate concentration in W2 were recorded in August 2005 and August 2006 with concentrations of 8.5mg/l and 14mg/l respectively. These peaks correspond temporally with peaks of ammoniacal nitrogen and nitrate at W2, suggesting possible impact from an organic source such as fertilisers or sewage/septic system.

3.1.3.11 Concentrations of sulphate in W1are relatively stable with an average concentration of 252.39mg/l. This concentration is higher than that recorded in W2 or downstream of the site in W3 (25.67mg/l and 100.92mg/l respectively). All concentrations recorded in W1 remained below the EQS for fresh water of 400mg/l except one occasion in June 2008. The existing waste mass at the site was shown to contain concrete, which could give rise to sulphate. It has also been suggested that the quarrying process might allow

the greater release of sulphate than would normally leach out from the rock, however this process is not thought to be dominant with regards to sulphate at this site.

3.1.3.12 Concentrations of potassium and sodium in W1 were slightly more elevated in W1 than in W2 and W3. Potassium levels remained relatively low, below 7.5mg/l in W1 in all monitoring visits. All sodium concentrations were below the EQS for fresh water of 170mg/l.

3.1.3.13 Concentrations of organic compounds in W1 were found to be relatively low. Total petroleum hydrocarbons (TPH) in W1 remained below 4mg/l throughout the review period. Concentrations of total organic carbon were below 9mg/l and did not exceed 7mg/l after July 2007, similarly to the concentrations recorded in W2 and W3 for this parameter. No mineral oils were detected at W1 on any of the monitoring occasions. There is indication that organic compounds are found upstream of the site in higher concentrations than at the site (a concentration of 350µg/l of mineral oils was recorded in W2 in May 2008). The concentrations of toluene extractable matter (TEM), in all locations remained below the detection limit except on one occasion in August 2005, when elevated concentrations were recorded in all three locations. The elevated TEM concentrations recorded in W1 are not thought to be representative of the water quality of the discharge from the site, as the distribution of the elevated concentrations suggests that an event affecting all of the surrounding area had occurred.

3.1.3.14 No polyaromatic hydrocarbons (PAHs) were detected in W1 except in September 2008 when 270ng/l was recorded there. No PAHs were recorded in W2 and W3, indicating that this elevated concentration did not have a discernable impact on the receiving stream. It is not considered that the recorded concentration is representative of the typical PAH concentrations within the discharge from the site.

3.1.3.15 The concentrations of mercury and cadmium were recorded below the detection limit in all monitoring locations throughout the reviewed period. Lead concentrations remained below 2µg/l in all surface water monitoring locations, and those of copper below 4µg/l. Chromium concentrations also remained low (below 5µg/l) during most visits. A slightly elevated concentration of 22µg/l recorded in W1 in March 2008 coincided temporally with elevated concentration being recorded in W2, suggesting that the elevated concentrations had resulted from an event affecting the surrounding area, rather than an impact from activities at the site.

3.1.3.16 The concentrations of zinc, nickel, manganese and iron at W1 were found to be typically slightly higher than those in W2, indicating that activities onsite might be giving rise to slightly increased concentrations of metals. This is likely to result primarily from the quarrying activities as they would lead to exposure of metal deposits within the rock to erosion. The recorded concentrations did not exceed the respective EQS for fresh water, indicating that the recorded releases of these compounds into the stream are unlikely to impact adversely this receptor or the SSSI receptor.

3.1.3.17 The surface water within the stream appears to be of relatively good quality during most monitoring visits. Nutrients are typically found in the upstream monitoring

location in significantly higher concentrations than in samples from the site. Slightly elevated concentrations of sulphates and certain metals are recorded in samples from the site in comparison to upstream quality in the water course. Where EQS standards for fresh water exist for these parameters, the recorded concentrations within W1 have been below those.

3.1.3.18 It is further noted that due to the draw-down effect created by the active water management within the site, there is an inward gradient of groundwater into the site, preventing any escape of surface or groundwater from the site to the surrounding area other than via the sump. All water collected within the sump includes that which comes into contact with any wastes on site, and all groundwater and runoff which might be affected by the quarrying activities. As it is discharged from the sump it subject to routine monitoring at W1. Therefore the reported surface water quality from this sample point reflects fully the current potential of the site for impact on the stream or the SSSI, including the nutrient and contaminant loading which is likely to result because of the activities undertaken at the site. The results discussed above indicate that that the current site activities are not having a discernable impact on the water quality of the receiving waters within the stream. As such it is considered that the continuation of these activities are extremely unlikely to pose a threat of contamination to the receiving surface water stream or the nearby SSSI/SAC site.

3.2 GEOLOGY

3.2.1 Regional geology

3.2.1.1 The geological map for the area[2], BGS map 105 shows an unconformable sequence of Precambrian, Ordovician, Devonian and Carboniferous rocks. The geological sequence of the rock strata is summarised in Table 4 below.

Table 4. Regional geological sequence

Group	Unit	Thickness	Description
Pliocene	Superficial	60+ (unproven)	Firm to stiff clays, with frequent to infrequent gravels
Carboniferous	Limestone		Fractured limestone varying in colour, interbedded with mudstones and shales
	Limestone, sandstone, conglomerates		interbedded limestones, sandstones and conglomerates forming the base of the Carboniferous Limestone
Devonian	Red Sandstone	Unknown	
Ordovician	Caradoc Beds	Unknown	
Precambrian	Charnwood, Lleyn Peninsular Beds	Unknown	

3.2.1.2 There are a number of intrusive igneous bodies within the region, and local variations in the strata from the published data are common.

3.2.2 Local geology (quarry face mapping)

3.2.2.1 A geotechnical engineer from Egniol Consulting Limited visited the quarry on the 4th June 2008 to map existing exposures and to measure the dip and the dip direction on bedding planes and discontinuities. The mapping was carried out to determine the geological and structural data for the purpose of a geotechnical assessment and is reproduced here. Drawing 3131.MAP.01 shows the locations of the mapped features.

3.2.2.2 The major rock strata were grey to black limestones interbedded with brown-black mudstone/shale. The limestone beds vary in thickness between 0.1mm and 0.6m but in places appear homogeneous with the interbedded mudstone due to colour similarities. The mudstone/shale beds vary in thickness between 0.02m and 0.1m.

3.2.2.3. Features, which were noted during the exposure mapping included presence of calcite mineral veins which intersect the bedding planes, discontinuities which were generally clean and discoloured to a light orange-brown due to weathering, slight deformation of the bedding surfaces due to folding with the orientation of the folding being perpendicular to that of the dip direction, and minor faults observed within the limestone, which are generally closed, with slight discolouration due to weathering.

[2] BRITISH GEOLOGICAL SURVEY. Sheet 105, Solid and Drift Edition, 1:25,000 online map.

3.2.2.4 The colour of the limestone was seen to alter from yellowish grey to dark grey/black. The mineralogy of the limestone was also noted to be altering with depth. Towards the upper limits of the quarry face the limestone was noted to be fine grained with skeletal fragments such as oolites. At the toe of the exposed quarry face the rock was considered to be representative of a low grade marble due to lack of sedimentation and separate grains.

3.2.2.5 Mineralogical alteration described above was also present within the mudstone and shale beds, which at the upper limits of the quarry face were observed to be laminated and friable, whereas at depth appeared fine grained and foliated, indicative of low grade slate.

3.2.2.6 A number of mineral veins could be observed throughout the quarry face, which varied in orientation but generally ran vertically through the strata, intersecting bedding planes. The veins were noted to be of predominantly calcitic composition and were interpreted as fracture infill of leached minerals from the limestone during heat and pressure alteration of the stratigraphic unit.

3.2.2.7 At several locations around the quarry there some small scale folding was observed. Whilst no major fold system was apparent, given the deformation history of Anglesey it was likely that the majority of the strata had been subject to folding deformation. The type of folding observed at Nant Newydd Quarry was typical small scale S-bend folding, which would be indicative of smaller scale deformation occurring along the left limb of a larger scale fold.

3.2.2.8 Within the limestone two major sub-vertical discontinuity sets were recorded striking at approximately 356-005° and 261-279°. It is considered likely that the observed discontinuities within the exposed quarry faces have been created primarily by the quarrying operations and do not necessarily represent the primary faulting and fracturing which is present within the in-situ rock.

3.2.3 Local geology (boreholes)

3.2.3.1 Four groundwater monitoring boreholes were installed around the site between the 28th May and the 2nd June 2008. Those were situated to the north of the currently quarried area within the site boundary and to the west of the quarry, within the neighbouring field. Locations of the boreholes are indicated on Drawing 3131.HRA.01 and 3131HRA.02. Borehole logs are included in Appendix 2.

3.2.3.2 Up to 1m of topsoil was noted at GW2, GW3 and GW3A (with greatest depth being recorded at GW2). All boreholes except GW2 intercepted light-brown to dark gravely cobbly clay with some rounded or sub-rounded boulders. This was noted to be of 4-5.5m depth and was interpreted to represent Pleistocene drift deposits.

3.2.3.3 Sandy clayey gravel with rounded and sub-rounded fragments of mudstone and limestone was intercepted in GW1, GW2 and GW3A with typical thickness of 1.5-2m (a greater thickness of 3.5m was recorded in GW2). This layer was interpreted as an

erosional feature where Pleistocene deposits unconformably overlie the Carboniferous rock.

3.2.3.4 In all boreholes hard brown/dark limestone with occasional limited mudstone/shale bands was found to underlie the drift deposits. This interbedded limestone sequence was intercepted from depths between 4.5 and 7m below ground level (at elevations of 85mAOD to 72m AOD). The limestone and mudstone sequence was interpreted as being part of the Carboniferous Limestone formation identified in the regional geology.

3.2.3.5 The observations of the strata within the boreholes indicate that Carboniferous Limestone underlies superficial deposits underneath the site and the surrounding area. The continuity of mudstone/shale bands between the different boreholes within the limestone interbedded sequence could not be confirmed. The more substantial thickness of mudstone/shale observed at GW3 (intercepted at depth below 60mAOD(is considered to represent a different geological unit to the interbedded limestone sequence which overlies it (monitored in GW1 and GW3A). Schematic cross sections of the site have been constructed along three lines shown on Drawing 3131.HRA.04 and the cross sections are included on Drawing 3131.HRA.05.

3.3 HYDROGEOLOGY

3.3.1 Regional hydrogeology

3.3.1.1 The Carboniferous Limestone has been classified as a Major Aquifer[3] as it may be highly permeable or there may be the presence of significant fracturing. The area where the site lies has been classified as being covered with soils of intermediate leaching potential, I1, i.e. they are considered to 'have a moderate ability to attenuate diffuse source pollutants or in which it is possible that some non-adsorbed diffuse source pollutants and liquids could penetrate the soil layer'.

3.3.1.2 The regional groundwater flow has been interpreted as being predominantly in a westerly direction, representing a depressed reflection of the topography.

3.3.2 Local hydrogeology

3.3.2.1 Four groundwater monitoring boreholes were installed at the site in May 2008. One of the boreholes is situated up-gradient of the site, and three down-gradient The locations of the boreholes in relation to the site and its environs are shown on Drawing 3131.HRA.01.

3.3.2.2 The groundwater monitoring boreholes were installed using a rotary drill rig to a depth of 5-32m below ground level. A monitoring standpipe of 50mm diameter was installed in all locations.

3.3.2.3 Table 5 contains a summary of the installation depths and screened lengths within each borehole, the level of water strike and the monitored horizon.

Table 5. Summary of groundwater monitoring installations

Borehole number	Depth of screened pipe (mAOD)	Monitored horizon	Geological layer/ interpreted aquifer	Water strike level (mAOD)
GW1	75.25 - 85.5	Predominantly hard LIMESTONE/marble, with soft mudstone layers	Limestone interbedded sequence (unconfined aquifer)	82
GW2	71.4 – 74.8	Sandy clayey GRAVEL, with fragments of mudstone		74.4
GW3	54.4 – 59	Dark black MUDSTONE	Shale underlying limestone sequence (partially confined aquifer)	62
GW3A	70.4 – 79.4	Hard LIMESTONE/marble with mudstone bands	Limestone interbedded sequence (unconfined aquifer)	77.4

[3] ENVIRONMENT AGENCY. Groundwater Vulnerability of Anglesey and the Lleyn Peninsula, Sheet 14, 1997.

3.3.3 Groundwater levels and direction of groundwater flow

3.3.3.1 Groundwater level monitoring at the site is carried out monthly. In addition, a more intensive programme of groundwater levels monitoring was carried out immediately after the installation of the boreholes in order to obtain data to allow interpretation of the groundwater behaviour to be made. The groundwater levels collected to date are summarised in Table 6 below. Hydrographs for the boreholes are presented on GW2 and GW3 in Appendix 4.

Table 6. Summary of groundwater levels

Location		mAOD	Dip
GW1	Minimum	81.22	4.65
	Mean	84.073	10.147
	Maximum	89.57	13
	Count	10	10
GW2	Minimum	74.03	0.55
	Mean	75.33	1.47
	Maximum	76.25	2.77
	Count	10	10
GW3	Minimum	77.95	7.62
	Mean	78.39	8.06
	Maximum	78.83	8.5
	Count	2	2
GW3A	Minimum	76.88	2.4
	Mean	79.433	7.017
	Maximum	84.05	9.57
	Count	10	10

3.3.3.2 Highest groundwater levels were recorded in GW1, and lowest in GW2, suggesting the predominant groundwater flow is towards the south/south-west. Groundwater levels in GW3 were higher than those in GW3A. This could be due to GW3 being slightly more up-gradient than GW3A. However, it is considered more likely that the shale monitored in GW3 represents a different hydrogeological layer that may be 'confined' within the shale/mudstone rock type, below the interbedded limestone sequence.

3.3.3.3 Groundwater levels were found to vary most in GW1, where a difference of 8.37m was noted between the lowest and highest groundwater levels. The smallest difference in groundwater levels during the reviewed period was observed in GW2, where groundwater varied by only 2.22m. This suggests, that the strata where GW2 is installed have the capacity to respond to heavy rainfall and store/transport the water faster than the rock within which GW1 (and GW3 and GW3A) is installed.

3.3.3.4 Contour plots of groundwater levels were created using Surfer. The monitoring results from each of the monitoring visits were used to evaluate the groundwater levels at the specific time. In order to more accurately specify the boundary conditions of the simulation area and allow extrapolation of the groundwater levels across the area between the site and Cors Erddreiniog, a number of additional points were added to the simulation, where information was available regarding the surrounding surface water features and their relation to the groundwater. GW3 was not included in this assessment as the behaviour of groundwater at this location suggests that the aquifer monitored within it may not be in hydraulic continuity with that within the Carboniferous Limestone. The results used for the plots and justifications for their use are summarised in Table 7 below.

Table 7. Groundwater level inputs for contour plot simulations

		Data	July	Aug	Sept	Oct	
Point type	Easting	Northing	mAOD	mAOD	mAOD	mAOD	Justification
GW1	247981.6	381496.1	81.21	83.03	83.34	89.11	Routine monitoring data
GW2	248059.2	381108.4	75.22	75.01	74.14	75.93	Routine monitoring data
GW3A	247944.5	381290.5	76.61	78.4	79.98	83.78	Routine monitoring data
Site sump	248130	381152.2	73	73	73	73	Measured level (actively managed to this level)
	248140.1	381152.2	73	73	73	73	
	248140.1	381169.1	73	73	73	73	
	248140.1	381189.3	73	73	73	73	
	248140.1	381202.8	73	73	73	73	
	248123.2	381189.3	73	73	73	73	
	248123.2	381172.4	73	73	73	73	
Spring NE	248339	381644.5	92.5	92.5	92.5	92.5	Assumed level based on map of the location of spring and surrounding topography
W4	247614.1	381762.5	72.5	72.5	72.5	72.5	
W5	247583.8	381529.8	70	70	70	70	
Stream crossing 90mAOD contour	248372.7	381516.3	90	90	90	90	Assumed level based on map of the stream and surrounding topography
	248409.8	381196	80	80	80	80	
	248065.9	381037.6	75	75	75	75	
	247947.9	381030.8	70	70	70	70	
	247900.7	381010.6	70	70	70	70	
	247860.2	380983.6	70	70	70	70	
	247813	380845.4	65	65	65	65	
Boundary of SSSI along 65mAOD contour	247489.4	381010.6	65	65	65	65	Assumed level based on map of the SSSI and surrounding topography
	247489.4	381091.5	65	65	65	65	
	247492.8	381175.8	65	65	65	65	
	247499.5	381314.1	65	65	65	65	
	247529.8	381388.2	65	65	65	65	
	247546.7	381492.7	65	65	65	65	
	247556.8	381573.7	65	65	65	65	
Assumed water level within SSSI	247405.1	381782.7	63	63	63	63	
	247405.1	381708.5	63	63	63	63	
	247401.7	381610.7	63	63	63	63	
	247384.9	381469.1	63	63	63	63	
	247371.4	381401.7	63	63	63	63	

3.3.3.5 The contour plots, presented on Drawing 3131.HRA.03 indicate that the groundwater table in the interbedded limestone sequence represents a depressed version of the

topography in the area. The dewatering carried out at the site is shown to cause a drawdown within the rock around the quarry.

3.3.3.6 Groundwater flow would be in a direction perpendicular to the plotted groundwater elevation contours. It can be seen that immediately east of the quarry and within the quarry the predominant groundwater flow direction is determined by the drawdown at the sump and is towards this lowest point. The dewatering at the site increases the groundwater gradient into the site, causing groundwater to flow into the site and collect at the sump.

3.3.3.7 If no drawdown effect was being caused within the site, groundwater from this part of the catchment would still flow towards the principal surface water feature in the area, the stream running past the southern site boundary, and drain to it up to approximately 300m downstream of the site. This indicates that the water discharged to the stream via the active water management system at the site would have naturally run off to the stream. Therefore dewatering operations in this area would not have an effect on the ratio of groundwater to surface water reaching the SSSI.

3.3.3.8 The groundwater flow direction in the very northern part of the site near GW1 is interpreted as being west/south-west, and would likely constitute part of the groundwater component of the water reaching the SSSI. The part of the site where groundwater flow is currently in this direction, has not been quarried to date, and it is not proposed that any quarrying is carried out there. The contour plots indicate that this curving effect of groundwater contours means that no direct link exists between the groundwater flowing through the quarry and the line of springs on the eastern boundary of the SSSI.

3.3.3.9 The simulated groundwater contours suggest that the groundwater gradient in the area surrounding the site can be as high as 6 in 100 or 0.06, but is typically 0.045. The observed relatively steep gradient supports the view that groundwater flow through the limestone aquifer would be very restricted.

3.3.4 Aquifer properties

3.3.4.1 The limestone at the site is characterised by a lack of well developed secondary porosity features (such as fissures, fractures, bedding planes, faults or karst features) as indicated by the onsite observations. These features would typically allow groundwater to flow freely within the rock strata.

3.3.4.2 Evidence of similar lack of secondary features has been reported for the Carboniferous Limestone at Rhuddlan Bach Quarry (approximately 600m south-east of Nant Newydd Quarry) indicating that this is likely to be a regional characteristic of the rock type rather than a localised irregularity.

3.3.4.3 Flow of water from the quarry faces has been observed to occur from the mudstone bands interbedded with the limestone. It is likely that even though secondary porosity is not well developed within the limestone, some exists in the form of poorly developed fissures within the mudstone bands within the interbedded limestone sequence. It is considered that this secondary porosity within the mudstone bands represents the dominant flow mechanism of groundwater within the interbedded limestone sequence.

3.3.4.4 Graphs GR2 and GR3 in Appendix 4 show the groundwater levels and groundwater levels in relation to rainfall hydrographs. It can be seen that groundwater in GW2 remained relatively stable throughout the reviewed period, while greater fluctuations were observed in the other boreholes. Groundwater level increased from the summer through to October, when the highest groundwater levels were recorded, and subsequently reduced in November.

3.3.4.5 The hydrograph presented on GR2 shows that groundwater level in GW1 and GW3A can increase rapidly at these locations. Sharp increases in groundwater level are likely to relate to prolonged periods of heavy rainfall events. The groundwater response to rainfall in the different locations can be assessed from graph GR3. It can be seen that after heavy rainfall on the 18th, 21st and 26th June groundwater level in GW1 increased by approximately 4m. Groundwater level in GW3A increased by 1m over the same time period. Throughout July rainfall was more sustained and evenly spread out during the month. Groundwater levels in GW1 fell by approximately 3m while groundwater levels in GW3A reduced by only 1m, and in GW2 did not change during this month.

3.3.4.6 In order to establish the hydraulic conductivity of the aquifer, slug tests were carried out. The slug tests were completed by removing 1l-2l of groundwater as quickly as possible (mimicking instantaneous removal of groundwater), and monitoring speed of the groundwater recovery to original groundwater levels. The methodology for conducting this investigation and the raw monitoring results are included in Appendix 6.

3.3.4.7 These were completed in all four boreholes. Two tests on two separate occasions were carried out in GW1 to decrease the uncertainty associated with the technique and the

analysis. The input parameters (excluding the input data) for each simulation are based on the installation details for each well and are included in Table 8 below.

Table 8. AquiferWin32 slug test parameters

Parameter/borehole	Units	GW1	GW2	GW3	GW3A
Casing inner diameter	m	0.05	0.05	0.05	0.05
Hole drilled diameter	m	0.15	0.15	0.15	0.15
Screened length	m	12	3	5	9
Screened top depth	m	9	2	26	7
aquifer thickness	m	26	26	10	26
Convergence level		$1E^{-5}$	$1E^{-5}$	$1E^{-5}$	$1E^{-5}$
Iteration number		100	100	100	100
Aquifer type		unconfined	unconfined	confined	unconfined
Solution		Bouwer and Rice	Bouwer and Rice	KGS Partial penetration	Bouwer and Rice

3.3.4.8 The groundwater encountered within the interbedded limestone in GW1 and GW3A, and within the drift deposits at GW2 was interpreted as being a hydraulically continuous unconfined aquifer spanning between these locations and the SSSI. The thickness of this aquifer is based on the depth at which the shale, monitored in GW3 was encountered. Because of the anticipated low permeability of the interbedded limestone sequence 'aquifer', the analysis of the slug test for GW3 assumed that the underlying shale represents a separate, confined aquifer. The convergence level of the solution, which was achieved was better than $1E^{-5}$ within up to 100 iterations. The accuracy of results for aquifers with very low permeability is reduced due to the assumptions of the analytical method. For all tests the convergence was reached before 100 iterations of the calculation were complete.

3.3.4.9 The results were assessed using Aquifer Win32, and are summarised in Table 9 below. The hydraulic conductivity of the limestone was found to be in the region of $1E^{-07}$m/s (between $1.5E^{-07}$m/s 2 and $6.5E^{-07}$m/s). There was a good correlation between the hydraulic conductivity estimate for GW1 and GW3A indicating that the properties of the interbedded limestone sequence are similar in the area, rather than localised near one borehole. The hydraulic conductivity calculated for GW3 was approximately $1E^{-09}$m/s, two orders of magnitude lower than that at GW1 and GW3A. While this result is associated with a large uncertainty, it does indicate that the hydraulic conductivity within the shale layer is significantly less than that within the interbedded limestone sequence. This supports the view that the groundwater within the interbedded limestone sequence and that within the underlying shale may not be in full hydraulic continuity and may represent two separate aquifers.

3.3.4.10 Groundwater level within GW2 recovered more quickly than the dip could be obtained after removal of water. At this location recovery of the groundwater table to its steady state level was almost instantaneous. Therefore an estimate of the minimum hydraulic conductivity of the drift deposits near this location was bade by calculating the displacement, which would be caused by the removal of 2l of water, and assigning this to a time of 1s, and assigning 0.01m drawdown one second before the time when the

first dip of the test was measured. The estimated hydraulic conductivity at this point is estimated as being approximately $1E^{-05}$m/s.

Table 9. Slug test analysis results.

	GW1	GW2	GW3	GW3A
convergence within 100 iterations	Y	Y	Y	Y
hydraulic conductivity (m/s)	$1.52E^{-07}$ $6.50E^{-07}$	$3.18E^{-05}$	$3.60E^{-09}$	$1.52E^{-07}$
Response zone type	Limestone rock	Drift deposits	Shale rock	Limestone rock

3.3.4.11 Based on the observations and analyses discussed above, it is interpreted that the interbedded limestone sequence and overburden deposits form a hydraulically continuous aquifer. Both the site and the SSSI sit above/within this aquifer. Despite the interpretation of these strata as an aquifer, at depth the interbedded limestone sequence is likely to contain only small volumes of groundwater and to a degree restrict the flow of groundwater both laterally and vertically. This view is supported by the calculated hydraulic conductivity of the interbedded limestone sequence. It is considered likely that the underlying shale represents a separate aquifer to that within the limestone.

3.3.5 Groundwater quality

3.3.5.1 Groundwater quality monitoring has been undertaken in springs and wells around the site and subsequently in dedicated groundwater monitoring boreholes. The results are graphed in Appendix 7, and are summarised in Tables 10a and 10b (below) respectively.

Table 10a. Summary statistics for groundwater monitoring in W4, W5 and WELL

Location		W4				W5				WELL			
Parameter	**Units**	**Min**	**Mean**	**Max**	**count**	**Min**	**Mean**	**Max**	**count**	**Min**	**Mean**	**Max**	**count**
Ammoniacal Nitrogen as N	mg/l	0.20	0.20	0.20	12	<0.20	<0.20	<0.20	7	<0.20	0.23	0.40	7
Arsenic Dissolved (ICP MS)	ug/l	<1.00	3.43	10.00	4	<1.00	4.63	10.00	3	<1.00	4.17	10.00	3
BOD	mg/l	<1.00	1.33	2.00	3	<1.00	1.00	1.00	1	<1.00	<1.00	<1.00	1
Cadmium Dissolved (ICP MS)	ug/l	<0.22	0.39	0.50	8	<0.22	0.38	<0.50	5	<0.22	0.39	<0.50	6
Calcium Dissolved (ICP MS)	ug/l	98000	112666	120000	3	120000	125000	130000	2	110000	120000	130000	2
Chloride	mg/l	20.00	24.08	27.00	12	25.00	27.00	31.00	7	33.00	37.00	43.00	7
Chromium Dissolved (ICP MS)	ug/l	1.00	2.83	6.00	6	<1.00	3.33	8.00	3	1.00	3.33	8.00	3
COD	mg/l	10.00	12.20	21.00	5	10.00	11.33	14.00	3	10.00	10.00	10.00	3
Conductivity (at 25 deg.C)	mS/cm	0.55	0.63	0.67	12	0.66	0.69	0.71	7	0.69	0.72	0.77	7
Copper Dissolved (ICP MS)	ug/l	1	11.2	31.00	4	1.00	1.30	1.60	3	3.00	6.20	9.40	3
Dissolved Oxygen	mg/l	6.00	8.25	10.00	12	4.00	7.86	9.00	7	3.00	6.86	9.00	7
Iron Dissolved (ICP MS)	ug/l	<5.00	59.67	120.00	6	5.00	21.33	54.00	3	<5.00	20.00	50.00	3
Lead Dissolved (ICP MS)	ug/l	<0.40	1.23	2.00	6	<0.40	0.80	1.00	3	0.50	0.83	1.00	3
Magnesium Dissolved (ICP MS)	ug/l	4300	5000	5600.00	4	5600	5800	6000	3	8000	8250	8500	3
Manganese Dissolved (ICP MS)	ug/l	<1.00	6.00	25.00	6	<2.00	2.33	3.00	3	<2.00	3.33	6.00	3
Mercury Dissolved (CVAF)	ug/l	<0.01	0.03	0.05	4	<0.01	0.02	0.05	3	<0.01	<0.02	<0.05	3
Mineral Oil Aqueous	ug/l	<10.00	<10.00	<10.00	3	<10.00	<10.00	<10.00	2	<10.00	<10.00	<10.00	2
Nickel Dissolved (ICP MS)	ug/l	<1.00	4.61	26.00	12	<1.00	2.00	3.20	7	<1.00	2.43	3.30	7
Nitrate as NO3	mg/l	<0.30	18.38	29.00	6	25.00	29.33	32.00	3	25.00	32.33	38.00	3
Nitrite as NO2	mg/l	<0.05	<0.05	<0.05	6	<0.05	0.05	0.05	3	<0.05	<0.05	<0.05	3
PAH 16 Total Aqueous	ng/l	<27.00	69.00	100.00	3	<26.00	63.00	100.00	2	<26.00	63.00	100.00	2
pH Value	pH Units	7.72	8.13	8.42	12	7.87	8.16	8.32	7	8.18	8.27	8.41	7
Phenols Monohydric	mg/l	<0.01	<0.01	<0.01	3	<0.01	<0.01	<0.01	2	<0.01	<0.01	<0.01	2
Phosphate (Ortho as PO4)	mg/l	<0.01	0.07	0.12	4	<0.01	<0.05	<0.08	2	<0.01	<0.05	<0.08	2
Potassium Dissolved	mg/l	1.10	1.33	1.50	3	1.40	1.60	1.80	2	5.30	5.60	5.90	2
Selenium Dissolved (ICP MS)	ug/l	<1.00	2.00	4.00	3	<1.00	3.00	5.00	2	<1.00	2.00	3.00	2
Sodium Dissolved	mg/l	12.00	12.33	13.00	3	11.00	12.00	13.00	2	9.80	11.90	14.00	2
Sulphate (soluble)	mg/l	20.00	24.25	31.00	12	22.00	25.57	27.00	7	26.00	31.29	38.00	7
Total Alkalinity as CaCO3	mg/l	260.00	265.00	270.00	2	280.00	280.00	280.00	2	270.00	275.00	280.00	2
Total Organic Carbon	mg/l	2.00	3.33	6.00	6	<3.00	<3.00	<3.00	3	<3.00	<3.00	<3.00	3
Total Oxidised Nitrogen as N	mg/l	0.90	3.40	5.90	2	-	-	-	-	-	-	-	-
Total Suspended Solids	mg/l	8.00	14.67	26.00	3	7.00	7.00	7.00	1	37.00	37.00	37.00	1
TPH	mg/l	<1.00	1.33	2.00	3	2.00	2.00	2.00	1	2.00	2.00	2.00	1
Zinc Dissolved (ICP MS)	ug/l	<3.00	9.67	23.00	9	<3.00	27.50	86.00	6	8.00	55.50	94.00	6

Table 10b. Summary statistic for groundwater monitoring in GW1. GW2 and GW3A

		GW1				GW2				GW3			
		Min	**Mean**	**Max**	**Count**	**Min**	**Mean**	**Max**	**Count**	**Min**	**Mean**	**Max**	**Count**
Ammoniacal Nitrogen as N	mg/l	0.2	0.26	0.4	5	0.2	0.22	0.3	5	0.2	0.22	0.3	5
Arsenic Dissolved (ICP-MS)	ug/l	1.1	1.2	1.3	2	0.75	0.755	0.76	2	3.1	7.05	11	2
Cadmium Dissolved (ICP-MS)	ug/l	0.22	0.263333	0.35	3	0.22	0.226667	0.24	3	0.22	0.22	0.22	3
Calcium Dissolved (ICP-MS)	ug/l	130000	130000	130000	2	140000	160000	180000	2	130000	130000	130000	2
Chloride	mg/l	26	35.2	48	5	28	33.8	38	5	38	84.2	150	5
Chromium Dissolved (ICP-MS)	ug/l	2	2	2	2	1	2	3	2	3	3.5	4	2
COD	mg/l	300	465	630	2	66	93	120	2	120	230	340	2
Conductivity (at 25 deg.C)	mS/cm	0.61	0.73	0.87	5	0.77	0.816	0.85	5	0.73	1.228	1.9	5
Copper Dissolved (ICP-MS)	ug/l	1.6	1.6	1.6	2	1.6	1.6	1.6	2	1.6	1.6	1.6	2
Dissolved Oxygen	mg/l	5	6.6	7	5	4	6.6	8	5	3	4.2	6	5
Iron Dissolved (ICP-MS)	ug/l	50	53.5	57	2	50	50	50	2	50	50	50	2
Lead Dissolved (ICP-MS)	ug/l	0.4	0.4	0.4	2	0.4	0.4	0.4	2	0.4	0.4	0.4	2
Magnesium Dissolved (ICP-MS)	ug/l	6200	7450	8700	2	5400	6450	7500	2	17000	17000	17000	2
Manganese Dissolved (ICP-MS)	ug/l	6	9.5	13	2	1	4	7	2	6	238	470	2
Mercury Dissolved (CVAF)	ug/l	0.01	0.01	0.01	1	0.01	0.01	0.01	1	0.01	0.01	0.01	1
Mineral Oil Aqueous	ug/l	10	10	10	1	10	10	10	1	1400	1400	1400	1
Nickel Dissolved (ICP-MS)	ug/l	10	15.25	19	4	2.4	4.625	6.3	4	40	61.5	90	4
Nitrate as NO3	mg/l	4.6	5.8	7	2	31	33	35	2	2.3	5.3	8.3	2
Nitrite as NO2	mg/l	0.4	0.555	0.71	2	0.05	0.07	0.09	2	0.07	5.035	10	2
PAH 16 Total Aqueous	ng/l	100	100	100	2	100	100	100	2	100	100	100	2
pH Value	pH Units	7.47	7.638	7.73	5	7.43	7.63	7.8	5	7.48	7.744	7.93	5
Phenols Monohydric	mg/l	0.01	0.18	0.35	2	0.01	0.18	0.35	2	0.01	0.18	0.35	2
Phosphorus Dissolved (ICP-MS)	ug/l	105	105	105	1	105	105	105	1	105	105	105	1
Potassium Dissolved	mg/l	2.6	2.65	2.7	2	2	2.6	3.2	2	1.2	4	6.8	2
Selenium Dissolved (ICP-MS)	ug/l	2	2.5	3	2	1	1.5	2	2	1	2	3	2
Sodium Dissolved	mg/l	19	42.5	66	2	20	26	32	2	15	20.5	26	2
Sulphate (soluble)	mg/l	61	115.8	220	5	43	98	150	5	59	277.6	630	5
Total Alkalinity as CaCO3	mg/l	320	1110	1900	2	210	380	550	2	240	870	1500	2
Total Organic Carbon	mg/l	4	6.5	9	2	3	3.5	4	2	3	4.5	6	2
Zinc Dissolved (ICP-MS)	ug/l	5	6.333333	9	3	5	5	5	3	5	7.333333	10	3

3.3.5.2 The elevated concentrations of calcium and magnesium recorded in the springs, the well and GW1, GW2 and GW3A are likely to result from the geological setting of the aquifer within Carboniferous limestone. The recorded concentrations of Calcium between 98mg/l inW4 and 180mg/l in GW2 are similar to those recorded in surface water. Magnesium concentrations varied between 4.3mg/l in W4 and 17mg/l in GW3A. The concentrations of magnesium in the WELL and groundwater monitoring boreholes are slightly more elevated than those in the two springs.

3.3.5.3 Total alkalinity in groundwater recovered from the groundwater monitoring boreholes was greater than that within the springs and the WELL. In the groundwater monitoring boreholes highest total alkalinity was recorded in GW1 (1900mg/l), and lowest in GW2 (210mg/l-550mg/l). The level of total alkalinity of the groundwater is likely to be related to the residence time of the groundwater within the aquifer. Such interpretation would indicate that W4 and W5 (the springs) are likely to be typified by flows which have shorter residence time within the limestone than the groundwater recovered from the groundwater monitoring boreholes.

3.3.5.4 pH value in groundwater monitoring boreholes was neutral to slightly alkaline. Samples from W4, W5 and the WELL were found to be more alkaline, similarly to the pH levels recorded in surface water monitoring locations.

3.3.5.6 Ammoniacal nitrogen was relatively low in all monitoring locations. Highest levels were recorded in GW1 (0.4mg/l) which is up-gradient of the site, and therefore representative of background conditions rather than indicative of a possible impact of the activities at the site.

3.3.5.7 Chloride concentrations in W4, W5 and WELL remained below 43mg/l in all monitoring occasions. The concentrations recorded in GW1 and GW2 are of similar concentrations as in W4, W5 and the WELL (on average 35.2mg/l and 33.8mg/l respectively). In GW3A relatively elevated concentrations of chloride were recorded in July and August 2008 (150mg/l and 130mg/l). This monitoring location would be down-gradient of the site, however only material stockpiles exist in the part of the site, which is up-gradient of this location. It is likely that any water coming into contact with the waste mass in this part of the site would be drawn down into the site under the current water management and would be discharged via W1, therefore being monitored at that point. It is considered that other sources could be impacting this well as it is situated within agricultural land. Chloride at the maximum recorded concentration is significantly below the EQS for fresh water for this parameter.

3.3.5.8 Electrical conductivity was found to be low in W4, W5 and WELL (below 770µS/cm). The levels of electrical conductivity recorded in the groundwater monitoring wells were slightly higher, reaching 1900µS/cm in GW3A. It is likely that this slightly elevated electrical conductivity result relates to the relatively higher chloride result at this location.

3.3.5.9 BOD levels in W4, W5 and the WELL were below the detection limit of 1mg/l on most occasions, with highest value of 0.2mg/l being recorded in W4. No analysis for BOD

has been completed on samples from GW1, GW2 and GW3A yet. COD levels in W4, W5 and WELL were relatively low, with highest reading of 14mg/l being recorded in W5. The COD levels in groundwater recovered from the monitoring boreholes were significantly higher with average concentrations of 465mg/l in GW1, 93mg/l in GW2 and 230mg/l in GW3A. The concentrations appear similarly elevated in all three monitoring locations, both up and down-gradient of the site, indicating that activities at the site are unlikely to have given rise to these concentrations. The levels of dissolved oxygen inW4, W5 and WELL were on average 8.25mg/l, 7.86mg/l and 6.86mg/l, of similar magnitude to those in surface water samples. The corresponding values in GW1, GW2 and GW3A were 6.6mg/l, 6.6mg/l and 4.2mg/l respectively, although it is likely that the process of obtaining the sample would have introduced some oxygen into the sample.

3.3.5.10 Nitrate concentrations in W4, W5 and WELL were found to be somewhat elevated with average concentrations of 18.38mg/l, 29.33mg/l and 32.33mg/l respectively. Nitrate concentrations in GW2 were similar, with an average of 33mg/l, whereas those in GW1 and GW3A were significantly lower, with average concentrations of 5.8mg/l and 5.3mg/l respectively. Nitrites in W4, W5 and WELL were recorded below the detection limit during all monitoring visits. The concentrations of this determinant in GW1 and GW3A were more elevated, with averages of 0.56mg/l and 5.035mg/l respectively, reflecting the more reducing conditions prevailing in the groundwater within the limestone at these locations. It is likely that the relatively wide-spread increase in nitrates and nitrites observed around the site in comparison to the levels in surface water is due to agricultural practises in the surrounding fields. The surface water monitoring results for the site support the view that there are no sources of nitrates within the quarry, and therefore there would be no releases of these nutrients because of activities undertaken at the site.

3.3.5.11 The concentrations of phosphate in W4, W5 and the WELL were relatively low, recorded slightly above the detection limit on one occasion in W4 (a concentration of 0.12mg/l has been reported as the maximum). No phosphate monitoring has been undertaken in the groundwater monitoring boreholes, as it is considered that Nant Newydd Quarry is not a source with regards to this nutrient, and activities at the site could not give rise to releases of phosphates into the environment. This interpretation is supported by the surface water monitoring results for the site.

3.3.5.12 Sulphate concentrations in W4, W5 and WELL were very low, on average 24.25mg/l, 25.57mg/l and 31.29mg/l. The corresponding concentrations recorded in GW1, GW2 and GW3A were 115.8mg/l, 98mg/l and 277.6mg/l respectively. The relatively similar concentrations both up and down-gradient of the site suggest that elevated sulphate concentrations may be typical for groundwater within this aquifer. It is unlikely that the recorded concentrations are impacted by activities onsite as the current active water management at the site would prevent water, which has been in contact with the wastes or been impacted by the quarrying activities at the site to reach GW3A.

3.3.5.13 Concentrations of potassium were very low in all groundwater monitoring locations, with averages of 1.33mg/l, 1.6mg/l, 5.6mg/l, 2.65mg/l, 0.2.6mg/l and 4mg/l inW4, W5, WELL, GW1, GW2 and GW3A respectively. Concentrations of sodium were also

very low in W4, W5 and WELL remaining below 14mg/l in all monitoring visits. Sodium concentrations in GW1, GW2 and GW3A were slightly more elevated to a maximum of 66mg/l in GW1, which is below the EQS for fresh water.

3.3.5.14 TPH and TOC levels in all groundwater monitoring locations were found to be low. Maximum TOC was recorded in GW1 as 9mg/l. in W5 and WELL the concentrations of TOC remained below the detection limit on all visits. The maximum TPH concentration recorded was 2mg/l in W4, W5 and WELL. The concentrations of mineral oils were below the detection limit of 0.01mg/l for all groundwater monitoring locations except GW3A where a concentration of 1.4mg/l was recorded. Due to the inward gradient into the site, it is not considered that there is a pathway between any wastes in the north of the site and GW3A at present. Therefore the observed result for mineral oils indicates that there are off-site sources, which could give rise to such concentrations of this determinant, or that there may be naturally occurring organic substances which have been detected as mineral oils at this location. No PAHs were detected in any of the groundwater samples when they were analysed for. Phenols were reported as being below the detection limit in all locations when they were analysed for.

3.3.5.15 Cadmium and mercury were recorded in groundwater below the detection limit during all relevant monitoring occasions. The concentrations of lead and selenium remained relatively low in all samples, not exceeding 2µg/l and 5µg/l respectively. Concentrations of arsenic were recorded as high as 10µg/l in W4, W5 and WELL and 11µg/l in GW3A. It is considered that these concentrations reflect the natural variation of this determinant within the rock.

3.3.5.16 The concentrations of chromium, copper, iron, and zinc were re found to be very low in groundwater monitoring boreholes GW1, GW2 and GW3A with maximum concentrations at these locations being reported as 4µg/l, 1.6µg/l, 57µg/l and 10µg/l respectively. Concentrations of chromium, copper and iron in W5 and WELL were relatively similar to those in the groundwater boreholes. In W4 the concentrations of these metals were higher than elsewhere with average concentrations of 2.83µg/l, 11.2µg/l, 59.67µg/l respectively. Manganese concentrations were below 25µg/l in all groundwater locations except GW3A where concentrations of up to 470µg/l were recorded. All of the recorded concentrations are considered to be representative of background groundwater quality in the area, since there is no direct hydrogeological pathway currently between the site and these monitoring locations.

3.3.5.17 The groundwater quality around the site reviewed in this report represents background groundwater quality, as the surface water management at the site creates an inward groundwater gradient into the site. The groundwater quality appears to be typical for a calcareous bedrock. Groundwater quality is generally good, and loading with organic compounds and metals is generally limited. Nutrient loading of groundwater particularly with nitrate appears to have occurred over the entire area possibly as a result of agricultural activities being undertaken in nearby fields. There seems to be a general difference between the groundwater quality within the aquifer (GW1 and GW3A) and the areas which are likely to be characterised by faster groundwater flow through fractures near the surface of the limestone or the overlying drift deposits(GW2, W4 and W5). There is evidence that GW3A might be impacted by

some offsite contamination, causing slight increase in the concentration of mineral oils, chloride and electrical conductivity in comparison to GW1. It is extremely unlikely to be as a result of any activities, which have been undertaken at Nant Newydd Quarry as the active water management within the quarry prevents the creation of a direct hydraulic pathway between the quarry and GW3A at present.

4 PROPOSED DEVELOPMENT

4.1 Quarrying activities

4.1.1 This report is produced in support of an application for continuation of planning permission condition to extract Carboniferous Limestone from the site with restoration via inert landfilling (PPC Permit no RP3337SE). As such, the proposed quarrying activities are in accordance with those permitted previously, and no plans have been made to deepen or extend the quarry further to what was approved previously.

4.1.2 The extent of the quarry area is to remain within the part of the quarry, where overburden materials have been stripped to date. It is not proposed that the area of quarrying activities is extended further to the north, past the current quarry face. It is understood that quarrying activities will be undertaken to deepen the floor of the quarry in the northern part of the site to extract the commercially viable stone, which is found there. While previously in the southern part of the quarry excavations have been undertaken to a level below the surrounding groundwater table (now forming the sump at the site), it is proposed that the future stone extraction at the site is carried out above the water table. The quarry floor can then be angled to the existing sump, above the groundwater level as interpreted from contour plots for the site, thus preventing further lowering of the groundwater table in the surrounding area.

4.1.3 Phasing of the site will be from the eastern side of the quarry, where final excavation levels have been reached, to the north and west of the quarry, where current levels are significantly higher (and smaller volumes of stone have been extracted to date).

4.1.4 It is proposed that extraction of stone is carried out using a pecker and a excavator as was done at the site previously. The stone will be removed and will be sorted onsite to allow different fractions and quality of stone to be sold off as required. The overburden material from the site will be retained in stockpiles to be used at the site as engineering material or for restoration purposes as required.

4.1.5 It is proposed that the quarrying activities will continue according to an evaluation of the groundwater table based on the current groundwater levels using contour plots to extrapolate between known groundwater elevations. These can be transposed to site by topographic surveying of the active areas and review of the remaining available thickness of rock above the water table. Quarrying to the existing groundwater levels should allow for the higher grade stone, which is found at a slightly greater depth, to be extracted.

4.2 Landfilling activities

4.2.1 Landfilling activities at the site are currently regulated by the PPC Permit issued in April 2007. The currently permitted tonnage of waste is 5000 tonnes per annum. The waste streams are strictly inert waste. The requirement for ensuring that the existing waste mass is also inert according to current standards was satisfied during a sampling and testing investigation carried out in summer 2006 and correspondence relating to this

issue is included in Appendix 1. The definition of inert waste is such waste, which will not undergo any significant chemical or physical changes. As such it is not anticipated that the wastes within the existing waste mass or within any of the future wastes, which will be accepted at the site will have the potential to generate 'leachate', which could pose a threat to the surrounding environment. It is considered that the currently observed surface water quality of W1 is representative of the likely contaminant loading which the site can give rise to. It is not likely that future landfilling activities will have an adverse impact on the quality at this sampling location due to the controls required for waste acceptance under the existing PPC regime.

4.2.2 Upon completion of the pre-operational conditions stipulated in the PPC Permit to the satisfaction of the EA and granting of extension to the planning permission for the site, waste acceptance will commence in accordance with the current requirements within the PPC Permit for the site. All future areas, where waste acceptance will be carried out will be lined using appropriate engineering material, according to the CQA plan for the site submitted in September 2008. The cells will be constructed in parts of the site, where excavation has reached its lowest level, and no further extraction would be carried out. This indicates that the phasing would be from south to north, and from east to west of the site.

4.2.3 The site will be restored to original ground levels using inert fill as indicated above. It is considered that during the operation of the quarry, active water management will continue as required. Upon completion of restoration active water management will cease.

5 POTENTIAL IMPACTS AND MITIGATION MEASURES

5.1 Groundwater flow direction

5.1.1 Cors Erddreiniog constitutes a receptor of particular sensitivity regarding the quantity and quality of groundwater and surface water reaching the site. The ration of surface water flow to groundwater flow has been highlighted as being particularly important to maintaining the ecology within the SAC.

5.1.2 The analysis of the hydrogeological regime of the site presented in this document suggests that groundwater flowing under the site southwards from GW1 would discharge to the stream forming the southern boundary of Nant Newydd Quarry, rather than forming groundwater flow input into the SAC. Therefore the active water management operations at the site are not causing an alteration in the groundwater/surface water budget of this sensitive area. The outlined methods of work have been designed, so as not to alter the existing conditions at the site, therefore the future quarrying and landfilling activities are also unlikely to pose a risk of altering groundwater flow directions and therefore volumes reaching the SAC.

5.2 Groundwater and surface water quality

5.2.1 Waste acceptance criteria testing (WAC) of the waste carried out as part of PPC application for the site provided evidence that the existing waste mass at the site was inert according to the current definition of the term. This indicates that 'leachate' from the existing wastes is in compliance with the groundwater regulations, and therefore this waste mass does not represent a potential source of contamination with regards to groundwater and surface water resources, and is not considered further.

5.2.2 The water quality at W1 was found to be generally good in relation to the surface water quality upstream of the site, and very good in relation to the groundwater quality observed in GW3A, GW1, W4 and W5. Monitoring at this location has been carried out for over 3 years providing a data set within which different conditions have occurred, including heavy rainfall/prolonged periods of no rainfall, and different activities onsite. Water monitoring carried out at W1 at the site monitors all water which collects at the base of the site. As samples obtained from W1 most accurately represent the pollution potential of the site, it is considered, that the activities do not give rise to potentially hazardous discharges of contaminants from the site. As proposed future quarrying activities are to remain in line with previously permitted activities, and landfilling is to be undertaken in accordance with the PPC Permit for the site, it is not anticipated that the proposed development will have an impact on the quality of the water within the stream down-gradient of the site or Cors Erddreiniog.

5.3 Groundwater and surface water quality

5.3.1 As no impacts are anticipated of the activities onsite, it is not considered that specific mitigation measures would be required. It is recognised that the performance of the site should be assessed rigorously to ensure that the interpretations made in relation to the groundwater regime at the site remain relevant. Therefore it is proposed that a

monitoring regime is adopted at the site in line with the current PPC permit requirements. This is summarised in Tables 10a and 10b below.

Table 10a. Proposed groundwater monitoring

Determinands	**Monitoring Frequencies**	**Normal Reporting Limits and Units**	**Monitoring locations**
Water levels	Monthly	+/- 10 mm	All locations
pH	Monthly	+/- 0.1 pH units	All locations
Temperature	Monthly	+/- 0.5 degC	All locations
Electrical Conductivity	Monthly	10 □S/cm	All locations
Ammoniacal Nitrogen	Monthly	0.04 mg/l	All locations
Chloride	Monthly	1 mg/l	All locations
Dissolved Oxygen	Monthly		All locations
Sulphate	Monthly	5 mg/l	All locations
TOC	Monthly	0.3 mg/l	All locations
Cd	Monthly	0.1 □µg/l	All locations
Ni	Monthly	10 □µg/l	All locations
Zn	Monthly	10 □µg/l	All locations
Total Alkalinity (as $CaCO_3$ at pH4.5)	Quarterly	5 mg/l	All locations
Phosphate	Quarterly	0.08mg/l	All locations
Chemical Oxygen Demand	Quarterly	5 mg/l	All locations
As	Quarterly	10 □µg/l	All locations
Na	Quarterly	1 mg/l	All locations
K	Quarterly	1 mg/l	All locations
Ca	Quarterly	1 mg/l	All locations
Mg	Quarterly	1 mg/l	All locations
Fe	Quarterly	10 □µg/l	All locations
Mn	Quarterly	20 □µg/l	All locations
Cr	Quarterly	10 □µg/l	All locations
Cu	Quarterly	10 □µg/l	All locations
Pb	Quarterly	10 □µg/l	All locations
Se	Quarterly	10 □µg/l	All locations
List I suite including Cd, Hg, PAH, mineral oils	Annually	various	All locations

Table 10b proposed surface water monitoring

Determinands	**Monitoring Frequencies**	**Normal Reporting Limits and Units**	**Monitoring locations**
pH	Monthly	+/- 0.1 pH units	All locations
Temperature	Monthly	+/- 0.5 degC	All locations
Electrical Conductivity	Monthly	10 □S/cm	All locations
Ammoniacal Nitrogen	Monthly	0.04 mg/l	All locations
Chloride	Monthly	1 mg/l	All locations
Dissolved Oxygen	Monthly		All locations
Sulphate	Monthly	5 mg/l	All locations
TOC	Monthly	0.3 mg/l	All locations
Total suspended solids	Monthly	0.1mg/l	All locations
BOC	Quarterly	5 mg/l	All locations
Total Alkalinity (as $CaCO_3$ at pH4.5)	Quarterly	5 mg/l	All locations
Phosphate	Quarterly	0.08mg/l	All locations
Chemical Oxygen Demand	Quarterly	5 mg/l	All locations
Na	Quarterly	1 mg/l	All locations
K	Quarterly	1 mg/l	All locations
Ca	Quarterly	1 mg/l	All locations
Mg	Quarterly	1 mg/l	All locations
Fe	Quarterly	10□□g/l	All locations
Mn	Quarterly	20□□g/l	All locations
Cd	Quarterly	0.1□□g/l	All locations
Cr	Quarterly	10□□g/l	All locations
Cu	Quarterly	10□□g/l	All locations
Ni	Quarterly	10□□g/l	All locations
Pb	Quarterly	10□□g/l	All locations
Zn	Quarterly	10□□g/l	All locations
List I suite including Cd, Hg, PAH, mineral oils	Annually	various	All locations

6 CONCLUSIONS

6.1 The site comprises a limestone quarry and inert landfill, which is currently permitted to accept strictly inert waste. The site is situated within a sensitive environmental setting, approximately 200m away from an SSSI and SAC designated site, Cors Erddreiniog. This site represents the most sensitive receptor with regards to activities at the site. Constant quantity of groundwater and surface water inflow into the wetland, coupled with no alterations in the groundwater and surface water chemistry of the wetland is crucial to ensuring the conservation of the site.

6.2 This report reviews the hydrogeological regime at the site and the existing monitoring data to assess the potential impact which proposed continuation of quarrying and landfilling might have on surface water and groundwater flows and quality.

6.3. Groundwater flow occurs through fractures, and at depth, intergranularly through the Carboniferous Limestone underlying the site and the surrounding area. Groundwater flow is restricted due to the poor development of secondary porosity (fractures) within the rock, and the lack of primary porosity, due to the nature of the rock. Hydraulic conductivity within the rock was found to be in the order of $1E^{-7}$m/s.

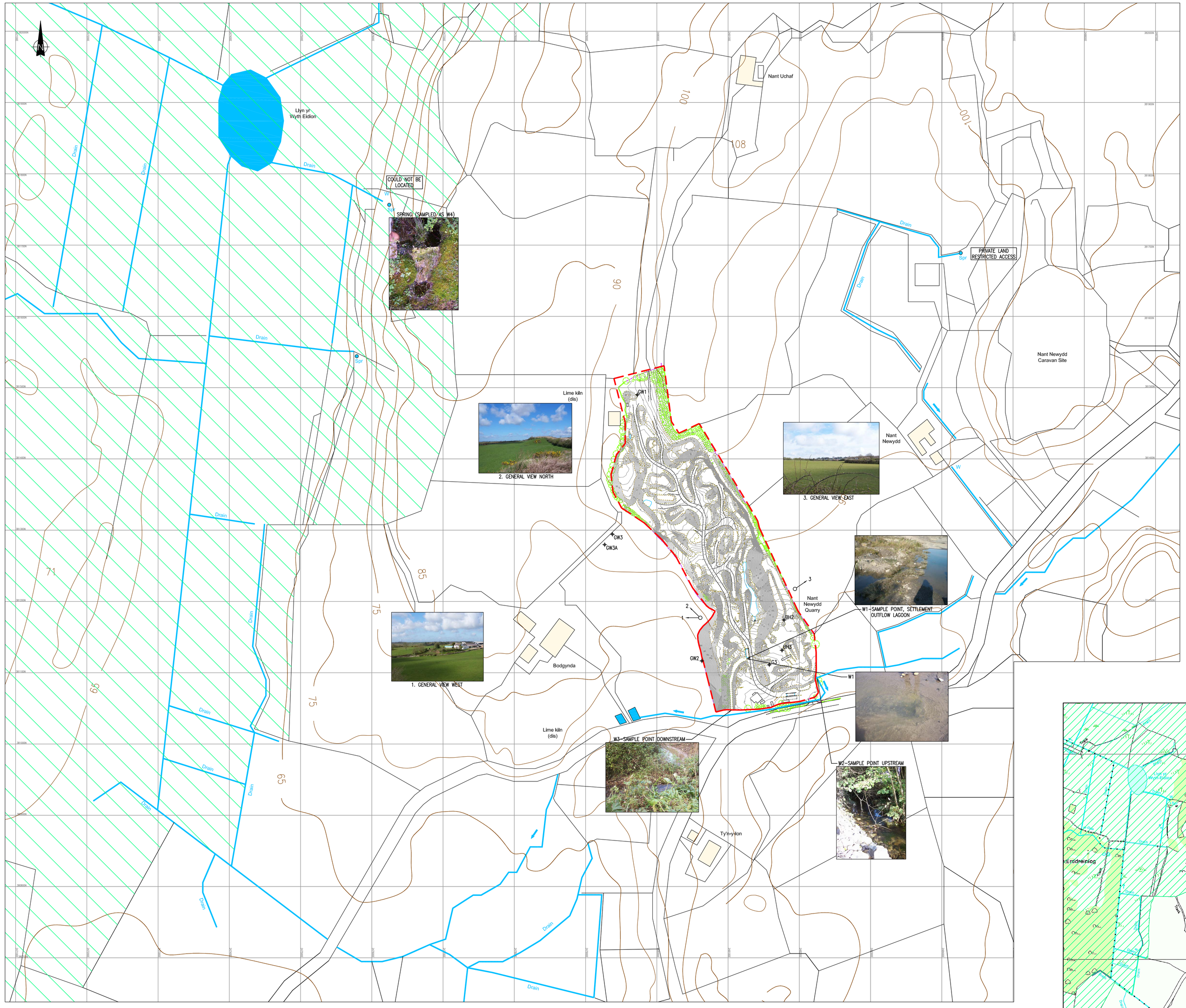
6.4 Groundwater flow direction was estimated using recent groundwater monitoring data, and evaluation of the likely connectivity between surface water features and the underlying groundwater. It was interpreted, that groundwater flow in the area would be overall towards south-west, with most of the groundwater flowing underneath the site, discharging to the stream forming the southern boundary of the site, rather than Cors Erddreiniog. A direct groundwater pathway to the SAC appears to exist only between the northern-most part of the site.

6.5 Currently surface water runoff is collected in the lowest part of the site and discharged to a stream running along the southern boundary of the site. The discharged water also includes a component of groundwater as evidenced by the groundwater levels surrounding the site being higher than the level of the water in the sump. This creates a draw-down effect into the site, 'containing' any water, which may be affected by quarrying activities undertaken there, or any 'leachate' (water which has come into contact with any waste deposited at the site).

6.6 The water quality at the discharge represents most accurately the total nutrient loading, which the site and the quarrying and landfilling operations could give rise to. This is monitored and approximately 3 years of monitoring data exist for this sampling location.

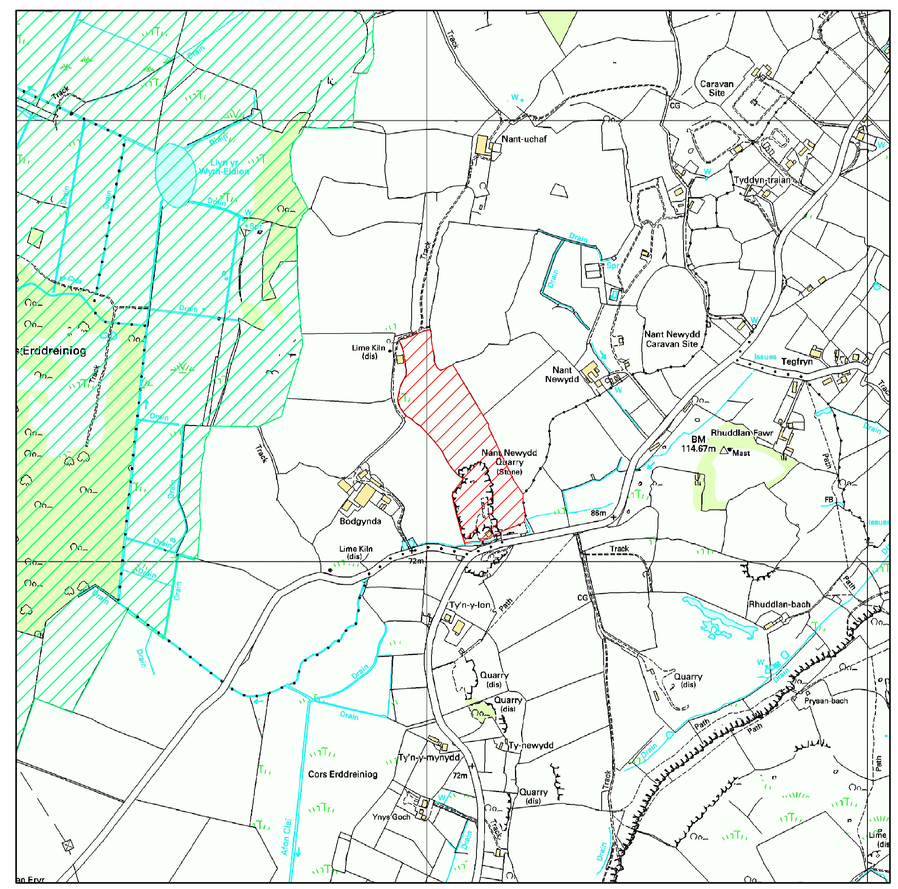
6.7 The water quality at W1 was found to be relatively good in relation to upstream surface water quality particularly regarding nutrient concentrations. It was noted that sulphate concentrations and concentrations of some metals were more elevated in W1 than upstream of the site. The recorded concentrations did not exceed the respective EQS for fresh water, and were found to be in lower concentrations than in groundwater monitoring locations representative of background groundwater quality.

6.8 The proposed activities are to extract stone similarly to the way this was carried out previously. Therefore an assessment of the impact of the historic activities is considered to be applicable for assessing the possible risks associated with similar future activities. The historic quarrying and landfilling activities were demonstrated not to give rise to any pollution, which would be of concern, therefore it is not anticipated that any of the proposed activities would have the potential to impact any surface or groundwater receptors or the SAC adversely.



ENLARGED DETAIL OF AREA

SCALE 1:2000



JPEG IMAGE OF NANT NEWYDD AREA

NOT TO SCALE

NOTES

1. LEGEND

W1	SURFACE WATER MONITORING POINTS
GW1	GROUNDWATER MONITORING BOREHOLES
G3,BH2,BH3	GAS MONITORING BOREHOLES
	SSSI AREA – CORS ERDDREINIOG
	SITE BOUNDARY
	DIRECTION OF FLOW
	DIRECTION OF PHOTOGRAPH TAKEN

REV	MODIFICATIONS	BY	CH	AP	DATE

W.J OWEN

NANT NEWYDD QUARRY

SURFACE WATER FEATURES (PHOTOS)

DRAWN BY: GOJR	DATE: 16.12.2008		
CHECKED BY: DK	SCALE @ A0: AS SHOWN		
APPROVED BY: AS	ISSUE: -	REVISION: -	
DRAWING NUMBER: 3131.HRA.01			

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CAD FILE REF:O:\Clients\O\W J Owen\3131 – Nant Newydd Works\Drawings\3131.HRA.01.dwg

NOTES

1. SURVEY BY EGNIOL CONSULTING LIMITED, REF: NANT NEWYDD QUARRY SURVEY AS-AH ALL DAYS.LSS. DATE UNDERTAKEN: 27-28.05.2008.

LEGEND

MON	SURVEY MONITORING STATION	BU	BUSH		GAS MAIN
	SURVEY CHECK SHOT		TREE		COMPRESSED AIR
STN	SURVEY STATION		TREE GIRTH		RECHARGE TRENCH
TRIG	SURVEY TRIG PILLER		DEAD TREE		TELEMETRY
	BLINDING LAYER	SAP	SAPLING		CABLE DUCT
BM	BENCH MARK		HEDGE		ASSUMED LINE OF ELECTRICITY CABLE
×	SPOT LEVEL		TREE CANOPY		BURRIED ELECTRICITY CABLE
FL	FLOOR LEVEL		VEGATATION / PLANTING BEDS		HIGH VOLTAGE ELECTRICITY PYLON LINE
INV	INVERT LEVEL	AP	ANCHOR POST		SURFACE ELECTRICITY CABLE
	SPOT LEVEL	MST	MAST		OVERHEAD HIGH VOLTAGE ELECTRICITY CABLE
SPG	SPRINGING POINT	PI	PIPE		OVERHEAD LOW VOLTAGE ELECTRICITY CABLE
SOFF	SOFFIT LEVEL	AV	AIR VALVE		UN-GROUND HIGH VOLTAGE ELECTRICITY CABLE
WL	WATER LEVEL	BB	BELISHA BEACON		UN-GROUND LOW VOLTAGE ELECTRICITY CABLE
PEG 0.00	AS SET OUT PEG	BIN	BIN		OVERHEAD TELEPHONE CABLE
DPEG 0.00	DESIGN PEG	B	BOLLARD		UN-GROUND TELEPHONE CABLE
PEG	PEG	BS	BUS STOP SIGN		CLAY
SPT	BOUNDARY MARKER	BT	CALL BOX		GEOCOMPOSITE DRAINAGE LAYER
BDY	BOUNDARY MARKER	BT	TELECOM COVER		GEO - FABRIC
CM	CABLE MARKER	IC	CIRCULAR INSPECTION COVER		HDPE
MP	MARKER POST	EB	ELECTRIC BOX		DRAINAGE LAYER
PO	POST	EP	ELECTRIC POST		PLASTIC LINER
SM	SERVICE MARKER	ER	EARTH ROD		POZZY DRAIN
WG	WOODLAND GRANT POST	MH	CIRCULAR MANHOLE		SUB SOIL
WT	WOODLAND TRUST POST	FH	FIRE HYDRANT		TERRAN
	BOUNDARY LINE	MH	SQUARE MANHOLE		TOP SOIL
	TOP OF KERB	MH	TRIANGULAR MANHOLE		GAS EXTRACTION LINE
	CHANNEL LINE	G	CIRCULAR GULLY	CND	CONDONSATE
	ROAD CENTRE LINE	GL	GROUND LIGHT	DC	DESILTING CHAMBER
	ROAD LINE / TRACK	G	GULLY	DW	GAS DEWATERING POINT
	CRASH BARRIER	SC	SQUARE INSPECTION COVER	ECU	END OF LINE CONDUIT
	FOOTPATH	JB	JUNCTION BOX	GMP	GAS MONITORING POINT
	EDGE OF PATH	KO	KERB OUTLET	GEX	GAS EXTRACTION POINT
	TRACK	LP	LAMP POST	GFS	GAS FLAIR STACK
	FOOTPATH	LR	LIFE RING	GV	GAS VALVE
	GENERAL VERGE / SURFACE CHANGE	TV	TV COVER	IDU	IN LINE CONDUIT
	GATE	PB	POST BOX	KP	KNOCKOUT POT
GP	GATE POST	SL	SECURITY LIGHT	MFD	GAS MANIFOLD
S	STYLE	DP	DOWN PIPE	GRAD	PIPELINE GRADIENT CHANGE
	FENCE - GENERAL	RE	RODDING EYE		VENT PIPE
	WALL	RS	ROAD SIGN	AR	
	BUILDING	SP	SIGN POST		AIR RELEASE COVER
	BUILDING OVERHEAD	SV	STOP VALVE		
	BRIDGE	Top	TAP	GXLM	LEACHATE / GAS EXTRACTION POINT
	CONTOUR	TL	TRAFFIC LIGHT	LCP	LEACHATE COLLECTION POINT
	TOP OF BATTER	TP	TELEGRAPH POLE	LCS	LEACHATE SUMP
	BOTTOM OF BATTER	TV	CATV COVER	LDP	LEACHATE DETECTION POINT
0.00	DESIGN TOP OF BATTER	UC	UNICOMS COVER	Lip	LEACHATE INJECTION POINT
0.00	DESIGN BOTTOM OF BATTER		VALVE	LMP	LEACHATE MONITORING POINT
	CLIFF TOP	WAT	WATER MAIN	LRP	LEACHATE RECIRCULATION POINT
	CLIFF BOTTOM	WO	WASH OUT		LEACHATE PIPE
	RESTORATION CONTOUR	WM	WATER METER	PEN	PENETROMETER
	LEVEL STRING		BENCH	NDG	NUCLEAR DENSITY TEST POINT
	DITCH TOP	BUS	BUS SHELTER	PMS	PERMINANT TEST POINT
	DITCH BOTTOM	GB	GAS BOX	PZ	PIEZOMETER
	STREAM	HT	HORSE TROUGH	TP	TRIAL PIT
	WATER	RS	ROAD SIGN	BH	BOREHOLE
	DRAIN	SB	SAND BIN	BHG	LANDFILL GAS BOREHOLE
	FRENCH DRAIN	CV	CULVERT	COW	COMBINED LANDFILL GAS AND GROUNDWATER BOREHOLE
	SLOT DRAIN	DU	DUCT	GW	GROUND WATER BOREHOLE
ISSU	SPRING		OVERHEAD PIPELINE	GWP	GAS / WATER PUMP
POND	POND		DUCT	SI	SITE INVESTIGATION BOREHOLE
SW	SURFACE WATER MONITORING POINT		PIPE / CULVERT		
SOAK	SOAKAWAY		FOUL SEWER		



REV	MODIFICATIONS	BY	CH	AP	DATE

W.J OWEN

NANT NEWYDD QUARRY

SURVEY
27-28.05.2008

DRAWN BY: EW	DATE: 10.06.2008	
CHECKED BY: DK	SCALE @ A1: 1:1000	
APPROVED BY: DK	ISSUE: -	REVISION: -

DRAWING NUMBER
3131.HRA.02

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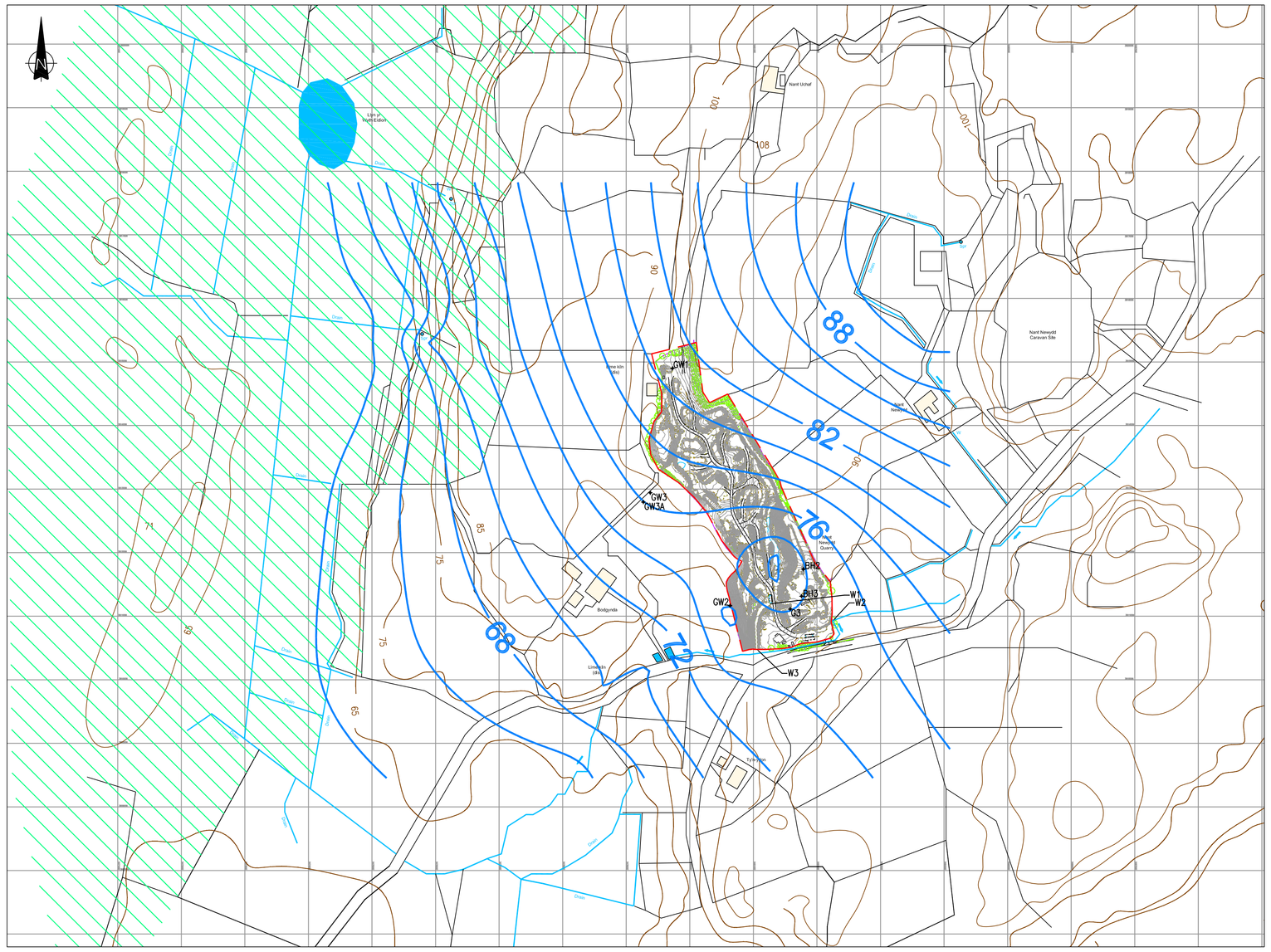
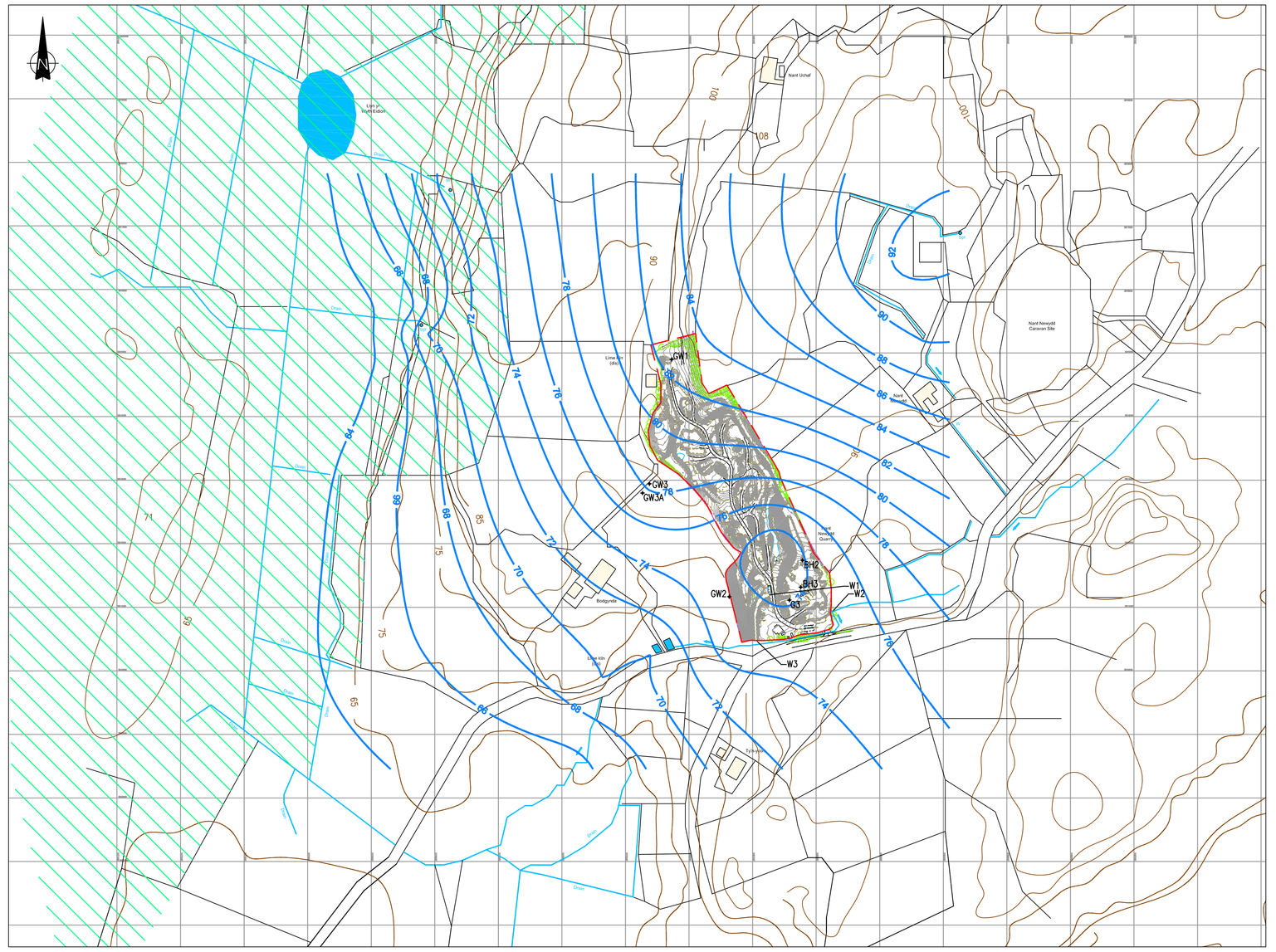


JULY 2008

SCALE 1:4000



AUGUST 2008

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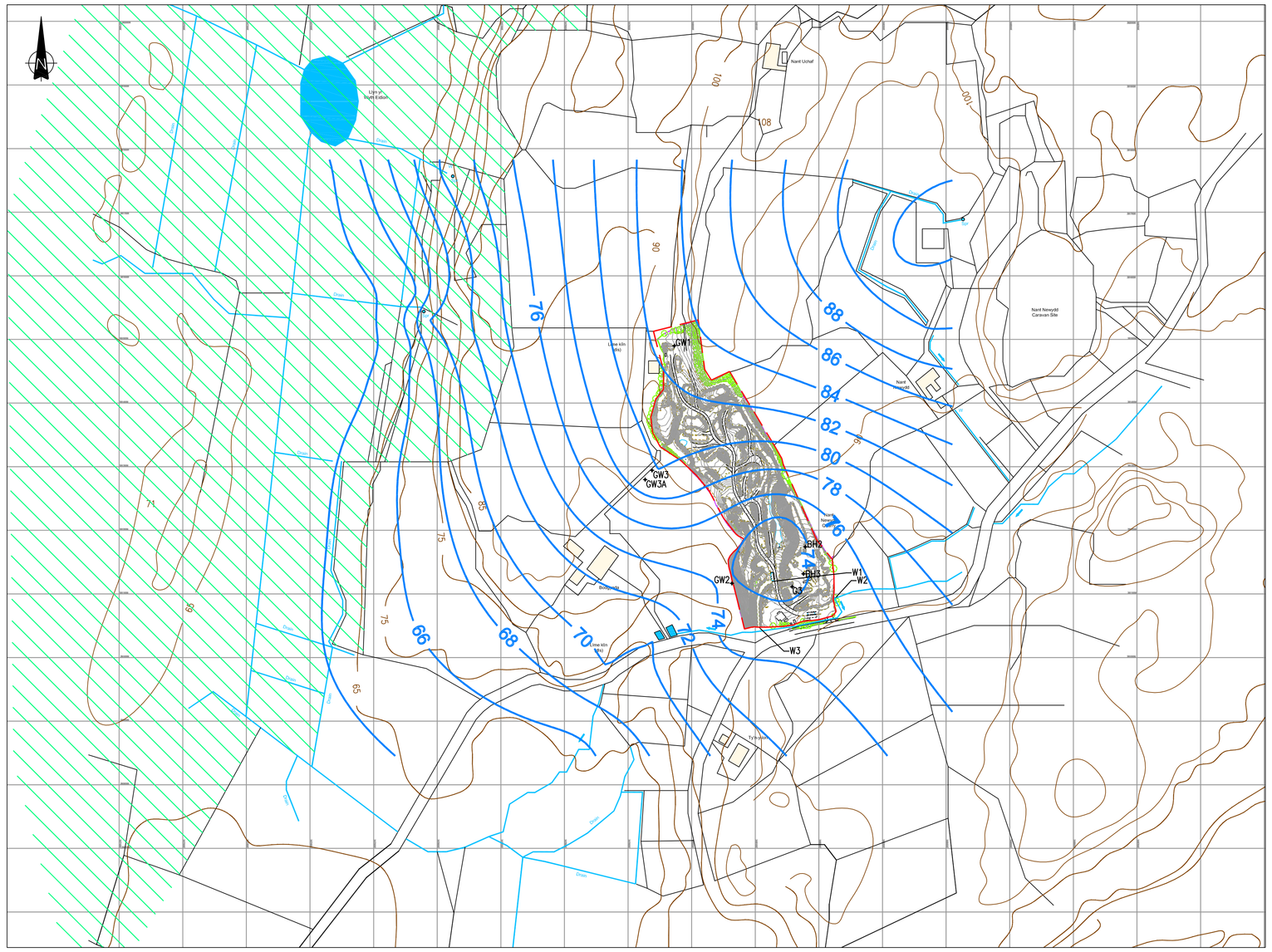

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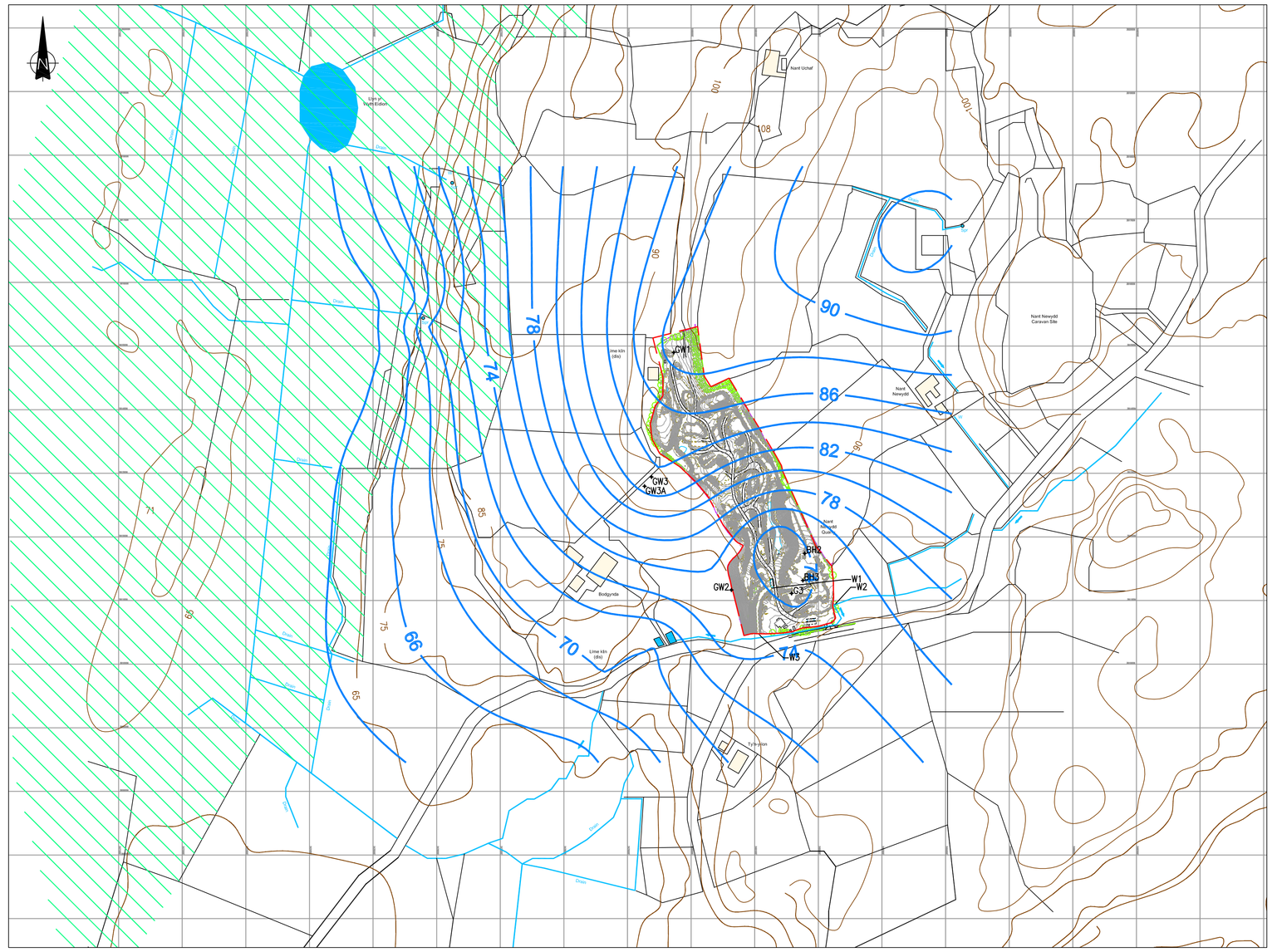

OCTOBER 2008

SCALE 1:4000

NOTES

1. LEGEND

W1	SURFACE WATER MONITORING POINTS
GW1	GROUNDWATER MONITORING BOREHOLES
G3,BH2,BH3	GAS MONITORING BOREHOLES
	SSSI AREA – CORS ERDDREINIOG
	SITE BOUNDARY
	DIRECTION OF FLOW

REV	MODIFICATIONS	BY	CH	AP	DATE

W.J OWEN

NANT NEWYDD QUARRY

GROUNDWATER CONTOUR MAPS
JULY - OCTOBER

DRAWN BY: GOJR	DATE: 16.12.2008	
CHECKED BY: DK	SCALE @ A0: AS SHOWN	
APPROVED BY: AS	ISSUE: -	REVISION: -

DRAWING NUMBER: 3131.HRA.03

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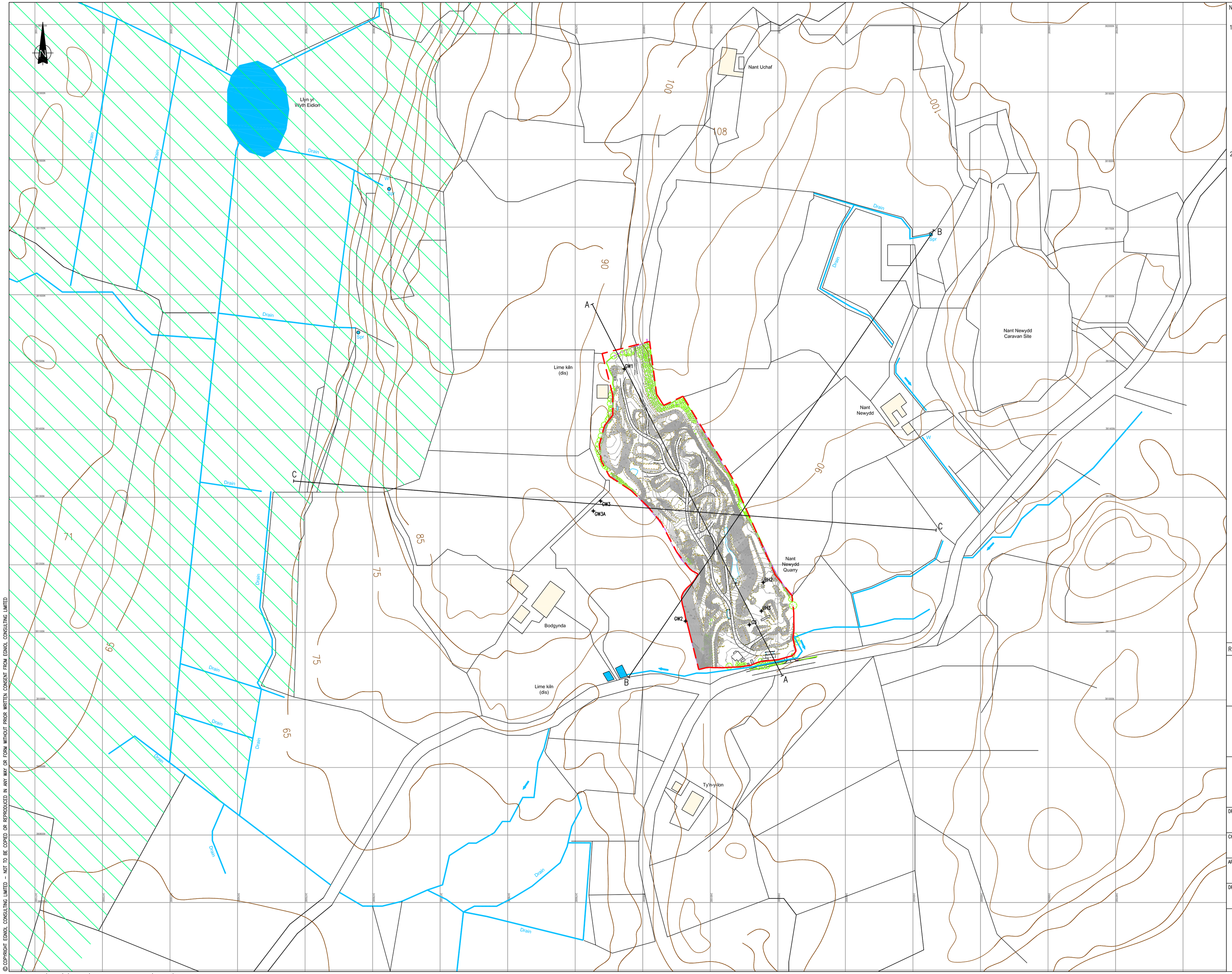

NOTES

1. LEGEND

W1	SURFACE WATER MONITORING POINTS
GW1	GROUNDWATER MONITORING BOREHOLES
G3,BH2,BH3	GAS MONITORING BOREHOLES
	SSSI AREA – CORS ERDDREINIOG
	SITE BOUNDARY
	DIRECTION OF FLOW

2. SEE DRAWING 3131.HRA.06 FOR DETAILS OF CROSS-SECTIONS.

REV	MODIFICATIONS	BY	CH	AP	DATE

W.J OWEN

NANT NEWYDD QUARRY

LOCATIONS OF CROSS-SECTIONS

DRAWN BY GOJR	DATE 16.12.2008
CHECKED BY DK	SCALE @ A1 1:2500
APPROVED BY AS	ISSUE - / REVISION -
DRAWING NUMBER 3131.HRA.04	

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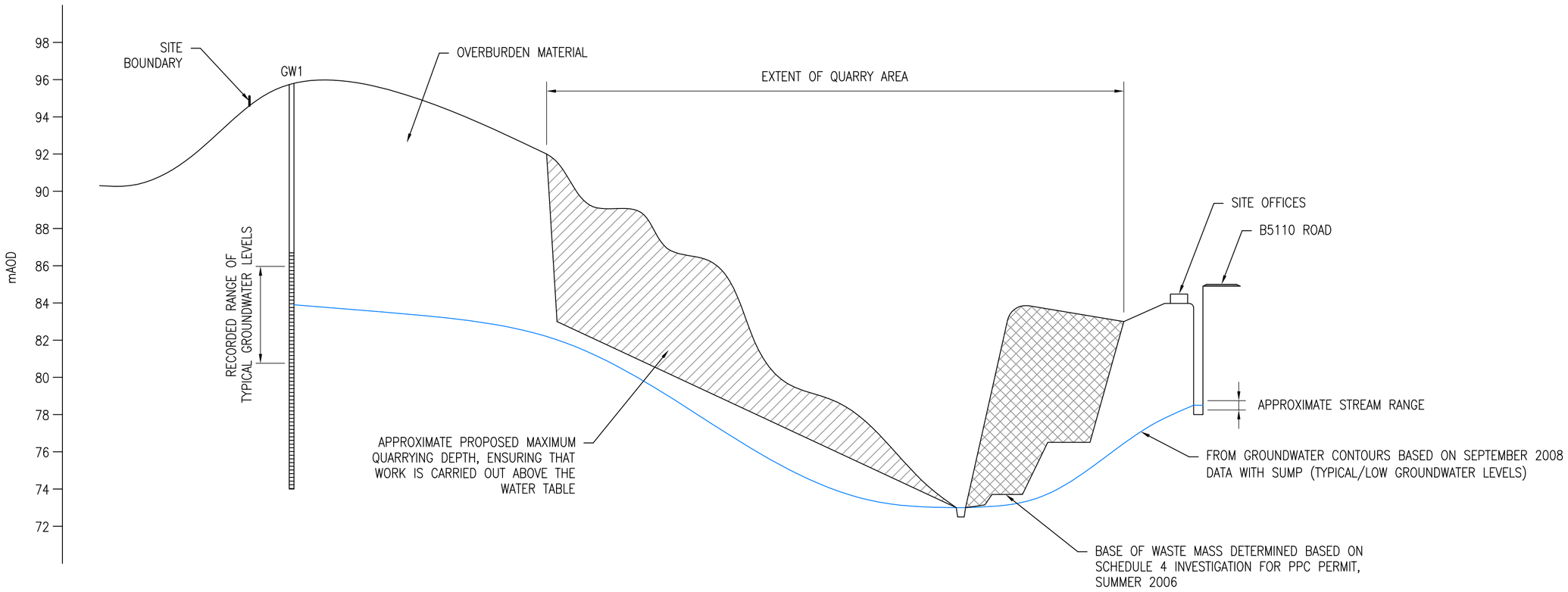
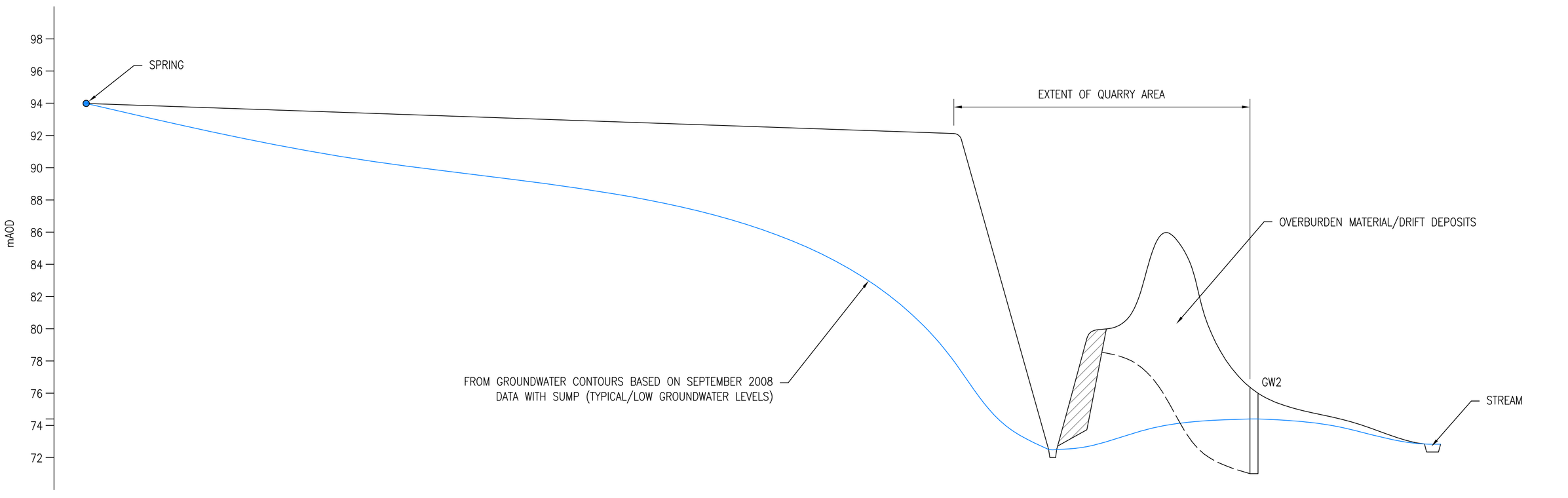
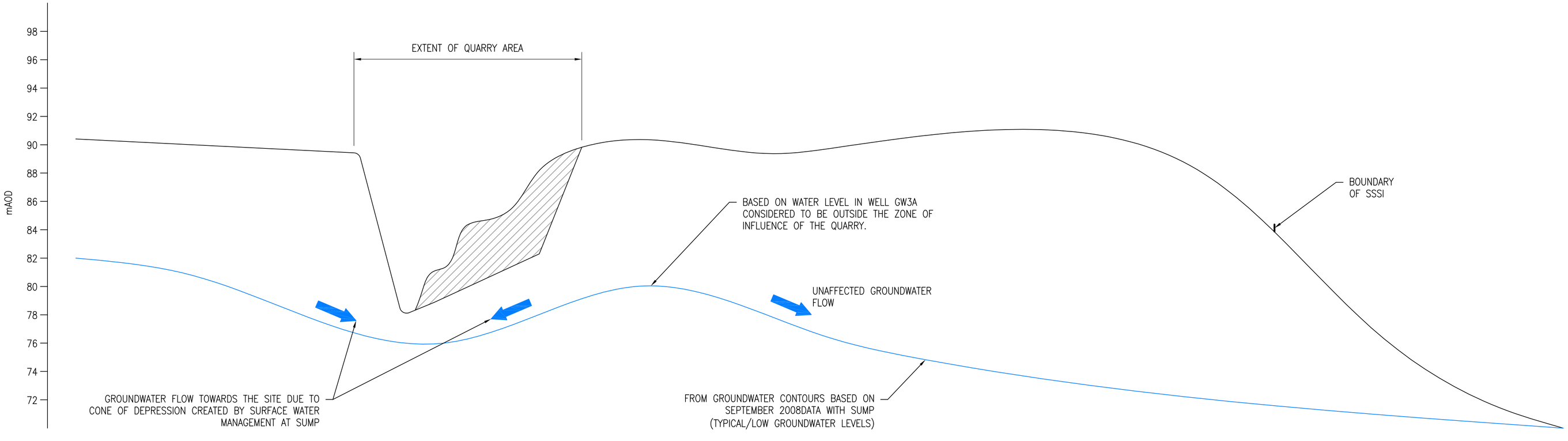
SECTION A – A



SECTION B – B



SECTION C – C



NOTES

1. SEE DRAWING 3131.HRA.05 FOR LOCATIONS OF THE CROSS–SECTIONS.
2. DO NOT SCALE FROM THIS DRAWING.
3. LEGEND

CURRENT WASTE MASS.

PROPOSED MAXIMUM EXTENT OF THE QUARRY WORKINGS.

REV	MODIFICATIONS	BY	CH	AP	DATE

W.J OWEN

NANT NEWYDD QUARRY

SCHEMATIC
SITE CROSS-SECTIONS

DRAWN BY	DATE	
GOJR	16.12.2008	
CHECKED BY	SCALE @ A1	
DK	NOT TO SCALE	
APPROVED BY	ISSUE	REVISION
AS	-	-

DRAWING NUMBER
3131.HRA.05

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ALcontrol Geochem Analytical Services
Sample Descriptions

Job Number: 06/15648/02/01
Client: Egniol Ltd.
Client Ref :

Grain sizes

<0.063mm	Very Fine
0.1mm - 0.063mm	Fine
0.1mm - 2mm	Medium
2mm - 10mm	Coarse
>10mm	Very Coarse

Sample Identity	Depth (m)	Colour	Grain Size	Description	Batch
BH04	4.9	Brown	0.1mm - 0.063mm	Sand with some Stones	2
BH05	2.3	Brown	0.1mm - 0.063mm	Sludge/Sediment with some Stones	2

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

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

Validated ✓
Preliminary

ALcontrol Geochem Analytical Services
Table Of Results

[#] ISO 17025 accredited
[M] MCERTS accredited
* Subcontracted test
» Shown on prev. report

Job Number: 06/15648/02/01 **Matrix:** SOLID
Client: Egniol Ltd. **Location:** NANT NEWYDD QUARRY
Client Ref. No.: **Client Contact:** Sarah Venning

Sample Identity	BH04	BH05								Method Code	LoD/Units
Depth (m)	4.9	2.3									
Sample Type	SOLID	SOLID									
Sampled Date											
Sample Received Date	14.09.06	14.09.06									
Batch	2	2									
Sample Number(s)	**23**	**24**									
Total Organic Carbon	1.00	0.85								TM050[#]	<0.01 %
Mineral Oil	216	93								TM061[#]	<1 mg/kg
GRO (C4-C10)	<10	157								TM089[#M]	<10 ug/kg
GRO (C10-C12)	<10	<10								TM089[#M]	<10 ug/kg
Benzene	<10	<10								TM089[#M]	<10 ug/kg
Toluene	<10	19								TM089[#M]	<10 ug/kg
Ethyl benzene	<10	<10								TM089[#M]	<10 ug/kg
m & p Xylene	<10	<10								TM089[#M]	<10 ug/kg
o Xylene	<10	<10								TM089[#M]	<10 ug/kg
MTBE	<10	27								TM089[#]	<10 ug/kg
PAH Total 17 (inc Coronene)	<10	<10								TM154	<10 mg/kg
PCB 7 Congeners											
PCB congener 28	<1	<1								TM070	<1 ug/kg
PCB congener 52	<1	<1								TM070	<1 ug/kg
PCB congener 101	<1	<1								TM070	<1 ug/kg
PCB congener 118	<1	<1								TM070	<1 ug/kg
PCB congener 153	<1	<1								TM070	<1 ug/kg
PCB congener 138	<1	<1								TM070	<1 ug/kg
PCB congener 180	<1	<1								TM070	<1 ug/kg
Total of 7 Congener PCBs	<1	<1								TM070	<1 ug/kg

All results expressed on a dry weight basis.

Date 02.10.2006

Validated ✓
Preliminary

ALcontrol Geochem Analytical Services
Table Of Results

[#] ISO 17025 accredited
[M] MCERTS accredited
[*] Subcontracted test
[»] Shown on prev. report

Job Number: 06/15648/02/01 **Matrix:** LEACHATE
Client: Egniol Ltd. **Location:** NANT NEWYDD QUARRY
Client Ref. No.: **Client Contact:** Sarah Venning

Sample Identity	BH04	BH05								Method Code	LoD/Units
Depth (m)	4.9	2.3									
Sample Type	SOLID	SOLID									
Sampled Date											
Sample Received Date	14.09.06	14.09.06									
Batch	2	2									
Sample Number(s)	**23**	**24**									
Antimony Dissolved (CEN 10:1C) (ICP-MS)	<0.04	<0.04								TM152	mg/kg
Arsenic Dissolved (CEN 10:1C) (ICP-MS)	<0.008	<0.008								TM152	mg/kg
Barium Dissolved (CEN 10:1C) (ICP-MS)	1.872	0.924								TM152	mg/kg
Boron Dissolved (CEN 10:1C) (ICP-MS)	2.21	0.69								TM152	mg/kg
Cadmium Dissolved (CEN 10:1C) (ICP-MS)	<0.0032	<0.0032								TM152	mg/kg
Chromium Dissolved (CEN 10:1C) (ICP-MS)	<0.008	0.020								TM152	mg/kg
Copper Dissolved (CEN 10:1C) (ICP-MS)	<0.008	<0.008								TM152	mg/kg
Lead Dissolved (CEN 10:1C) (ICP-MS)	<0.008	0.016								TM152	mg/kg
Molybdenum Dissolved (CEN 10:1C) (ICP-MS)	0.070	0.096								TM152	mg/kg
Nickel Dissolved (CEN 10:1C) (ICP-MS)	0.236	<0.008								TM152	mg/kg
Selenium Dissolved (CEN 10:1C) (ICP-MS)	<0.008	<0.008								TM152	mg/kg
Zinc Dissolved (CEN 10:1C) (ICP-MS)	0.718	0.080								TM152	mg/kg
Mercury Dissolved (CEN 10:1C) (CVAA)	<0.0004	<0.0004								TM127	mg/kg
Chloride (CEN 10:1C)	170	22								TM097	mg/kg
Fluoride (CEN 10:1C)	<4	<4								TM104	mg/kg
Sulphate (CEN 10:1C)	2274	<24								TM098	mg/kg
Dissolved Organic Carbon (CEN 10:1C)	78	<8								TM090	mg/kg
Total Dissolved Solids (CEN 10:1C)	3146	404								TM123	mg/kg
Phenols Monohydric (CEN 10:1C)	<0.08	<0.08								TM062	mg/kg

Date 02.10.2006

Validated ✓
Preliminary

ALcontrol Geochem Analytical Services
Table Of Results

[#] ISO 17025 accredited
[M] MCERTS accredited
[*] Subcontracted test
[»] Shown on prev. report

Job Number: 06/15648/02/01 **Matrix:** LEACHATE
Client: Egniol Ltd. **Location:** NANT NEWYDD QUARRY
Client Ref. No.: **Client Contact:** Sarah Venning

Sample Identity	BH04	BH05								Method Code	LoD/Units
Depth (m)	4.9	2.3									
Sample Type	SOLID	SOLID									
Sampled Date											
Sample Received Date	14.09.06	14.09.06									
Batch	2	2									
Sample Number(s)	**23**	**24**									
Antimony Dissolved (CEN 2:1) (ICP-MS)	7	<5								TM152	<5 ug/l
Antimony Dissolved (CEN 8:1) (ICP-MS)	<5	<5								TM152	<5 ug/l
Antimony Dissolved (CEN 10:1C) (ICP-MS)	<0.04	<0.04								TM152	mg/kg
Arsenic Dissolved (CEN 2:1) (ICP-MS)	3	<1								TM152	<1 ug/l
Arsenic Dissolved (CEN 8:1) (ICP-MS)	<1	<1								TM152	<1 ug/l
Arsenic Dissolved (CEN 10:1C) (ICP-MS)	<0.008	<0.008								TM152	mg/kg
Barium Dissolved (CEN 2:1) (ICP-MS)	272	122								TM152	<1 ug/l
Barium Dissolved (CEN 8:1) (ICP-MS)	166	85								TM152	<1 ug/l
Barium Dissolved (CEN 10:1C) (ICP-MS)	1.872	0.924								TM152	mg/kg
Boron Dissolved (CEN 2:1) (ICP-MS)	443	59								TM152	<10 ug/l
Boron Dissolved (CEN 8:1) (ICP-MS)	166	71								TM152	<10 ug/l
Boron Dissolved (CEN 10:1C) (ICP-MS)	2.21	0.69								TM152	mg/kg
Cadmium Dissolved (CEN 2:1) (ICP-MS)	<0.4	<0.4								TM152	<0.4 ug/l
Cadmium Dissolved (CEN 8:1) (ICP-MS)	<0.4	<0.4								TM152	<0.4 ug/l
Cadmium Dissolved (CEN 10:1C) (ICP-MS)	<0.0032	<0.0032								TM152	mg/kg
Chromium Dissolved (CEN 2:1) (ICP-MS)	1	2								TM152	<1 ug/l
Chromium Dissolved (CEN 8:1) (ICP-MS)	<1	2								TM152	<1 ug/l
Chromium Dissolved (CEN 10:1C) (ICP-MS)	<0.008	0.020								TM152	mg/kg
Copper Dissolved (CEN 2:1) (ICP-MS)	<1	<1								TM152	<1 ug/l
Copper Dissolved (CEN 8:1) (ICP-MS)	<1	<1								TM152	<1 ug/l
Copper Dissolved (CEN 10:1C) (ICP-MS)	<0.008	<0.008								TM152	mg/kg
Lead Dissolved (CEN 2:1) (ICP-MS)	2	<1								TM152	<1 ug/l
Lead Dissolved (CEN 8:1) (ICP-MS)	<1	2								TM152	<1 ug/l
Lead Dissolved (CEN 10:1C) (ICP-MS)	<0.008	0.016								TM152	mg/kg
Molybdenum Dissolved (CEN 2:1) (ICP-MS)	11	8								TM152	<1 ug/l
Molybdenum Dissolved (CEN 8:1) (ICP-MS)	6	10								TM152	<1 ug/l
Molybdenum Dissolved (CEN 10:1C) (ICP-MS)	0.070	0.096								TM152	mg/kg
Nickel Dissolved (CEN 2:1) (ICP-MS)	62	<1								TM152	<1 ug/l
Nickel Dissolved (CEN 8:1) (ICP-MS)	14	<1								TM152	<1 ug/l
Nickel Dissolved (CEN 10:1C) (ICP-MS)	0.236	<0.008								TM152	mg/kg
Selenium Dissolved (CEN 2:1) (ICP-MS)	2	<1								TM152	<1 ug/l

Supplemental Report

Date 02.10.2006

Validated ✓
Preliminary

ALcontrol Geochem Analytical Services
Table Of Results

[#] ISO 17025 accredited
[M] MCERTS accredited
* Subcontracted test
» Shown on prev. report

Job Number: 06/15648/02/01 **Matrix:** LEACHATE
Client: Egniol Ltd. **Location:** NANT NEWYDD QUARRY
Client Ref. No.: **Client Contact:** Sarah Venning

Sample Identity	BH04	BH05								Method Code	LoD/Units
Depth (m)	4.9	2.3									
Sample Type	SOLID	SOLID									
Sampled Date											
Sample Received Date	14.09.06	14.09.06									
Batch	2	2									
Sample Number(s)	**23**	**24**									
Selenium Dissolved (CEN 8:1) (ICP-MS)	<1	<1								TM152	<1 ug/l
Selenium Dissolved (CEN 10:1C) (ICP-MS)	<0.008	<0.008								TM152	mg/kg
Zinc Dissolved (CEN 2:1) (ICP-MS)	139	<3								TM152	<3 ug/l
Zinc Dissolved (CEN 8:1) (ICP-MS)	55	10								TM152	<3 ug/l
Zinc Dissolved (CEN 10:1C) (ICP-MS)	0.718	0.080								TM152	mg/kg
Mercury Dissolved (CEN 2:1) (CVAA)	<0.05	<0.05								TM127	<0.05 ug/l
Mercury Dissolved (CEN 8:1) (CVAA)	<0.05	<0.05								TM127	<0.05 ug/l
Mercury Dissolved (CEN 10:1C) (CVAA)	<0.0004	<0.0004								TM127	mg/kg
Chloride (CEN 2:1)	69	3								TM097	<1 mg/l
Chloride (CEN 8:1)	4	2								TM097	<1 mg/l
Chloride (CEN 10:1C)	170	22								TM097	mg/kg
Fluoride (CEN 2:1)	<0.5	<0.5								TM104	<0.5 mg/l
Fluoride (CEN 8:1)	<0.5	<0.5								TM104	<0.5 mg/l
Fluoride (CEN 10:1C)	<4	<4								TM104	mg/kg
Sulphate (CEN 2:1)	689	6								TM098	<3 mg/l
Sulphate (CEN 8:1)	112	<3								TM098	<3 mg/l
Sulphate (CEN 10:1C)	2274	<24								TM098	mg/kg
Dissolved Organic Carbon (CEN 2:1)	23	1								TM090	<1 mg/l
Dissolved Organic Carbon (CEN 8:1)	4	<1								TM090	<1 mg/l
Dissolved Organic Carbon (CEN 10:1C)	78	<8								TM090	mg/kg
Total Dissolved Solids (CEN 2:1	817	70								TM123	<5 mg/l
Total Dissolved Solids (CEN 8:1	189	33								TM123	<5 mg/l
Total Dissolved Solids (CEN 10:1C)	3146	404								TM123	mg/kg
Phenols Monohydric (CEN 2:1)	0.02	<0.01								TM062	<0.01 mg/l
Phenols Monohydric (CEN 8:1)	<0.01	<0.01								TM062	<0.01 mg/l
Phenols Monohydric (CEN 10:1C)	<0.08	<0.08								TM062	mg/kg

Supplemental Report

Date 02.10.2006

ALcontrol Geochem Analytical Services
Table Of Results - Appendix

Job Number: 06/15648/02/01
Client: Egniol Ltd.
Client Ref. No.:

Report Key :

Results expressed as (e.g.) 1.03E-07 is equivalent to 1.03×10^{-7}

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

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

Summary of Method Codes contained within report :

Method No.	Reference	Description	ISO 17025 Accredited	MCERTS Accredited	Wet/Dry Sample [1]	Surrogate Corrected
PM024	Modified BS 1377	Soil preparation including homogenisation, moisture content and description			WET	
TM050	Method 5310B, AWWA/APHA, 20th Ed., 1999 / DIN EN 13137	Total Organic Carbon determination by combustion method	✓		DRY	
TM061	Method for the Determination of EPH,Massachusetts Dept.of EP, 1998	Determination of Extractable Petroleum Hydrocarbons by GC-FID (C10-C40)	✓		DRY	
TM062	MEWAM BOOK 124 1988.HMSO/ Method 17.7, Second Site property, March 2003	Determination of Phenolic compounds by HPLC with electro-chemical detection			NA	
TM070	Modified: US EPA Method 8250 & 625	Determination of Total Polychlorinated Biphenyls (PCB's) as Aroclor 1254 and the ICE 7 Congeners by GC-MS			DRY	
TM089	Modified: US EPA Methods 8020 & 602	Determination of Gasoline Range Hydrocarbons (GRO) and BTEX (MTBE) compounds by Headspace GC-FID (C4-C12)	✓		WET	
TM089	Modified: US EPA Methods 8020 & 602	Determination of Gasoline Range Hydrocarbons (GRO) and BTEX (MTBE) compounds by Headspace GC-FID (C4-C12)	✓	✓	WET	
TM090	Method 5310, AWWA/APHA, 20th Ed., 1999 / Modified: US EPA Method 415.1 & 9060	Determination of Total Organic Carbon/Total Inorganic Carbon in Water and Waste Water			NA	
TM097	Modified: US EPA Method 325.1 & 325.2	Determination of Chloride using the Kone Analyser			NA	
TM098	Method 4500E, AWWA/APHA, 20th Ed., 1999	Determination of Sulphate using the Kone Analyser			NA	
TM104	Method 4500F, AWWA/APHA, 20th Ed., 1999	Determination of Fluoride using the Kone Analyser			NA	
TM123	BS 2690: Part 121:1981	The Determination of Total dissolved Solids in Water			NA	
TM127	Method 3112B, AWWA/APHA, 20th Ed., 1999	The Determination of Trace Level Mercury in Aqueous Media and Soil Extracts by Atomic Absorption Spectroscopy			NA	
TM152	Method 3125B, AWWA/APHA, 20th Ed., 1999	Analysis of Aqueous Samples by ICP-MS			NA	

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

ALcontrol Geochem Analytical Services
Table Of Results - Appendix

Job Number: 06/15648/02/01
Client: Egniol Ltd.
Client Ref. No.:

Report Key :

Results expressed as (e.g.) 1.03E-07 is equivalent to 1.03×10^{-7}

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

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

Summary of Method Codes contained within report :

Method No.	Reference	Description	ISO 17025 Accredited	MCERTS Accredited	Wet/Dry Sample [1]	Surrogate Corrected
TM154	In - house Method	Determination of Petroleum Hydrocarbons by EZ Flash GC-FID in the Carbon range C6- C40			WET	

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

ALcontrol Geochem Analytical Services
Table Of Results - Appendix

Job Number: 06/15648/02/01
Client: Egniol Ltd.
Client Ref. No.:

Summary of Coolbox temperatures

Batch No.	Coolbox Temperature (°C)
2	15

John Madden
Environment Agency
Richard Fairclough House
Knutsford Road
Latchford
Warrington, Cheshire
WA4 1HG

Our ref: A2252/SV/DRK
Your ref: EA/PPC/RP3337SE

Date : 6th October 2006

Dear Mr Madden,

Re: NOTICE REQUIRING FURTHER INFORMATION REGARDING NANT NEWYDD QUARRY LANDFILL PPC APPLICATION, REFERENCE: EA/PPC/RP3337SE

This report summarising the results of the soil testing for the above site has been prepared in response to your e-mail sent on the 21st September 2006, and subsequent correspondence by Roy Middleton on the 9th October 2006, containing queries regarding the submitted information collected during the site investigation at Nant Newydd Quarry. This letter expands on the e-mail correspondence sent to yourself by Sarah Venning on the 26th September 2006, and in summarising all of the results acts as interpretative report of the drilling investigation at the site.

All of the monitoring results from the different samples obtained onsite are summarised in the tables below. The results of the Waste Acceptance Criteria (WAC) testing of the leachate generated by four samples of the waste are presented in Tables 1 and 1A. The results of the WAC of the solid waste are summarised in Table 2. Table 3 contains the test results of the general suite analysis, which was carried out on 5 samples of the waste obtained in different locations around the site. Table 4 presents the results of the chemical analysis of the two samples of leachate obtained in BH2 and BH3 of the site.

WAC testing results

The results presented within Tables 1, 1A and 2 indicate that all of the parameters analysed for within the WAC suite remained below their respective Inert WAC in all of the four waste samples tested, except sulphate and TDS in some locations.

The Inert WAC of 1000mg/kg of sulphate was exceeded in three of the four samples of waste tested. The concentrations recorded were 4142mg/kg, 2296mg/kg and 2274mg/kg at BH1 (5m), BH2 (7.5m) and

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Company Registered No. 4207036

BH4 (4.9m) respectively. In addition to this, a concentration of TDS slightly in excess of 4000mg/kg was recorded in BH1 (5m) (4098mg/kg).

It is considered likely, that the exceedances of sulphate concentrations relative to the Inert WAC, are primarily the result of concrete encountered during drilling. This is particularly likely to be the case at BH1, where the highest concentrations of sulphate, and only exceedance of TDS were recorded, as the borehole was terminated near the sampling depth due to refusal because of concrete. It should be noted, however, that

'if an inert waste does not meet the SO4 L/S10 limit, alternative limit values of 1500 mg/l SO_4 at C_0 (initial eluate from the percolation test) AND 6000mg/kg SO_4 at L/S10 (either from the percolation test or branch test BS EN 12457/3) can be used to demonstrate compliance with the acceptance criteria for inert wastes'[1].

The results contained within Table 1A show that if the above criteria is applied, all samples can be classed as inert waste with regards to the concentration of sulphate. It should be noted further, that as sulphate is a non-listed substance, the elevated concentrations detected do not indicate contamination, which has a significant potential to impact on controlled waters, and thus cause a breach of the Groundwater Directive.

[1] Guidance on sampling and testing of wastes to meet landfill waste acceptance procedures, Environment Agency, April 2005, page 10.

Table 1. Results of the Inert WAC Testing of samples of the historic waste mass from the site.

	Sample Identity	BH1	BH2	BH04	BH05	Inert WAC
	Depth	5.0	7.5	4.9	2.3	
	Sample Type	SOLID	SOLID	SOLID	SOLID	
	Sampled Date	07/09/2006	07/09/2006	13/09/2006	13/09/2006	
	Units					
Antimony Dissolved	mg/kg	<0.04	<0.04	<0.04	<0.04	0.06
Arsenic Dissolved	mg/kg	0.012	0.052	<0.008	<0.008	0.5
Barium Dissolved	mg/kg	1.548	1.632	1.872	0.924	20
Boron Dissolved	mg/kg	0.67	0.65	2.21	0.69	
Cadmium Dissolved	mg/kg	<0.0032	<0.0032	<0.0032	<0.0032	0.04
Chromium Dissolved	mg/kg	0.012	0.024	<0.008	0.020	0.5
Copper Dissolved	mg/kg	0.052	0.080	<0.008	<0.008	2
Lead Dissolved	mg/kg	0.024	0.040	<0.008	0.016	0.5
Molybdenum Dissolved	mg/kg	0.130	0.136	0.070	0.096	0.5
Nickel Dissolved	mg/kg	0.070	0.034	0.236	<0.008	0.4
Selenium Dissolved	mg/kg	0.014	0.022	<0.008	<0.008	0.1
Zinc Dissolved	mg/kg	0.740	0.174	0.718	0.080	4
Mercury Dissolved	mg/kg	<0.0004	<0.0004	<0.0004	<0.0004	0.01
Chloride	mg/kg	46	68	170	22	800
Fluoride	mg/kg	<4	<4	<4	<4	10
Sulphate	mg/kg	4142	2296	2274	<24	1000
Dissolved Organic Carbon	mg/kg	24	38	78	<8	500
Total Dissolved Solids	mg/kg	4098	2514	3146	404	4000
Phenols Monohydric	mg/kg	<0.08	<0.08	<0.08	<0.08	1

Table 1A. Results of the leachate supplementary analysis for sulphate, and relevant inert WAC, as detailed in the EA 'Guidance on sampling and testing of wastes to meet landfill waste acceptance procedures'.

	Sample Identity		BH1	BH2	BH04	BH05	Inert WAC
	Depth		5.0	7.5	4.9	2.3	
	Sample Type		SOLID	SOLID	SOLID	SOLID	
	Sampled Date		07/09/2006	07/09/2006	13/09/2006	13/09/2006	
	Units	**Detection Limit**					
Sulphate (CEN 2:1)	mg/l	<3	1379	924	689	6	1500
Sulphate (CEN 8:1)	mg/l	<3	173	56	112	<3	
Sulphate (CEN 10:1C)	mg/kg		4142	2296	2274	<24	1000/6000

Table 2. Parameters determined on the waste relative to the Inert WAC concentrations.

	Sample Identity		BH1	BH2	BH04	BH05	Inert WAC
	Depth		5.0	7.5	4.9	2.3	
	Sample Type		SOLID	SOLID	SOLID	SOLID	
	Sampled Date		07/09/2006	07/09/2006	13/09/2006	13/09/2006	
	Units	Detection Limit					
Total Organic Carbon	%	<0.01	0.98	0.63	1.00	0.85	3.00
Mineral Oil	mg/kg	<1	113	147	216	93	500
GRO (C4-C10)	µg/kg	<10	40	30	<10	157	
GRO (C10-C12)	ug/kg	<10	<10	<10	<10	<10	
Benzene	µg/kg	<10	<10	<10	<10	<10	
Toluene	µg/kg	<10	<10	<10	<10	19	
Ethyl benzene	µg/kg	<10	<10	<10	<10	<10	
m & p Xylene	µg/kg	<10	22	<10	<10	<10	
o Xylene	µg/kg	<10	<10	<10	<10	<10	6000
MTBE	µg/kg	<10	18	30	<10	27	
PAH Total 17 (inc Coronene)	mg/kg	<10	<10	<10	<10	<10	

Solid waste samples testing

In order to obtain the greatest amount of information as quickly as possible, general testing for metals, non metals and organics was scheduled for five samples of the waste (all of which were obtained within the southern section of the site). The results of this analysis are presented in Table 3.

The results obtained are not unusual for an inert landfill, and none of the parameters were recorded in significantly elevated concentrations. The concentrations of total sulphate detected within the waste samples varied between 894 mg/kg in BH3 (2.5m) and 8034 mg/kg in BH1A (6m). It should be noted however, that these concentrations reflect the total sulphate within the waste, and are not representative of the likely amount of this determinant, which might be leached by water percolating through the waste.

Table 3. Laboratory results of general monitoring of soil samples

	Sample Identity		BH1A	BH1B	BH2	BH03	BH03
	Depth		6.0	5.0	5.0	2.5	5.0
	Sample Type		SOLID	SOLID	SOLID	SOLID	SOLID
	Sampled Date		07/09/2006	07/09/2006	07/09/2006	13/09/2006	13/09/2006
	Units	Detection Limit					
Total Sulphate	mg/kg	<100	8034	5127	4858	894	2234
Boron Water Soluble	mg/kg	<1	<1	<1	<1	2	<1
Arsenic	mg/kg	<3.0	14	15	8	24	16
Cadmium	mg/kg	<1	<1	<1	<1	<1	<1
Chromium	mg/kg	<4.5	30.6	27.6	18.1	25.2	18.8
Copper	mg/kg	<6.0	<6	16	39	48	33
Lead	mg/kg	<2.0	22	21	51	83	34
Mercury	mg/kg	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
Nickel	mg/kg	<1	47	41	14	22	34
Selenium	mg/kg	<3	<3	<3	<3	<3	<3
Zinc	mg/kg	<2.5	56.1	62.9	116.2	139.6	87.0
Acid Soluble Sulphide	mg/kg	<50	89	<50	<50	<50	<50
Hexavalent Chromium	mg/kg	<0.3	<0.3	<0.3	<0.3	<3.0	<0.3
Phenols Monohydric	mg/kg	<0.01	0.04	0.01	0.04	<0.01	<0.01
Thiocyanate	mg/kg	<1	<1	<1	<1	<1	<1
Total Cyanide	mg/kg	<1	<1	<1	<1	<1	<1
Free Cyanide	mg/kg	<1	<1	<1	<1	<1	<1
pH Value	pH Units	<1.00	7.30	7.36	7.51	8.05	7.97
Total Sulphur	%	<0.01	0.75	0.74	0.30	0.06	0.91
EPH (DRO) (C10-C40)	mg/kg	<1	178	144	594	708	495
GRO (C4-C10)	µg/kg	<10	<10	<10	<10	<10	23
GRO (C10-C12)	µg/kg	<10	<10	<10	<10	<10	<10
Benzene	µg/kg	<10	<10	<10	<10	<10	<10
Toluene	µg/kg	<10	<10	<10	<10	<10	<10
Ethyl benzene	µg/kg	<10	<10	<10	<10	<10	<10
m & p Xylene	µg/kg	<10	<10	<10	<10	<10	<10
o Xylene	µg/kg	<10	<10	<10	<10	<10	<10
MTBE	µg/kg	<10	<10	<10	<10	<10	23
PAH Total	mg/kg	<10	<10	<10	<10	21	19

Water sample monitoring

The results of the analysis of the water samples, presented in Table 4 indicate that the leachate generated at the site has characteristics, which are typical of inert landfill leachate.

Table 4. Results of the analysis of the water samples obtained at the site.

	Sample Identity		BH2	BH03
	Depth		9.9	6.9
	Sample Type		LIQUID	LIQUID
	Sampled Date		07/09/2006	13/09/2006
	Units	**Detection Limit**		
Arsenic Dissolved (ICP-MS)	µg/l	<1	16	2
Boron Dissolved (ICP-MS)	µg/l	<10	40	75
Cadmium Dissolved (ICP-MS)	µg/l	<0.4	<0.4	<0.4
Chromium Dissolved (ICP-MS)	µg/l	<1	2	<1
Copper Dissolved (ICP-MS)	µg/l	<1	4	<1
Lead Dissolved (ICP-MS)	µg/l	<1	<1	<1
Nickel Dissolved (ICP-MS)	µg/l	<1	17	5
Selenium Dissolved (ICP-MS)	µg/l	<1	8	2
Zinc Dissolved (ICP-MS)	µg/l	<3	27	15
Mercury Dissolved (CVAA)	µg/l	<0.05	<0.05	<0.05
Conductivity (at 25 deg.C)	mS/cm	<0.014	1.425	1.297
Sulphate (soluble)	mg/l	<3	663	548
Chloride	mg/l	<1	63	86
Sulphide	mg/l	<0.5	<0.5	<0.5
Total Ammonium as NH4	mg/l	<0.3	10.0	0.4
Hexavalent Chromium	mg/l	<0.03	<0.03	<0.03
Phenols Monohydric	mg/l	<0.01	0.01	<0.01
Thiocyanate	mg/l	<0.05	0.06	<0.05
Total Cyanide	mg/l	<0.05	<0.05	<0.05
Free Cyanide	mg/l	<0.05	<0.05	<0.05
Free Sulphur	mg/l	<0.05	0.20	<0.05
pH Value	pH Units	<1.00	9.48	8.22
PAH by GCMS				
Naphthalene	ng/l	<10	284	137
Acenaphthylene	ng/l	<10	20	12
Acenaphthene	ng/l	<10	229	208
Fluorene	ng/l	<10	117	94
Phenanthrene	ng/l	<10	387	296
Anthracene	ng/l	<10	123	72
Fluoranthene	ng/l	<10	677	334
Pyrene	ng/l	<10	578	233
Benz(a)anthracene	ng/l	<10	236	112
Chrysene	ng/l	<10	359	97
Benzo(b)fluoranthene	ng/l	<10	278	72
Benzo(k)fluoranthene	ng/l	<10	397	88
Benzo(a)pyrene	ng/l	<10	363	92
Indeno(123cd)pyrene	ng/l	<10	211	47
Dibenzo(ah)anthracene	ng/l	<10	75	17
Benzo(ghi)perylene	ng/l	<10	388	83
PAH 16 Total	ng/l	<10	4722	1994

Conclusions

The above results from the general testing and WAC testing of the waste samples from the site indicate that the historic waste mass at the site should be considered inert.

In your e-mail correspondence on the 27th September 2006, and in a subsequent correspondence sent on the 9th October 2006, you raised some concerns regarding the concentrations of some of the determinants at the site. These issues have been addressed below.

Sulphate

The sulphate concentration within the leachate samples obtained at the site appears to be greater than the fresh water quality standard of 400mg/l (as quoted in the Guidance for Monitoring Groundwater Leachate and Surface Water (concentrations of 663mg/l and 548mg/l were recorded in BH2 and BH3 respectively). However, these concentrations may reflect localised conditions, and the WAC results from the different parts of the landfill indicate that although elevated, the concentrations of sulphate within the waste are within the limits set for inert waste landfills, and as such will not require actions to be taken in order to remediate any hotspots. It is most likely, that increased sulphate concentrations recorded at the site are associated with concrete, which has been accepted onsite.

Hydrocarbons

Concerns were raised regarding the concentrations of hydrocarbons detected at the site. With regards to the questions raised within your correspondence, please consider the following comments:

Mineral oils and EPH (DRO)

Four samples of the waste were tested for WAC assessment. As a part of this analysis, the solid samples were tested for mineral oils. The results of this analysis can be compared to the Inert WAC. The four concentrations recorded were below the Inert WAC of 500mg/kg, with the highest concentration, which was recorded at BH4 at a depth of 4.9m, being less than half of the quoted standard (216mg/kg). As such, the recorded concentrations of mineral oils confirm that all of tested waste can be classed as inert, and therefore does not pose a significant risk to controlled waters.

5 samples of the waste, collected within the southern section of the waste were subjected to general ‘totals’ testing, where the concentrations of metals and organics within the waste were

recorded. Concentrations of EPH DRO (C_{10}-C_{40}) recorded were between 144mg/kg at BH1B at a depth of 5m, and 708mg/kg in BH3 at a depth of 2.5m. The concentrations recorded at BH2 (5m) and BH3 (2.5m), are greater than the Inert WAC for mineral oils. However, EPH (formally DRO) presents the concentration of any compound extractable with n-hexane within the carbon range (C_{10}-C_{40}), including aliphatic (mineral oil), aromatic (PAH's) and naturally occurring compounds. Therefore the concentration of mineral oil will be less than the recorded concentration of EPH within the sample. Furthermore, no visual or olfactory evidence of contamination of hydrocarbons was observed in any of the locations where samples for totals testing were obtained. As such, while the results indicate, that there may be localised hot-spots with slightly elevated concentrations of extractable petroleum hydrocarbons, the overall waste character should be considered inert (as established by the WAC testing of the waste samples).

Gasoline Range Organics (GRO).

As part of the WAC testing, and the general 'totals' testing, the concentration of GRO (C_4-C_{10}) and GRO (C_{10}-C_{12}) were recorded. Of the five samples analysed for totals, only one had a GRO (C_4-C_{10}) concentration above the detection limit of 10µg/kg – BH3 at a depth of 5m, where a concentration of 23 µg/kg. The concentrations of GRO recorded as part of the WAC testing, were only slightly above the detection limit of 10 µg/kg, with the highest concentration of 157 µg/kg recorded in BH5 at a depth of 2.3m. This concentration is very low (less than 1mg/kg), and as such is unlikely to represent a contamination hotspot. Therefore it is not considered, that there is a potential source of hydrocarbon contamination within the area where this soil sample was obtained.

BTEX

The concentration of volatile organic compounds (BTEX) was recorded for the four samples subjected to WAC testing. The Inert WAC value for the total concentration of these compounds is 6mg/l. While a concentration of 19 µg/kg of toluene was detected in BH5 at a depth of 2.3m, and 22µg/kg of m&p xylenes in BH1 at a depth of 5m, the total concentrations of BTEX compounds within each sample are significantly below the Inert WAC. This indicates that the waste is inert, and therefore is not likely to give rise to contamination of groundwater resources. Additionally, these concentrations are very low, and only found within very localised sections of the waste. Therefore it is considered, that any leachate resulting from the waste onsite will contain negligible traces of these List I substances, and will not result in their introduction into Groundwater, thus not resulting in breach of the Groundwater Directive.

MTBE

The concentrations of MTBE recorded in samples of waste at the site were only slightly above the detection limit for the substance, and varied from 18µg/kg in BH1 at a depth of 5m to 30µg/kg in BH2 at a depth of 7.5 m. The concentration of MTBE was below the 10µg/kg detection limit in BH4 (4.9m), BH1A (6m), BH1B (5m), BH2 (5m), and BH3 (2.5m). The distribution of MTBE within the soil samples is similar to the distribution of concentration of GRO. It should be noted, however, that concentrations above the detection limit were recorded in only 4 of the 9 samples obtained, and the concentrations recorded were only slightly elevated. Therefore it is not considered, that the MTBE concentrations at the site are likely to pose a significant risk of pollution to controlled waters.

Laboratory interpretations of terminology

The laboratory, which undertook the analysis of the waste samples provided interpretations of the terms used for describing the organic material observed in the different samples. These interpretations are as follows:

- Biodegraded diesel – Diesel which has undergone microbial biodegradation which would cause reduction or depletion of n-Alkenes.
- Used engine oil – Often used when diesel (either weathered or biodegraded) is accompanied by the presence of a lubricating oil.
- PAHs – Poly-aromatic hydrocarbons, readily recognisable by their distinctive pattern on the chromatogram
- Bitumen/Tar – often contain the distinctive pattern if PAHs coupled with a UCM (Unresolved Complex Matter) OR 'hump' which extends beyond nC40.
- Humic Acids – Naturally occurring fatty acids, often called carboxylic acids (e.g. peat contains relatively high levels).

Distribution of hotspots of hydrocarbon pollution

The results obtained for the different testing carried out on samples of the waste indicate, that the material can be classed as inert. The concentrations of hydrocarbons detected at the site are not elevated above the relevant inert WAC and therefore do not signify the presence of hotspots of hydrocarbon contamination, which require remediation.

The waste sampling results for the 9 samples of waste obtained at the site and tested for 'totals' and WAC indicate, that the waste at these locations is unlikely to give rise to contamination of groundwater with hydrocarbons (when compared to inert WAC, as discussed above). It is possible, that hotspots of waste with high concentrations of hydrocarbons were not intercepted during the site works, but this is not considered to be likely. The boreholes were located in such a manner, that wastes of different ages could be sampled, in order to better characterise the historic waste mass. There are no records of contaminated soils being accepted at the site. Discrete samples of the waste were obtained. While every effort was made to locate any hotspots of contamination, which might be present on the site, it should be considered that the sample results reflect the waste quality at the sampling location only.

Material within BH4

The photographs of the waste observed in BH4 indicated, that the material was significantly darker than in other boreholes at the site. A sample obtained at a depth of 4.9m at this location was subjected to WAC testing. The results indicate that the waste at that depth can be classed as inert (see above). The black staining presented within the photograph extended to the sampled depth, and it is therefore considered, that should it represent any contamination, this would have been detected during the testing of the sample. In view of the results obtained, it must be concluded, that the staining is not a strong indication of contamination.

BH5

The material recovered from this location, which was sent for WAC testing was a disturbed sample from a depth between 2m and 2.3m. The borehole log submitted indicates that there was difficulty with drilling after 2.1m, and the site engineer noted an increase in the number of fragments of rock within the arisings, which was interpreted as rock being encountered at an approximate depth of 2.1m. The material sent to the lab was mainly a fine silty CLAY (described by the lab as a sediment, with broken up fragments). The reference made to sludge in the analytical report is based on the observation, that the sample was received very wet. This is considered to be the result of the drilling operations (as water had to be added at times to allow progress), and therefore would not be considered appropriate to characterise the material as sludge.

With regards to the concentrations of different organic compounds at the above location, as described above, all of the concentrations were below the Inert WAC, and therefore the location is not considered to represent a hotspot of contamination, which might cause contamination to the surrounding environment.

I hope this letter provides sufficient information about the analytical results received to date to address the issues which you raised in your Notice Requiring Further Information. Should you require any further information, or have any comments regarding this correspondence, please do not hesitate to contact me, or Sarah Venning.

Yours sincerely

Diana R. Kountcheva

for Egniol Ltd

ALcontrol Geochem

Extractable Petroleum Hydrocarbons (EPH) By GC-FID

Carbon Range C10-C40

Job Number : 06/15648/02/01
Client : Egniol Ltd.
Client Ref :
Matrix [Units] : SOLID [mg/kg]

All results expressed on a dry weight basis.

Sample No	Sample Identity	Depth	EPH	Interpretation
5	BH1A	6.0	178	used engine oil/humic acids
6	BH1B	5.0	144	used engine oil
8	BH2	5.0	594	biodegraded diesel/bitumen/tar

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

ALcontrol Geochem

Extractable Petroleum Hydrocarbons (EPH) By GC-FID

Mineral Oil - Carbon Range C10-C40

Job Number : 06/15648/02/01
Client : Egniol Ltd.
Client Ref :
Matrix [Units] : SOLID [mg/kg]

All results expressed on a dry weight basis.

Sample No	Sample Identity	Depth	Mineral Oil	Interpretation
3	BH1	5.0	113	
12	BH2	7.5	147	

Mineral Oil :- Aliphatic compounds in the range C10-C40 which are not retained on Silica.

ALcontrol Geochem

Extractable Petroleum Hydrocarbons (EPH) By GC-FID

Carbon Range C10-C40

Job Number : 06/15648/02/01
Client : Egniol Ltd.
Client Ref :
Matrix [Units] : SOLID [mg/kg]

All results expressed on a dry weight basis.

Sample No	Sample Identity	Depth	EPH	Interpretation
16	BH03	2.5	708	PAHs/Bitumen/Tar
18	BH03	5.0	495	PAHs/Bitumen/Tar

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

ALcontrol Geochem

Extractable Petroleum Hydrocarbons (EPH) By GC-FID

Mineral Oil - Carbon Range C10-C40

Job Number : 06/15648/02/01
Client : Egniol Ltd.
Client Ref :
Matrix [Units] : SOLID [mg/kg]

All results expressed on a dry weight basis.

Sample No	Sample Identity	Depth	Mineral Oil	Interpretation
23	BH04	4.9	216	
24	BH05	2.3	93	

Mineral Oil :- Aliphatic compounds in the range C10-C40 which are not retained on Silica.

ALcontrol Geochem Analytical Services
Sample Descriptions

Job Number: 06/15648/02/01
Client: Egniol Ltd.
Client Ref :

Grain sizes

<0.063mm	Very Fine
0.1mm - 0.063mm	Fine
0.1mm - 2mm	Medium
2mm - 10mm	Coarse
>10mm	Very Coarse

Sample Identity	Depth (m)	Colour	Grain Size	Description	Batch
BH1	5.0	Dark Brown	n/a	Clay with some Stones	1
BH1A	6.0	Brown	<0.063mm	Top Soil	1
BH1B	5.0	Brown	<0.063mm	Clay	1
BH2	5.0	Brown	<0.063mm	Clay	1
BH2	7.5	Dark Brown	n/a	Clay with some Stones	1

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

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

Validated ✓
Preliminary

ALcontrol Geochem Analytical Services
Table Of Results

[#] ISO 17025 accredited
[M] MCERTS accredited
* Subcontracted test
» Shown on prev. report

Job Number: 06/15648/02/01 **Matrix:** SOLID
Client: Egniol Ltd. **Location:** NANT NEWYDD QUARRY
Client Ref. No.: **Client Contact:** Sarah Venning

Sample Identity	BH1	BH1A	BH1B	BH2	BH2					Method Code	LoD/Units
Depth (m)	5.0	6.0	5.0	5.0	7.5						
Sample Type	SOLID	SOLID	SOLID	SOLID	SOLID						
Sampled Date	07.09.06	07.09.06	07.09.06	07.09.06	07.09.06						
Sample Received Date	09.09.06	09.09.06	09.09.06	09.09.06	09.09.06						
Batch	1	1	1	1	1						
Sample Number(s)	**3**	**4-5**	**6-7**	**8-9**	**10-12**						
Total Sulphate	-	8034	5127	4858	-					TM129[#M]	<100 mg/kg
Boron Water Soluble	-	<1	<1	<1	-					TM129[#M]	<1 mg/kg
Arsenic	-	14	15	8	-					TM129[#M]	<3.0 mg/kg
Cadmium	-	<1	<1	<1	-					TM129[#M]	<1 mg/kg
Chromium	-	30.6	27.6	18.1	-					TM129[#M]	<4.5 mg/kg
Copper	-	<6	16	39	-					TM129[#M]	<6.0 mg/kg
Lead	-	22	21	51	-					TM129[#M]	<2.0 mg/kg
Mercury	-	<1.5	<1.5	<1.5	-					TM129[#M]	<1.5 mg/kg
Nickel	-	47	41	14	-					TM129[#M]	<1 mg/kg
Selenium	-	<3	<3	<3	-					TM129[#M]	<3 mg/kg
Zinc	-	56.1	62.9	116.2	-					TM129[#M]	<2.5 mg/kg
Acid Soluble Sulphide	-	89	<50	<50	-					TM101[#]	<50 mg/kg
Hexavalent Chromium	-	<0.3	<0.3	<0.3	-					TM151[#]	<0.3 mg/kg
Total Organic Carbon	0.98	-	-	-	0.63					TM050[#]	<0.01 %
Phenols Monohydric	-	0.04	0.01	0.04	-					TM062	<0.01 mg/kg
Thiocyanate	-	<1	<1	<1	-					TM153[#M]	<1 mg/kg
Total Cyanide	-	<1	<1	<1	-					TM153[#M]	<1 mg/kg
Free Cyanide	-	<1	<1	<1	-					TM153[#M]	<1 mg/kg
pH Value	-	7.30	7.36	7.51	-					TM133[#M]	<1.00 pH Units
Total Sulphur	-	0.75	0.74	0.30	-					TM068[#]	<0.01 %
EPH (DRO) (C10-C40)	-	178	144	594	-					TM061[#M]	<1 mg/kg
Mineral Oil	113	-	-	-	147					TM061[#]	<1 mg/kg
GRO (C4-C10)	40	<10	<10	<10	30					TM089[#M]	<10 ug/kg
GRO (C10-C12)	<10	<10	<10	<10	<10					TM089[#M]	<10 ug/kg
Benzene	<10	<10	<10	<10	<10					TM089[#M]	<10 ug/kg
Toluene	<10	<10	<10	<10	<10					TM089[#M]	<10 ug/kg
Ethyl benzene	<10	<10	<10	<10	<10					TM089[#M]	<10 ug/kg
m & p Xylene	22	<10	<10	<10	<10					TM089[#M]	<10 ug/kg
o Xylene	<10	<10	<10	<10	<10					TM089[#M]	<10 ug/kg
MTBE	18	<10	<10	<10	30					TM089[#]	<10 ug/kg
PAH Total 17 (inc Coronene)	<10	-	-	-	<10					TM154	<10 mg/kg

All results expressed on a dry weight basis.

Date 26.09.2006

Validated ✓
Preliminary

ALcontrol Geochem Analytical Services
Table Of Results

[#] ISO 17025 accredited
[M] MCERTS accredited
* Subcontracted test
» Shown on prev. report

Job Number: 06/15648/02/01 **Matrix:** SOLID
Client: Egniol Ltd. **Location:** NANT NEWYDD QUARRY
Client Ref. No.: **Client Contact:** Sarah Venning

Sample Identity	BH1	BH1A	BH1B	BH2	BH2					Method Code	LoD/Units
Depth (m)	5.0	6.0	5.0	5.0	7.5						
Sample Type	SOLID	SOLID	SOLID	SOLID	SOLID						
Sampled Date	07.09.06	07.09.06	07.09.06	07.09.06	07.09.06						
Sample Received Date	09.09.06	09.09.06	09.09.06	09.09.06	09.09.06						
Batch	1	1	1	1	1						
Sample Number(s)	**3**	**4-5**	**6-7**	**8-9**	**10-12**						
PAH Total	-	<10	<10	<10	-					TM154[#]	<10 mg/kg
PCB 7 Congeners											
PCB congener 28	<1	-	-	-	<1					TM070	<1 ug/kg
PCB congener 52	<1	-	-	-	<1					TM070	<1 ug/kg
PCB congener 101	<1	-	-	-	<1					TM070	<1 ug/kg
PCB congener 118	<1	-	-	-	<1					TM070	<1 ug/kg
PCB congener 153	<1	-	-	-	<1					TM070	<1 ug/kg
PCB congener 138	<1	-	-	-	<1					TM070	<1 ug/kg
PCB congener 180	<1	-	-	-	<1					TM070	<1 ug/kg
Total of 7 Congener PCBs	<1	-	-	-	<1					TM070	<1 ug/kg

All results expressed on a dry weight basis.

Date 26.09.2006

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Preliminary

ALcontrol Geochem Analytical Services
Table Of Results

[#] ISO 17025 accredited
[M] MCERTS accredited
[*] Subcontracted test
[»] Shown on prev. report

Job Number: 06/15648/02/01 **Matrix:** LIQUID
Client: Egniol Ltd. **Location:** NANT NEWYDD QUARRY
Client Ref. No.: **Client Contact:** Sarah Venning

Sample Identity	BH2									Method Code	LoD/Units
Depth (m)	9.9										
Sample Type	LIQUID										
Sampled Date	07.09.06										
Sample Received Date	09.09.06										
Batch	1										
Sample Number(s)	**13-15**										
Arsenic Dissolved (ICP-MS)	16									TM152[#]	<1 ug/l
Boron Dissolved (ICP-MS)	40									TM152[#]	<10 ug/l
Cadmium Dissolved (ICP-MS)	<0.4									TM152[#]	<0.4 ug/l
Chromium Dissolved (ICP-MS)	2									TM152[#]	<1 ug/l
Copper Dissolved (ICP-MS)	4									TM152[#]	<1 ug/l
Lead Dissolved (ICP-MS)	<1									TM152[#]	<1 ug/l
Nickel Dissolved (ICP-MS)	17									TM152[#]	<1 ug/l
Selenium Dissolved (ICP-MS)	8									TM152[#]	<1 ug/l
Zinc Dissolved (ICP-MS)	27									TM152[#]	<3 ug/l
Mercury Dissolved (CVAA)	<0.05									TM127[#]	<0.05 ug/l
Conductivity (at 25 deg.C)	1.425									TM120[#]	<0.014 mS/cm
Sulphate (soluble)	663									TM098[#]	<3 mg/l
Chloride	63									TM097[#]	<1 mg/l
Sulphide	<0.5									TM101[#]	<0.5 mg/l
Total Ammonium as NH4	10.0									TM099[#]	<0.3 mg/l
Hexavalent Chromium	<0.03									TM151[#]	<0.03 mg/l
Phenols Monohydric	0.01									TM062	<0.01 mg/l
Thiocyanate	0.06									TM153[#]	<0.05 mg/l
Total Cyanide	<0.05									TM153[#]	<0.05 mg/l
Free Cyanide	<0.05									TM153[#]	<0.05 mg/l
Free Sulphur	0.20									TM136[#]	<0.05 mg/l
pH Value	9.48									TM133[#]	<1.00 pH Units

Date 26.09.2006

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Preliminary

ALcontrol Geochem Analytical Services
Table Of Results

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[*] Subcontracted test
[»] Shown on prev. report

Job Number: 06/15648/02/01 **Matrix:** LIQUID
Client: Egniol Ltd. **Location:** NANT NEWYDD QUARRY
Client Ref. No.: **Client Contact:** Sarah Venning

Sample Identity	BH2									Method Code	LoD/Units
Depth (m)	9.9										
Sample Type	LIQUID										
Sampled Date	07.09.06										
Sample Received Date	09.09.06										
Batch	1										
Sample Number(s)	13-15										
PAH by GCMS											
Naphthalene	284									TM074	<10 ng/l
Acenaphthylene	20									TM074	<10 ng/l
Acenaphthene	229									TM074	<10 ng/l
Fluorene	117									TM074	<10 ng/l
Phenanthrene	387									TM074	<10 ng/l
Anthracene	123									TM074	<10 ng/l
Fluoranthene	677									TM074	<10 ng/l
Pyrene	578									TM074	<10 ng/l
Benz(a)anthracene	236									TM074	<10 ng/l
Chrysene	359									TM074	<10 ng/l
Benzo(b)fluoranthene	278									TM074	<10 ng/l
Benzo(k)fluoranthene	397									TM074	<10 ng/l
Benzo(a)pyrene	363									TM074	<10 ng/l
Indeno(123cd)pyrene	211									TM074	<10 ng/l
Dibenzo(ah)anthracene	75									TM074	<10 ng/l
Benzo(ghi)perylene	388									TM074	<10 ng/l
PAH 16 Total	4722									TM074	<10 ng/l

Date 26.09.2006

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ALcontrol Geochem Analytical Services
Table Of Results

[#] ISO 17025 accredited
[M] MCERTS accredited
[*] Subcontracted test
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Job Number: 06/15648/02/01 **Matrix:** LEACHATE
Client: Egniol Ltd. **Location:** NANT NEWYDD QUARRY
Client Ref. No.: **Client Contact:** Sarah Venning

Sample Identity	BH1	BH2								Method Code	LoD/Units
Depth (m)	5.0	7.5									
Sample Type	SOLID	SOLID									
Sampled Date	07.09.06	07.09.06									
Sample Received Date	09.09.06	09.09.06									
Batch	1	1									
Sample Number(s)	**3**	**10-12**									
Antimony Dissolved (CEN 10:1C) (ICP-MS)	<0.04	<0.04								TM152	mg/kg
Arsenic Dissolved (CEN 10:1C) (ICP-MS)	0.012	0.052								TM152	mg/kg
Barium Dissolved (CEN 10:1C) (ICP-MS)	1.548	1.632								TM152	mg/kg
Boron Dissolved (CEN 10:1C) (ICP-MS)	0.67	0.65								TM152	mg/kg
Cadmium Dissolved (CEN 10:1C) (ICP-MS)	<0.0032	<0.0032								TM152	mg/kg
Chromium Dissolved (CEN 10:1C) (ICP-MS)	0.012	0.024								TM152	mg/kg
Copper Dissolved (CEN 10:1C) (ICP-MS)	0.052	0.080								TM152	mg/kg
Lead Dissolved (CEN 10:1C) (ICP-MS)	0.024	0.040								TM152	mg/kg
Molybdenum Dissolved (CEN 10:1C) (ICP-MS)	0.130	0.136								TM152	mg/kg
Nickel Dissolved (CEN 10:1C) (ICP-MS)	0.070	0.034								TM152	mg/kg
Selenium Dissolved (CEN 10:1C) (ICP-MS)	0.014	0.022								TM152	mg/kg
Zinc Dissolved (CEN 10:1C) (ICP-MS)	0.740	0.174								TM152	mg/kg
Mercury Dissolved (CEN 10:1C) (CVAA)	<0.0004	<0.0004								TM127	mg/kg
Chloride (CEN 10:1C)	46	68								TM097	mg/kg
Fluoride (CEN 10:1C)	<4	<4								TM104	mg/kg
Sulphate (CEN 10:1C)	4142	2296								TM098	mg/kg
Dissolved Organic Carbon (CEN 10:1C)	24	38								TM090	mg/kg
Total Dissolved Solids (CEN 10:1C)	4098	2514								TM123	mg/kg
Phenols Monohydric (CEN 10:1C)	<0.08	<0.08								TM062	mg/kg

Date 26.09.2006

Validated ✓
Preliminary

ALcontrol Geochem Analytical Services
Table Of Results

[#] ISO 17025 accredited
[M] MCERTS accredited
* Subcontracted test
» Shown on prev. report

Job Number: 06/15648/02/01 **Matrix:** LEACHATE
Client: Egniol Ltd. **Location:** NANT NEWYDD QUARRY
Client Ref. No.: **Client Contact:** Sarah Venning

Sample Identity	BH1	BH2								Method Code	LoD/Units
Depth (m)	5.0	7.5									
Sample Type	SOLID	SOLID									
Sampled Date	07.09.06	07.09.06									
Sample Received Date	09.09.06	09.09.06									
Batch	1	1									
Sample Number(s)	**3**	**10-12**									
Antimony Dissolved (CEN 2:1) (ICP-MS)	<5	6								TM152	<5 ug/l
Antimony Dissolved (CEN 8:1) (ICP-MS)	<5	<5								TM152	<5 ug/l
Antimony Dissolved (CEN 10:1C) (ICP-MS)	<0.04	<0.04								TM152	mg/kg
Arsenic Dissolved (CEN 2:1) (ICP-MS)	2	6								TM152	<1 ug/l
Arsenic Dissolved (CEN 8:1) (ICP-MS)	1	5								TM152	<1 ug/l
Arsenic Dissolved (CEN 10:1C) (ICP-MS)	0.012	0.052								TM152	mg/kg
Barium Dissolved (CEN 2:1) (ICP-MS)	226	276								TM152	<1 ug/l
Barium Dissolved (CEN 8:1) (ICP-MS)	137	135								TM152	<1 ug/l
Barium Dissolved (CEN 10:1C) (ICP-MS)	1.548	1.632								TM152	mg/kg
Boron Dissolved (CEN 2:1) (ICP-MS)	93	76								TM152	<10 ug/l
Boron Dissolved (CEN 8:1) (ICP-MS)	60	62								TM152	<10 ug/l
Boron Dissolved (CEN 10:1C) (ICP-MS)	0.67	0.65								TM152	mg/kg
Cadmium Dissolved (CEN 2:1) (ICP-MS)	<0.4	<0.4								TM152	<0.4 ug/l
Cadmium Dissolved (CEN 8:1) (ICP-MS)	<0.4	<0.4								TM152	<0.4 ug/l
Cadmium Dissolved (CEN 10:1C) (ICP-MS)	<0.0032	<0.0032								TM152	mg/kg
Chromium Dissolved (CEN 2:1) (ICP-MS)	2	4								TM152	<1 ug/l
Chromium Dissolved (CEN 8:1) (ICP-MS)	1	2								TM152	<1 ug/l
Chromium Dissolved (CEN 10:1C) (ICP-MS)	0.012	0.024								TM152	mg/kg
Copper Dissolved (CEN 2:1) (ICP-MS)	6	12								TM152	<1 ug/l
Copper Dissolved (CEN 8:1) (ICP-MS)	5	7								TM152	<1 ug/l
Copper Dissolved (CEN 10:1C) (ICP-MS)	0.052	0.080								TM152	mg/kg
Lead Dissolved (CEN 2:1) (ICP-MS)	<1	<1								TM152	<1 ug/l
Lead Dissolved (CEN 8:1) (ICP-MS)	3	5								TM152	<1 ug/l
Lead Dissolved (CEN 10:1C) (ICP-MS)	0.024	0.040								TM152	mg/kg
Molybdenum Dissolved (CEN 2:1) (ICP-MS)	13	32								TM152	<1 ug/l
Molybdenum Dissolved (CEN 8:1) (ICP-MS)	13	9								TM152	<1 ug/l
Molybdenum Dissolved (CEN 10:1C) (ICP-MS)	0.130	0.136								TM152	mg/kg
Nickel Dissolved (CEN 2:1) (ICP-MS)	23	9								TM152	<1 ug/l
Nickel Dissolved (CEN 8:1) (ICP-MS)	3	2								TM152	<1 ug/l
Nickel Dissolved (CEN 10:1C) (ICP-MS)	0.070	0.034								TM152	mg/kg
Selenium Dissolved (CEN 2:1) (ICP-MS)	3	3								TM152	<1 ug/l

Supplemental Report

Date 26.09.2006

Validated ✓
Preliminary

ALcontrol Geochem Analytical Services
Table Of Results

[#] ISO 17025 accredited
[M] MCERTS accredited
* Subcontracted test
» Shown on prev. report

Job Number: 06/15648/02/01 **Matrix:** LEACHATE
Client: Egniol Ltd. **Location:** NANT NEWYDD QUARRY
Client Ref. No.: **Client Contact:** Sarah Venning

Sample Identity	BH1	BH2								Method Code	LoD/Units
Depth (m)	5.0	7.5									
Sample Type	SOLID	SOLID									
Sampled Date	07.09.06	07.09.06									
Sample Received Date	09.09.06	09.09.06									
Batch	1	1									
Sample Number(s)	**3**	**10-12**									
Selenium Dissolved (CEN 8:1) (ICP-MS)	1	2								TM152	<1 ug/l
Selenium Dissolved (CEN 10:1C) (ICP-MS)	0.014	0.022								TM152	mg/kg
Zinc Dissolved (CEN 2:1) (ICP-MS)	198	15								TM152	<3 ug/l
Zinc Dissolved (CEN 8:1) (ICP-MS)	43	18								TM152	<3 ug/l
Zinc Dissolved (CEN 10:1C) (ICP-MS)	0.740	0.174								TM152	mg/kg
Mercury Dissolved (CEN 2:1) (CVAA)	<0.05	<0.05								TM127	<0.05 ug/l
Mercury Dissolved (CEN 8:1) (CVAA)	<0.05	<0.05								TM127	<0.05 ug/l
Mercury Dissolved (CEN 10:1C) (CVAA)	<0.0004	<0.0004								TM127	mg/kg
Chloride (CEN 2:1)	11	22								TM097	<1 mg/l
Chloride (CEN 8:1)	3	3								TM097	<1 mg/l
Chloride (CEN 10:1C)	46	68								TM097	mg/kg
Fluoride (CEN 2:1)	<0.5	<0.5								TM104	<0.5 mg/l
Fluoride (CEN 8:1)	<0.5	<0.5								TM104	<0.5 mg/l
Fluoride (CEN 10:1C)	<4	<4								TM104	mg/kg
Sulphate (CEN 2:1)	1379	924								TM098	<3 mg/l
Sulphate (CEN 8:1)	173	56								TM098	<3 mg/l
Sulphate (CEN 10:1C)	4142	2296								TM098	mg/kg
Dissolved Organic Carbon (CEN 2:1)	4	7								TM090	<1 mg/l
Dissolved Organic Carbon (CEN 8:1)	2	3								TM090	<1 mg/l
Dissolved Organic Carbon (CEN 10:1C)	24	38								TM090	mg/kg
Total Dissolved Solids (CEN 2:1	1185	885								TM123	<5 mg/l
Total Dissolved Solids (CEN 8:1	216	93								TM123	<5 mg/l
Total Dissolved Solids (CEN 10:1C)	4098	2514								TM123	mg/kg
Phenols Monohydric (CEN 2:1)	<0.01	<0.01								TM062	<0.01 mg/l
Phenols Monohydric (CEN 8:1)	<0.01	<0.01								TM062	<0.01 mg/l
Phenols Monohydric (CEN 10:1C)	<0.08	<0.08								TM062	mg/kg

Supplemental Report

Date 26.09.2006

ALcontrol Geochem Analytical Services
Table Of Results - Appendix

Job Number: 06/15648/02/01
Client: Egniol Ltd.
Client Ref. No.:

Report Key :

Results expressed as (e.g.) 1.03E-07 is equivalent to 1.03×10^{-7}

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

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

Summary of Method Codes contained within report :

Method No.	Reference	Description	ISO 17025 Accredited	MCERTS Accredited	Wet/Dry Sample [1]	Surrogate Corrected
PM024	Modified BS 1377	Soil preparation including homogenisation, moisture content and description			WET	
TM050	Method 5310B, AWWA/APHA, 20th Ed., 1999 / DIN EN 13137	Total Organic Carbon determination by combustion method	✓		DRY	
TM061	Method for the Determination of EPH,Massachusetts Dept.of EP, 1998	Determination of Extractable Petroleum Hydrocarbons by GC-FID (C10-C40)	✓		DRY	
TM061	Method for the Determination of EPH,Massachusetts Dept.of EP, 1998	Determination of Extractable Petroleum Hydrocarbons by GC-FID (C10-C40)	✓	✓	DRY	
TM062	MEWAM BOOK 124 1988.HMSO/ Method 17.7, Second Site property, March 2003	Determination of Phenolic compounds by HPLC with electro-chemical detection			WET	
TM068	ASTM D-1552	Total sulphur determination by combustion method	✓		DRY	
TM070	Modified: US EPA Method 8250 & 625	Determination of Total Polychlorinated Biphenyls (PCB's) as Aroclor 1254 and the ICE 7 Congeners by GC-MS			DRY	
TM074	Modified: US EPA Method 8100	Determination of Polynuclear Aromatic Hydrocarbons (PAH) by GC-MS. MCERTS Accreditation on Soils for Naphthalene except when Kerosene present.			NA	
TM089	Modified: US EPA Methods 8020 & 602	Determination of Gasoline Range Hydrocarbons (GRO) and BTEX (MTBE) compounds by Headspace GC-FID (C4-C12)	✓		WET	
TM089	Modified: US EPA Methods 8020 & 602	Determination of Gasoline Range Hydrocarbons (GRO) and BTEX (MTBE) compounds by Headspace GC-FID (C4-C12)	✓	✓	WET	
TM090	Method 5310, AWWA/APHA, 20th Ed., 1999 / Modified: US EPA Method 415.1 & 9060	Determination of Total Organic Carbon/Total Inorganic Carbon in Water and Waste Water			NA	
TM097	Modified: US EPA Method 325.1 & 325.2	Determination of Chloride using the Kone Analyser			NA	
TM097	Modified: US EPA Method 325.1 & 325.2	Determination of Chloride using the Kone Analyser	✓		NA	
TM098	Method 4500E, AWWA/APHA, 20th Ed., 1999	Determination of Sulphate using the Kone Analyser			NA	

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

ALcontrol Geochem Analytical Services
Table Of Results - Appendix

Job Number: 06/15648/02/01
Client: Egniol Ltd.
Client Ref. No.:

Report Key :

Results expressed as (e.g.) 1.03E-07 is equivalent to 1.03×10^{-7}

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

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

Summary of Method Codes contained within report :

Method No.	Reference	Description	ISO 17025 Accredited	MCERTS Accredited	Wet/Dry Sample [1]	Surrogate Corrected
TM098	Method 4500E, AWWA/APHA, 20th Ed., 1999	Determination of Sulphate using the Kone Analyser	✓		NA	
TM099	BS 2690: Part 7:1968 / BS 6068: Part2.11:1984	Determination of Ammonium in Water Samples using the Kone Analyser	✓		NA	
TM101	Method 4500B & C, AWWA/APHA, 20th Ed., 1999	Determination of Sulphide in soil and water samples using the Kone Analyser	✓		WET	
TM104	Method 4500F, AWWA/APHA, 20th Ed., 1999	Determination of Fluoride using the Kone Analyser			NA	
TM120	Method 2510B, AWWA/APHA, 20th Ed., 1999 / BS 2690: Part 9:1970	Determination of Electrical Conductivity using a Conductivity Meter	✓		NA	
TM123	BS 2690: Part 121:1981	The Determination of Total dissolved Solids in Water			NA	
TM127	Method 3112B, AWWA/APHA, 20th Ed., 1999	The Determination of Trace Level Mercury in Aqueous Media and Soil Extracts by Atomic Absorption Spectroscopy			NA	
TM127	Method 3112B, AWWA/APHA, 20th Ed., 1999	The Determination of Trace Level Mercury in Aqueous Media and Soil Extracts by Atomic Absorption Spectroscopy	✓		NA	
TM129	Method 3120B, AWWA/APHA, 20th Ed., 1999 / Modified: US EPA Method 3050B	Determination of Metal Cations by IRIS Emission Spectrometer	✓	✓	DRY	
TM133	BS 1377: Part 3 1990	Determination of pH in Soil and Water using the GLpH pH Meter	✓		NA	
TM133	BS 1377: Part 3 1990	Determination of pH in Soil and Water using the GLpH pH Meter	✓	✓	WET	
TM136	Method 17.10, Second Site property, March 2003	Determination of Sulphur by HPLC	✓		NA	
TM151	Method 3500D, AWWA/APHA, 20th Ed., 1999	Determination of Hexavalent Chromium using Kone analyser	✓		WET	
TM152	Method 3125B, AWWA/APHA, 20th Ed., 1999	Analysis of Aqueous Samples by ICP-MS			NA	

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

ALcontrol Geochem Analytical Services
Table Of Results - Appendix

Job Number: 06/15648/02/01
Client: Egniol Ltd.
Client Ref. No.:

Report Key :

Results expressed as (e.g.) 1.03E-07 is equivalent to 1.03×10^{-7}

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

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

Summary of Method Codes contained within report :

Method No.	Reference	Description	ISO 17025 Accredited	MCERTS Accredited	Wet/Dry Sample [1]	Surrogate Corrected
TM152	Method 3125B, AWWA/APHA, 20th Ed., 1999	Analysis of Aqueous Samples by ICP-MS	✓		NA	
TM153	Method 4500A,B,C, I, M AWWA/APHA, 20th Ed., 1999	Determination of Total Cyanide, Free (Easily Liberatable) Cyanide and Thiocyanate using the "Skalar SANS+ System" Segmented Flow Analyser	✓		NA	
TM153	Method 4500A,B,C, I, M AWWA/APHA, 20th Ed., 1999	Determination of Total Cyanide, Free (Easily Liberatable) Cyanide and Thiocyanate using the "Skalar SANS+ System" Segmented Flow Analyser	✓	✓	WET	
TM154	In - house Method	Determination of Petroleum Hydrocarbons by EZ Flash GC-FID in the Carbon range C6- C40			WET	
TM154	In - house Method	Determination of Petroleum Hydrocarbons by EZ Flash GC-FID in the Carbon range C6- C40	✓		WET	

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

ALcontrol Geochem Analytical Services
Table Of Results - Appendix

Job Number: 06/15648/02/01
Client: Egniol Ltd.
Client Ref. No.:

Summary of Coolbox temperatures

Batch No.	Coolbox Temperature (°C)
1	14

ALcontrol Geochem Analytical Services
Sample Descriptions

Job Number: 06/15648/02/01
Client: Egniol Ltd.
Client Ref :

Grain sizes

<0.063mm	Very Fine
0.1mm - 0.063mm	Fine
0.1mm - 2mm	Medium
2mm - 10mm	Coarse
>10mm	Very Coarse

Sample Identity	Depth (m)	Colour	Grain Size	Description	Batch
BH03	2.5	Brown	0.1mm - 0.063mm	Clay with some Stones	2
BH03	5.0	Brown	0.1mm - 0.063mm	Clay with some Stones	2

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

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

Validated ✓
Preliminary

ALcontrol Geochem Analytical Services
Table Of Results

[#] ISO 17025 accredited
[M] MCERTS accredited
* Subcontracted test
» Shown on prev. report

Job Number: 06/15648/02/01 **Matrix:** SOLID
Client: Egniol Ltd. **Location:** NANT NEWYDD QUARRY
Client Ref. No.: **Client Contact:** Sarah Venning

Sample Identity	BH03	BH03								Method Code	LoD/Units
Depth (m)	2.5	5.0									
Sample Type	SOLID	SOLID									
Sampled Date											
Sample Received Date	14.09.06	14.09.06									
Batch	2	2									
Sample Number(s)	**16-17**	**18-19**									
Total Sulphate	894	2234								TM129[#M]	<100 mg/kg
Boron Water Soluble	2	<1								TM129[#M]	<1 mg/kg
Arsenic	24	16								TM129[#M]	<3.0 mg/kg
Cadmium	<1	<1								TM129[#M]	<1 mg/kg
Chromium	25.2	18.8								TM129[#M]	<4.5 mg/kg
Copper	48	33								TM129[#M]	<6.0 mg/kg
Lead	83	34								TM129[#M]	<2.0 mg/kg
Mercury	<1.5	<1.5								TM129[#M]	<1.5 mg/kg
Nickel	22	34								TM129[#M]	<1 mg/kg
Selenium	<3	<3								TM129[#M]	<3 mg/kg
Zinc	139.6	87.0								TM129[#M]	<2.5 mg/kg
Acid Soluble Sulphide	<50	<50								TM101[#]	<50 mg/kg
Hexavalent Chromium	<3.0	<0.3								TM151[#]	<0.3 mg/kg
Phenols Monohydric	<0.01	<0.01								TM062	<0.01 mg/kg
Thiocyanate	<1	<1								TM153[#M]	<1 mg/kg
Total Cyanide	<1	<1								TM153[#M]	<1 mg/kg
Free Cyanide	<1	<1								TM153[#M]	<1 mg/kg
pH Value	8.05	7.97								TM133[#M]	<1.00 pH Units
Total Sulphur	0.06	0.91								TM068[#]	<0.01 %
EPH (DRO) (C10-C40)	708	495								TM061[#M]	<1 mg/kg
GRO (C4-C10)	<10	23								TM089[#M]	<10 ug/kg
GRO (C10-C12)	<10	<10								TM089[#M]	<10 ug/kg
Benzene	<10	<10								TM089[#M]	<10 ug/kg
Toluene	<10	<10								TM089[#M]	<10 ug/kg
Ethyl benzene	<10	<10								TM089[#M]	<10 ug/kg
m & p Xylene	<10	<10								TM089[#M]	<10 ug/kg
o Xylene	<10	<10								TM089[#M]	<10 ug/kg
MTBE	<10	23								TM089[#]	<10 ug/kg
PAH Total	21	19								TM154[#]	<10 mg/kg

All results expressed on a dry weight basis.

Date 26.09.2006

Validated ✓
Preliminary

ALcontrol Geochem Analytical Services
Table Of Results

[#] ISO 17025 accredited
[M] MCERTS accredited
[*] Subcontracted test
[»] Shown on prev. report

Job Number: 06/15648/02/01 **Matrix:** LIQUID
Client: Egniol Ltd. **Location:** NANT NEWYDD QUARRY
Client Ref. No.: **Client Contact:** Sarah Venning

Sample Identity	BH03									**Method Code**	**LoD/Units**
Depth (m)	6.9										
Sample Type	LIQUID										
Sampled Date											
Sample Received Date	14.09.06										
Batch	2										
Sample Number(s)	**20-22**										
Arsenic Dissolved (ICP-MS)	2									TM152[#]	<1 ug/l
Boron Dissolved (ICP-MS)	75									TM152[#]	<10 ug/l
Cadmium Dissolved (ICP-MS)	<0.4									TM152[#]	<0.4 ug/l
Chromium Dissolved (ICP-MS)	<1									TM152[#]	<1 ug/l
Copper Dissolved (ICP-MS)	<1									TM152[#]	<1 ug/l
Lead Dissolved (ICP-MS)	<1									TM152[#]	<1 ug/l
Nickel Dissolved (ICP-MS)	5									TM152[#]	<1 ug/l
Selenium Dissolved (ICP-MS)	2									TM152[#]	<1 ug/l
Zinc Dissolved (ICP-MS)	15									TM152[#]	<3 ug/l
Mercury Dissolved (CVAA)	<0.05									TM127[#]	<0.05 ug/l
Conductivity (at 25 deg.C)	1.297									TM120[#]	<0.014 mS/cm
Sulphate (soluble)	548									TM098[#]	<3 mg/l
Chloride	86									TM097[#]	<1 mg/l
Sulphide	<0.5									TM101[#]	<0.5 mg/l
Total Ammonium as NH4	0.4									TM099[#]	<0.3 mg/l
Hexavalent Chromium	<0.03									TM151[#]	<0.03 mg/l
Phenols Monohydric	<0.01									TM062	<0.01 mg/l
Thiocyanate	<0.05									TM153[#]	<0.05 mg/l
Total Cyanide	<0.05									TM153[#]	<0.05 mg/l
Free Cyanide	<0.05									TM153[#]	<0.05 mg/l
Free Sulphur	<0.05									TM136[#]	<0.05 mg/l
pH Value	8.22									TM133[#]	<1.00 pH Units

Date 26.09.2006

Validated ✓
Preliminary

ALcontrol Geochem Analytical Services
Table Of Results

[#] ISO 17025 accredited
[M] MCERTS accredited
[*] Subcontracted test
[»] Shown on prev. report

Job Number: 06/15648/02/01 **Matrix:** LIQUID
Client: Egniol Ltd. **Location:** NANT NEWYDD QUARRY
Client Ref. No.: **Client Contact:** Sarah Venning

Sample Identity	BH03									Method Code	LoD/Units
Depth (m)	6.9										
Sample Type	LIQUID										
Sampled Date											
Sample Received Date	14.09.06										
Batch	2										
Sample Number(s)	20-22										
PAH by GCMS											
Naphthalene	137									TM074	<10 ng/l
Acenaphthylene	12									TM074	<10 ng/l
Acenaphthene	208									TM074	<10 ng/l
Fluorene	94									TM074	<10 ng/l
Phenanthrene	296									TM074	<10 ng/l
Anthracene	72									TM074	<10 ng/l
Fluoranthene	334									TM074	<10 ng/l
Pyrene	233									TM074	<10 ng/l
Benz(a)anthracene	112									TM074	<10 ng/l
Chrysene	97									TM074	<10 ng/l
Benzo(b)fluoranthene	72									TM074	<10 ng/l
Benzo(k)fluoranthene	88									TM074	<10 ng/l
Benzo(a)pyrene	92									TM074	<10 ng/l
Indeno(123cd)pyrene	47									TM074	<10 ng/l
Dibenzo(ah)anthracene	17									TM074	<10 ng/l
Benzo(ghi)perylene	83									TM074	<10 ng/l
PAH 16 Total	1994									TM074	<10 ng/l

Date 26.09.2006

ALcontrol Geochem Analytical Services
Table Of Results - Appendix

Job Number: 06/15648/02/01
Client: Egniol Ltd.
Client Ref. No.:

Report Key :

Results expressed as (e.g.) 1.03E-07 is equivalent to 1.03×10^{-7}

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

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

Summary of Method Codes contained within report :

Method No.	Reference	Description	ISO 17025 Accredited	MCERTS Accredited	Wet/Dry Sample [1]	Surrogate Corrected
TM061	Method for the Determination of EPH,Massachusetts Dept.of EP, 1998	Determination of Extractable Petroleum Hydrocarbons by GC-FID (C10-C40)	✓	✓	DRY	
TM062	MEWAM BOOK 124 1988.HMSO/ Method 17.7, Second Site property, March 2003	Determination of Phenolic compounds by HPLC with electro-chemical detection			WET	
TM068	ASTM D-1552	Total sulphur determination by combustion method	✓		DRY	
TM074	Modified: US EPA Method 8100	Determination of Polynuclear Aromatic Hydrocarbons (PAH) by GC-MS. MCERTS Accreditation on Soils for Naphthalene except when Kerosene present.			NA	
TM089	Modified: US EPA Methods 8020 & 602	Determination of Gasoline Range Hydrocarbons (GRO) and BTEX (MTBE) compounds by Headspace GC-FID (C4-C12)	✓		WET	
TM089	Modified: US EPA Methods 8020 & 602	Determination of Gasoline Range Hydrocarbons (GRO) and BTEX (MTBE) compounds by Headspace GC-FID (C4-C12)	✓	✓	WET	
TM097	Modified: US EPA Method 325.1 & 325.2	Determination of Chloride using the Kone Analyser	✓		NA	
TM098	Method 4500E, AWWA/APHA, 20th Ed., 1999	Determination of Sulphate using the Kone Analyser	✓		NA	
TM099	BS 2690: Part 7:1968 / BS 6068: Part2.11:1984	Determination of Ammonium in Water Samples using the Kone Analyser	✓		NA	
TM101	Method 4500B & C, AWWA/APHA, 20th Ed., 1999	Determination of Sulphide in soil and water samples using the Kone Analyser	✓		WET	
TM120	Method 2510B, AWWA/APHA, 20th Ed., 1999 / BS 2690: Part 9:1970	Determination of Electrical Conductivity using a Conductivity Meter	✓		NA	
TM127	Method 3112B, AWWA/APHA, 20th Ed., 1999	The Determination of Trace Level Mercury in Aqueous Media and Soil Extracts by Atomic Absorption Spectroscopy	✓		NA	
TM129	Method 3120B, AWWA/APHA, 20th Ed., 1999 / Modified: US EPA Method 3050B	Determination of Metal Cations by IRIS Emission Spectrometer	✓	✓	DRY	
TM133	BS 1377: Part 3 1990	Determination of pH in Soil and Water using the GLpH pH Meter	✓		NA	

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

ALcontrol Geochem Analytical Services
Table Of Results - Appendix

Job Number: 06/15648/02/01
Client: Egniol Ltd.
Client Ref. No.:

Report Key :

Results expressed as (e.g.) 1.03E-07 is equivalent to 1.03×10^{-7}

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

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

Summary of Method Codes contained within report :

Method No.	Reference	Description	ISO 17025 Accredited	MCERTS Accredited	Wet/Dry Sample [1]	Surrogate Corrected
TM133	BS 1377: Part 3 1990	Determination of pH in Soil and Water using the GLpH pH Meter	✓	✓	WET	
TM136	Method 17.10, Second Site property, March 2003	Determination of Sulphur by HPLC	✓		NA	
TM151	Method 3500D, AWWA/APHA, 20th Ed., 1999	Determination of Hexavalent Chromium using Kone analyser	✓		WET	
TM152	Method 3125B, AWWA/APHA, 20th Ed., 1999	Analysis of Aqueous Samples by ICP-MS	✓		NA	
TM153	Method 4500A,B,C, I, M AWWA/APHA, 20th Ed., 1999	Determination of Total Cyanide, Free (Easily Liberatable) Cyanide and Thiocyanate using the "Skalar SANS+ System" Segmented Flow Analyser	✓		NA	
TM153	Method 4500A,B,C, I, M AWWA/APHA, 20th Ed., 1999	Determination of Total Cyanide, Free (Easily Liberatable) Cyanide and Thiocyanate using the "Skalar SANS+ System" Segmented Flow Analyser	✓	✓	WET	
TM154	In - house Method	Determination of Petroleum Hydrocarbons by EZ Flash GC-FID in the Carbon range C6- C40	✓		WET	

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

ALcontrol Geochem Analytical Services
Table Of Results - Appendix

Job Number: 06/15648/02/01
Client: Egniol Ltd.
Client Ref. No.:

Summary of Coolbox temperatures

Batch No.	Coolbox Temperature (°C)
2	15

John Madden
Environment Agency
Richard Fairclough House
Knutsford Road
Latchford
Warrington, Cheshire
WA4 1HG

Our ref: A2252/SV/DRK
Your ref: EA/PPC/RP3337SE

Date : 14th September 2006

Dear Mr Madden,

Re: NOTICE REQUIRING FURTHER INFORMATION REGARDING NANT NEWYDD QUARRY LANDFILL PPC APPLICATION, REFERENCE: EA/PPC/RP3337SE

I am writing in response to your letter dated as the 3rd April 2006, constituting "Notice Requiring Further Information" regarding the above mentioned site, and detailing a schedule of the necessary actions to be carried out by the applicant.

The information contained in this letter aims to present a record of the works being carried out onsite. A correspondence will be issued after the laboratory results of the soil testing of the waste become available, summarising the results, and using them to address the issues raised in the Schedule 4 notice.

In addition to the onsite observations during drilling works undertaken at the site between the 5th and 13th September 2006, this letter will also discusses the historic photographs, taken prior to some of the waste being emplaced, which were obtained from the site owner.

HISTORIC PHOTOGRAPHS

A number of photographs were obtained from the site owner during the first site visit. Some of these, which provide most information regarding the development of the site, have been included in Appendix 1.

Picture number 1

This photograph was taken on 12/10/1996. The view is to the west, and the shed near the weighbridge is visible at the back of the piles of soil. These soil piles, to the left of the picture, constitute the waste mass.

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It has been suggested, that the black terrace visible below the waste in the middle of the picture, adjacent to the pool of water, is the bedrock. The scale is difficult to determine, but there is likely to be a thickness of waste of approximately 2-4m. The present level of the haul road within his section of the site does not appear to be significantly higher.

Picture number 2

The view of this aerial photograph is approximately north. The site entrance is in the middle, near the southern edge of the site. The weighbridge and the office building can be seen near the site entrance. The grassed area to the south of the site constitutes an area of tipping operations, which had been completed prior to the current owner acquiring the site. It does not seem to be particularly deep (assuming that this southern area was not excavated to a level below the rest of the site on this picture). It is not likely, that significant quantities of waste have been deposited over this area since, as the level appears similar to that of haul roads within the area at present relative to the site entrance. There appears to be more waste within this area at present, because of a number of stockpiles, which have been located within this southern section of the site, south of the quarry. It is anticipated, that after crushing and screening, most of this material will be removed (sold).

Of further interest is the area to the north of the quarry. The site boundary runs along the line on the photograph, separating the grey outline of the quarry and the green area of grass to the north (including the area of brown soil in the middle of the northern-most section). It is likely, that the base level of the site, as indicated on this picture, coincides with the bedrock over the area to the north (except where haul roads have been constructed). There has been some indication that waste may have been tipped within this area to the north of the quarry. The aerial photograph does not confirm that to be the case. It is plausible, that if waste was emplaced within the north-western and north-eastern corners of the licensed area, the thickness of waste would be minimal (as bedrock appears to be within 2-3m of the ground-level of the field to the north of the quarry).

INTRUSIVE INVESTIGATION

In order to characterise the waste in more detail, an intrusive investigation was undertaken. Four boreholes were scheduled for drilling through the waste in the different areas of the landfill. Samples would be obtained from different depths, at 2.5m intervals, from each borehole drilled, providing an indication of the waste variability with depth, as well as across the site.

Site walkover

Site works were started on the 5th September 2006. A site walkover was conducted, to establish the layout of the site, and the appropriate locations for the boreholes.

During the walkover survey, it appeared that the largest volume of waste was deposited in the southern section of the landfill. The exposed waste cross section at the tipping face indicates that there is an approximate minimum thickness of 10m of waste in the most recent area where waste is being tipped.

Within the southern section of the landfill, a number of stockpiles of rubble and inert material for recycling (crushing and sorting, and subsequent use offsite) were noted. Stockpiles of quarried limestone blocks, and other quarried material were observed within the central section of the site. To the north, stockpiles of builder's rubble, stones and soils were noted.

In the north-western section of the site, a large quantity of soils has been deposited. The site owner anticipates that those would be sorted, and removed for use offsite. It is therefore not certain whether these deposits constitute stockpiles or waste mass. Some concrete blocks were observed to the north-east of the site, suggesting, that there is some made ground in this area, although the thickness could not be ascertained.

As the largest volume of waste appeared to be within the southern section of the landfill, to the south of the quarry, three drilling areas were selected within this zone of the landfill (a borehole to be located in each). Those are:

In the south eastern corner of the site (where waste is oldest)

Near the tipping phase (where waste is newest)

In the middle of the area, approximately 7m east of the existing gas monitoring borehole onsite.

The forth one was proposed to be within the soils within the north-western section of the landfill, to the north of the quarry. After conversations with the EA, it was suggested, that a further borehole is located within the northern section of the landfill to the east, to determine the nature of the superficial deposits (natural soils or made ground/waste), and the depth of the bedrock.

Observations during drilling

The drilling works were supervised by an onsite engineer. The boreholes were logged according to BS5930:1999 "Code of Practise for Site Investigations". Photographs of the borehole locations and the arisings are included in Appendix 2. Borehole logs are included in Appendix 3.

Area 1

BH1 was located to the eastern side of the area, on the outside of the haul road bend. The materials encountered were primarily brown to dark brown inert soils (clayey in parts) with rubble and rock fragments. Some twigs were found at a depth of 2.25m. A small lump of tarmac was encountered at this location, at a depth of approximately 4.1m below ground level. The borehole was terminated at 4.7m, due to refusal as the borehole could not be progressed through a concrete block, which was encountered at 4.5m.

As the bedrock was not established in this location, drilling of another borehole in this location was undertaken. BH1A was located to the inside of the haul road bend. The material drilled through was similar to that in BH1. The waste was typified by soils with fragments of rock and rubble. A small piece of black material, possibly tarmac was found at a depth of 1m, and some woody material was found at 1.6m. The soil became more clayey with depth. A hard dark grey rock was encountered at a depth of 6.25m, and the borehole was terminated at 6.5m.

As the proposed depth (based on available information about the depth of waste in this area) of drilling was not achieved at this borehole, a further borehole, BH1B was sunk in this area. The location of BH1B was 2m to the north-west of the location of BH1A. The material at this location was primarily dark brown soil with rock pieces. A 'horizon' of clay with rock fragments, and isolated pieces of plastic, was encountered between a depth of 2.8 and 5.8m. A dark grey rock, similar to that in BH1A was encountered at a depth of 5.8m and the borehole was terminated at 6m.

It is considered, that the rock encountered at BH1A and BH1B constitutes the bedrock in this older are of the landfill. The historic photographs indicate that there was a terrace of rock, which could have been as little as 6m below the top of the waste mass.

Area 2

This area was near the tipping face of the site. Borehole 2 was situated approximately 4m from the edge of the waste mass, and approximately 8m from the eastern site boundary. The material drilled through in this location was typified by inert soils with rock fragments, and a number of other inclusions, such as glass, brick, wood and plastic. The distribution of these was varied, and no particular layering of the waste was evident at this location (possibly due to the tipping practise at the site, of tipping the material over the edge, rather than spreading it over the surface of the existing waste). Water strike was recorded at a depth of 9.6m, and the resting water level rose to 8.5 within the borehole. The liquid appeared to be within the waste, and should therefore be considered leachate. BH2 was terminated at a depth of 10m after rock was encountered at 9.6m. The rock (interpreted as the bedrock at this location) was a hard, darkly coloured rock, similar to that seen at BH1A and BH1B.

BH2 was installed as a water and gas monitoring borehole. The installation details are included within the borehole logs, in Appendix 3.

Area 3

This area is to the centre of the waste mass in the southern section of the landfill. The borehole for this area, BH3, was sunk approximately 7m to the east of the existing gas monitoring borehole on the site. The waste materials seen were primarily dark brown sandy and clayey soils with rock fragments, within the upper 5m below ground level. At 5.5m below ground level a horizon of relatively homogeneous, light brown clayey soil with rock fragments was found. Water strike at this borehole was at a depth of 6.9m below ground level. A hard dark grey rock was encountered at 8.7m, and the borehole was terminated at 8.9m.

BH3 was installed as a water and gas monitoring borehole. The installation details are included within the borehole logs, in Appendix 3.

Northern area

As there is evidence to suggest, that some waste was tipped to the north of the site, two boreholes were scheduled for installation within this area. A ‘stockpiling’ of soils was observed to the west of the northern section of the landfill, and flat area with grassed-over mounds of soil and rubble to the east.

Pieces of concrete and brick were noted on the surface of the ground in the flat area to the east of the northern section, suggesting that there was made ground in the area.

BH4 was located in the soils to the western side of the northern area, approximately 4m from the western boundary. The material drilled through in this location was primarily dark brown/black dry soil with rock fragments, and other inclusions, including plastic, glass, wood, brick and some tarmac. The soils in this area had a pungent smell. At a depth of 3.5m, as well as the dark brown/black soil, lighter brown clayey soil was found. At a depth of 5.3m a hard grey rock was encountered which allowed no further progression. The borehole was terminated at this depth and backfilled.

BH5 was located to the north-east of the site approximately 6m north from the haul road bend. The material recovered from the top 1m was brown dry soil containing rock fragments and brick pieces. At 1m below ground levels a dark brown/black clayey soil was found which contained rock fragments. At 2.3m below ground level a hard grey rock was encountered. This rock was interpreted as bedrock and was similar to the rock type encountered at BH4. This borehole was terminated at 2.3m and backfilled.

As the proposed depth (based on the available information about the depth of the waste in this area) of drilling was not achieved at this borehole, a further borehole, BH5A, was sunk in the area. BH5A was located approximately 15m south-west of BH5, nearer the quarry edge, about 2m east from the haul road. The material drilled through in this area was primarily medium brown dry soil with rock fragments. No other inclusions were observed. At a depth of 2.2m a hard grey rock was encountered similar to that encountered at BH5. This borehole was terminated at 2.2m and backfilled.

Scheduled analytical works

A number of samples were sent for analysis on Friday 8th September 2006 and a subsequent batch on the 13th September 2006. The soil samples sent are detailed in the Table below. With regards to the urgency associated with receiving analytical results and forwarding them to the regulating authority, two sets of tests were scheduled. The Waste Acceptance Criteria testing requires a minimum of days, and the results are therefore expected around the 20th of September. However, two samples per area would be sent for metals and organics testing. This, while not WAC testing, would provide an indication of the quality of the waste at varying depths and locations at the site. These tests have been scheduled on the fastest turnaround available, and the first set of results are expected around the 15th September 2006.

	WAC	EPH/GRO	Soils Midi Suite
Area 1	BH1A at 5m	BH1 at 2.5m	BH1 at 2.5m
		BH1B at 5m	BH1B at 5m
		BH1A at 5m	BH1A at 5m
Area 2	BH2 at 7.5m	BH2 at 5m	BH2 at 5m
		BH2 at 7.5m	BH2 at 7.5m
Area 3		BH3 at 2.5m	BH3 at 2.5m
		BH3 at 5m	BH3 at 5m
Northern Area	BH4 at 4.9m		
	BH5 at 2.3m		

Additionally, liquid samples recovered from BH2 and BH3 have been sent for analysis. The results would provide a good indication of the overall leachate, which would be generated by water percolating through the waste.

I hope this letter provides sufficient information about the observations onsite, and scheduled works to address the issues which you raised in your Notice Requiring Further Information. Should you require any further information, or have any comments regarding this correspondence, please do not hesitate to contact me, or Sarah Venning.

Yours sincerely

Diana R. Kountcheva

for Egniol Ltd

Environment Agency Wales
For the attention of Mr. Phil Goodman
Llwyn Brain
Ffordd Penlan
Parc Menai
Bangor
LL57 4BP

2498/CON/DRK

5th June 2007

Dear Phil,

RE: NANT NEWYDD MONITORING REGIME

As discussed during our meeting on the 9th May 2007, Egniol Consulting Limited (Egniol) would like to propose on behalf of G.T. Owen of Nant Newydd Quarry (the client) a relaxation of the monitoring regime stipulated within the PPC permit issued for the site including justification for the proposed reduction. The client has expressed a desire to suspend tipping at the site ('mothball' the site) for an initial period of 12 months due to economical constraints resulting from the PPC permit regime for the site. During this period we would like to propose the following monitoring regime.

1. Number and location of monitoring points

Surface water monitoring locations

Five surface water monitoring locations have been specified for the site within the PPC permit issued in March 2007. These include two onsite monitoring locations in the ditch routing runoff offsite (W1 and W1a), an upstream and downstream monitoring location within the receiving surface water course (W2 and W3 respectively), and a spring located approximately 1 km to the north-west of the site (W4).

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W1 and W1a are situated within the same body of water, approximately 1m apart (as indicated in a letter dated as 23rd May 2005, describing the monitoring undertaken by Egniol that month (attached to this correspondence)). The results during this visit indicate that the water quality at both of these monitoring locations is very similar (with the exception of suspended solids). It is likely that the concentration of suspended solids recorded in W1a is related to the greater amount of sediment within this body of water. Therefore it is not considered that monitoring this location provides additional information regarding the quality of the water leaving the site, to that obtained from monitoring W1. As such, we propose that this surface water monitoring location is excluded from the list of surface water monitoring locations for the site.

W4 is a water monitoring point near lake Llyn yr Wyth Eidion, situated approximately 0.7 km to the north west of the site. It has been described as a spring. If it is viewed as surface water (i.e. a spring fed by a subsurface water course, which is not the aquifer that could be affected by actions carried out at the site), it is possible that water quality may be affected by sources of contamination present between the site and the spring (the area is typified by agricultural fields). Therefore W4 is not considered to be a representative surface water monitoring location to be used in order to monitor any adverse impacts that activities within the site might be having on surface water receptors.

If the spring is fed by the groundwater body, which forms the aquifer lying below or down-gradient of the site, monitoring at this location should be carried out as part of the groundwater monitoring for the site. Therefore we propose that W4 is not monitored under the surface water monitoring regime but moved to the groundwater monitoring regime. If the origin of the spring could not be confirmed as the groundwater aquifer immediately below or down-gradient of the site, we propose that this monitoring point is excluded from the list of monitoring locations for the site.

Therefore the surface water locations which are to be monitored on a monthly basis would be W1, W2 and W3.

Groundwater monitoring locations

Four groundwater monitoring locations are to be installed at the site as a pre-operational condition stipulated within the permit. As discussed at the meeting, the minimum number of groundwater monitoring locations required to monitor the impact of a landfill on groundwater resources is three – one up-gradient and two down-gradient (as indicated in the Guidance document on the Monitoring of Landfill Leachate, Groundwater and Surface water (LFTGN02) issued by the Environment Agency, 2003 and Schedule 3 of the Landfill (England and Wales) Regs 2002). There is no evidence to suggest that the geology at the site is complex, or the site big enough to require further groundwater monitoring locations situated up or down-gradient of the site other than the minimum number indicated within the Landfill Regulations.

Therefore we propose that three groundwater monitoring locations are established. It should be further considered, that if it can be shown that W4 represents a spring, fed by the aquifer immediately below/down-gradient of the site, W4 could be used as a down-gradient groundwater monitoring location, reducing the number of wells to be installed to two.

We therefore propose that a brief investigation is undertaken into the nature of the spring at W4 prior to carrying out installation of groundwater monitoring boreholes. Thus the number of monitoring boreholes required could be ascertained and approved prior to their installation. This would reduce cost to the client by ensuring that drilling equipment is mobilised to the site once.

2. Monitoring regime

The monitoring results obtained during the April monitoring visit are included with this correspondence. Concentrations of iron, manganese, nickel and sulphate were elevated in W1 and W3 compared to the other monitoring locations. Nitrates and phosphates had highest concentrations in W2, which is upstream of the site. They are likely to originate at the farm to the east of the site. Concentrations of total petroleum hydrocarbons (TPH) were low in all monitoring locations. The concentrations of most other determinants did not show a significant difference in between the different monitoring locations, and most were at or below their detection limit (such as lead, chromium, ammoniacal nitrogen and biological oxygen demand (BOD)).

It is recognised, that the available information regarding the concentrations of metals and organics within water around the site is limited. No extended surface water or groundwater monitoring suites were performed as part of the PPC application preparation for the site. Therefore it is proposed that a round of extended monitoring is carried out in June 2007. This will allow for the investigation into the origin of the spring at W4 and installation of the groundwater monitoring boreholes to be carried out beforehand.

The analytical suite would constitute the annual monitoring for the site, detailed in the PPC permit for Nant Newydd, optimising the amount of information obtained from the monitoring round, while maintaining continuity of the monitoring regime for the site. The annual suite includes a full List I substances screen (Alcontrol laboratories standard List I suite will be utilised). It is proposed that after this monitoring round, only substances found above the detection limit be tested for within the next six-monthly List I screen for groundwater and surface water. If none were detected, the minimum analysis suite would incorporate the minimum number of List I substances indicated within the PPC permit for the site, including Cd, Hg, PAH, Mineral oils, MTBE and pesticides.

Surface water

The current monitoring regime and the suggested monitoring regime for surface water at the site are included on a separate sheet with this correspondence.

Surface water monitoring undertaken at the site during the previous two years indicates that concentration of phosphates and toluene extractable matter (TEM) are typically below the detection limit in all monitoring locations sampled, and as such are not considered to constitute a significant risk to receiving waters. No sulphide was recorded in any of the monitored locations throughout the previous 2 years. Therefore we propose that sulphide and phosphate are monitored as part of a six monthly suite.

It is proposed that the monthly monitoring suite is reduced to include pH, temperature, electrical conductivity, ammoniacal nitrogen, chloride, sulphate dissolved oxygen, total suspended solids, and total organic carbon. It is considered that Oil and Grease monitoring should be carried out

as a visual determination only rather than TPH laboratory water analysis. A more extensive suite including metals and COD and BOD would then be tested for quarterly, with List I substances analysis being included on a six monthly basis.

Groundwater monitoring

The current monitoring regime and the proposed monitoring regime for groundwater at the site are included on a separate sheet with this correspondence.

No groundwater quality information is available for the site at present. Therefore the proposed reduction in the monitoring requirements, which can be made at this stage is to perform testing for mineral oils, PAH and MTBE as part of the proposed six-monthly List I screen. It is envisaged, that this will reduce the overall cost of monitoring significantly while maintaining environmental protection through increasing the List I screen frequency to six monthly (for substances, which have been detected during the previous visit).

3. Summary

Our proposals regarding Nant Neywdd quarry, based on the justifications detailed above, can be summarised as follows:

May

- *Monitoring*
    - W1, W2 and W3 surface water monthly suite (as stipulated in the PPC Permit);
    - W4 groundwater monthly monitoring suite (as stipulate in the PPC Permit).
- *Other*
    - Investigation into the spring at W4 and its likely source;

June

- Installation of groundwater monitoring locations (two or 3 depending on the findings of the investigation into the source of the spring).
- *Monitoring*
    - W1, W2 and W3 extended baseline suite (equivalent of the annual suite for the site required in the PPC permit for the site);

- Groundwater monitoring locations (3), extended baseline suite (equivalent to the annual suite for the site required by the PPC permit for the site), if the boreholes have been installed earlier in the month.

July and thereafter

Monitoring would be carried out at the same locations as in June, according to a relaxed monitoring regime as suggested in the tables included with this correspondence. The proposed monitoring regime (and the relaxation it provides from that stipulated within the PPC permit) will be confirmed upon receipt of the monitoring results from the extended suite carried out in June 2007 (or in the case of the groundwater monitoring locations after completion of the baseline suite after the installation of these monitoring locations).

If there is further information, which you would need in order to be able to assess the suggested monitoring regime, please do not hesitate to contact me. I will supply further monitoring information as it becomes available, and confirm the suggested monitoring regime as our proposal after the baseline monitoring results become available in June 2007.

Once the proposed 12 months of suspension of tipping operations are complete, we would like to evaluate the data collected during the period and, in discussion with the client regarding the site's future, re-evaluate the monitoring regime.

I hope you find the suggestions within this correspondence appropriate in view of relaxing the monitoring regime for the site. Please do not hesitate to contact me to discuss any of the above.

Kind Regards

Diana R. Kountcheva

For Egniol Consulting Ltd

cc. Gwylum, G.T. Owen, Nant Newydd Quary

Environment Agency Wales
For the attention of Mr. Gareth Lewis
Llwyn Brain
Ffordd Penlan
Parc Menai
Bangor
LL57 4BP

3004/CON/DRK/080422

22nd April 2008

Dear Gareth,

RE: NANT NEWYDD QUARRY
AMMENDED MONITORING REGIME PROPOSAL (V2)

This letter is a revision and replacement of our letter sent to the EA on the 11th December 2007. The revision has become necessary due to recent developments at the site. As discussed, Egniol Consulting Ltd (Egniol) would also like to confirm the monitoring locations at the site and propose, on behalf of G.T Owen of Nant Newydd Quarry (the client), a reduced monitoring regime (including justification for the proposed reduction) while the site is 'mothballed'.

Current Monitoring

A PPC Permit (RP3337SE) for Nant Newydd Quarry was granted on 30th March 2007. Monitoring requirements for surface water and groundwater are stipulated within tables S4.5 and S4.6 of the permit. Waste acceptance at the site is currently suspended due to financial difficulties of the operator in particular regarding the pre-operational conditions detailed in table S1.4A of the permit. As no waste is currently being accepted, it can be reasoned that the risks posed to the environment by operations at the site are limited to those relating to sources within the historic waste mass.

This correspondence reviews the monitoring data obtained between May 2005 and October 2007 (with monitoring rounds between April 2007 – October 2007 being under the current PPC

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Permit monitoring regime) and in conjunction with data from the WAC testing carried out in September 2006, provides justification for the proposed reduction in the monitoring regime.

Background

It is believed that the historic waste at the site poses the highest risk to the environment. Any future waste accepted at the sute will be of a quality deemed to pose a minimal risk to the environment. This is because of recent changes in legislation requiring all inert waste to be pre-treated and tested prior to landfilling: therefore such waste is less likely to be a source of contamination compared to waste accepted prior to the PPC regime.

Groundwater Monitoring Points

The minimum number of groundwater monitoring locations required to monitor the impact of a landfill on groundwater resources is three – one up-gradient and two down-gradient (as indicated in the Guidance document on the Monitoring of Landfill Leachate, Groundwater and Surface water (LFTGN02) issued by the Environment Agency, 2003. Three boreholes will be drilled and installed in accordance with the above-mentioned guidance, one up-gradient and two down-gradient, (proposal for their location and installation is discussed in a separate letter, and provisional timescales are included below). Upon completion of these locations, groundwater monitoring will be undertaken at these three wells.

Currently groundwater is monitored at the natural springs (W4 and W5) and a well located at Bodgynda Farm.

As discussed within the application for the PPC Permit for the site, the quarry is recorded to be positioned at an elevation of approximately 83mAOD in the south of the site to 95mAOD in the north of the site. The lowest point of the waste mass in the south of the site was established during the drilling works completed by Egniol in summer 2006 and was shown to be at an elevation of between 73 and 74mAOD. The waste to the north of the site was shown to sit at a minimum elevation of 89mAOD or more. The Carboniferous Limestone which underlies the site and the area to where the springs monitored as W4 and W5 emerge, is interpreted to represent an unconfined aquifer. Groundwater flow in the area is interpreted to follow topography, and therefore flow in a predominantly north/north-westward direction. The springs

at locations W4 and W5 emerge along a line at an approximate elevation of 70mAOD where there is a steep slope in the topography from the level of the fields of Bodgynda Farm to the east to the level of the SSSI site Cors Erddreiniog to the west, and are likely to represent the approximate elevation where the groundwater table in the area is intercepted by the local topography. This elevation is below the lowest point of the quarry where waste has been positioned. Therefore the springs are thought to be representative of downstream monitoring locations for the site.

The well which was monitored in October 2007, lies to the north-west of nant Newydd Quarry within land owned by Bodgynda Farm. It has an approximate elevation of between 90 and 95mAOD, and lies in a different watershed to Nant Newydd Quarry, to the north of the site. No sources of contamination appear to be positioned up-gradient of this monitoring location, therefore it is considered that the water from the well is representative of the background water quality in the area. This indicates that it would also be representative of groundwater before it passes through the site and therefore could act as an up gradient monitoring location for Nant Newydd Quarry.

The current and proposed groundwater monitoring locations provide one monitoring location up gradient and two down gradient thus satisfying the requirements for groundwater monitoring at the site.

Monitoring Regime

The monitoring results obtained up to and including the October monitoring visit were reviewed Concentrations of iron, manganese, nickel and sulphate were elevated in W1 and W3 compared to the other monitoring locations. Nitrates and phosphates had highest concentrations in W2, which is upstream of the site. They are likely to originate at Nant Newydd Caravan site situated east of the site. The concentrations of most other determinants did not show a significant difference between the different monitoring locations, and most were at or below their respective detection limits (such as lead, ammoniacal nitrogen and biological oxygen demand (BOD)).

Surface Water

Summary tables of the current monitoring regime and the proposed monitoring regime for surface water at the site are included on a separate sheet with this correspondence.

Surface water monitoring undertaken at the site during the previous two years indicates that concentration of phosphates and toluene extractable matter (TEM) are typically below the detection limit in all monitoring locations sampled, and as such are not considered to constitute a significant risk to receiving waters. No sulphide was recorded in any of the monitored locations throughout the previous 2 years. Therefore we propose that sulphide and phosphate are monitored only as part of the annual suite.

It is proposed that the monthly monitoring suite is reduced to include ammoniacal nitrogen, chloride, dissolved oxygen (DO), electrical conductivity (EC), pH, sulphate, total organic carbon (TOC) and total suspended solids (TSS). It is considered that Oil and Grease monitoring should be carried out as a visual determination only rather than TPH laboratory water analysis. A more extensive suite including metals (including As, Ca, Cd, Cr, Cu, Fe, K, Mg, Mn, Na, Pb, Se) and COD and BOD would then be tested for quarterly, with List I substances analysis being included on a six monthly basis. It is proposed that a full List I screen is carried out annually, and only types of List I species which were found to be above the detection limit in this monitoring to be re-tested for in all locations after six months.

Groundwater

Summary tables of the current monitoring regime and the proposed monitoring regime for groundwater at the site are included with this correspondence.

The available data for groundwater quality is limited, as no groundwater monitoring was undertaken prior to the issue of the PPC Permit. Following a review of the surface water monitoring points in June 2007, it was decided that it would be most appropriate to monitor W4 as a down gradient groundwater monitoring point (as discussed in correspondence with the EA on the 5th June 2007). It is proposed that the monthly suite should include ammoniacal nitrogen, chloride, DO, EC, nickel, pH, sulphate and zinc. A more extensive suite of metals will be tested

for in the quarterly suite (including As, Ca, Cd, Cr, Cu, Fe, K, Mg, Mn, Na, Pb, Se). Many of the metals have been removed from the monthly suite as recent monitoring data suggests the concentrations of the metals are negligible in groundwater, and the site appears to have no impact on groundwater quality with regards to metals.

It is envisaged that proposal for the design and location of the groundwater monitoring boreholes will be completed and distributed by the end of May 2008. Upon agreement on the design from all interested parties, we envisage that the borehole installation can be completed within 4 weeks (to include drilling contractors lead-in time, installation and subsequent CQA report for the installation). Groundwater monitoring will then be undertaken from the installed boreholes, and monitoring at the wells is envisaged to be discontinued.

I hope you find the suggestions within this correspondence appropriate in a view to relaxing the monitoring schedule for the site. Please do not hesitate to contact me if you have any queries.

Kind Regards,

Diana R. Kountcheva
Senior Environmental Scientist
For Egniol Consulting Ltd

cc. Gwilym Owen, Nant Newydd Quarry

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RECEIVED
19 MAY 2008

Asiantaeth yr Amgylchedd Cymru
Environment Agency Wales

Mr. G Owen
Nant Newydd Quarry Ltd
Brynteg
Anglesey
LL78 7LL

Ein cyf/Our ref:RP3337SE
Eich cyf/Your ref:

Dyddiad/Date: 6th May 2008

Dear Mr Owen

Pollution Prevention and Control (PPC) Permit No. RP3337SE
Nant Newydd Quarry

I am writing to you in response to 2 letters received from Diana Koutcheva of Egniol consulting, regarding your monitoring requirements.

Changes in Monitoring Frequencies

Happy considered your proposals, I can confirm that the Environment Agency is satisfied that your proposals for a reduced environmental monitoring scheme should not result in a reduction in the level of protection offered to the local environment. This reduction in monitoring agreement is made on an interim basis, and will need to be reviewed no less than annually.

If any elevated levels of contaminants be found during the course of the monitoring programme, then the full monitoring schedule, as described in Section 3.6.1, and Schedules S4.2, S4.5 and S4.6 of your Permit, shall be undertaken as a minimum. S

Monitoring shall also be restored to the levels specified in the permit no later than 2 months prior to the tipping of waste within the site.

Borehole Specification

Having studied the design specification for the installation of the groundwater boreholes, I can confirm that the Environment Agency is satisfied with your proposals. All boreholes proposed shall be installed to the specification detailed in your submission.

A validation report, detailing how compliance was achieved shall be submitted to the Environment Agency following completion of the installation.
Upon completion of the installation to a satisfactory standard, the Environment Agency will consider Pre Operational Condition S1.4a (3) to be completed.

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Asiantaeth yr Amgylchedd Cymru
Environment Agency Wales

If you have any queries, please do not hesitate to contact me on the number given below

Yours truly,

Gareth Lewis
Regulatory Officer (PIR / RSR)

01248 484077
01244 894560

Current monitoring regime for surface water (as detailed in the PPC permit for the site

SW		
monthly	quarterly	annually
pH	monthly +	Full List I Screen
Oil and grease	TON	
Temperature	Calcium (Ca)	
Electrical conductivity	Cadmium (Cd)	
Ammoniacal nitrogen	Mercury (Hg)	
Chloride	Magnesium (Mg)	
Dissolved oxygen	Sodium (Na)	
Biological oxygen demand (BOD)	Potassium (K)	
Chemical oxygen demand (COD)	Alkalinity	
Total suspended solids (TSS)	Copper (Cu)	
Total organic carbon (TOC)	Zinc (Zn)	
Iron (Fe)	Mineral Oils	
Chromium (Cr)	Poly-aromatic hydrocarbons (PAH)	
Manganese (Mn)	MTBE	
Nickel (Ni)		
Lead (Pb)		
Phosphate		
Sulphate		
Nitrate		
Nitrite		

Current monitoring regime for groundwater (as detailed in the PPC permit for the site

GW		
monthly	quarterly	annually
Water level	monthly +	Full List I screen
Temperature	Alkalinity	
pH	COD	
Electrical conductivity	Arsenic (As)	
Dissolved oxygen	Selenium (Se)	
Chloride	Phosphorus (P)	
Sulphate	Ca	
Cd	Cr	
Ni	Cu	
Zn	Fe	
Ammoniacal nitrogen	Mg	
	Mn	
	Pb	
	Hg	
	K	
	Na	
	Nitrate	
	Nitrite	
	Phenols	
	TOC	
	Mineral oils	
	PAH	
	MTBE	
	Ionic balance	

Current monitoring regime for groundwater (as detailed in the PPC permit for the site)

SW

monthly	quarterly	six monthly
pH	monthly+	quarterly+
Oil and grease (visual)	Alkalinity	List I analysis*
Temperature	BOD	
Electrical conductivity	COD	
Ammoniacal nitrogen	Ca	
Chloride	Cr	
Sulphate	Cu	
Dissolved oxygen	Fe	
TSS	Mg	
TOC	Mn	
	Ni	
	Na	
	K	
	Zn	
	Pb	
	Nitrate	
	Nitrite	

* A full list I screen will be performed as part of the analysis carried out in June 2007. However, it is proposed that further monitoring targets only groups of compounds, which were recorded above the detection limit. If none were detected, the minimum suite would incorporate the minimum number of List I substances indicated within the PPC permit for the site, including Cd, Hg, PAH, Mineral oils, MTBE and pesticides

Suggested monitoring regime for groundwater (as detailed in the PPC permit for the site

GW		
monthly	quarterly	six monthly
Water level	monthly +	quarterly+
Temperature	Alkalinity	List I analysis*
pH	COD	
Electrical conductivity	As	
Dissolved oxygen	Se	
Chloride	Ca	
Sulphate	Cr	
Cd	Cu	
Ni	Fe	
Zn	Mg	
Ammoniacal nitrogen	Mn	
	Pb	
	P	
	K	
	Na	
	Nitrate	
	Nitrite	
	Phenols	
	Ionic balance	

Egniol Engineering and Environmental Consultancy Services

Client: W.J. Owens & Sons	Northing:	Sheet: 1 of 1	**Borehole ID: GW1**
Site: Nant Newydd	Easting:	Job Number: 3131	
Site Engineer: D. Kountcheva	Elevation: 92mAOD	Drill Date: 29/05/2008, 02/06/2008	
Contractor: CC Geotechnical			

Samples & Tests			Water	Strata			Instrument/ Backfill
Depth	Type	Test Result		Depth (m)	Legend	Description	
92				0.0		Brown gravely CLAY	
91				1.0			
90				2.0		Stiff/hard dark brown gravelly cobbly CLAY with frequent boulders	
89				3.0			
88				4.0			
87				5.0			
86				6.0		Sandy clayey GRAVEL with limestone fragments	
85				7.0			
84				8.0		Hard LIMESTONE, weak and dark at the top	
83				9.0			
82				10.0			
81				11.0			
80			▼	12.0			
79				13.0		Soft MUDSTONE	
78				14.0		Hard white LIMESTONE/MARBLE	
77				15.0			
76				16.0			
75				17.0			
74				18.0			
73				19.0			
72				20.0		Soft MUDSTONE	
71						Hard white LIMESTONE/MARBLE	

Boring Progress and Water Observations						Chiselling			Water Added		General Remarks
Date	Time	Depth	Casing Depth	Dia. mm	Water Dpt	From	To	Hours	From	To	Lithology logged as chippings

Egniol Engineering and Environmental Consultancy Services

Client: W.J. Owens & Sons	Northing:	Sheet: 1 of 1	**Borehole ID: GW2**
Site: Nant Newydd	Easting:	Job Number: 3131	
Site Engineer: D. Kountcheva	Elevation: 76.85mAOD	Drill Date: 28/05/2008, 02/06/2008	
Contractor: CC Geotechnical			

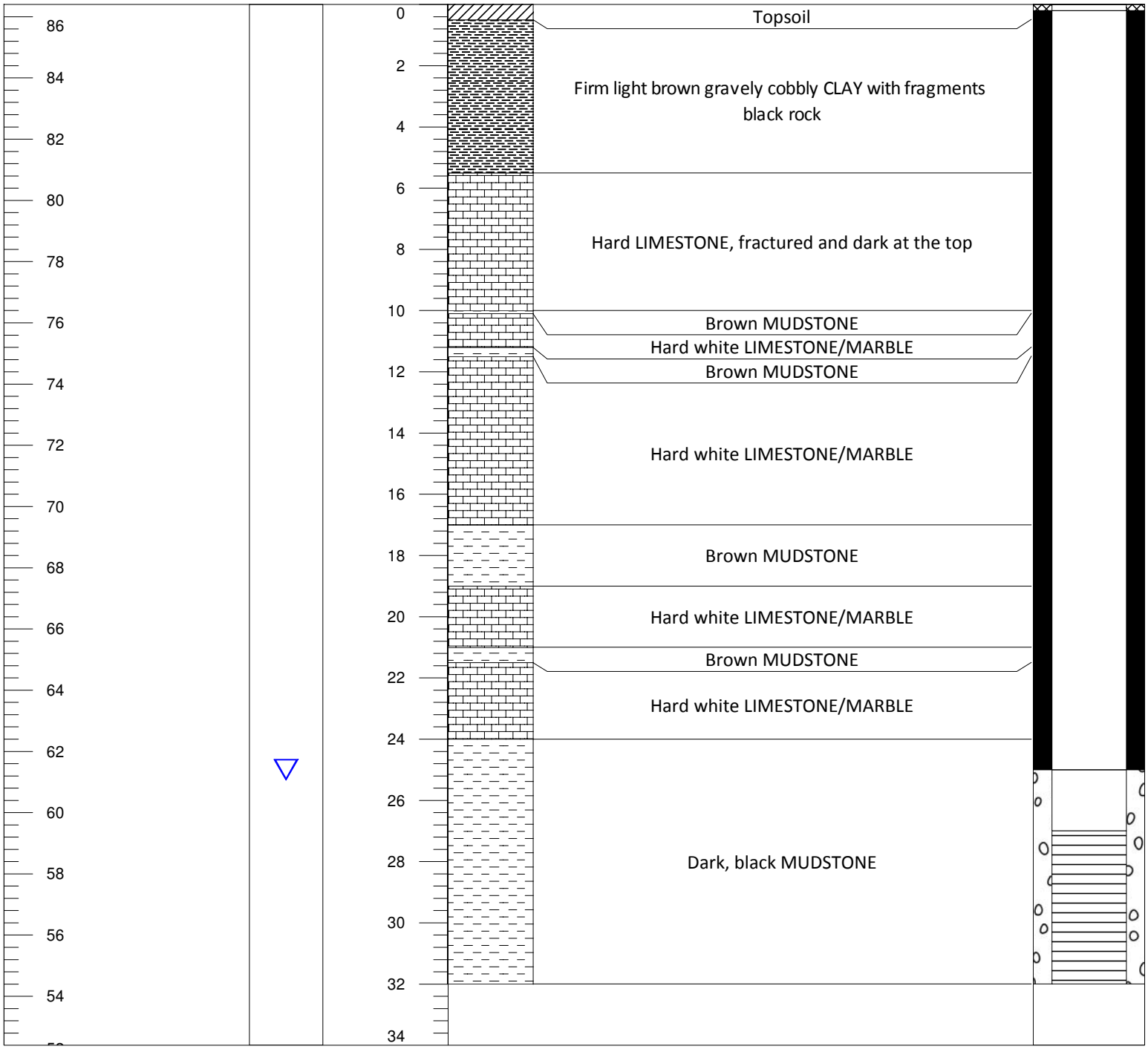
Samples & Tests			Water	Strata			Instrument/ Backfill
Elevation	Type	Test Result		Depth (m)	Legend	Description	
76.4				0.0			
76.0				0.5		Topsoil with plant roots, clayey, damp	
75.6				1.0			
75.2				1.5			
74.8				2.0			
74.4			▼	2.5		Sandy clayey GRAVEL with rounded fragments of mudstone, malleable, cobbles at depth	
74.0				3.0			
73.6				3.5			
73.2				4.0			
72.8				4.5			
72.4				5.0			
72.0				5.5			
71.6				6.0		Weak grey-black LIMESTONE 'gravel'	
71.2				6.5			
70.8				7.0			
70.4				7.5			
70.0				8.0			
69.6							
69.2							
68.8							
68.4							

Boring Progress and Water Observations						Chiselling			Water Added		General Remarks
Date	Time		Casing	Dia. mm	Water Dpt	From	To	Hours	From	To	
											Lithology logged as chippings

Egniol Engineering and Environmental Consultancy Services

Client: W.J. Owens & Sons	Northing:	Sheet: 1 of 1	**Borehole ID: GW3**
Site: Nant Newydd	Easting:	Job Number: 3131	
Site Engineer: R. Jones	Elevation: 86.4mAOD	Drill Date: 29/05/2008	
Contractor: CC Geotechnical			

Samples & Tests			Water	Strata			Instrument/ Backfill
Elevation	Type	Test Result		Depth (m)	Legend	Description	



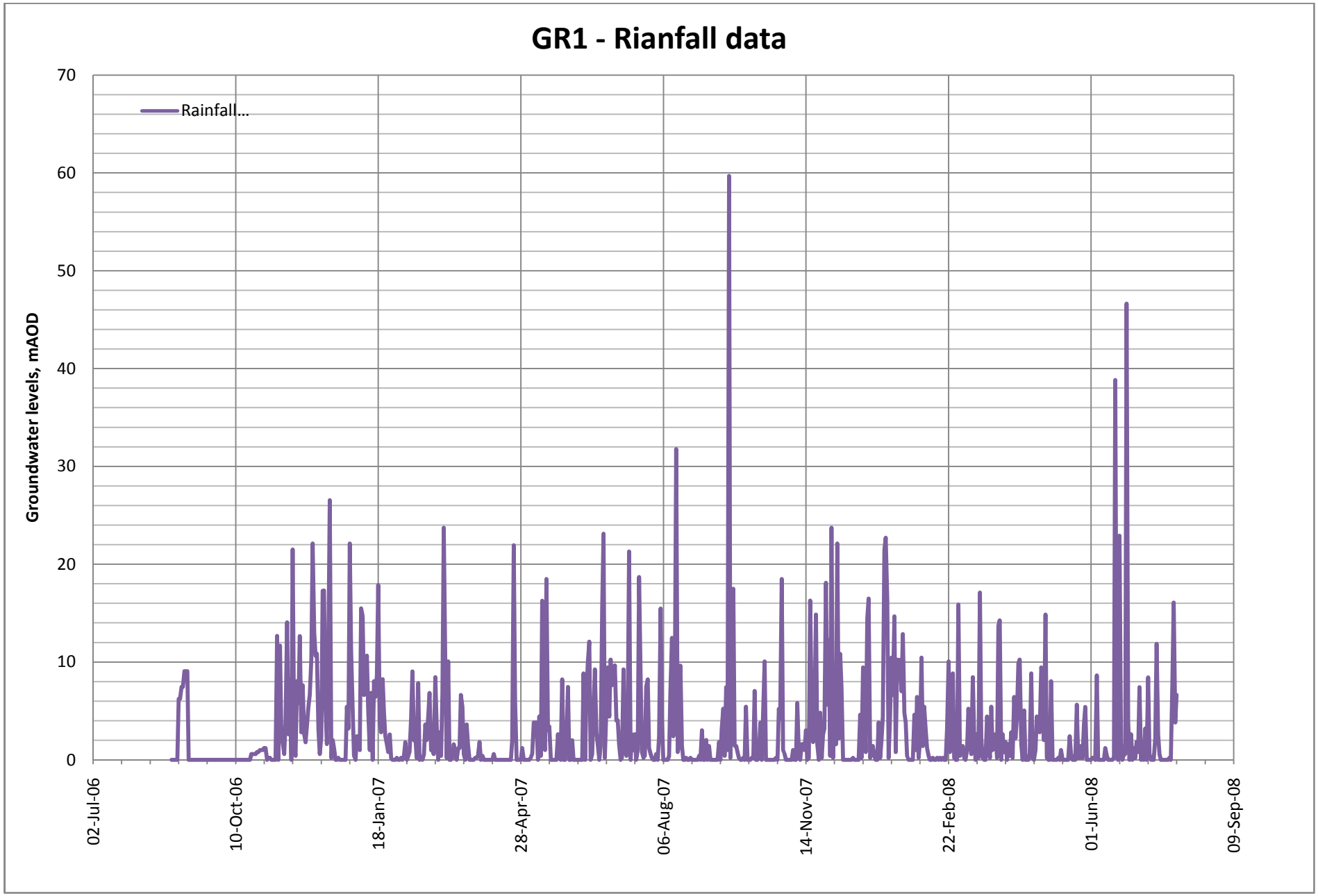
Boring Progress and Water Observations						Chiselling			Water Added		General Remarks
Date	Time		Casing Dia. mm		Water Dpt	From	To	Hours	From	To	
											Very slow recharge Lithology logged from chippings

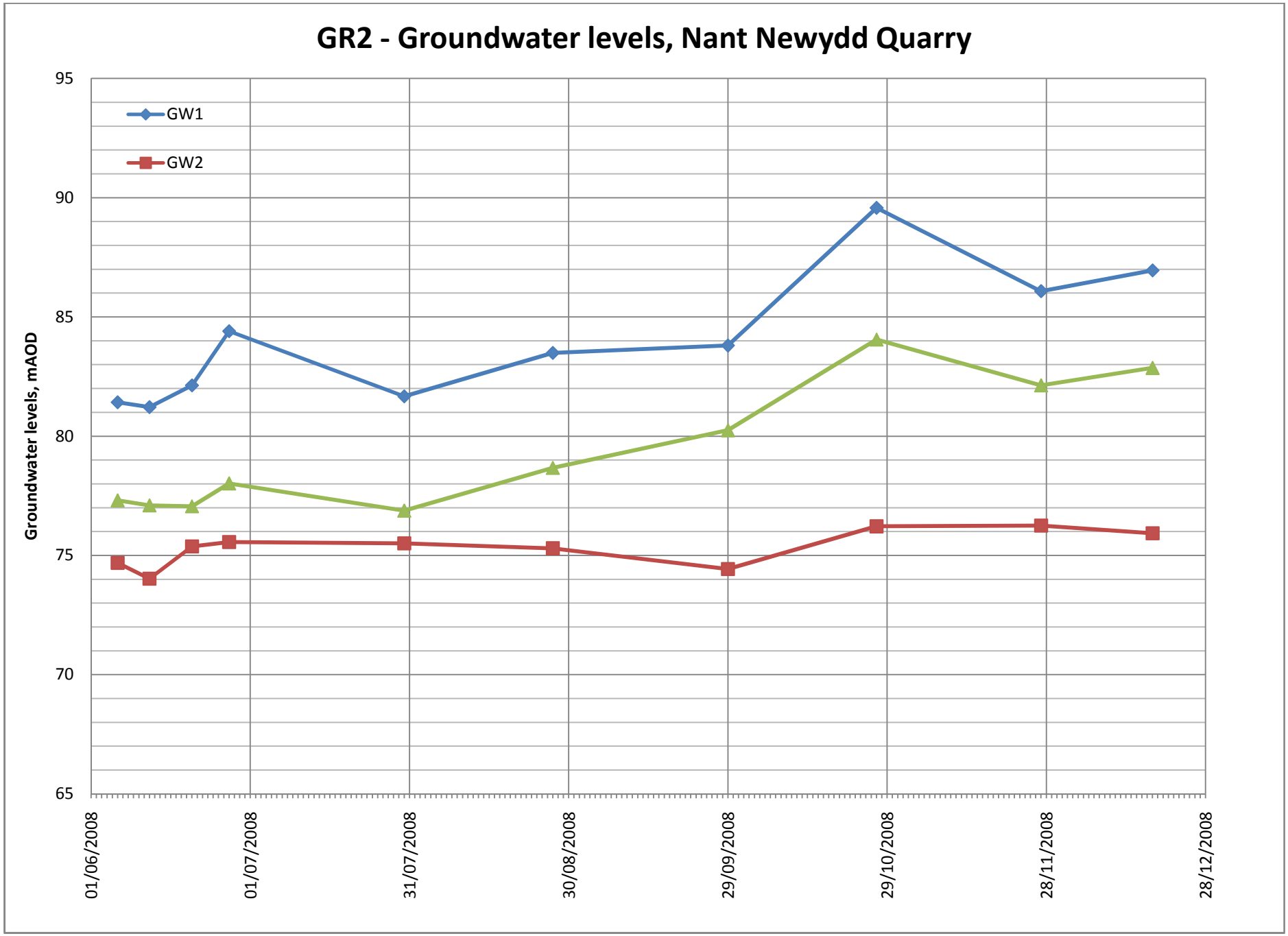
Egniol Engineering and Environmental Consultancy Services

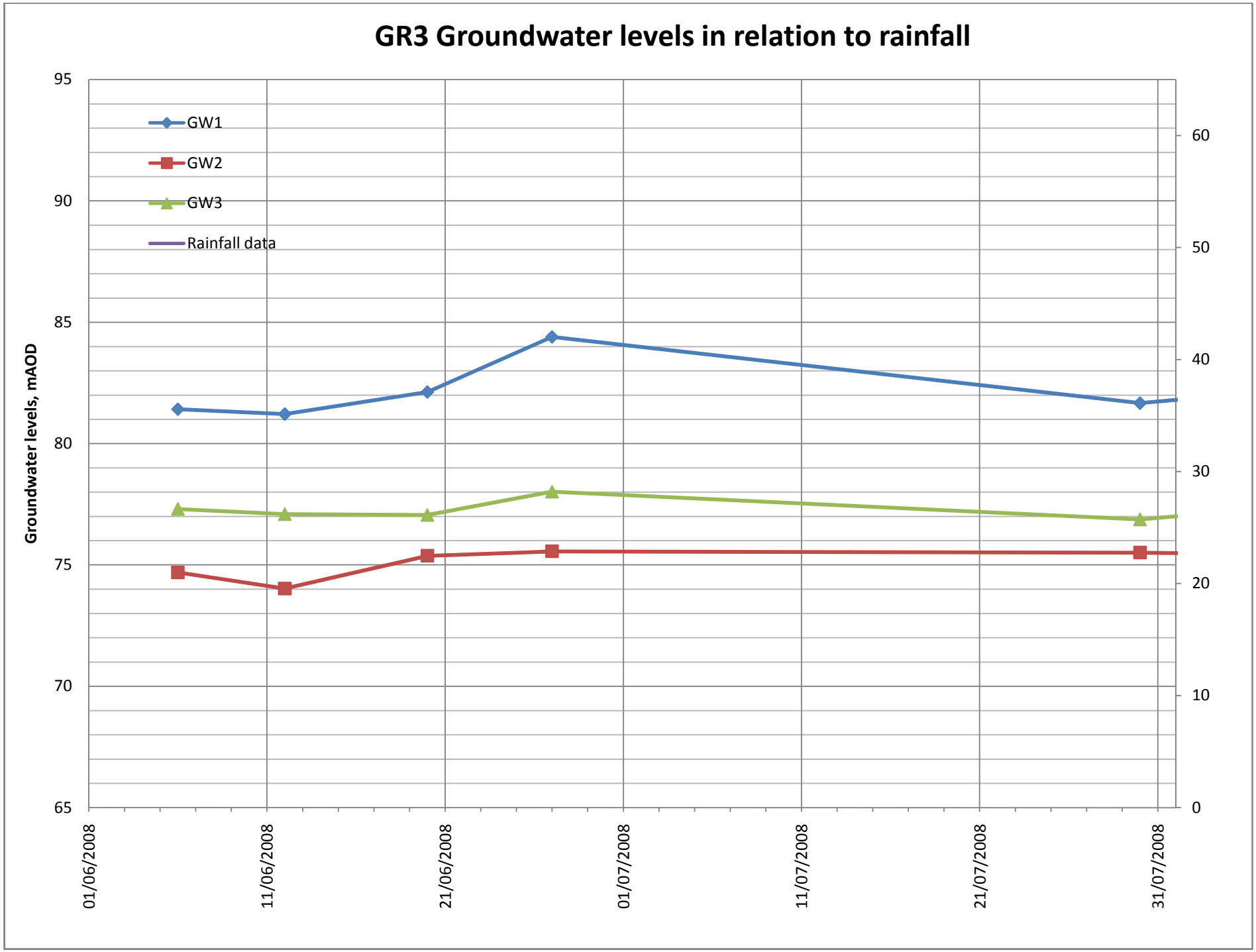
Client: W.J. Owens & Sons	Northing:	Sheet: 1 of 1	**Borehole ID: GW3A**
Site: Nant Newydd	Easting:	Job Number: 3131	
Site Engineer: J. McClymont	Elevation: 86.4mAOD	Drill Date: 03/06/2008	
Contractor: CC Geotechnical			

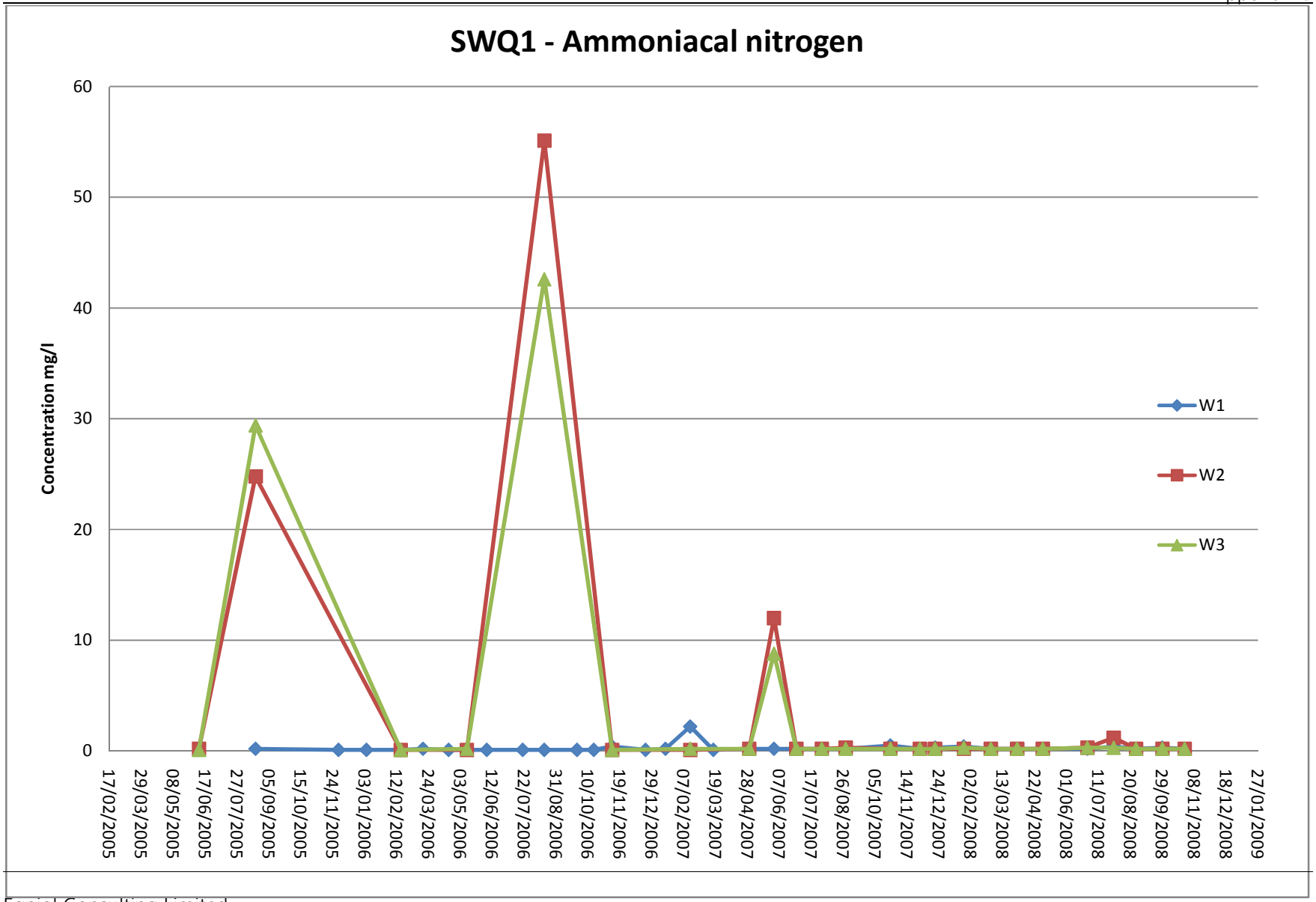
Samples & Tests			Water	Strata			Instrument/ Backfill
Elevation	Type	Test Result		Depth (m)	Legend	Description	
86				0		Topsoil	
85				1			
84				2		Firm light brown gravely cobbly CLAY with fragments black rock	
83				3			
82				4			
81				5		Sandy clayey GRAVEL with limestone fragments	
80				6			
79				7			
78				8			
77			▼	9			
76				10			
75				11		Hard white/light grey LIMESTONE/MARBLE with occasional thin mudstone bands	
74				12			
73				13			
72				14			
71				15			
70				16			
				17			

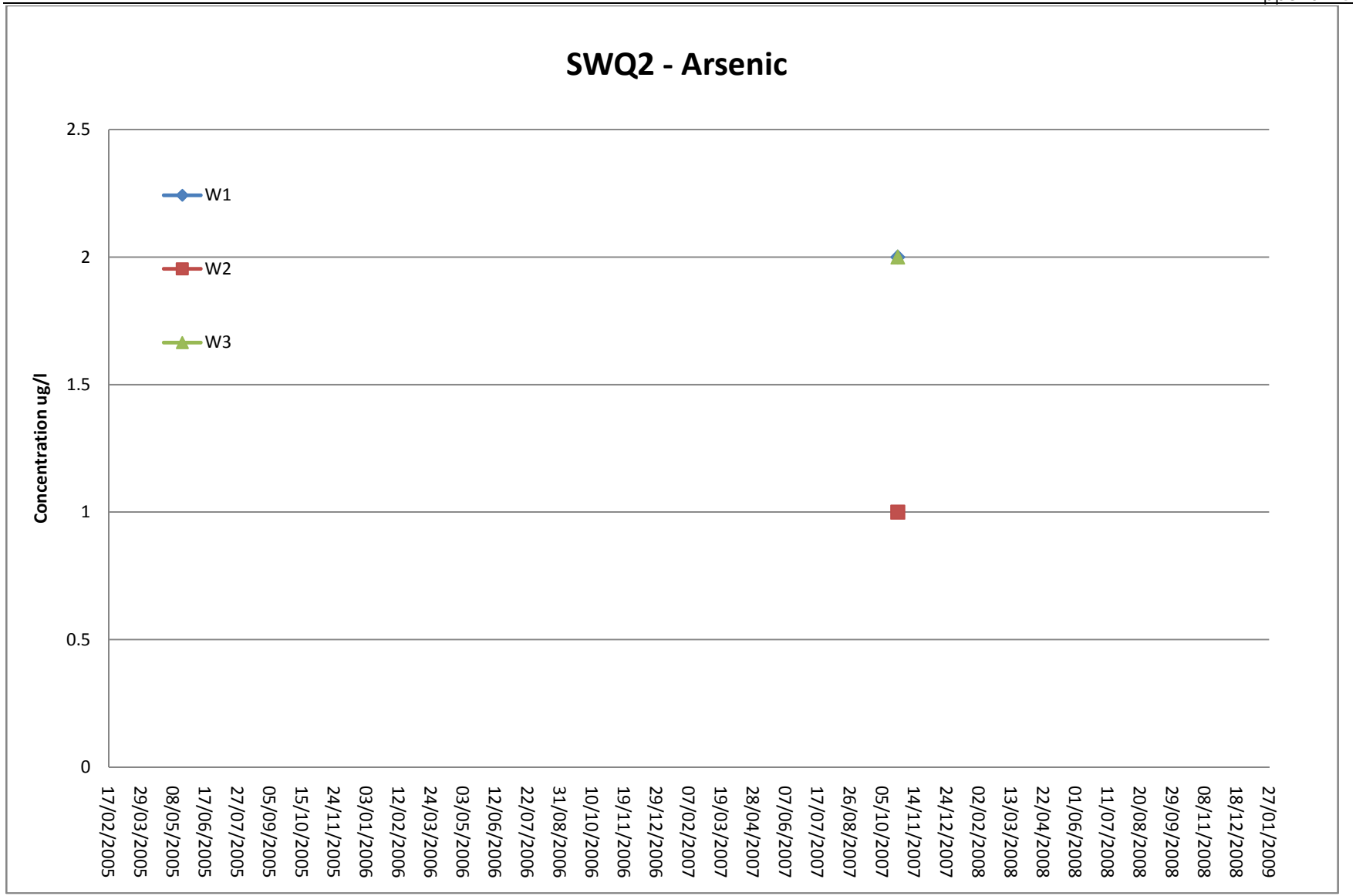
Boring Progress and Water Observations						Chiselling			Water Added		General Remarks
Date	Time		Casing	Dia. mm	Water Dpt	From	To	Hours	From	To	
											Lithology logged from chippings

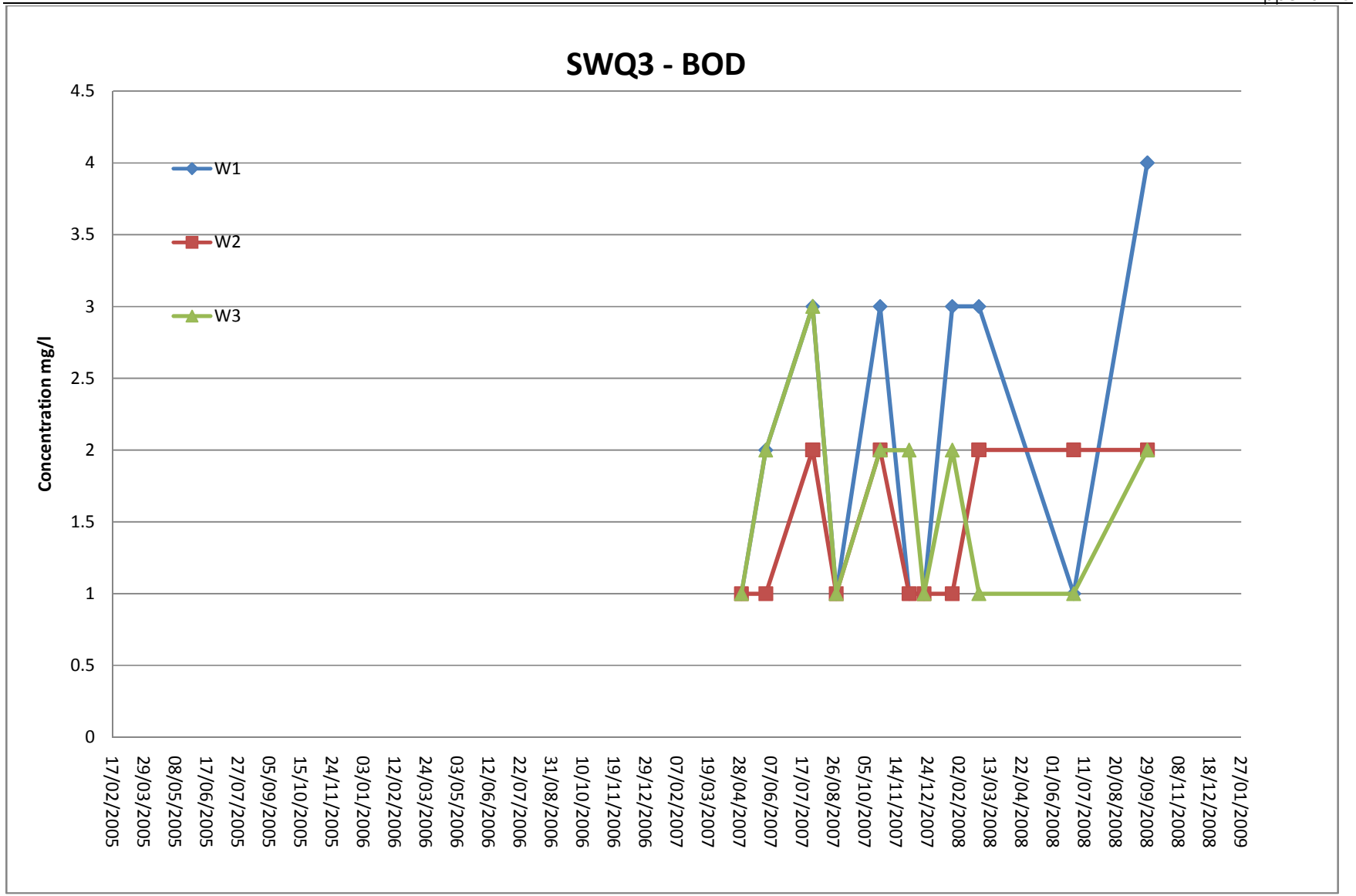

GR1 - Rianfall data
Rainfall...
Groundwater levels, mAOD
70
60
50
40
30
20
10
0
02-Jul-06
10-Oct-06
18-Jan-07
28-Apr-07
06-Aug-07
14-Nov-07
22-Feb-08
01-Jun-08
09-Sep-08

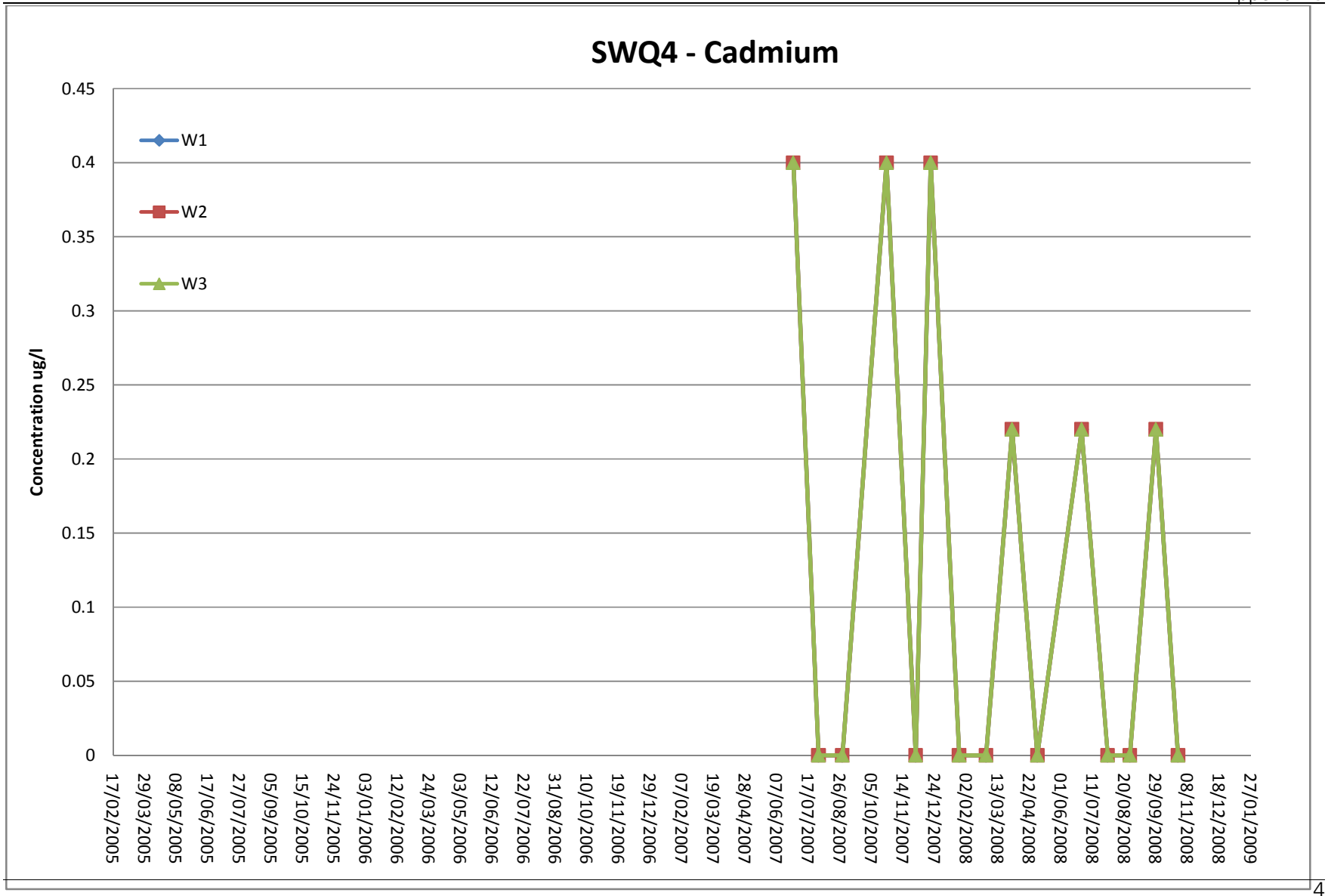

GR2 - Groundwater levels, Nant Newydd Quarry
Groundwater levels, mAOD
95
90
85
80
75
70
65
GW1
GW2
01/06/2008
01/07/2008
31/07/2008
30/08/2008
29/09/2008
29/10/2008
28/11/2008
28/12/2008

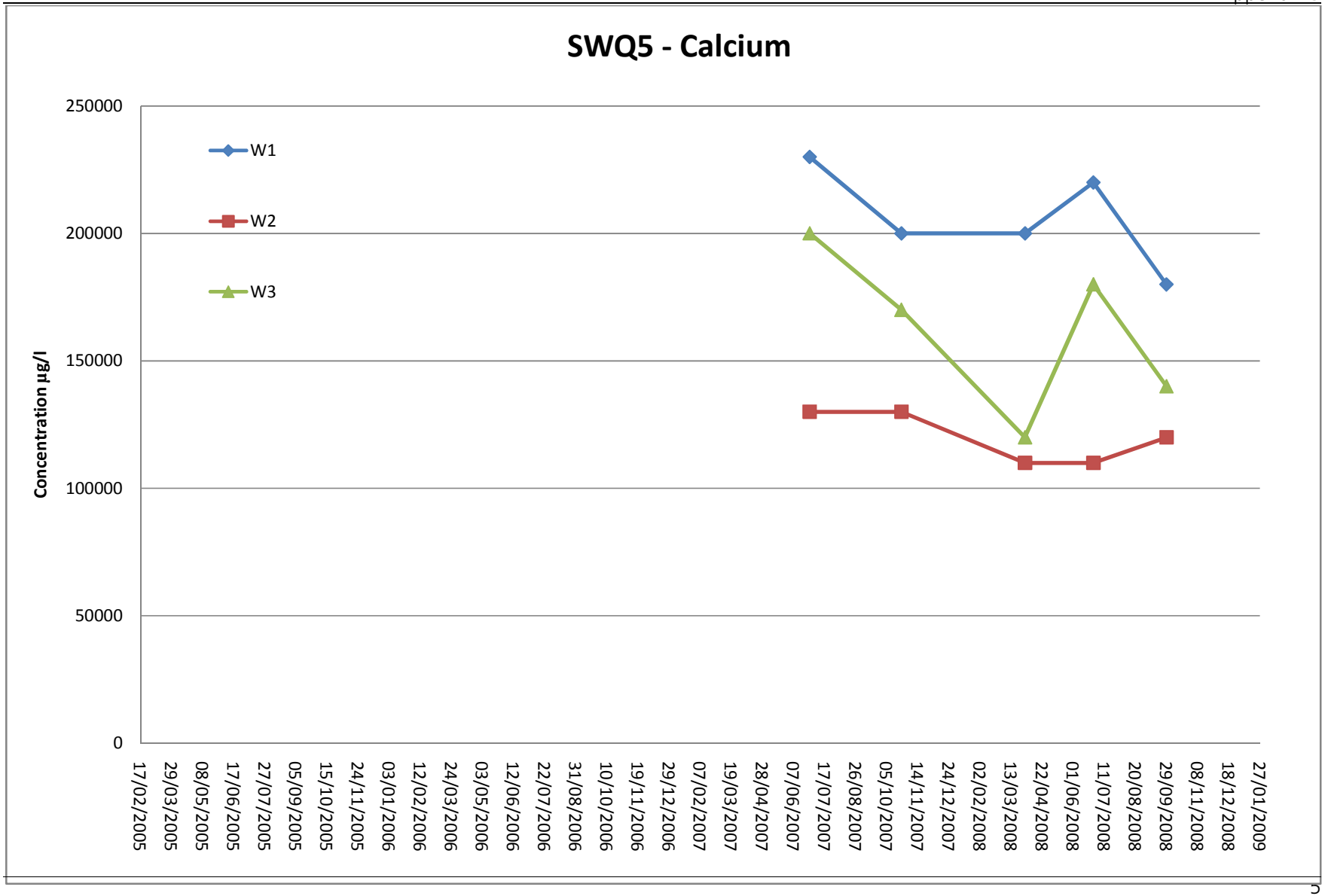

GR3 Groundwater levels in relation to rainfall
Groundwater levels, mAOD
95
90
85
80
75
70
65
60
50
40
30
20
10
0
GW1
GW2
GW3
Rainfall data
01/06/2008
11/06/2008
21/06/2008
01/07/2008
11/07/2008
21/07/2008
31/07/2008


SWQ1 - Ammoniacal nitrogen
Concentration mg/l
60
50
40
30
20
10
0
W1
W2
W3
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
19/11/2006
29/12/2006
07/02/2007
19/03/2007
28/04/2007
07/06/2007
17/07/2007
26/08/2007
05/10/2007
14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009


SWQ2 - Arsenic
Concentration ug/l
2.5
2
1.5
1
0.5
0
W1
W2
W3
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
19/11/2006
29/12/2006
07/02/2007
19/03/2007
28/04/2007
07/06/2007
17/07/2007
26/08/2007
05/10/2007
14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009


SWQ3 - BOD
Concentration mg/l
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
W1
W2
W3
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
19/11/2006
29/12/2006
07/02/2007
19/03/2007
28/04/2007
07/06/2007
17/07/2007
26/08/2007
05/10/2007
14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009


SWQ4 - Cadmium
Concentration ug/l
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
W1
W2
W3
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
19/11/2006
29/12/2006
07/02/2007
19/03/2007
28/04/2007
07/06/2007
17/07/2007
26/08/2007
05/10/2007
14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009


SWQ5 - Calcium
250000
200000
150000
100000
50000
0
Concentration µg/l
W1
W2
W3
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
19/11/2006
29/12/2006
07/02/2007
19/03/2007
28/04/2007
07/06/2007
17/07/2007
26/08/2007
05/10/2007
14/11/2007
24/12/2007
02/02/2008
13/03/2008
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01/06/2008
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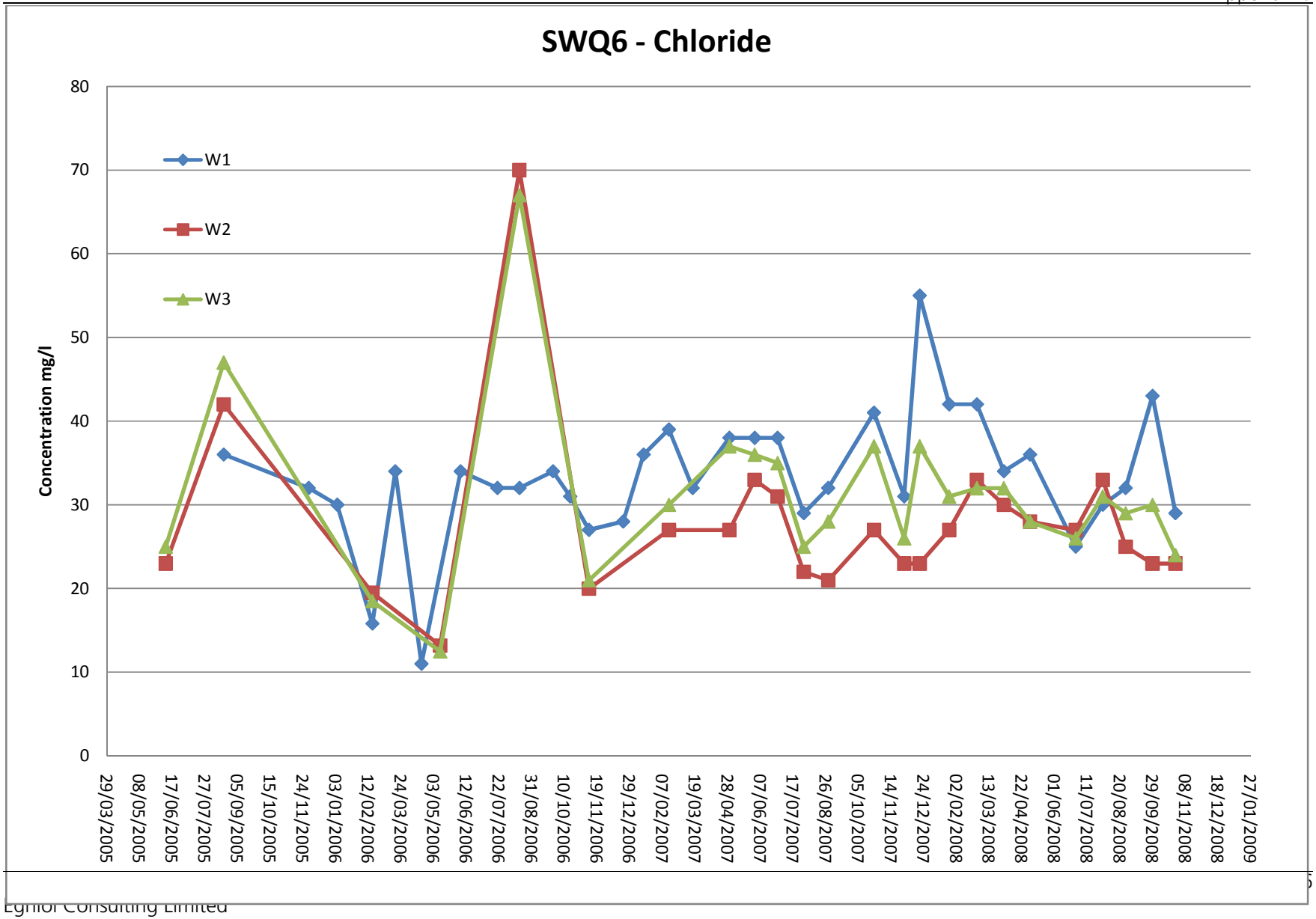
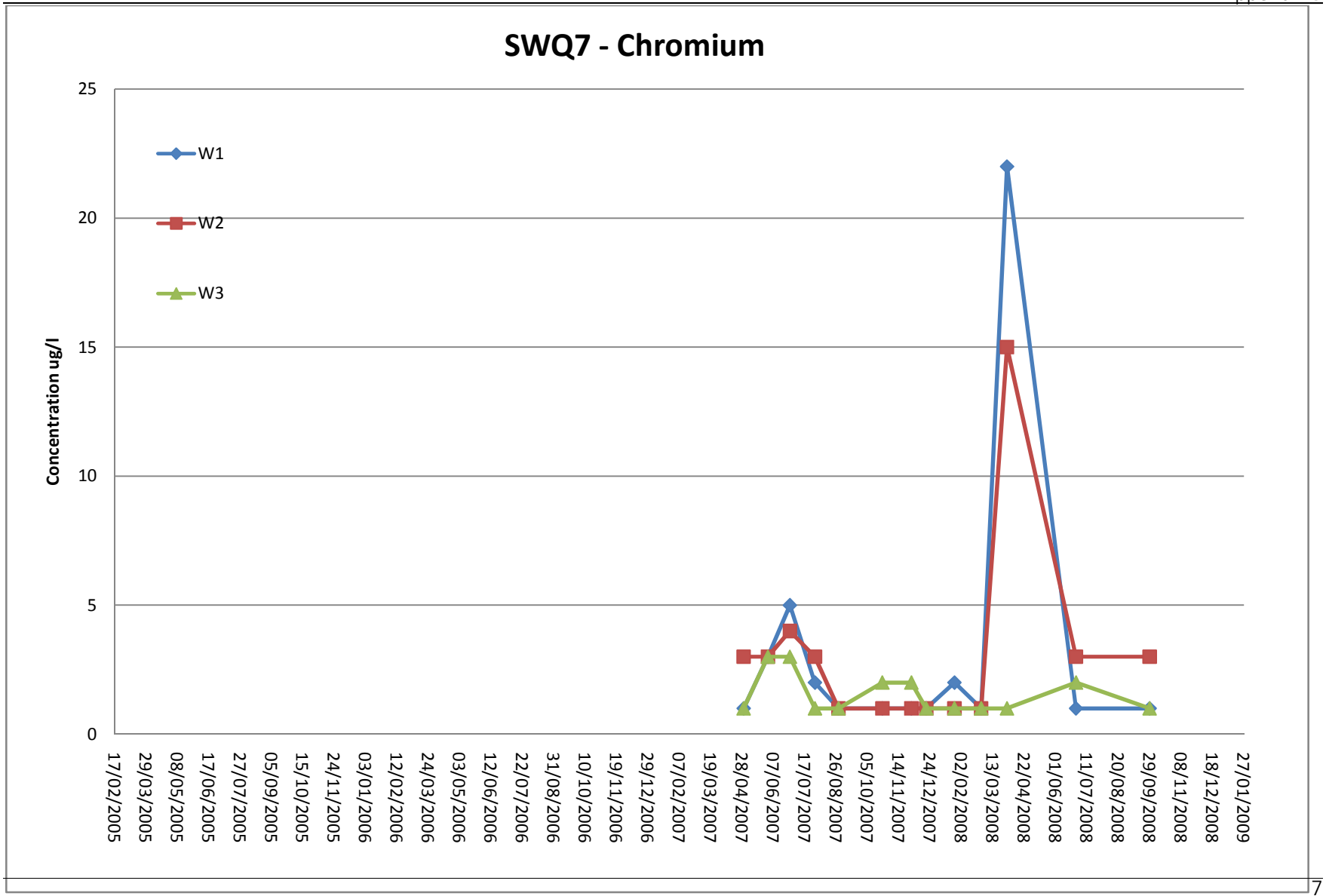
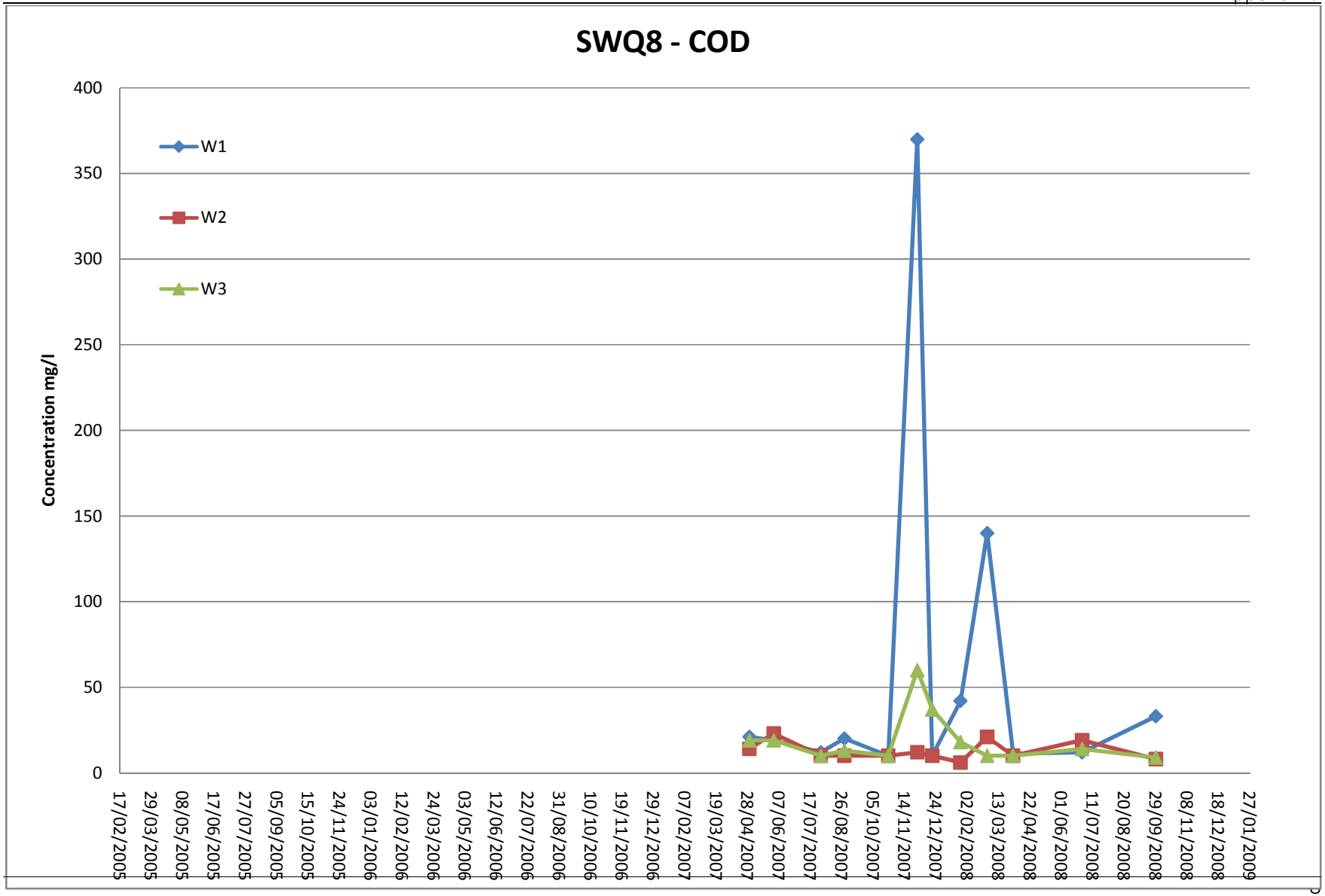
08/11/2008
18/12/2008
27/01/2009


SWQ6 - Chloride
Concentration mg/l
W1
W2
W3
80
70
60
50
40
30
20
10
0
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
19/11/2006
29/12/2006
07/02/2007
19/03/2007
28/04/2007
07/06/2007
17/07/2007
26/08/2007
05/10/2007
14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009


SWQ7 - Chromium
Concentration ug/l
25
20
15
10
5
0
W1
W2
W3
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
19/11/2006
29/12/2006
07/02/2007
19/03/2007
28/04/2007
07/06/2007
17/07/2007
26/08/2007
05/10/2007
14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009


SWQ8 - COD
Concentration mg/l
400
350
300
250
200
150
100
50
0
W1
W2
W3
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
19/11/2006
29/12/2006
07/02/2007
19/03/2007
28/04/2007
07/06/2007
17/07/2007
26/08/2007
05/10/2007
14/11/2007
24/12/2007
02/02/2008
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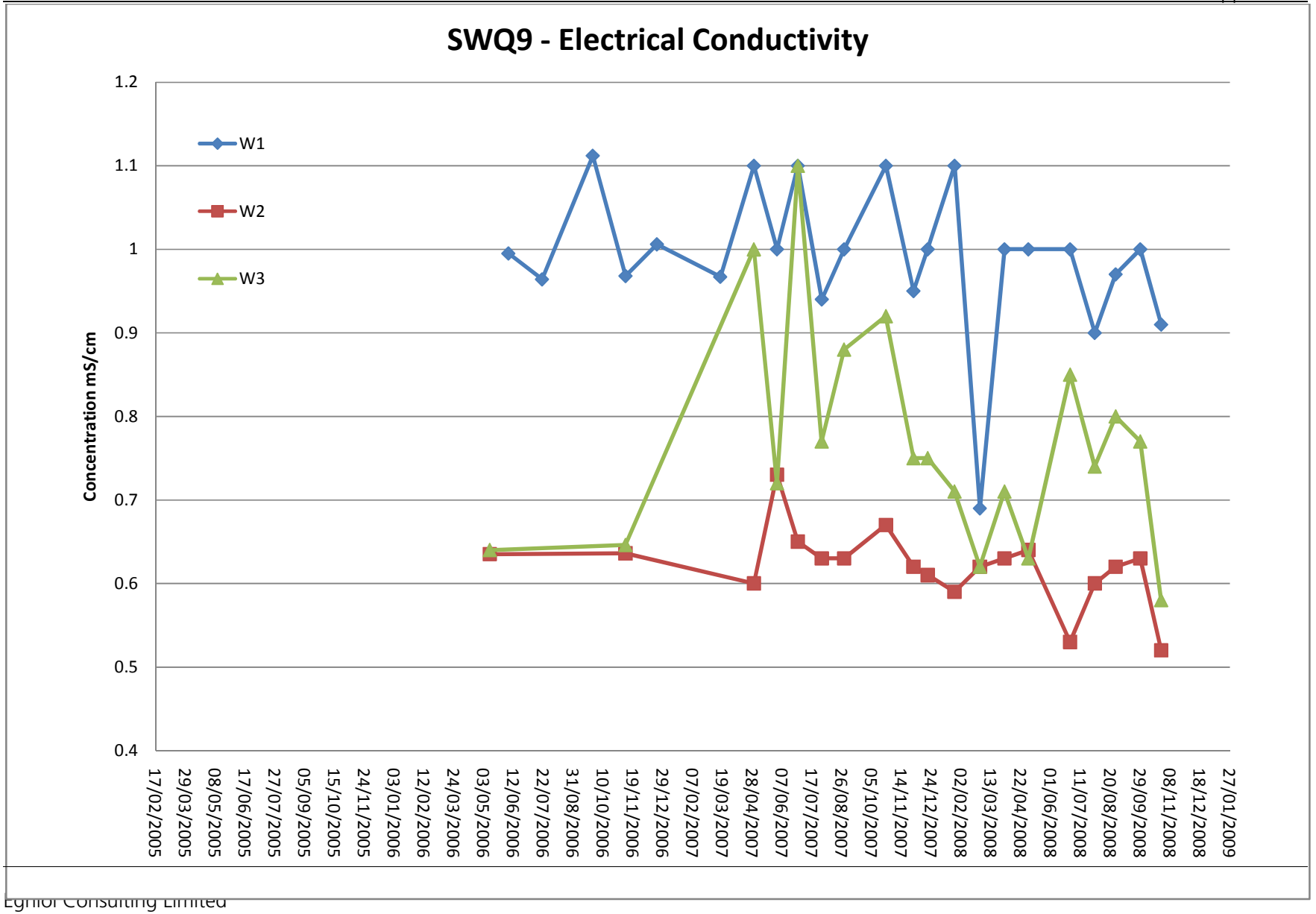
18/12/2008
27/01/2009


SWQ9 - Electrical Conductivity
Concentration mS/cm
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
W1
W2
W3
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
19/11/2006
29/12/2006
07/02/2007
19/03/2007
28/04/2007
07/06/2007
17/07/2007
26/08/2007
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14/11/2007
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13/03/2008
22/04/2008
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11/07/2008
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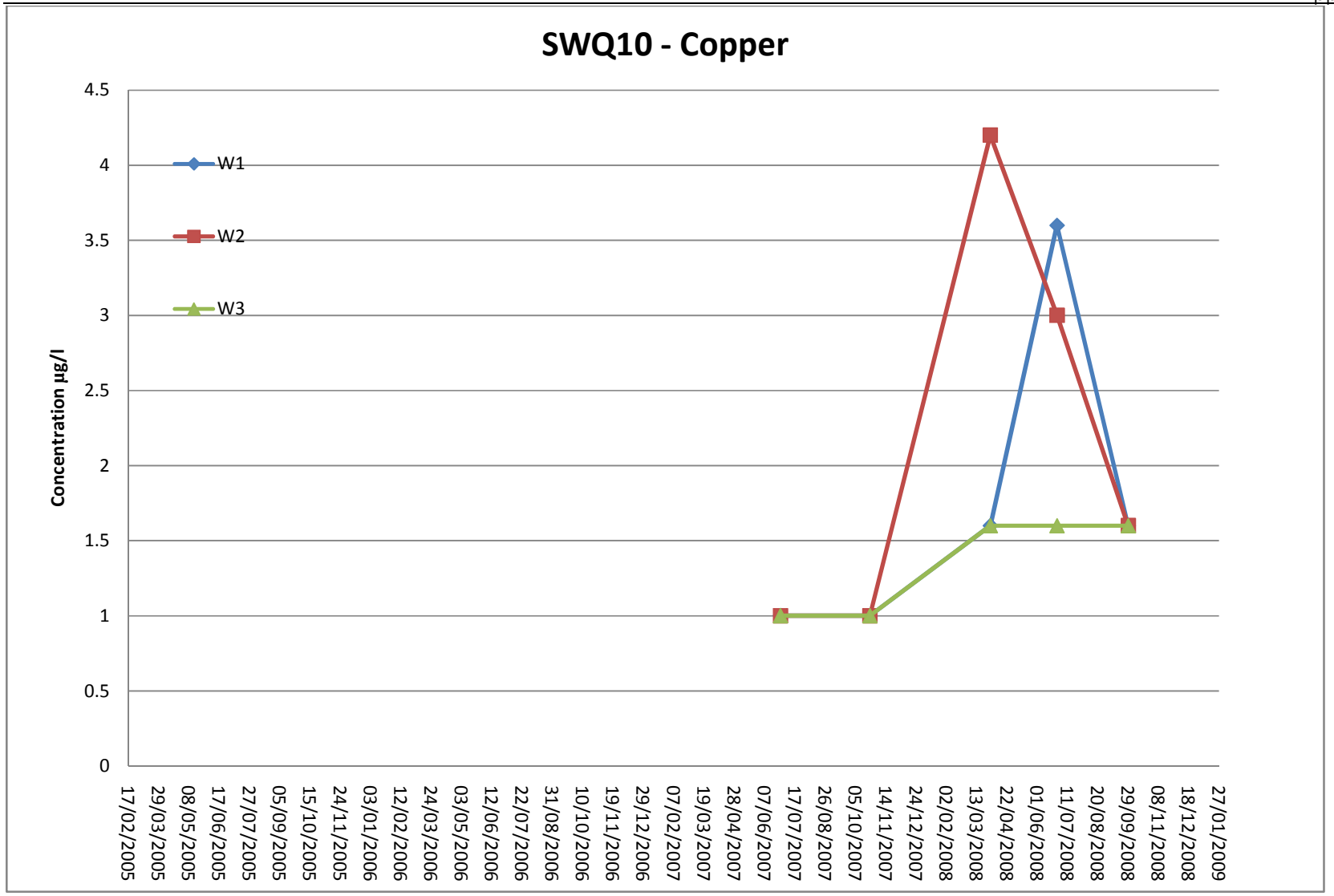
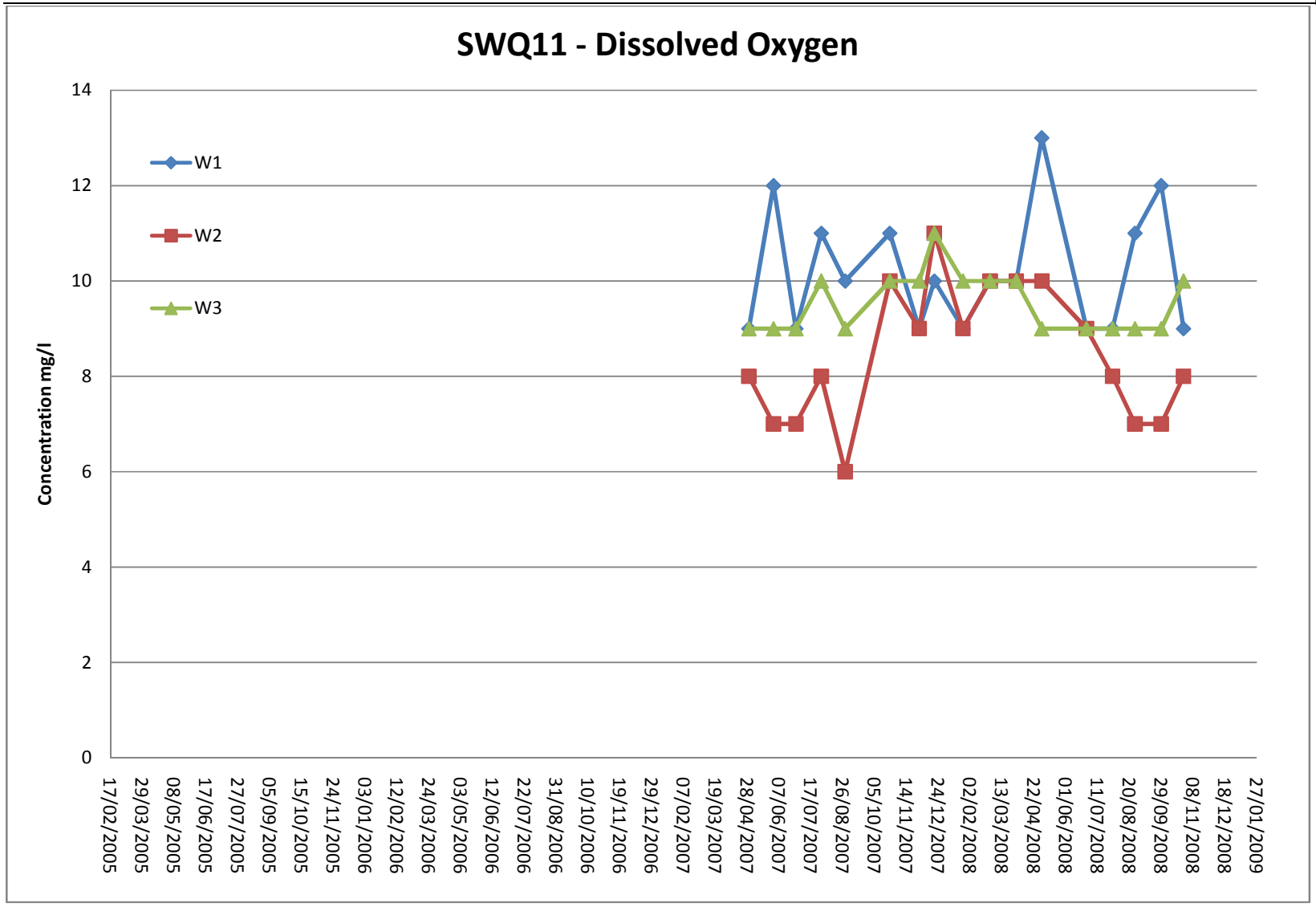
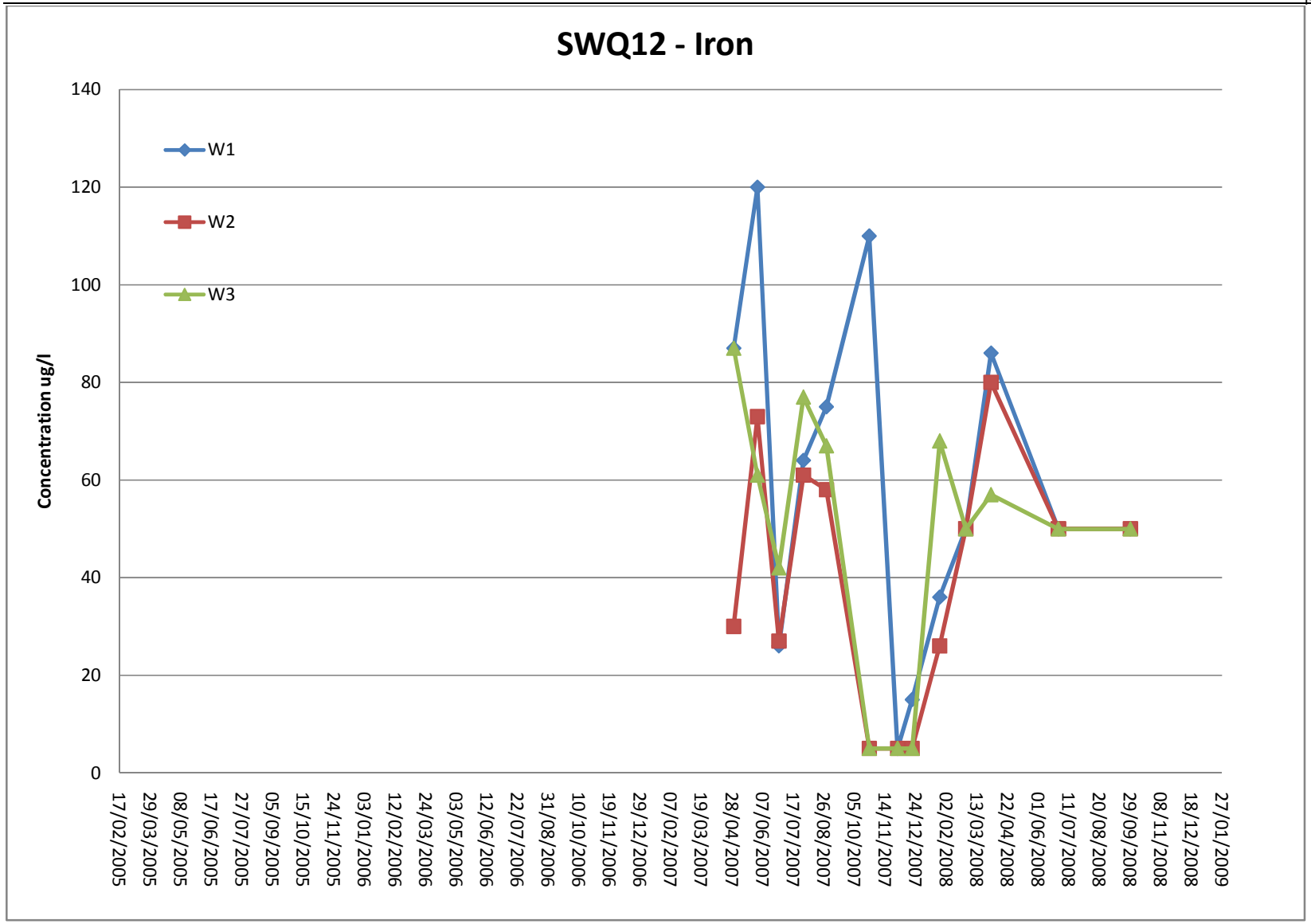
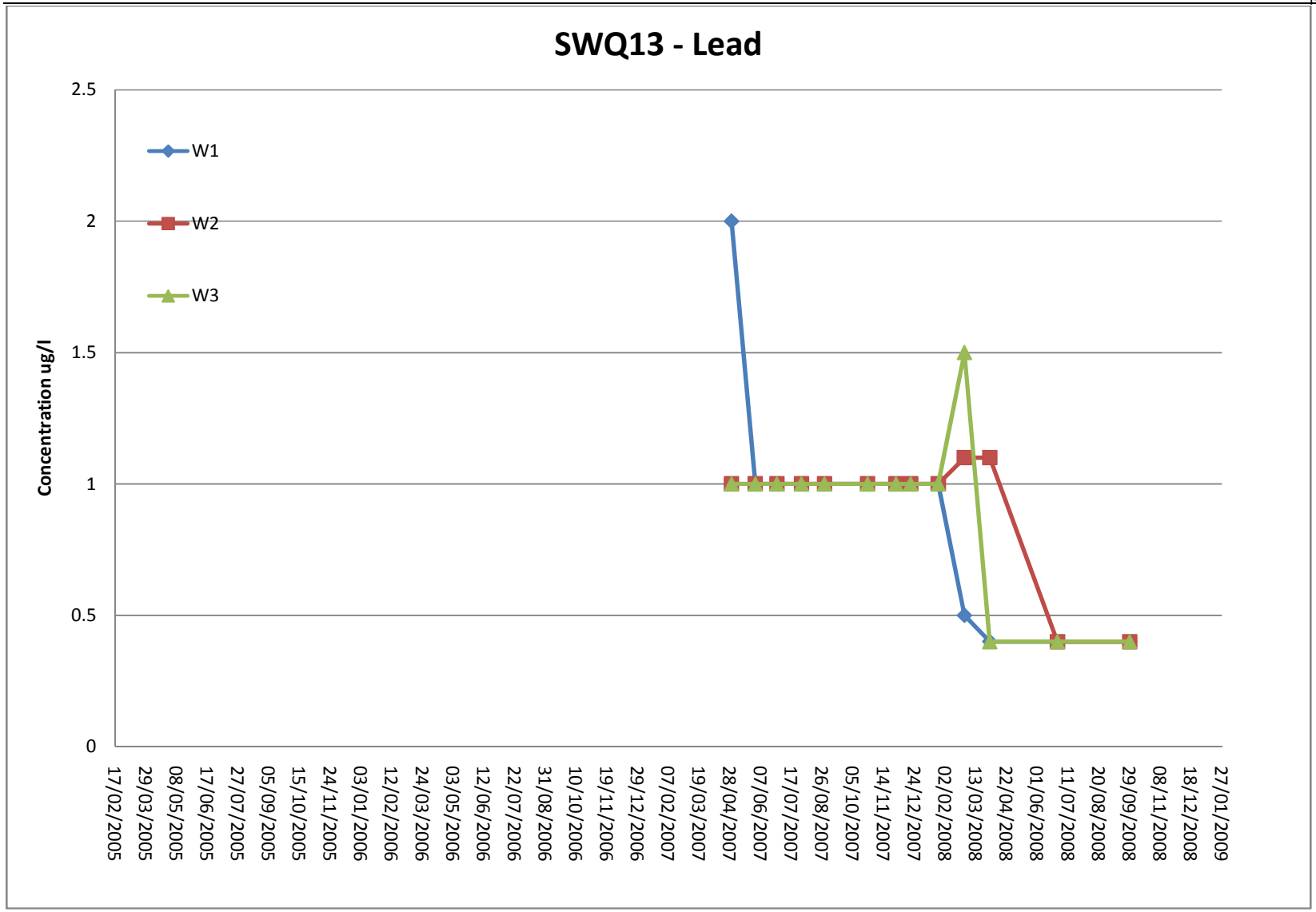
29/09/2008
08/11/2008
18/12/2008
27/01/2009


SWQ10 - Copper
Concentration µg/l
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
W1
W2
W3
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
19/11/2006
29/12/2006
07/02/2007
19/03/2007
28/04/2007
07/06/2007
17/07/2007
26/08/2007
05/10/2007
14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009


SWQ11 - Dissolved Oxygen
Concentration mg/l
W1
W2
W3
0
2
4
6
8
10
12
14
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
19/11/2006
29/12/2006
07/02/2007
19/03/2007
28/04/2007
07/06/2007
17/07/2007
26/08/2007
05/10/2007
14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009


SWQ12 - Iron
Concentration ug/l
140
120
100
80
60
40
20
0
W1
W2
W3
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
19/11/2006
29/12/2006
07/02/2007
19/03/2007
28/04/2007
07/06/2007
17/07/2007
26/08/2007
05/10/2007
14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009


SWQ13 - Lead
Concentration ug/l
2.5
2
1.5
1
0.5
0
W1
W2
W3
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
19/11/2006
29/12/2006
07/02/2007
19/03/2007
28/04/2007
07/06/2007
17/07/2007
26/08/2007
05/10/2007
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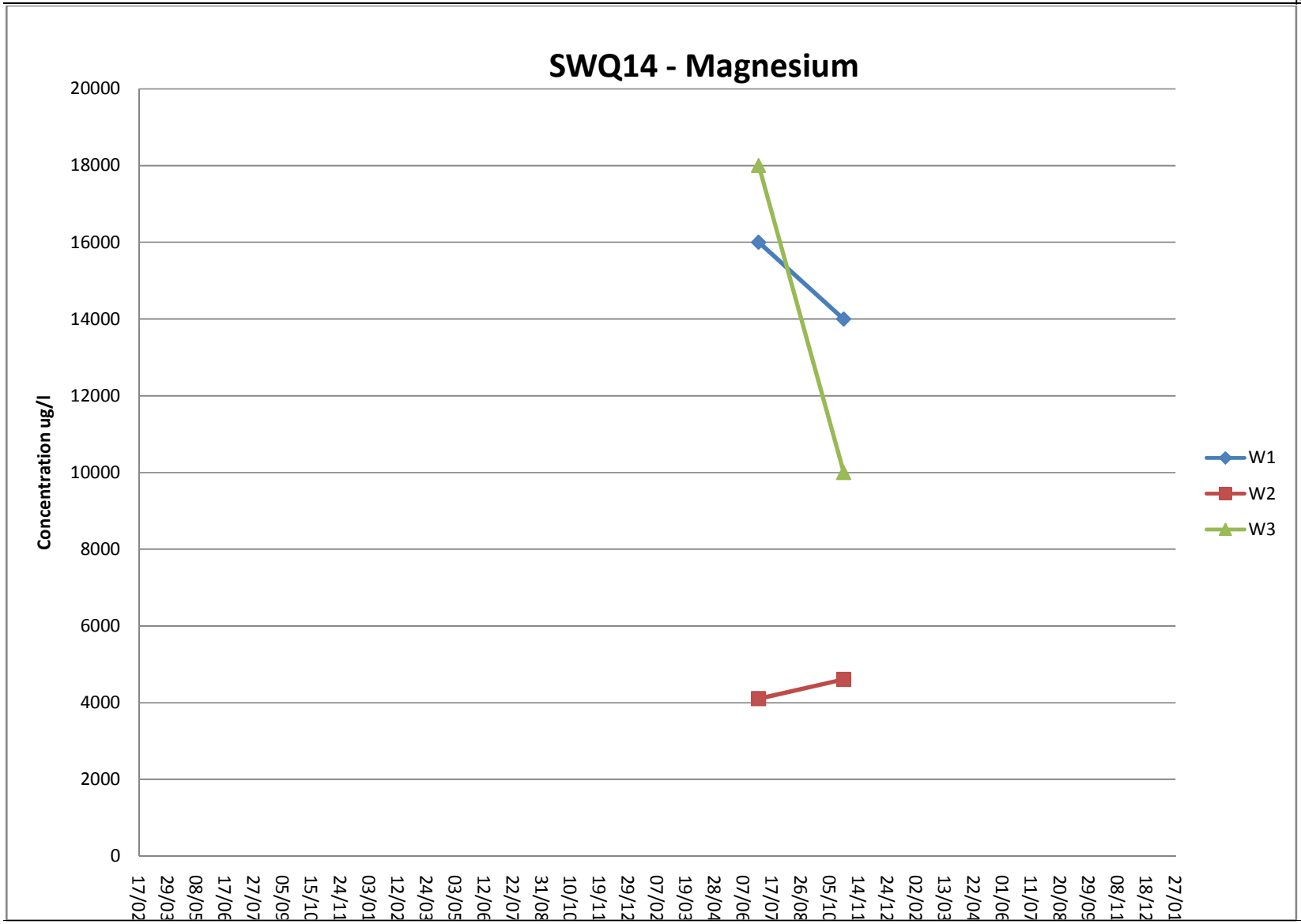
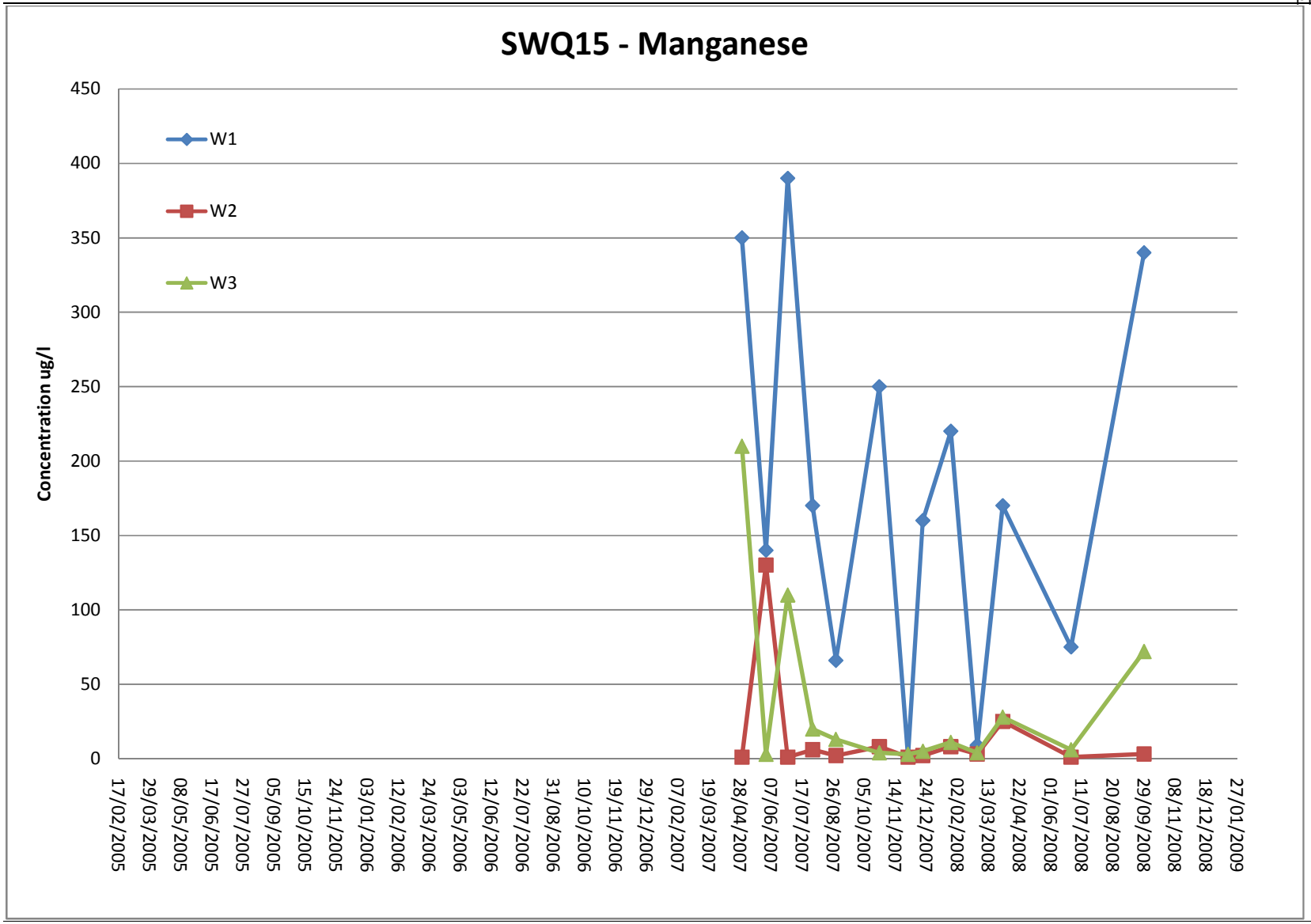
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009


SWQ14 - Magnesium
Concentration ug/l
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
W1
W2
W3
17/02
29/03
08/05
17/06
27/07
05/09
15/10
24/11
03/01
12/02
24/03
03/05
12/06
22/07
31/08
10/10
19/11
29/12
07/02
19/03
28/04
07/06
17/07
26/08
05/10
14/11
24/12
02/02
13/03
22/04
01/06
11/07
20/08
29/09
08/11
18/12
27/01


SWQ15 - Manganese
Concentration ug/l
450
400
350
300
250
200
150
100
50
0
W1
W2
W3
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
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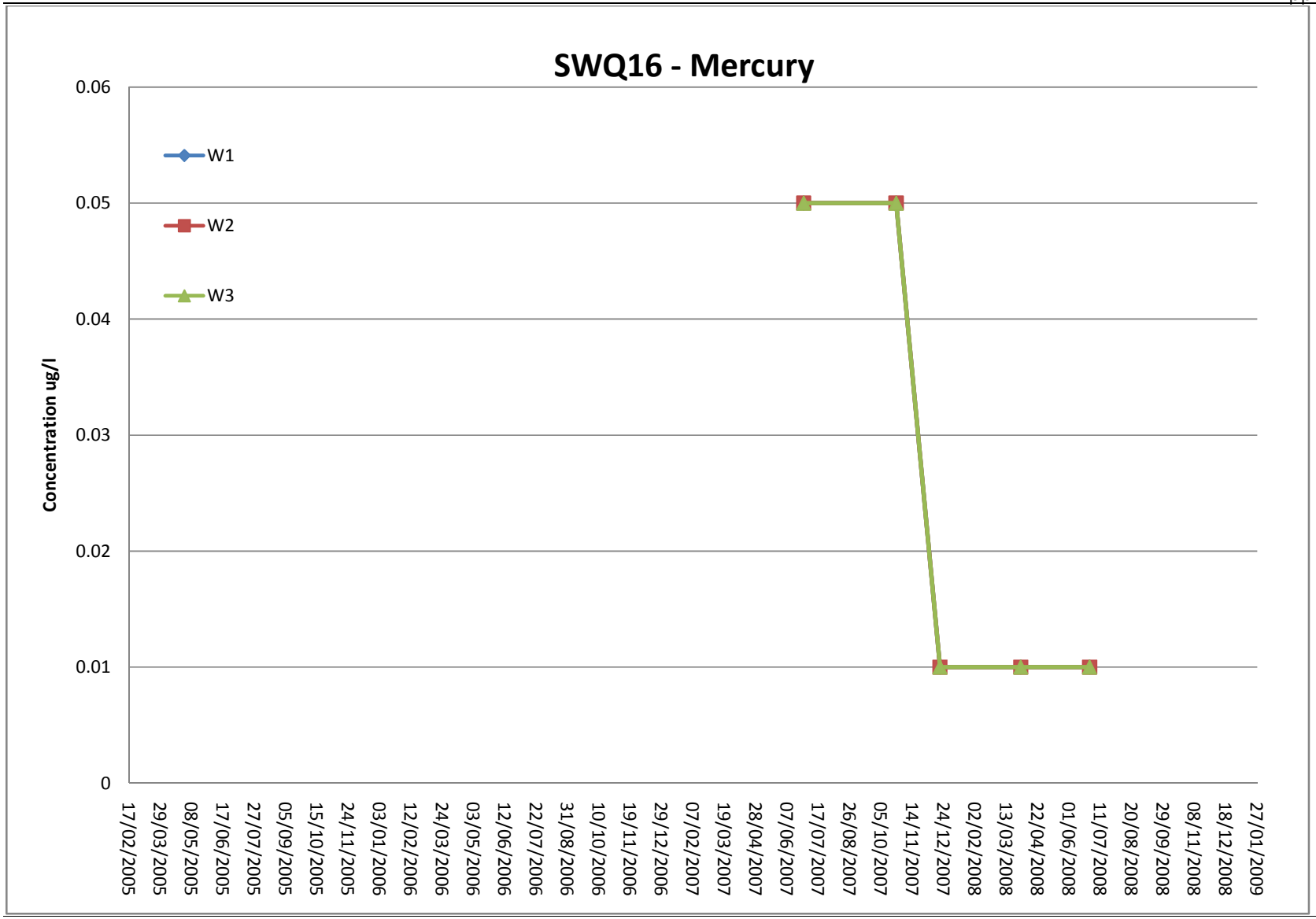
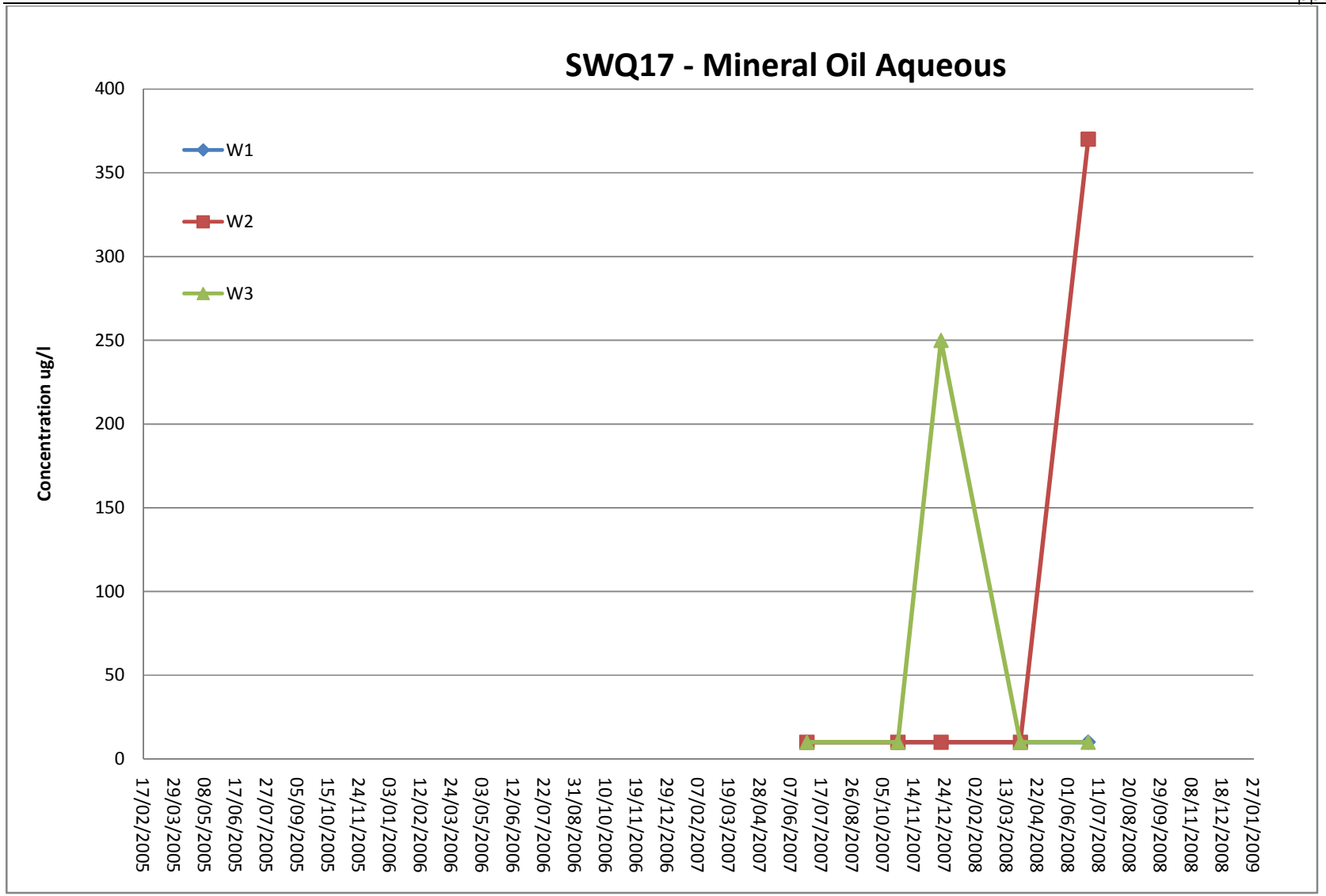
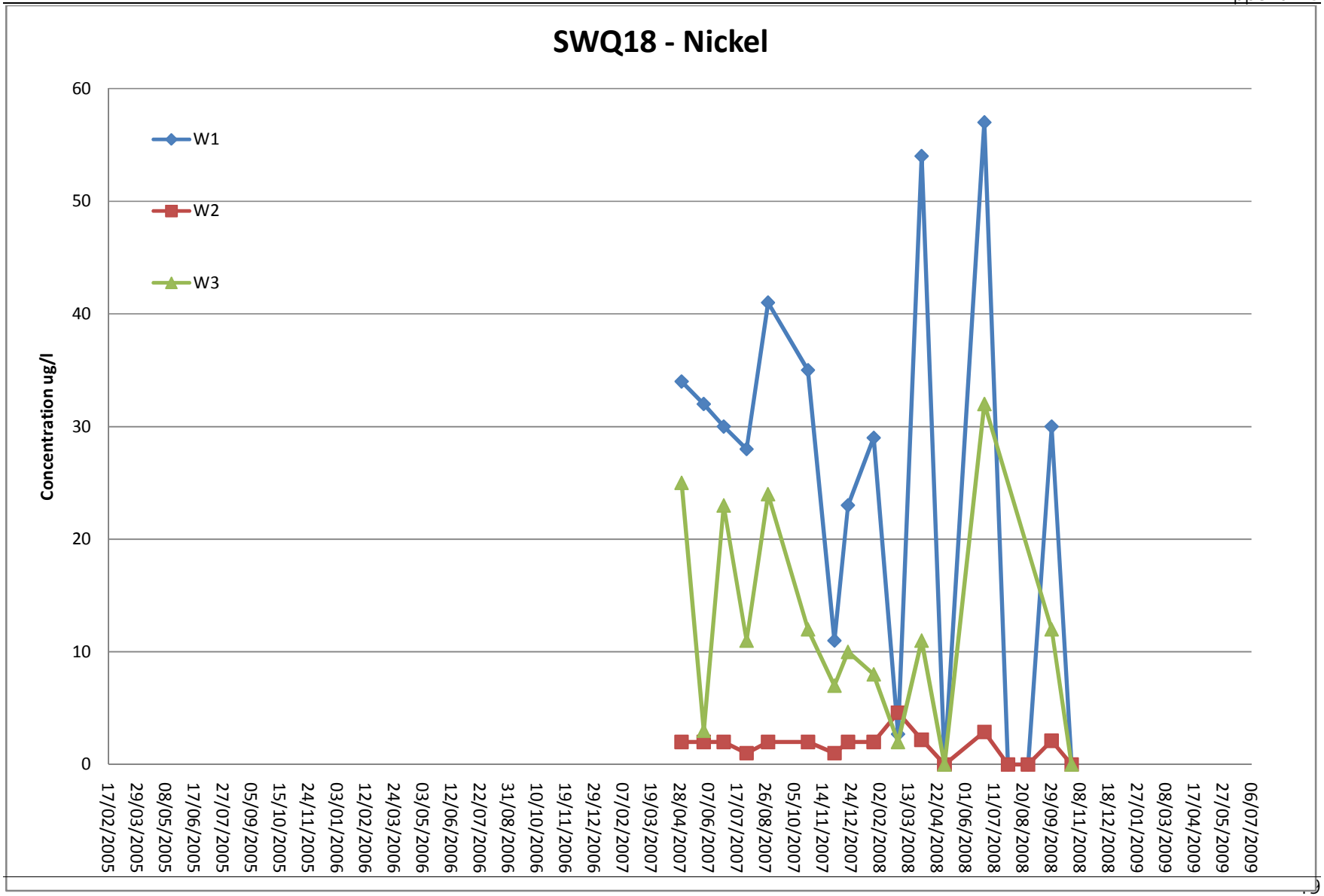
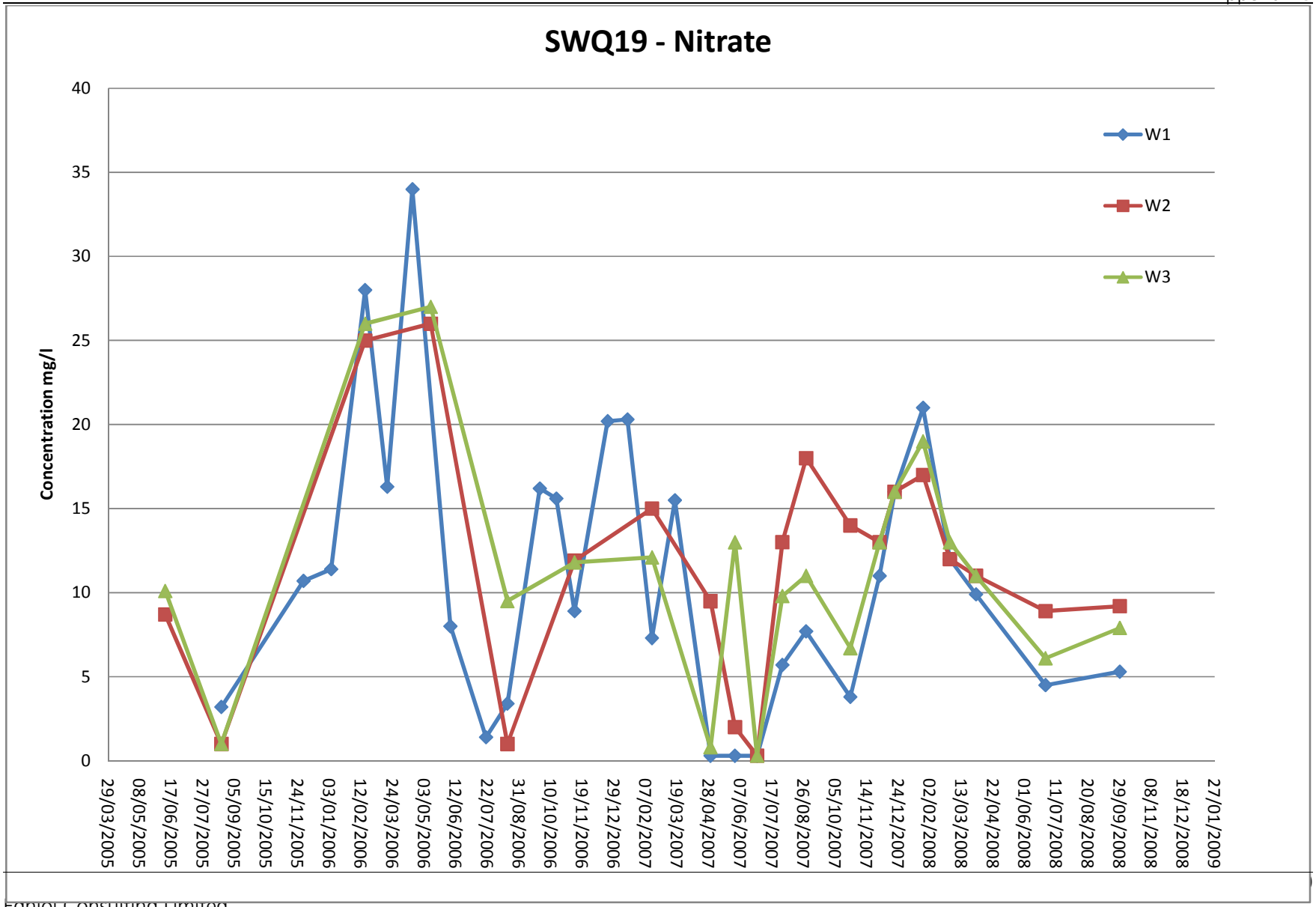
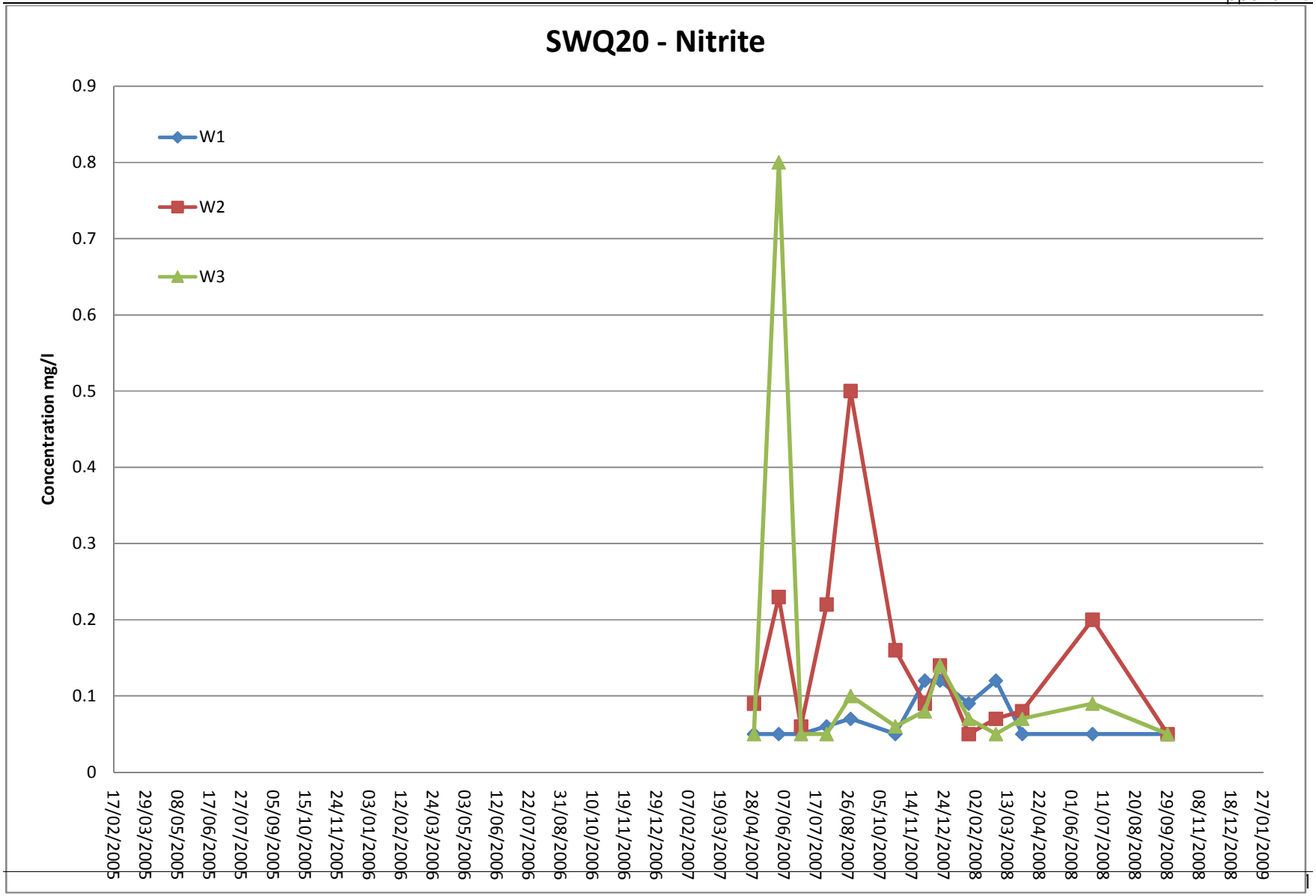
07/02/2007
19/03/2007
28/04/2007
07/06/2007
17/07/2007
26/08/2007
05/10/2007
14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009


SWQ16 - Mercury
Concentration ug/l
0.06
0.05
0.04
0.03
0.02
0.01
0
W1
W2
W3
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
19/11/2006
29/12/2006
07/02/2007
19/03/2007
28/04/2007
07/06/2007
17/07/2007
26/08/2007
05/10/2007
14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009


SWQ17 - Mineral Oil Aqueous
Concentration ug/l
400
350
300
250
200
150
100
50
0
W1
W2
W3
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
19/11/2006
29/12/2006
07/02/2007
19/03/2007
28/04/2007
07/06/2007
17/07/2007
26/08/2007
05/10/2007
14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009


SWQ18 - Nickel
Concentration ug/l
60
50
40
30
20
10
0
W1
W2
W3
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
19/11/2006
29/12/2006
07/02/2007
19/03/2007
28/04/2007
07/06/2007
17/07/2007
26/08/2007
05/10/2007
14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009
08/03/2009
17/04/2009
27/05/2009
06/07/2009


SWQ19 - Nitrate
Concentration mg/l
40
35
30
25
20
15
10
5
0
W1
W2
W3
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
19/11/2006
29/12/2006
07/02/2007
19/03/2007
28/04/2007
07/06/2007
17/07/2007
26/08/2007
05/10/2007
14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009


SWQ20 - Nitrite
Concentration mg/l
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
W1
W2
W3
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
19/11/2006
29/12/2006
07/02/2007
19/03/2007
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07/06/2007
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14/11/2007
24/12/2007
02/02/2008
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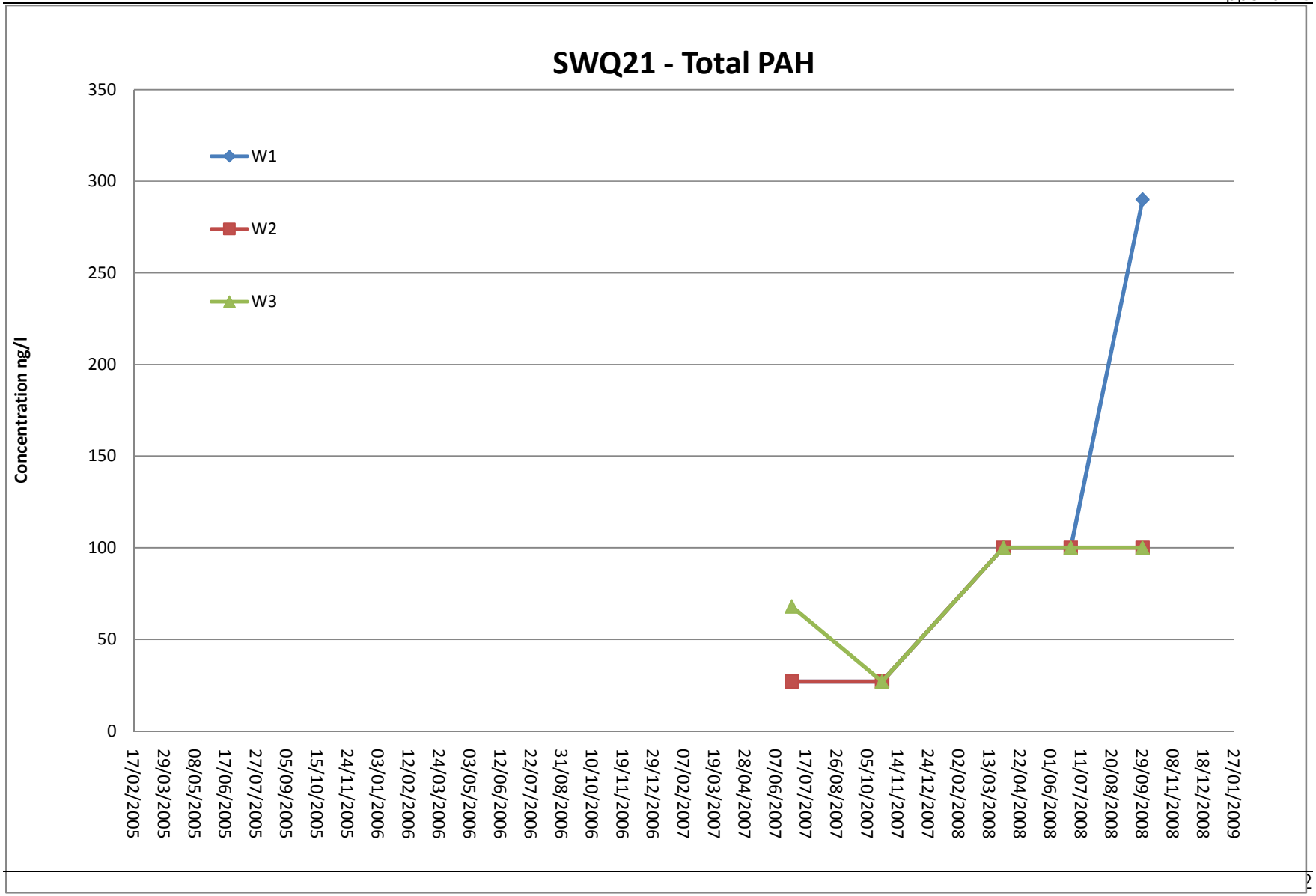
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009


SWQ21 - Total PAH
Concentration ng/l
350
300
250
200
150
100
50
0
W1
W2
W3
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
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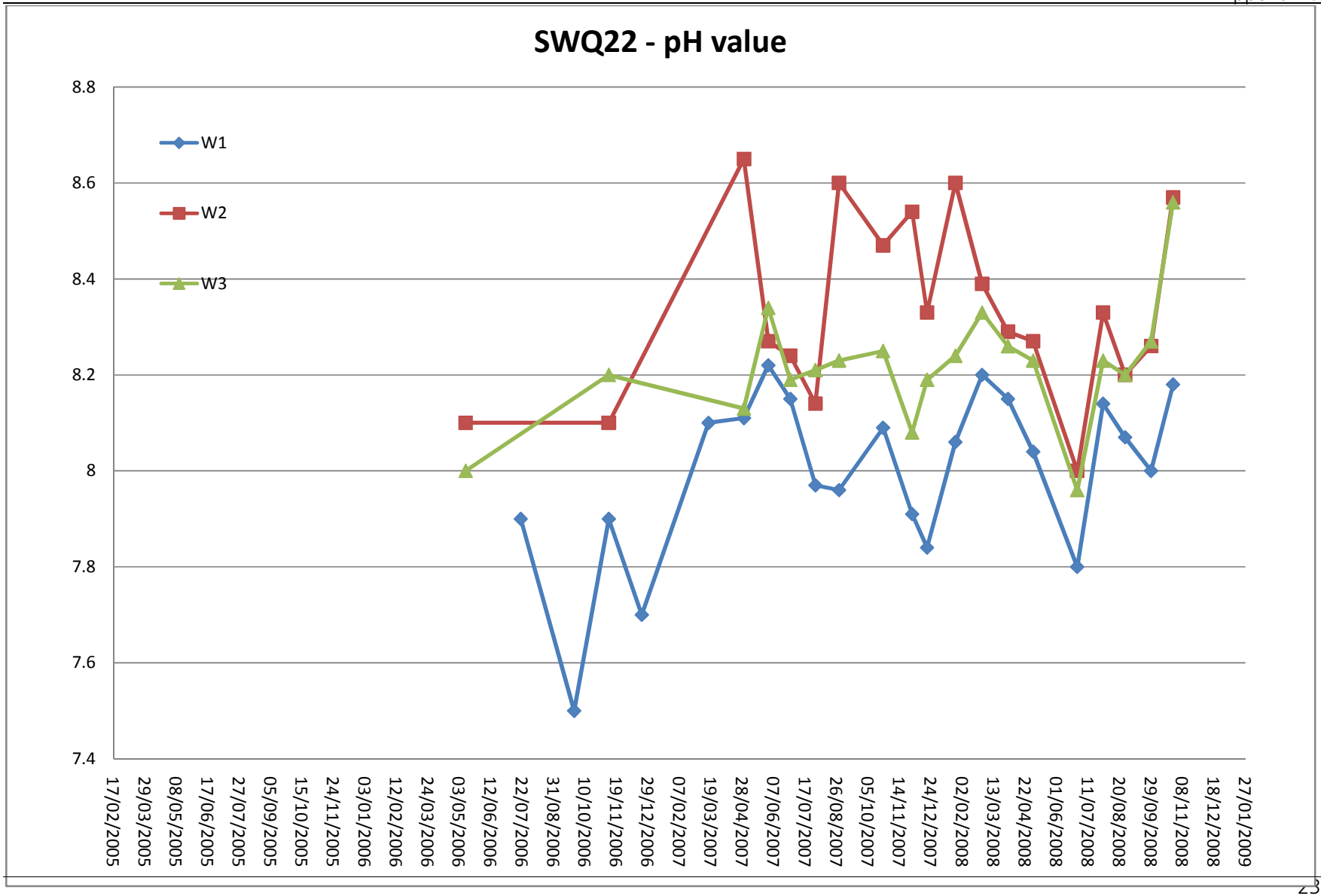
17/07/2007
26/08/2007
05/10/2007
14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009


SWQ22 - pH value
8.8
8.6
8.4
8.2
8
7.8
7.6
7.4
W1
W2
W3
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
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10/10/2006
19/11/2006
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07/02/2007
19/03/2007
28/04/2007
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26/08/2007
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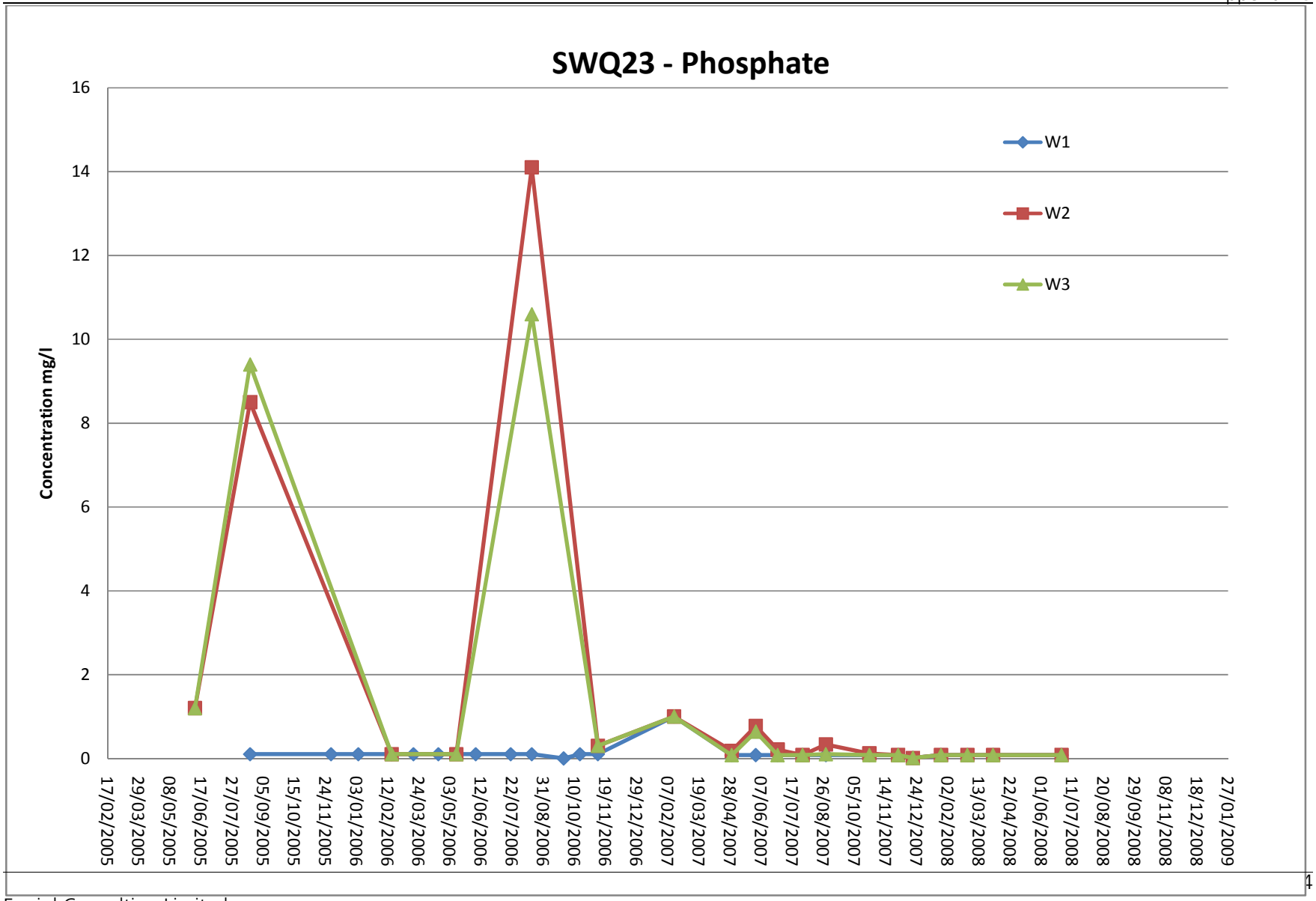
14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009


SWQ23 - Phosphate
Concentration mg/l
16
14
12
10
8
6
4
2
0
W1
W2
W3
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
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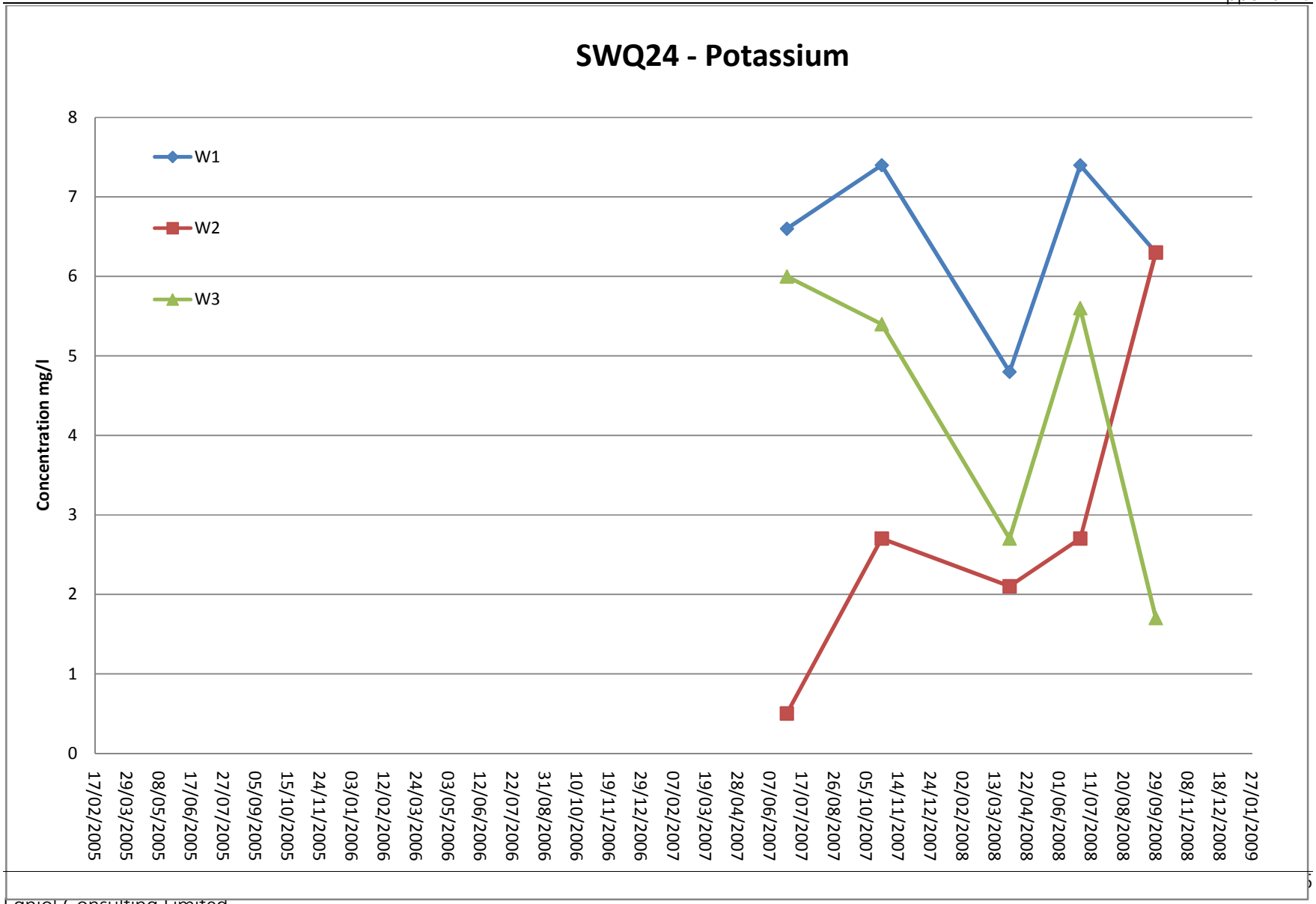
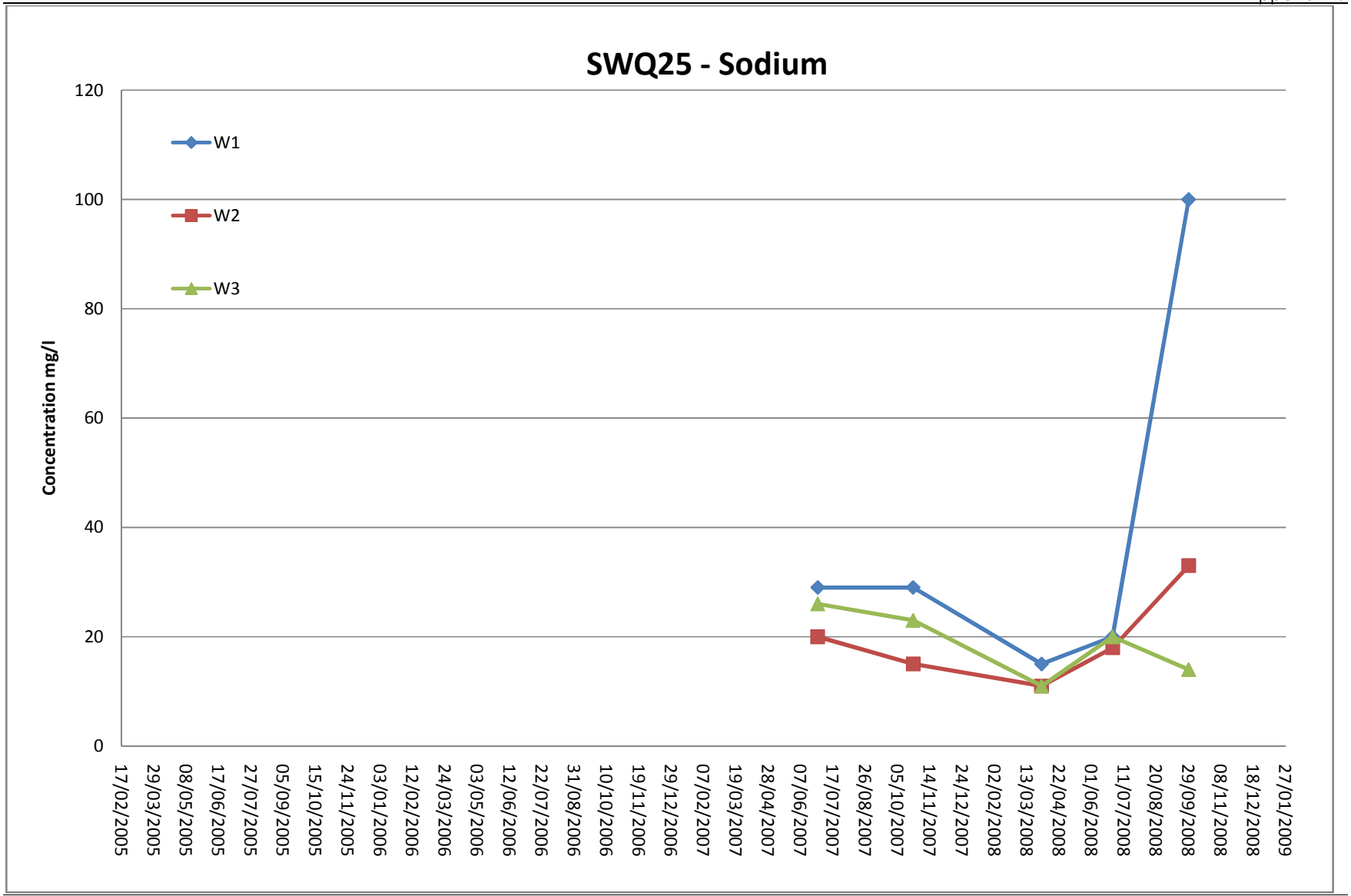
10/10/2006
19/11/2006
29/12/2006
07/02/2007
19/03/2007
28/04/2007
07/06/2007
17/07/2007
26/08/2007
05/10/2007
14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009


SWQ24 - Potassium
Concentration mg/l
W1
W2
W3
0
1
2
3
4
5
6
7
8
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
19/11/2006
29/12/2006
07/02/2007
19/03/2007
28/04/2007
07/06/2007
17/07/2007
26/08/2007
05/10/2007
14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009


SWQ25 - Sodium
Concentration mg/l
120
100
80
60
40
20
0
W1
W2
W3
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
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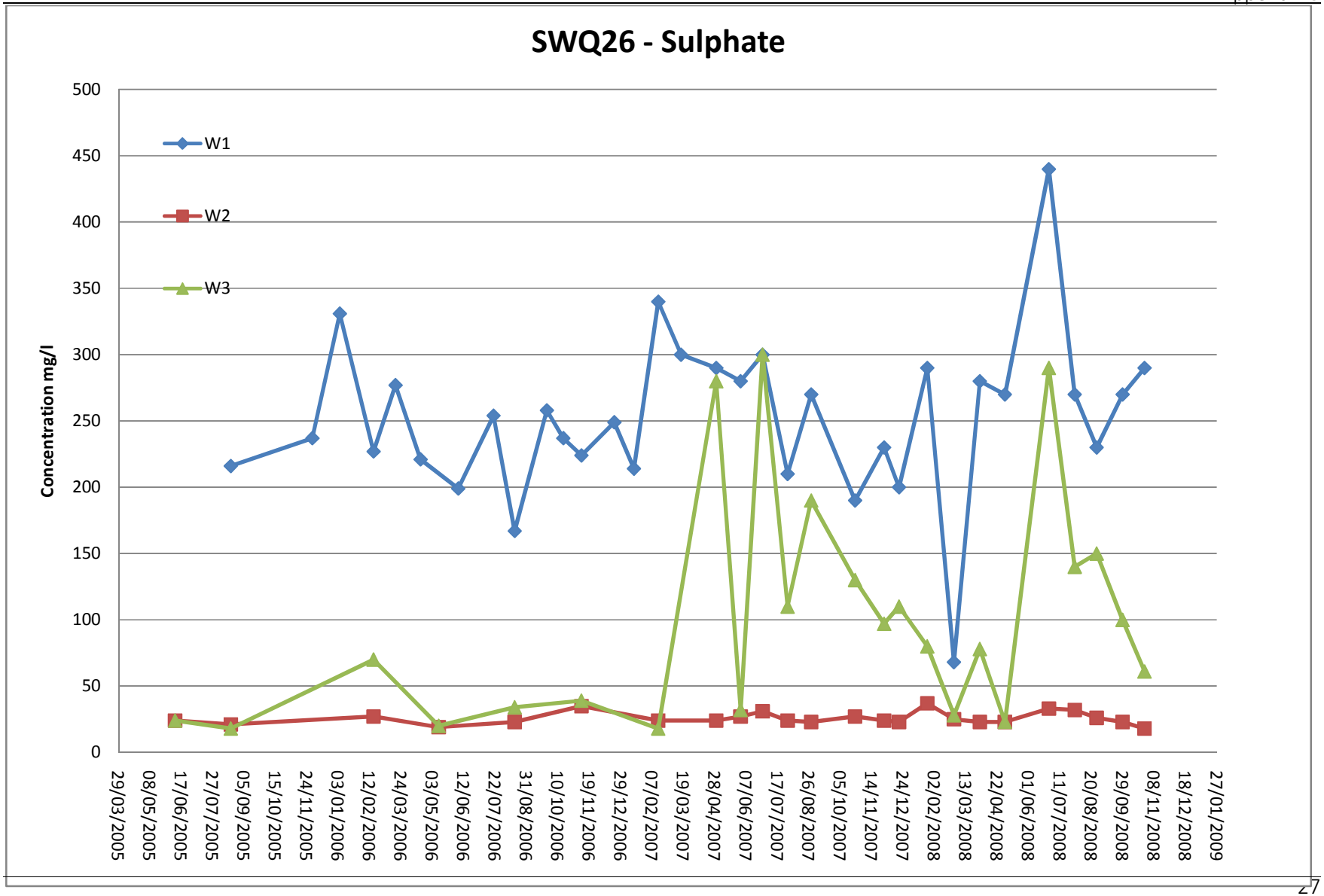
29/12/2006
07/02/2007
19/03/2007
28/04/2007
07/06/2007
17/07/2007
26/08/2007
05/10/2007
14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009


SWQ26 - Sulphate
Concentration mg/l
W1
W2
W3
500
450
400
350
300
250
200
150
100
50
0
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
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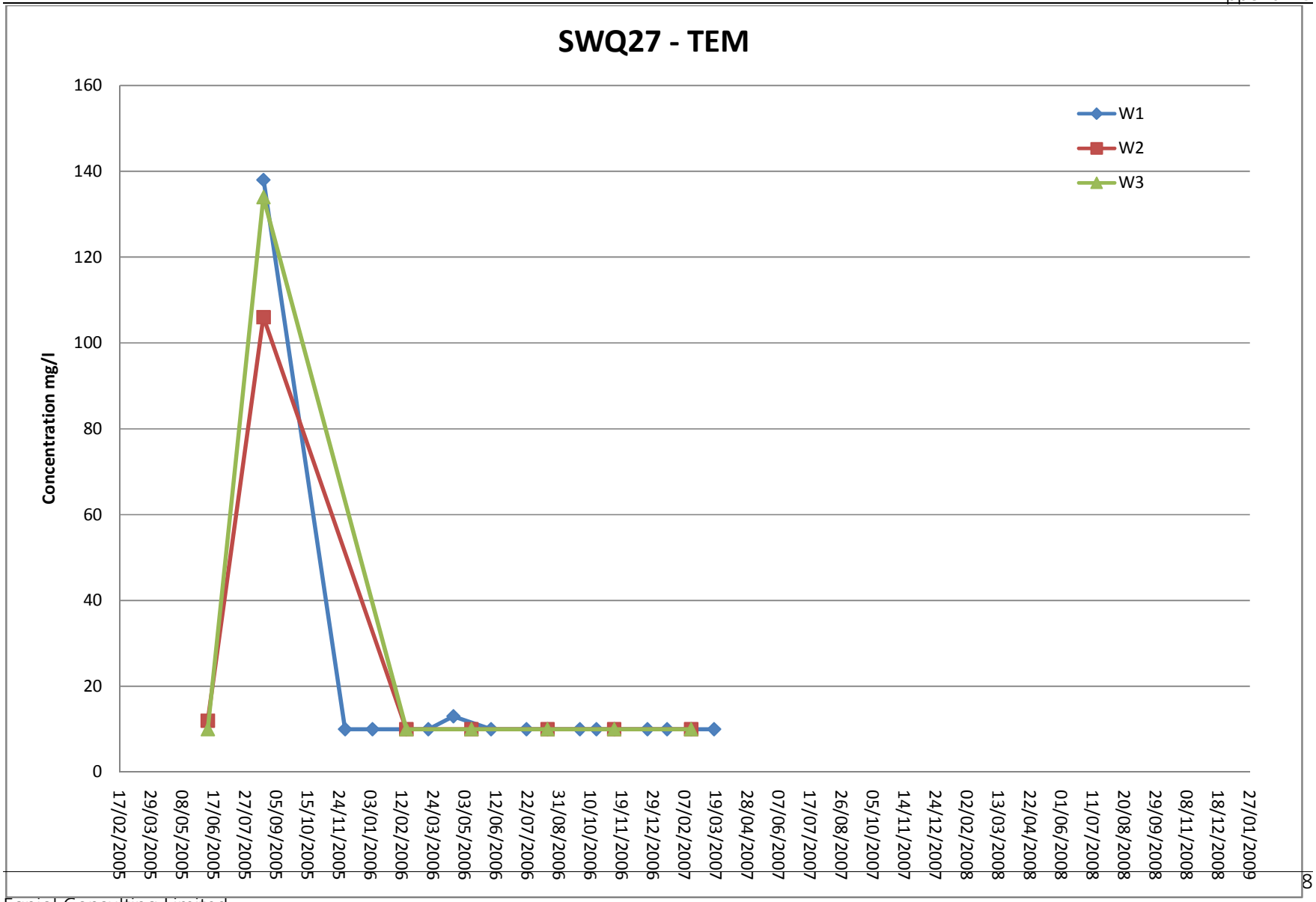
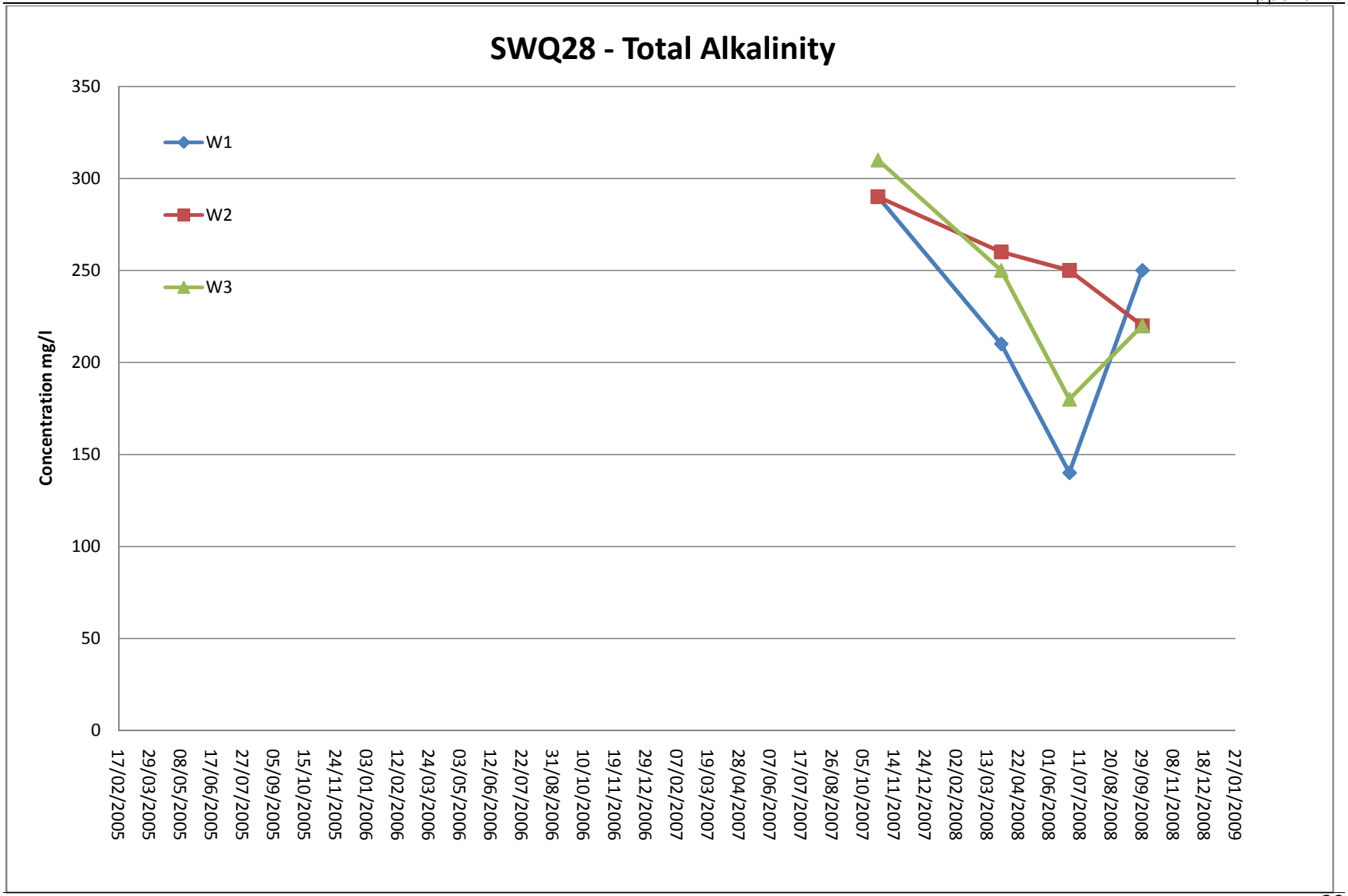
29/12/2006
07/02/2007
19/03/2007
28/04/2007
07/06/2007
17/07/2007
26/08/2007
05/10/2007
14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009


SWQ27 - TEM
Concentration mg/l
160
140
120
100
80
60
40
20
0
W1
W2
W3
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
19/11/2006
29/12/2006
07/02/2007
19/03/2007
28/04/2007
07/06/2007
17/07/2007
26/08/2007
05/10/2007
14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009


SWQ28 - Total Alkalinity
Concentration mg/l
350
300
250
200
150
100
50
0
W1
W2
W3
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
19/11/2006
29/12/2006
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28/04/2007
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14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
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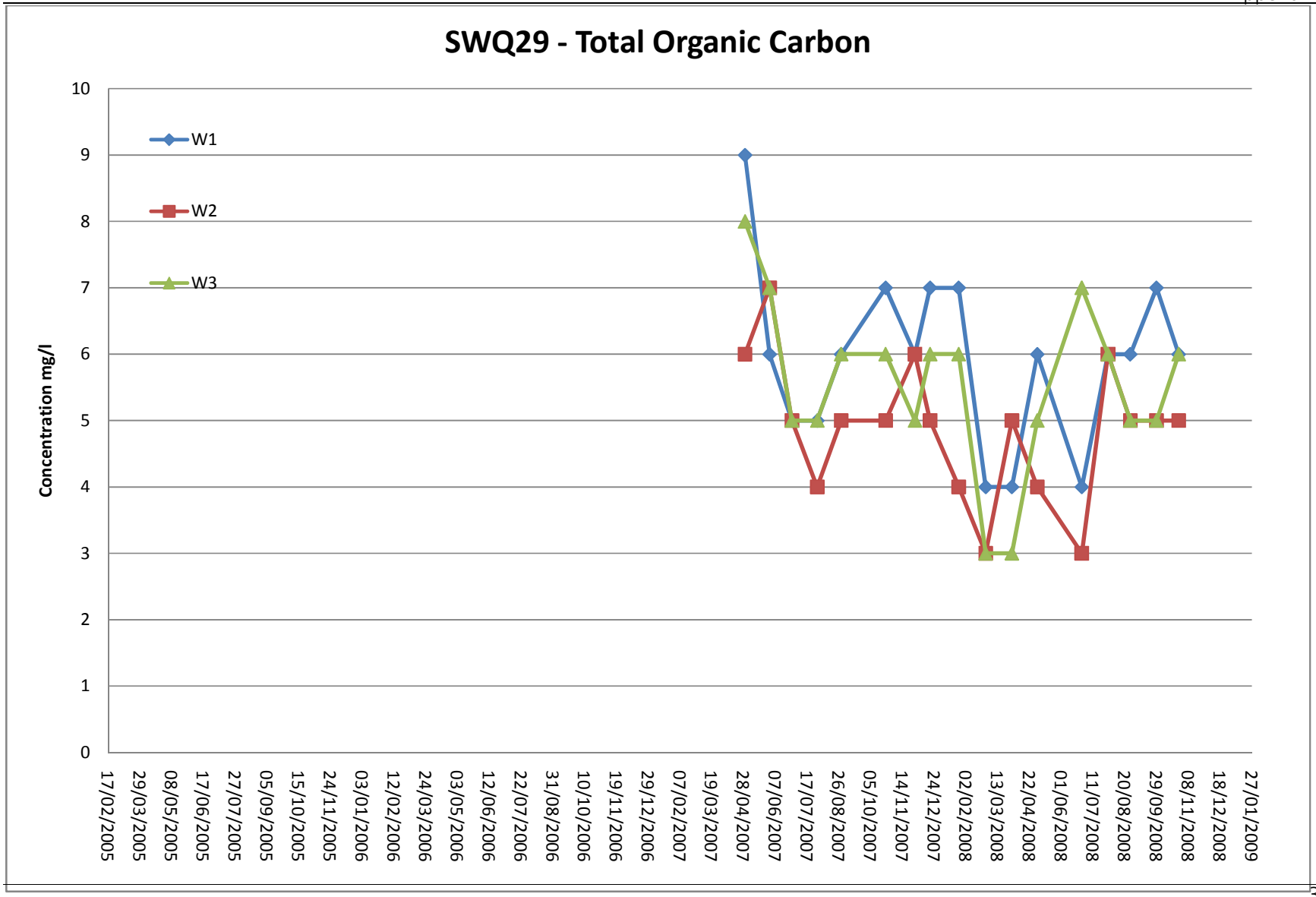
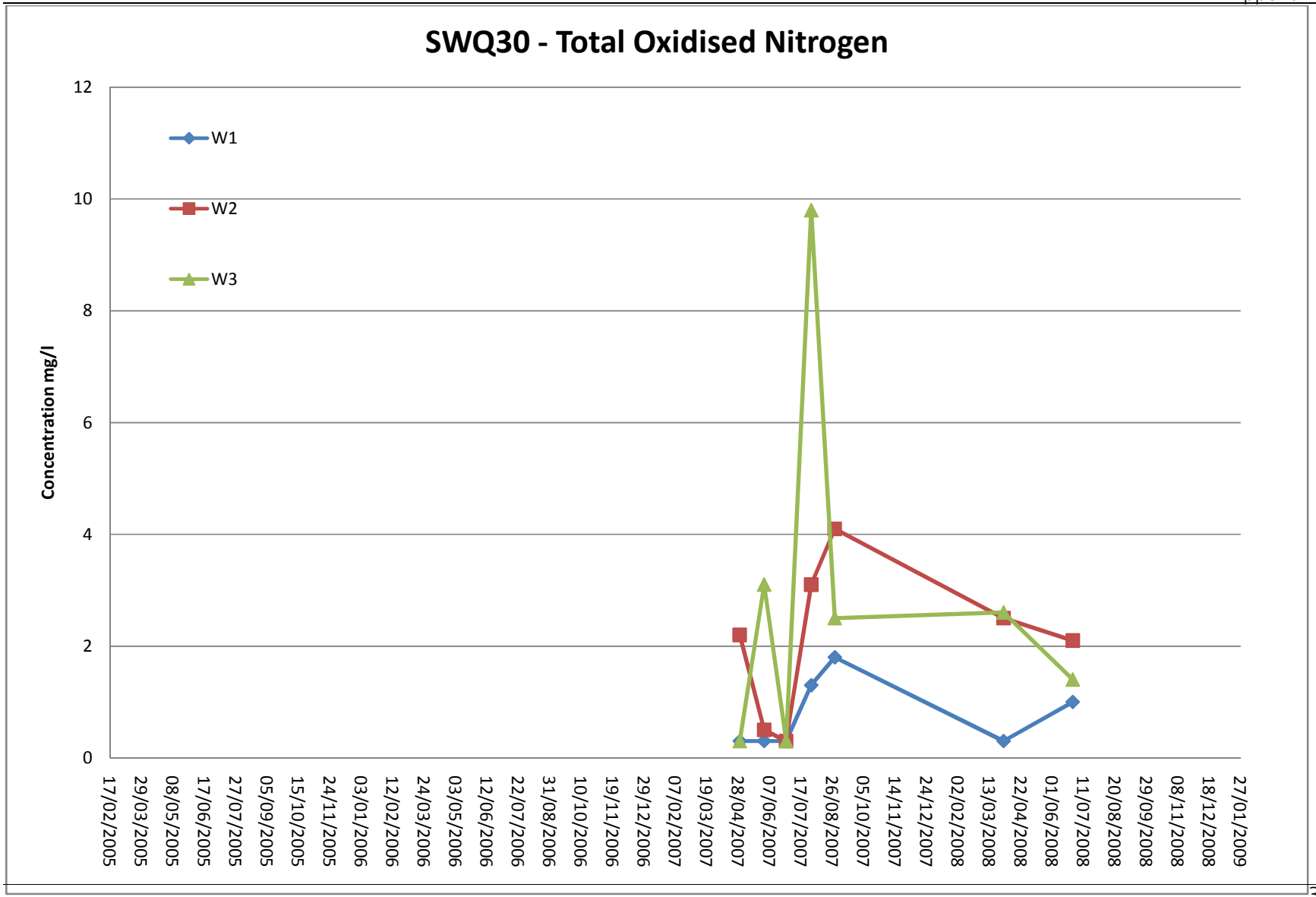
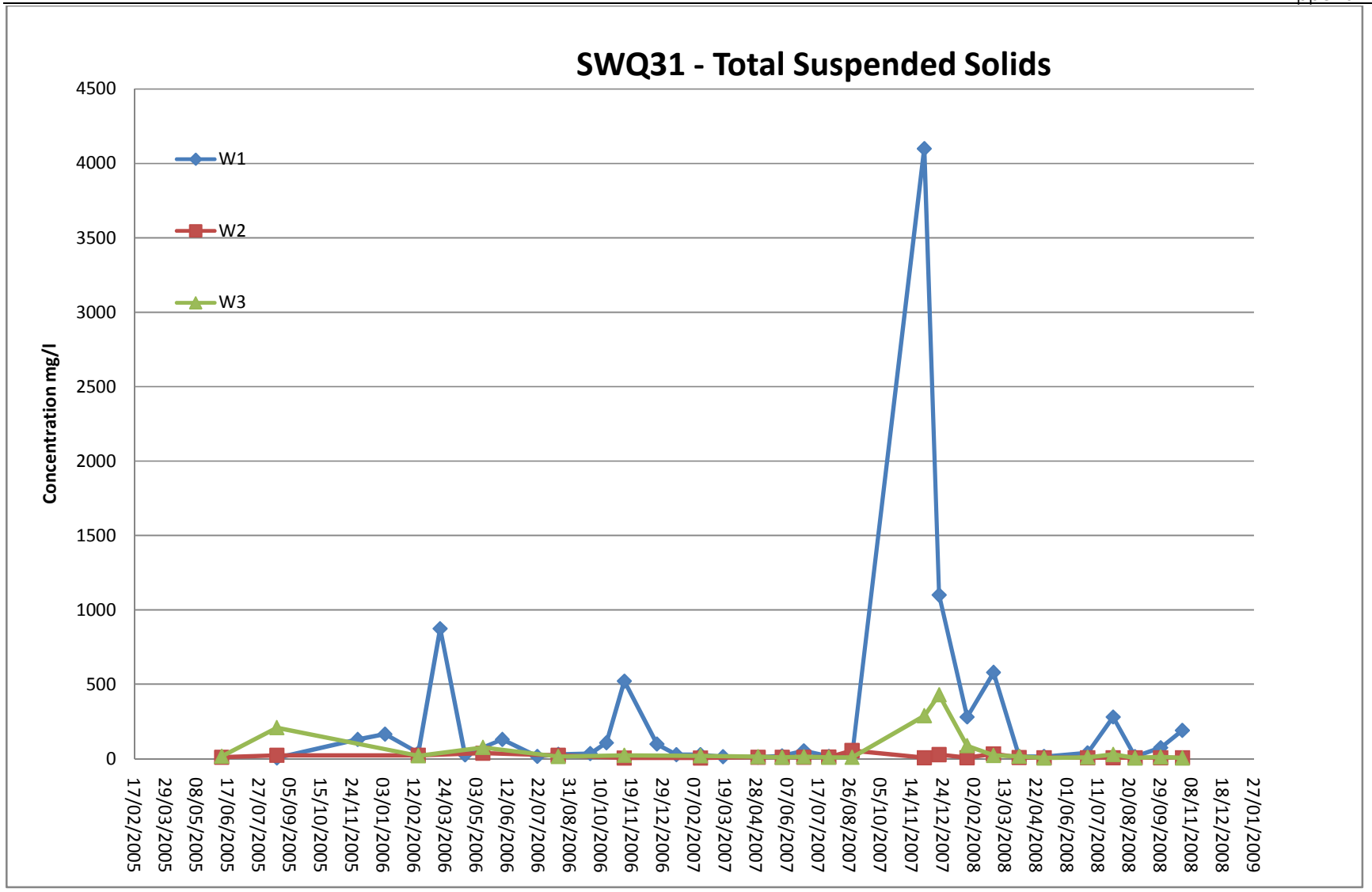
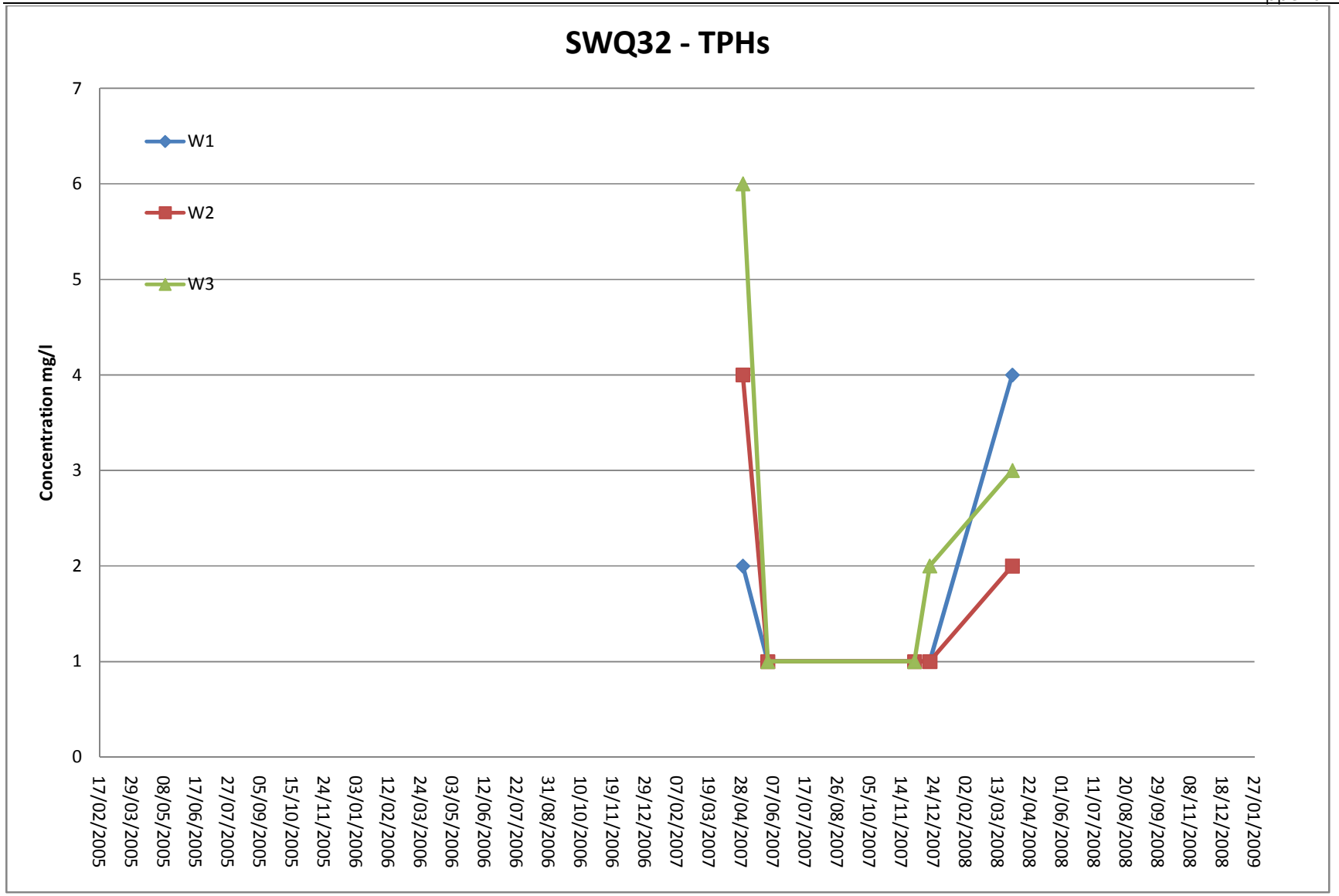
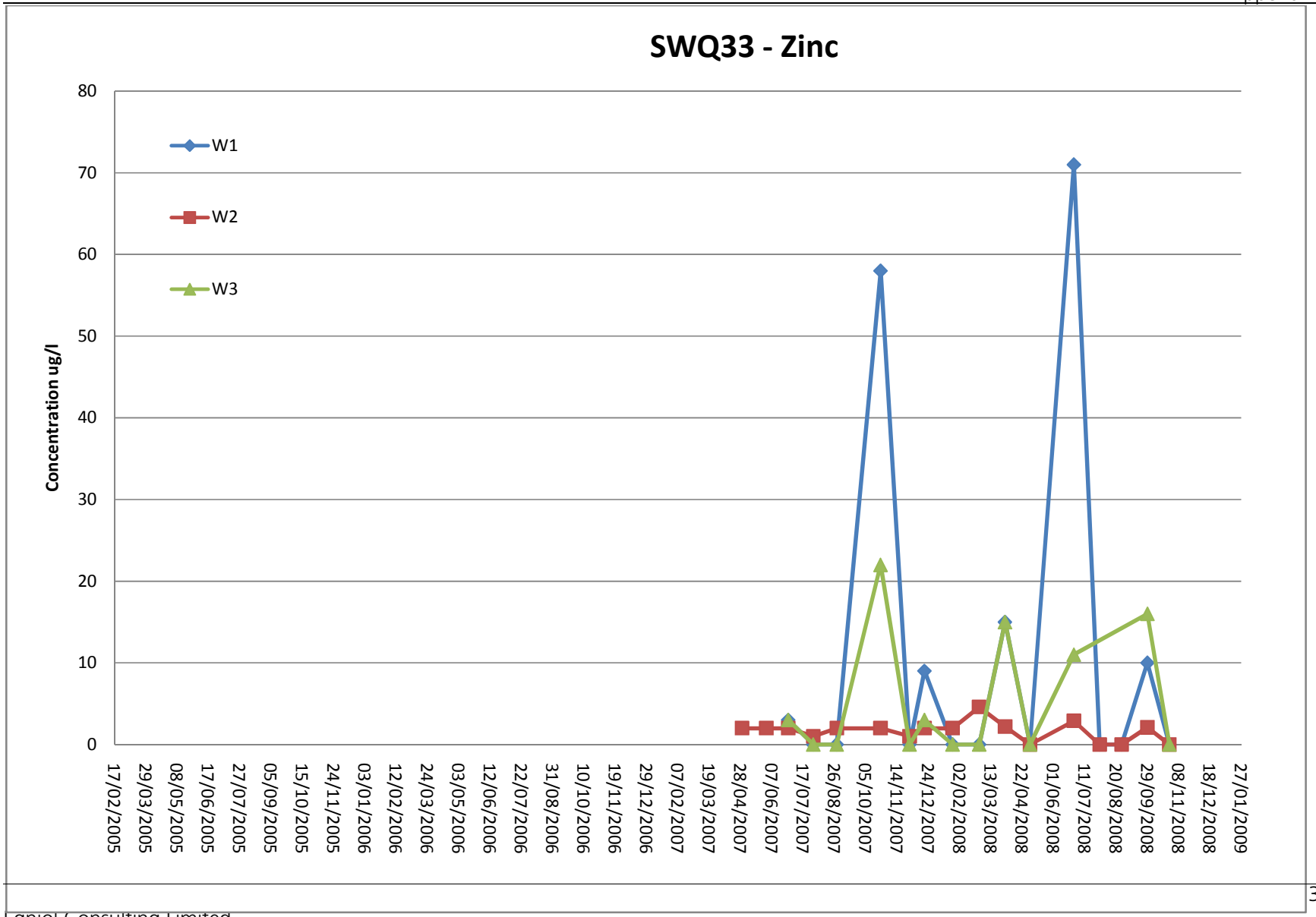
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009


SWQ29 - Total Organic Carbon
Concentration mg/l
W1
W2
W3
10
9
8
7
6
5
4
3
2
1
0
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
19/11/2006
29/12/2006
07/02/2007
19/03/2007
28/04/2007
07/06/2007
17/07/2007
26/08/2007
05/10/2007
14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009


SWQ30 - Total Oxidised Nitrogen
Concentration mg/l
W1
W2
W3
0
2
4
6
8
10
12
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
19/11/2006
29/12/2006
07/02/2007
19/03/2007
28/04/2007
07/06/2007
17/07/2007
26/08/2007
05/10/2007
14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009


SWQ31 - Total Suspended Solids
Concentration mg/l
4500
4000
3500
3000
2500
2000
1500
1000
500
0
W1
W2
W3
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
19/11/2006
29/12/2006
07/02/2007
19/03/2007
28/04/2007
07/06/2007
17/07/2007
26/08/2007
05/10/2007
14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009


SWQ32 - TPHs
Concentration mg/l
W1
W2
W3
0
1
2
3
4
5
6
7
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
19/11/2006
29/12/2006
07/02/2007
19/03/2007
28/04/2007
07/06/2007
17/07/2007
26/08/2007
05/10/2007
14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009


SWQ33 - Zinc
Concentration ug/l
80
70
60
50
40
30
20
10
0
W1
W2
W3
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
19/11/2006
29/12/2006
07/02/2007
19/03/2007
28/04/2007
07/06/2007
17/07/2007
26/08/2007
05/10/2007
14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009

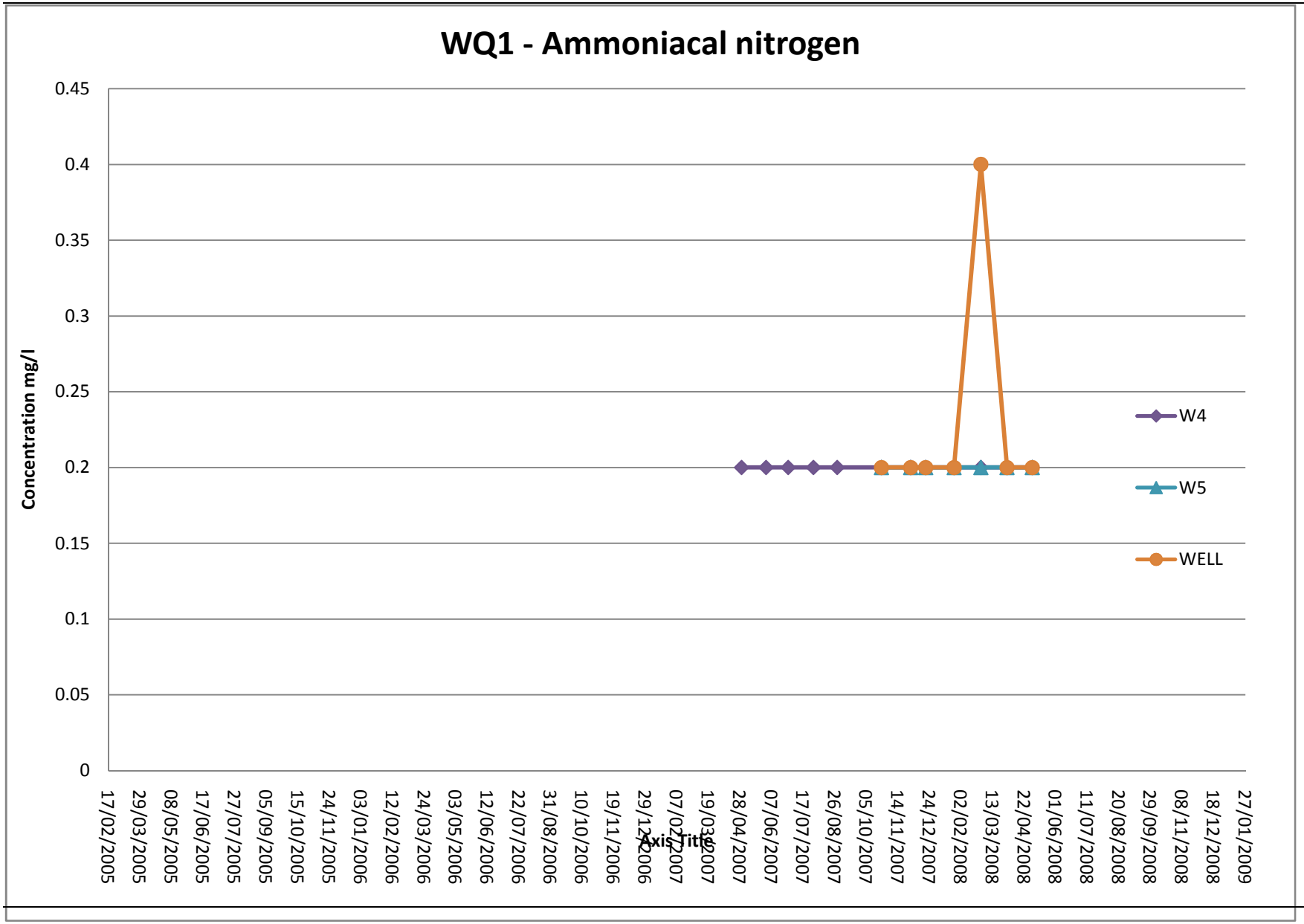
GW1							
Time (s)	drawdown	dip (m)		Volume removed = 1.75L			
0.00				starting dip	12.86		
2.00							
4.00							
6.00							
8.00							
10.00							
12.00							
14.00							
16.00							
18.00							
20.00							
22.00							
24.00							
26.00							
28.00							
30.00							
32.00							
34.00							
36.00							
38.00							
40.00							
42.00	0.10	12.96					
44.00							
46.00							
48.00	0.08	12.94					
50.00							
52.00							
54.00	0.09	12.95					
56.00							
58.00	0.07	12.93					
60.00							
65.00							
70.00	0.07	12.93					
75.00							
80.00	0.07	12.925					
85.00							
90.00	0.06	12.92					
95.00							
100.00	0.06	12.92					
105.00							
110.00							
120.00	0.05	12.915					
130.00	0.05	12.915					
140.00	0.05	12.91					
150.00	0.05	12.91					
160.00							
170.00	0.04	12.905					
180.00	0.04	12.9					
190.00	0.04	12.9					
200.00	0.04	12.9					
210.00	0.04	12.895					
220.00							
230.00							
240.00	0.03	12.89					
300.00	0.03	12.89					
360.00	0.02	12.88					
420.00	0.02	12.88					
480.00							
540.00	0.02	12.88					
600.00	0.02	12.875					
750.00	0.02	12.875					
900.00	0.02	12.875					
1200.00	0.02	12.875					
1800.00	0.01	12.8725					

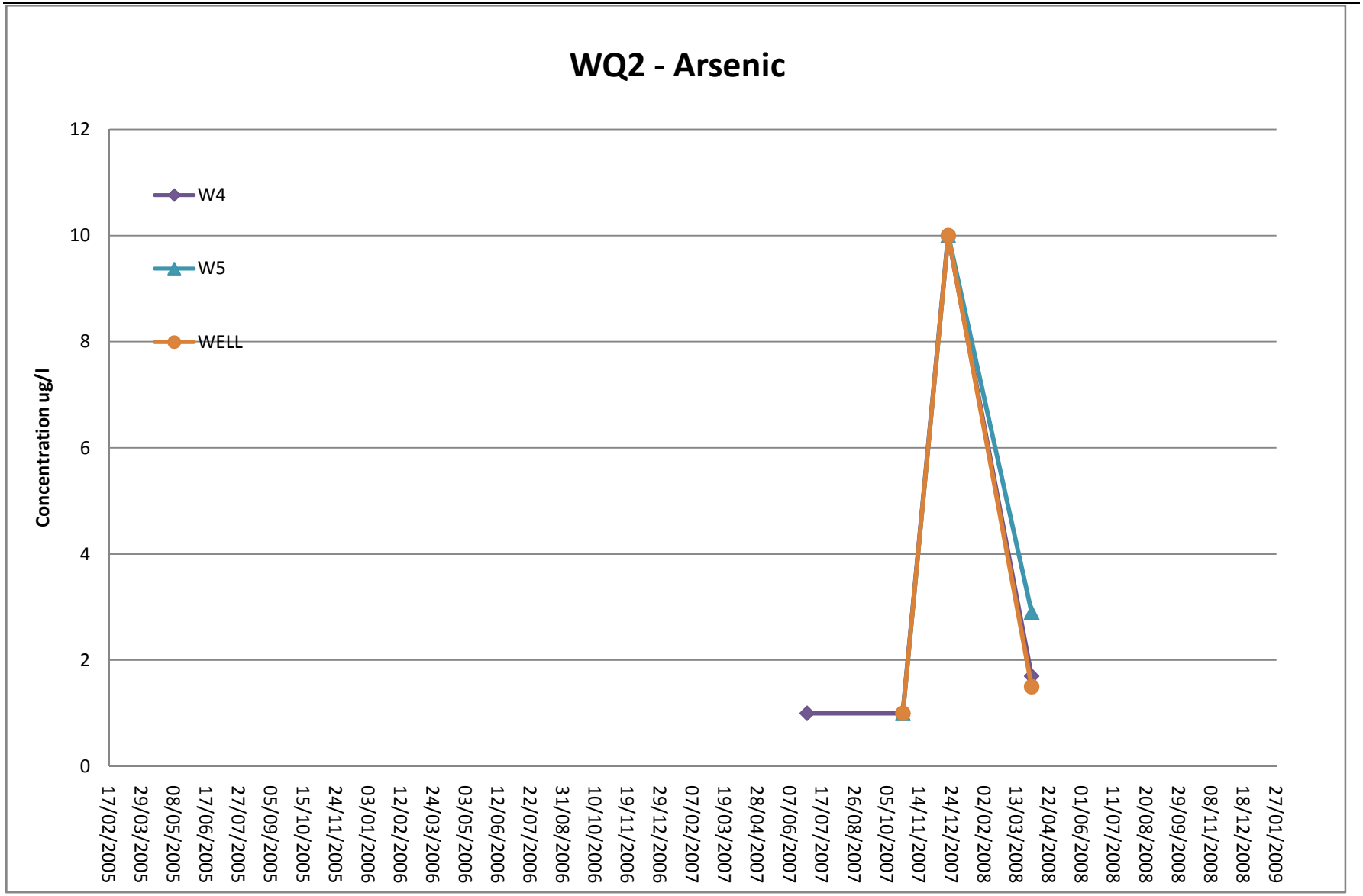
GW1							
Time (s)	drawdown	dip (m)		Volume rer	1l?		
30.00				starting dip	12.84		
35.00							
40.00							
45.00							
50.00	0.06	12.9					
55.00							
60.00	0.045	12.885					
65.00							
70.00							
75.00	0.04	12.88					
80.00	0.035	12.875					
85.00	0.035	12.875					
90.00	0.03	12.87					
95.00	0.03	12.87					
100.00	0.03	12.87					
105.00	0.0275	12.8675					
110.00	0.025	12.865					
115.00	0.025	12.865					
120.00	0.025	12.865					
125.00	0.0225	12.8625					
130.00	0.0225	12.8625					
135.00	0.0225	12.8625					
140.00	0.0225	12.8625					
145.00	0.0225	12.8625					
150.00	0.02	12.86					
155.00	0.02	12.86					
160.00	0.02	12.86					
165.00	0.02	12.86					
170.00	0.0175	12.8575					
175.00	0.0175	12.8575					
180.00	0.0175	12.8575					
185.00	0.015	12.855					
190.00	0.015	12.855					
195.00	0.015	12.855					
200.00	0.015	12.855					
205.00	0.0125	12.8525					
210.00	0.0125	12.8525					
215.00	0.0125	12.8525					
220.00	0.0125	12.8525					
225.00	0.0125	12.8525					
230.00	0.0125	12.8525					
235.00	0.0125	12.8525					
240.00	0.01	12.85					
245.00	0.01	12.85					
250.00	0.01	12.85					
255.00	0.01	12.85					
260.00	0.01	12.85					
265.00	0.01	12.85					
270.00	0.01	12.85					
275.00	0.01	12.85					
280.00	0.01	12.85					
285.00	0.01	12.85					
290.00	0.01	12.85					
295.00	0.01	12.85					
300.00	0.01	12.85					
310.00	0.01	12.85					
320.00	0.01	12.85					
330.00	0.01	12.85					
340.00	0.01	12.85					
350.00	0.01	12.85					
360.00	0.005	12.845					
370.00	0.005	12.845					
380.00	0.005	12.845					
390.00	0.005	12.845					
400.00	0.005	12.845					
410.00	0.005	12.845					
420.00	0.005	12.845					
430.00	0.005	12.845					
440.00	0.005	12.845					
450.00	0.005	12.845					
460.00	0.005	12.845					
470.00	0.005	12.845					
480.00	0.005	12.845					
490.00	0.005	12.845					
500.00	0.005	12.845					
510.00	0.005	12.845					
520.00	0.005	12.845					
530.00	0.005	12.845					
540.00	0.005	12.845					
550.00	0.005	12.845					
560.00	0.005	12.845					
570.00	0	12.84					

BH2*				Volume removed = 2L			
Time		dip	actual dip		1.13		
5.00							
10.00							
15.00							
20.00							
25.00							
30.00	0.01	1.14					
35.00	0.01	1.14					
40.00	0	1.13					
45.00							
50.00							
55.00							
60.00							
* Borehole recharged almost instantly							

GW3							
time (s)	Drawdown	dip		Volume removed = 1.75L			
0.00				Start dip	8.37		
5.00							
10.00							
15.00							
20.00							
25.00							
30.00							
35.00							
40.00							
45.00							
50.00	0.74	9.11					
55.00	0.68	9.05					
60.00	0.63	9					
65.00							
70.00							
75.00							
80.00	0.58	8.95					
85.00	0.56	8.93					
90.00	0.53	8.9					
95.00	0.51	8.88					
100.00	0.49	8.86					
105.00	0.47	8.84					
110.00							
115.00	0.46	8.83					
120.00	0.45	8.82					
130.00	0.44	8.81					
140.00	0.40	8.77					
150.00	0.39	8.76					
160.00	0.37	8.74					
170.00	0.36	8.73					
180.00	0.35	8.72					
190.00	0.33	8.7					
200.00	0.33	8.7					
210.00	0.33	8.7					
220.00	0.33	8.7					
230.00	0.32	8.69					
240.00	0.31	8.68					
250.00	0.31	8.68					
260.00	0.31	8.68					
270.00	0.31	8.68					
280.00	0.31	8.68					
290.00	0.31	8.68					
300.00	0.31	8.68					
310.00	0.31	8.68					
320.00	0.31	8.68					
330.00	0.31	8.68					
340.00	0.31	8.68					
350.00	0.31	8.68					
360.00	0.31	8.68					
390.00	0.31	8.675					
420.00	0.31	8.675					
450.00	0.31	8.675					
480.00	0.31	8.675					
1740.00	0.31	8.675					

GW3A							
Time		dip	actual dip		Volume removed = 1.75L		
0.00					Start dip	9.35	
2.00							
4.00							
6.00							
8.00							
10.00							
12.00							
14.00							
16.00							
18.00							
20.00							
22.00							
24.00							
26.00							
28.00							
30.00							
32.00							
34.00							
36.00							
38.00							
40.00							
42.00							
44.00							
46.00							
48.00	0.37	9.72					
50.00	0.37	9.72					
52.00	0.36	9.71					
54.00	0.36	9.71					
56.00	0.36	9.71					
58.00	0.36	9.71					
60.00	0.36	9.71					
65.00	0.36	9.71					
70.00	0.35	9.70					
75.00	0.35	9.70					
80.00	0.35	9.70					
85.00	0.345	9.70					
90.00	0.34	9.69					
95.00	0.335	9.69					
100.00	0.335	9.69					
105.00	0.33	9.68					
110.00	0.325	9.68					
115.00	0.325	9.68					
120.00	0.32	9.67					
125.00	0.315	9.67					
130.00	0.315	9.67					
135.00	0.315	9.67					
140.00	0.31	9.66					
145.00	0.31	9.66					
150.00	0.305	9.66					
155.00	0.305	9.66					
160.00	0.3	9.65					
165.00	0.3	9.65					
170.00	0.295	9.65					
175.00	0.295	9.65					
180.00	0.29	9.64					
190.00	0.285	9.64					
200.00	0.285	9.64					
210.00	0.28	9.63					
220.00	0.275	9.63					
230.00	0.27	9.62					
240.00	0.27	9.62					
250.00	0.265	9.62					
260.00	0.26	9.61					
270.00	0.26	9.61					
280.00	0.2575	9.61					
290.00	0.25	9.60					
300.00	0.25	9.60					
330.00	0.24	9.59					
360.00	0.23	9.58					
390.00	0.225	9.58					
420.00	0.22	9.57					
450.00	0.215	9.57					
480.00	0.205	9.56					
510.00	0.2	9.55					
540.00	0.195	9.55					
570.00	0.1875	9.54					
600.00	0.18	9.53					
660.00	0.17	9.52					
720.00	0.1625	9.51					
780.00	0.155	9.51					
840.00	0.1475	9.50					
900.00	0.14	9.49					
960.00	0.1325	9.48					
1020.00	0.1275	9.48					
1080.00	0.1225	9.47					
1140.00	0.115	9.47					
1200.00	0.11	9.46					
1260.00	0.105	9.46					
1320.00	0.095	9.45					
1380.00	0.09	9.44					
1440.00	0.0875	9.44					
1500.00	0.0825	9.43					
1560.00	0.08	9.43					
1620.00	0.0775	9.43					
1680.00	0.0725	9.42					
1740.00	0.07	9.42					
1800.00	0.075	9.43					
2400.00	0.035	9.39					


WQ1 - Ammoniacal nitrogen
Concentration mg/l
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
19/11/2006
29/12/2006
07/02/2007
19/03/2007
28/04/2007
07/06/2007
17/07/2007
26/08/2007
05/10/2007
14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009
Axis Title
W4
W5
WELL


WQ2 - Arsenic
Concentration ug/l
0
2
4
6
8
10
12
W4
W5
WELL
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
19/11/2006
29/12/2006
07/02/2007
19/03/2007
28/04/2007
07/06/2007
17/07/2007
26/08/2007
05/10/2007
14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009


WQ3 - BOD
Concentration mg/l
2.5
2
1.5
1
0.5
0
W4
W5
WELL
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
19/11/2006
29/12/2006
07/02/2007
19/03/2007
28/04/2007
07/06/2007
17/07/2007
26/08/2007
05/10/2007
14/11/2007
24/12/2007
02/02/2008
13/03/2008
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01/06/2008
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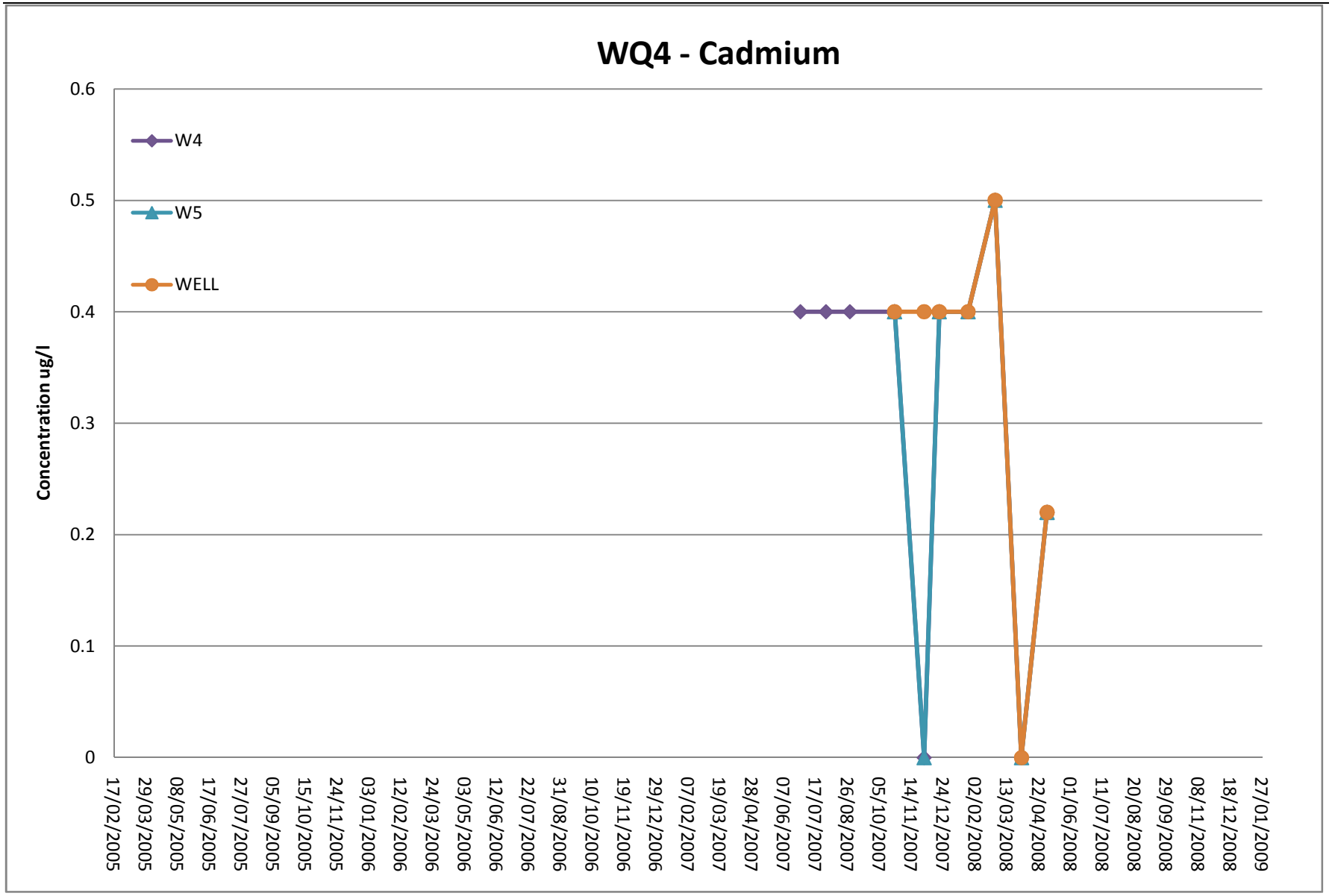
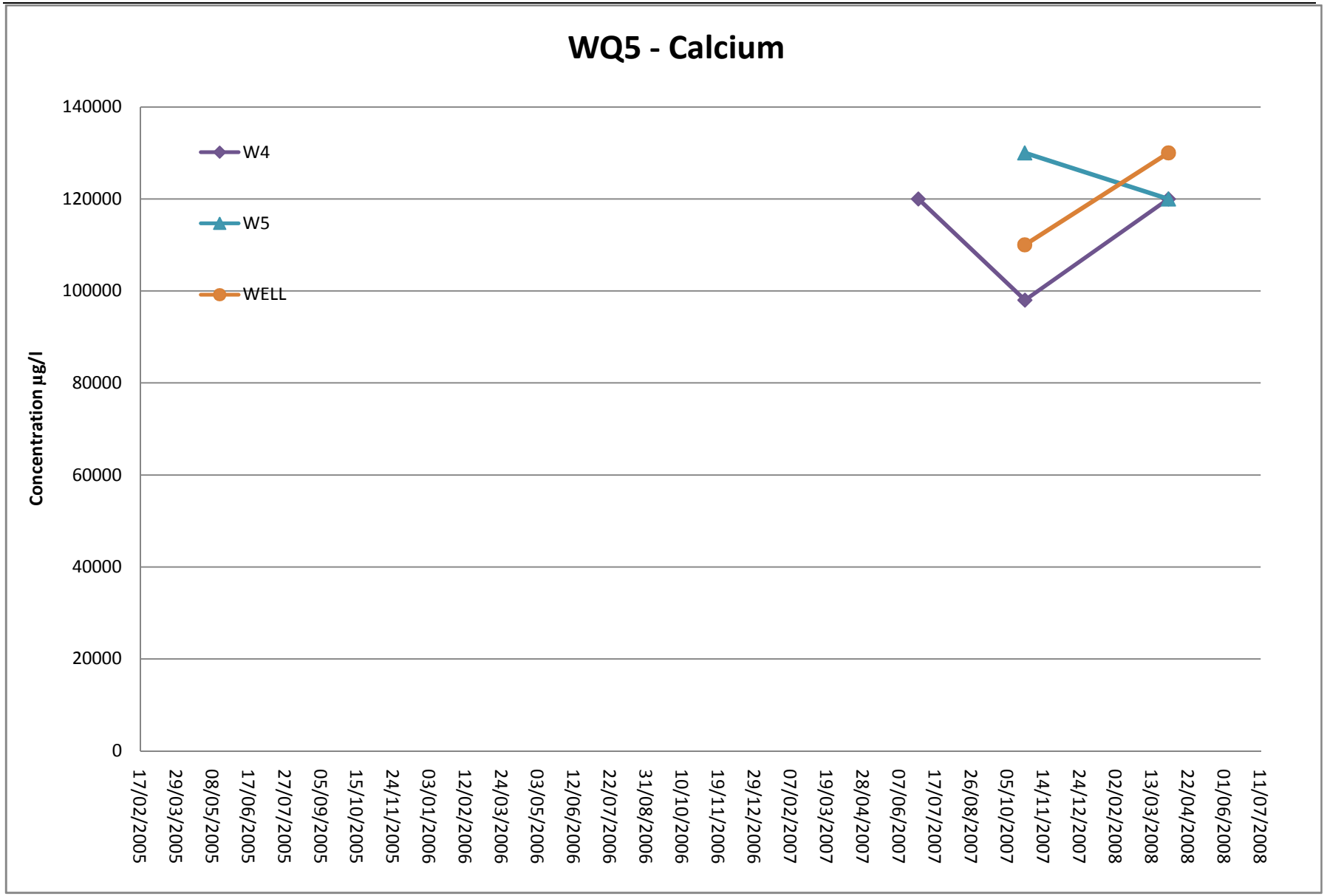
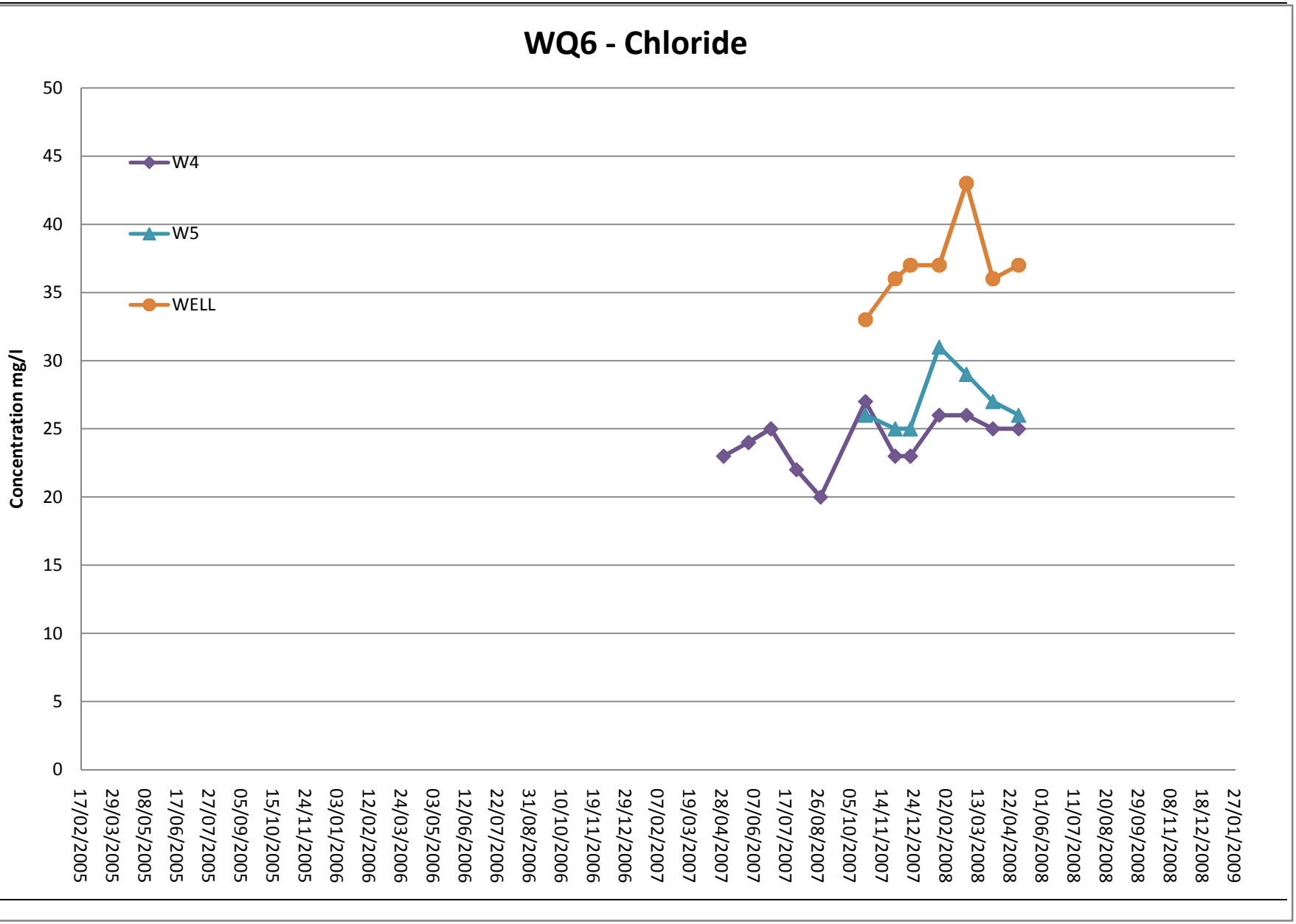
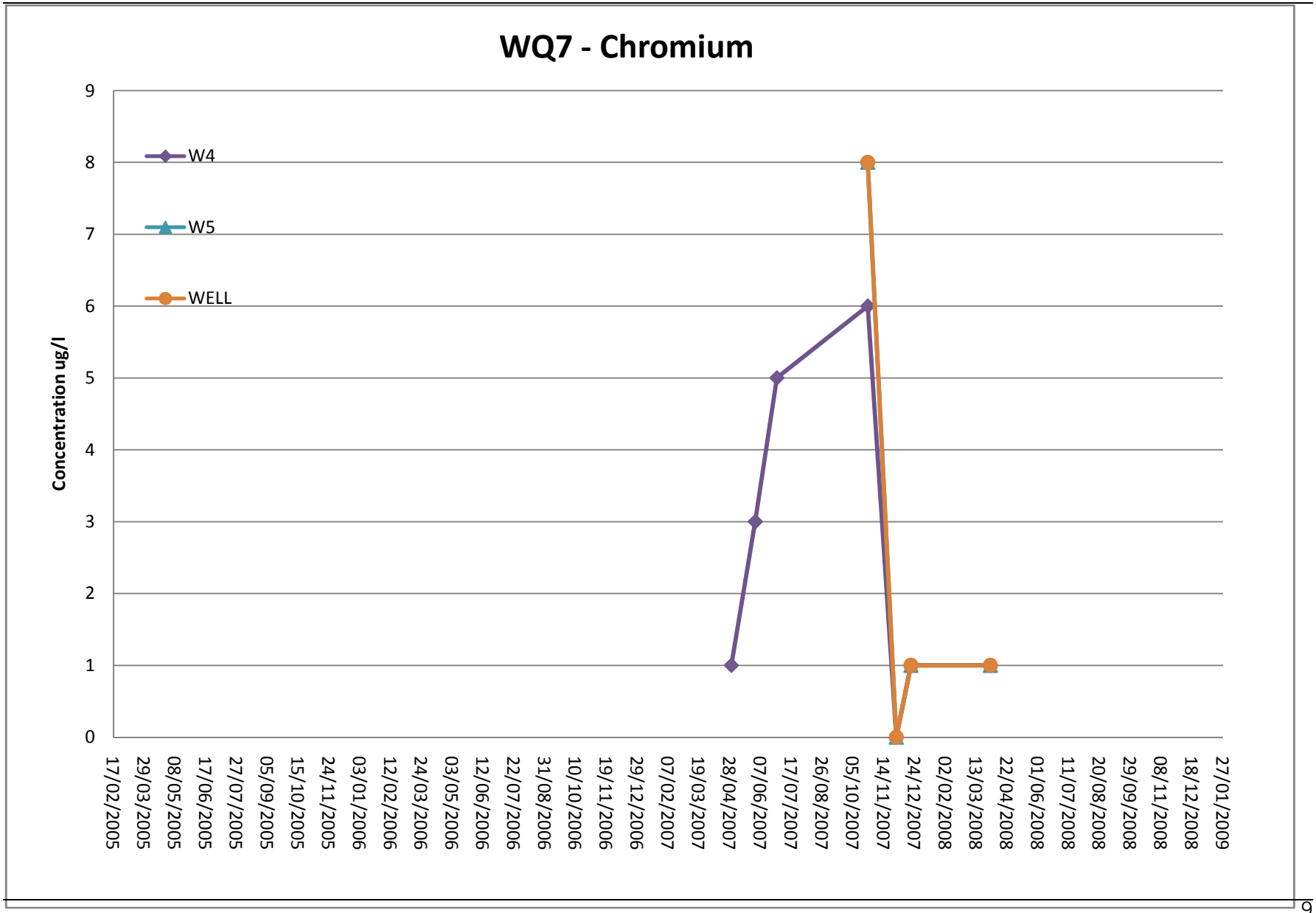
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009


WQ4 - Cadmium
Concentration ug/l
0.6
0.5
0.4
0.3
0.2
0.1
0
W4
W5
WELL
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
19/11/2006
29/12/2006
07/02/2007
19/03/2007
28/04/2007
07/06/2007
17/07/2007
26/08/2007
05/10/2007
14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009


WQ5 - Calcium
Concentration µg/l
140000
120000
100000
80000
60000
40000
20000
0
W4
W5
WELL
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
19/11/2006
29/12/2006
07/02/2007
19/03/2007
28/04/2007
07/06/2007
17/07/2007
26/08/2007
05/10/2007
14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008


WQ6 - Chloride
Concentration mg/l
50
45
40
35
30
25
20
15
10
5
0
W4
W5
WELL
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
19/11/2006
29/12/2006
07/02/2007
19/03/2007
28/04/2007
07/06/2007
17/07/2007
26/08/2007
05/10/2007
14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009


WQ7 - Chromium
Concentration ug/l
W4
W5
WELL
0
1
2
3
4
5
6
7
8
9
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
19/11/2006
29/12/2006
07/02/2007
19/03/2007
28/04/2007
07/06/2007
17/07/2007
26/08/2007
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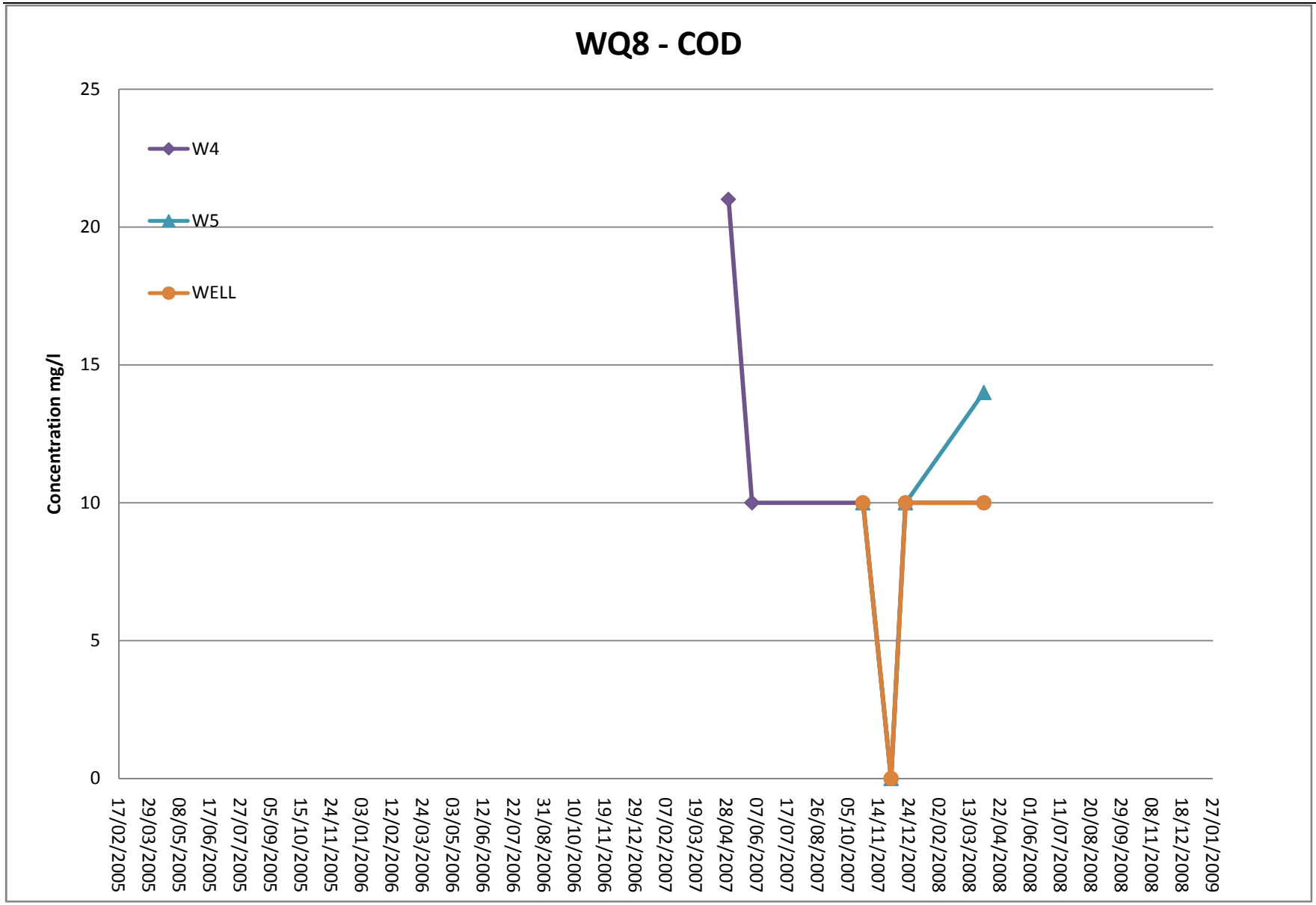
14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009


WQ8 - COD
Concentration mg/l
25
20
15
10
5
0
W4
W5
WELL
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
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07/02/2007
19/03/2007
28/04/2007
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17/07/2007
26/08/2007
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14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
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08/11/2008
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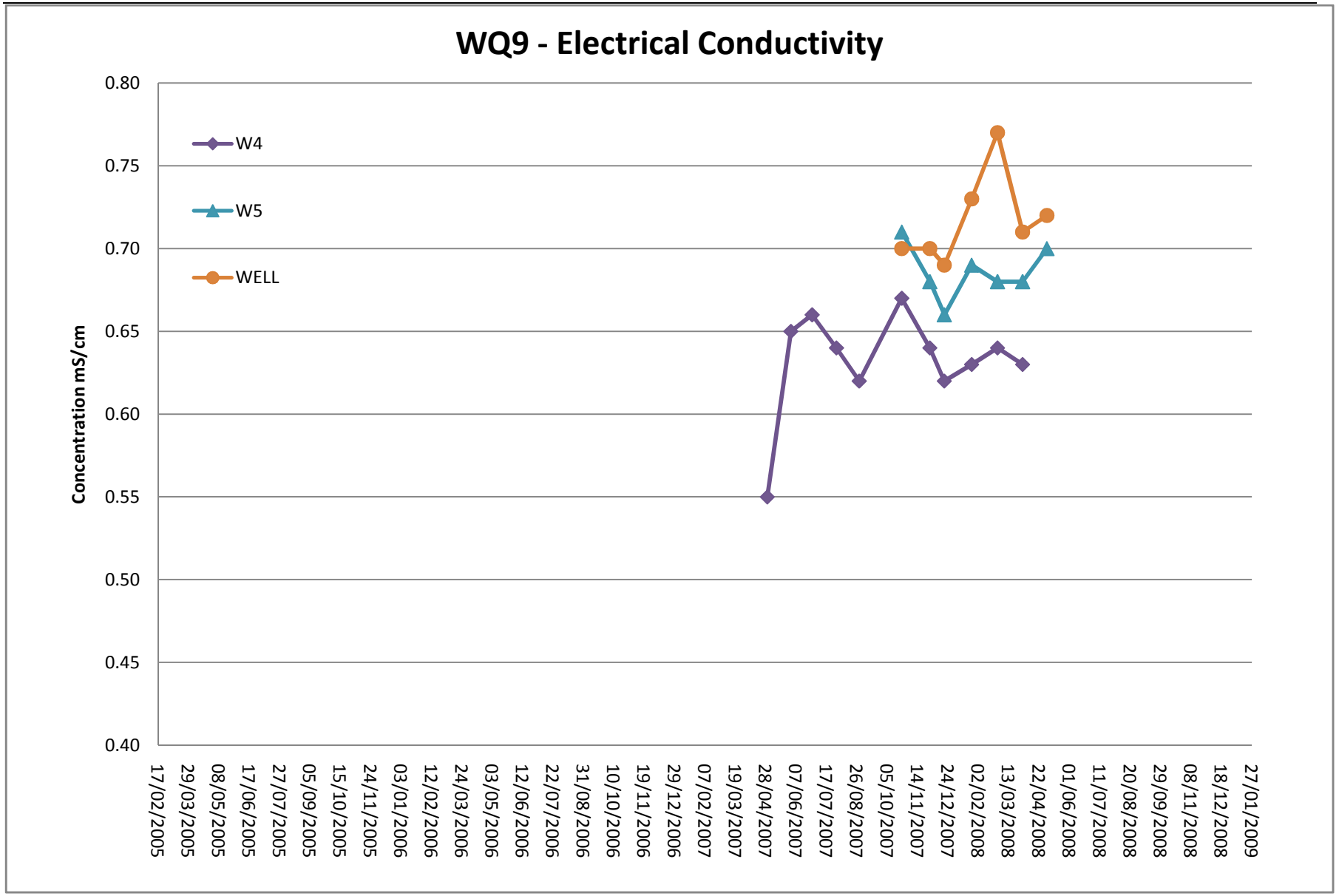
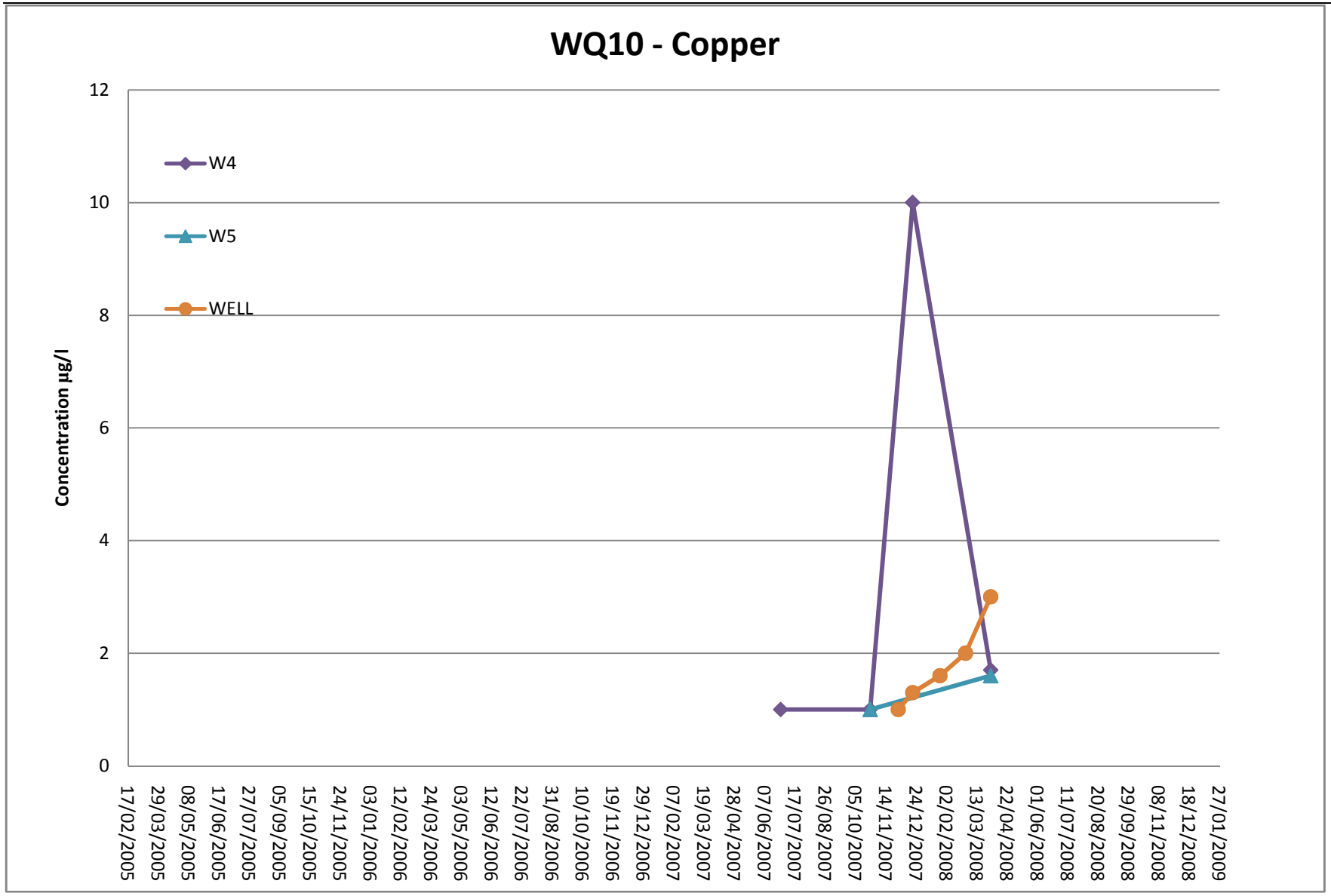
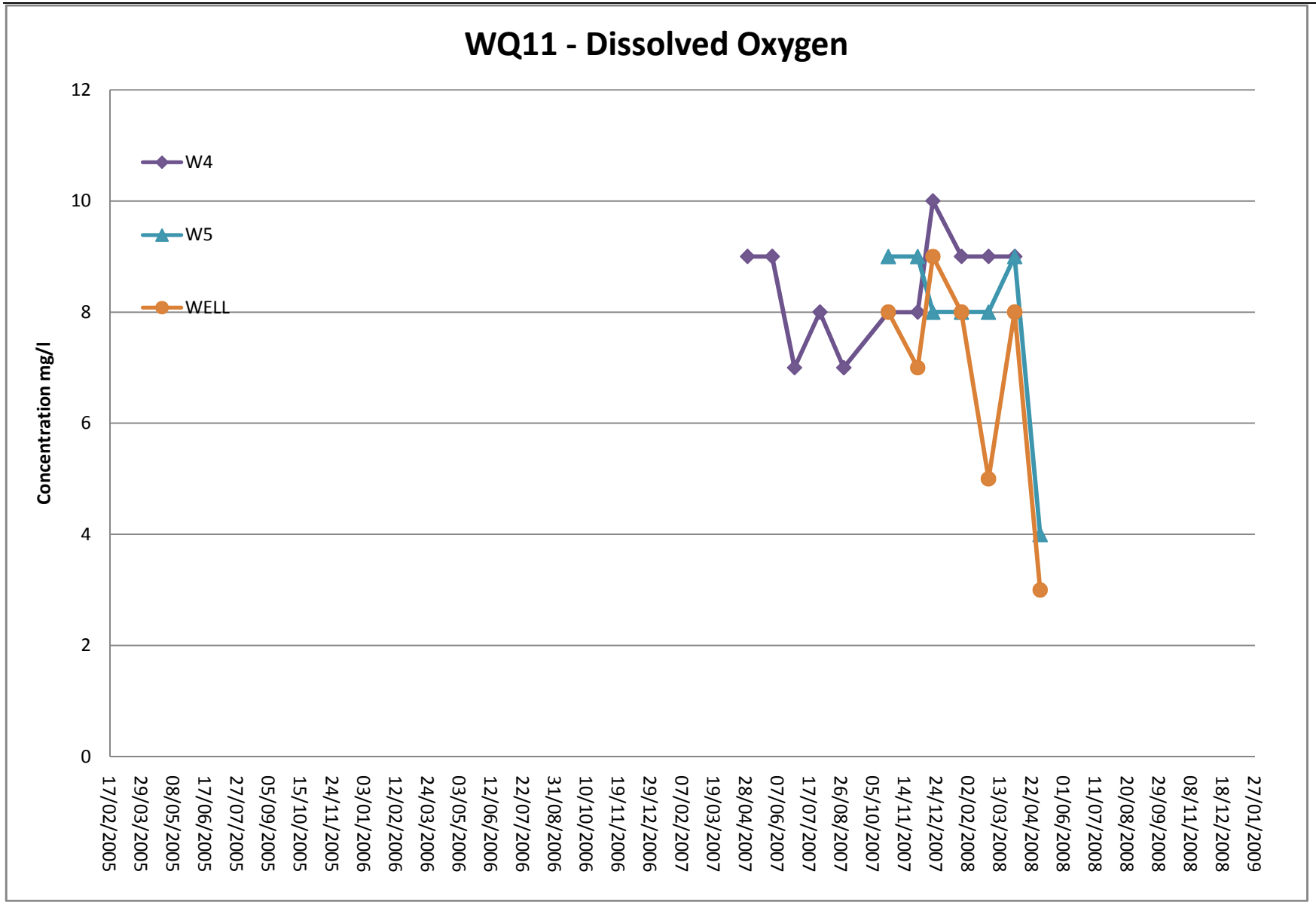
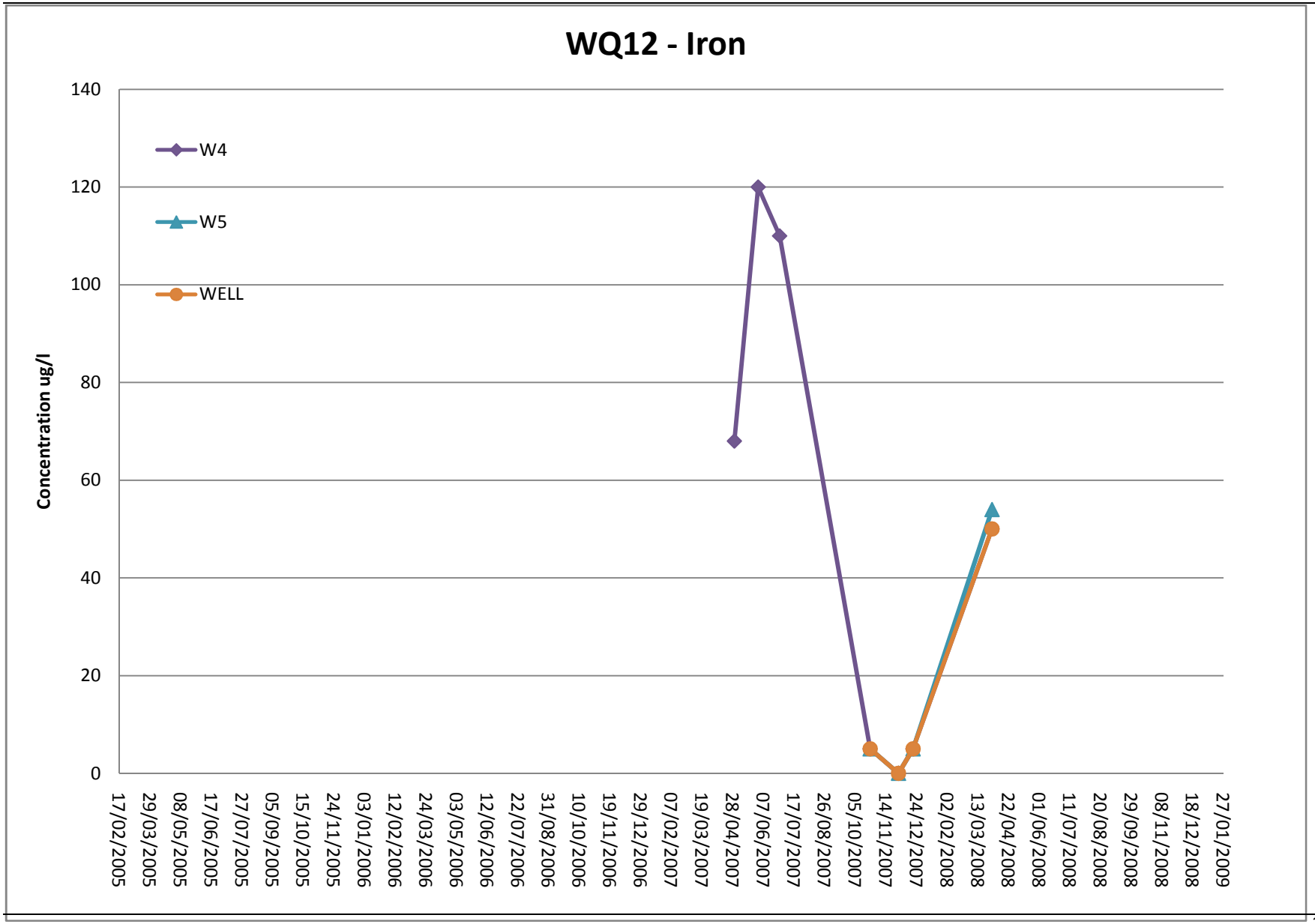
27/01/2009


WQ9 - Electrical Conductivity
Concentration mS/cm
0.80
0.75
0.70
0.65
0.60
0.55
0.50
0.45
0.40
W4
W5
WELL
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
19/11/2006
29/12/2006
07/02/2007
19/03/2007
28/04/2007
07/06/2007
17/07/2007
26/08/2007
05/10/2007
14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009


WQ10 - Copper
Concentration µg/l
0
2
4
6
8
10
12
W4
W5
WELL
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
19/11/2006
29/12/2006
07/02/2007
19/03/2007
28/04/2007
07/06/2007
17/07/2007
26/08/2007
05/10/2007
14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009


WQ11 - Dissolved Oxygen
Concentration mg/l
12
10
8
6
4
2
0
W4
W5
WELL
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
19/11/2006
29/12/2006
07/02/2007
19/03/2007
28/04/2007
07/06/2007
17/07/2007
26/08/2007
05/10/2007
14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009


WQ12 - Iron
Concentration ug/l
140
120
100
80
60
40
20
0
W4
W5
WELL
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
19/11/2006
29/12/2006
07/02/2007
19/03/2007
28/04/2007
07/06/2007
17/07/2007
26/08/2007
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14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
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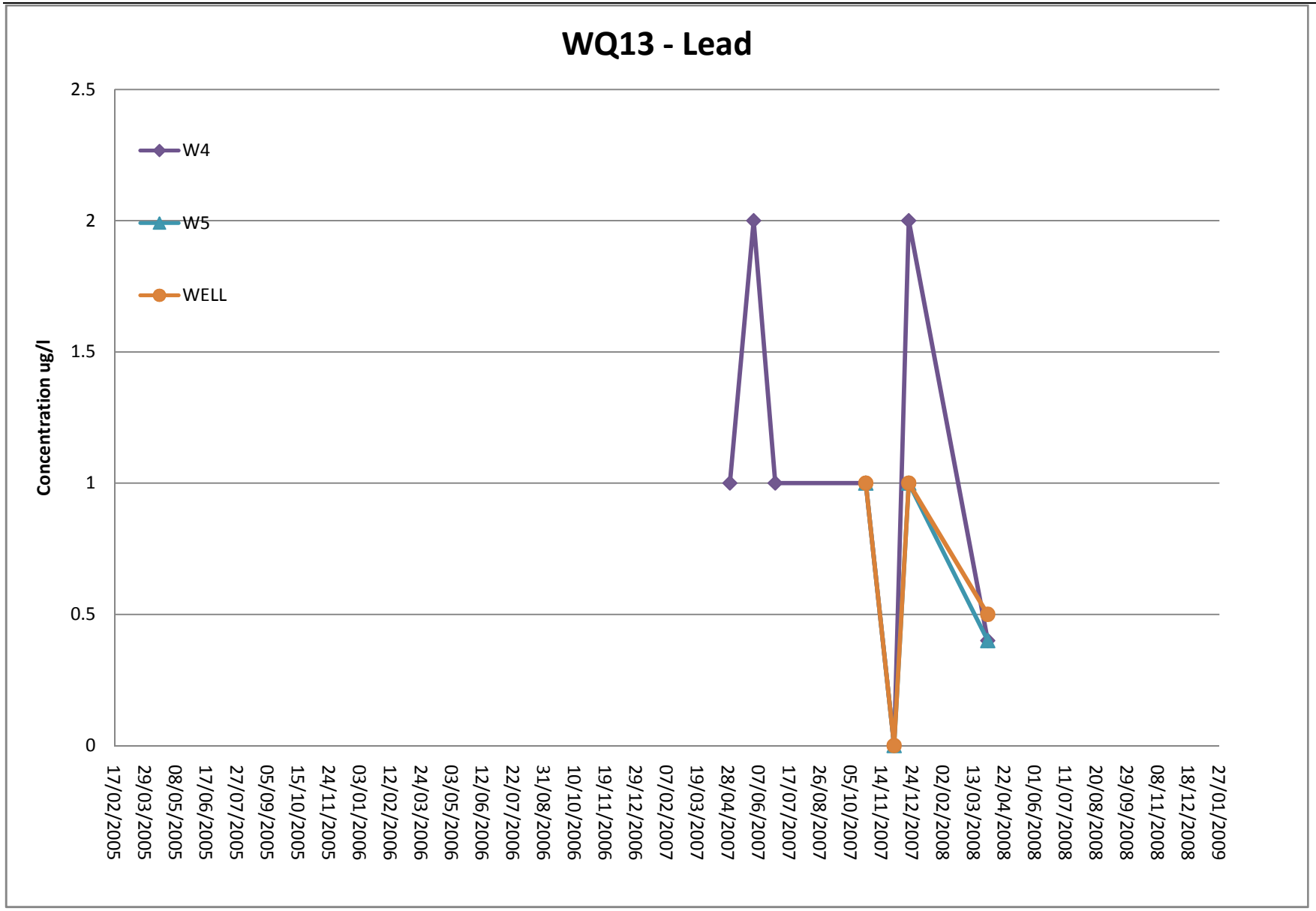
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009


WQ13 - Lead
Concentration ug/l
2.5
2
1.5
1
0.5
0
W4
W5
WELL
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
19/11/2006
29/12/2006
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28/04/2007
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17/07/2007
26/08/2007
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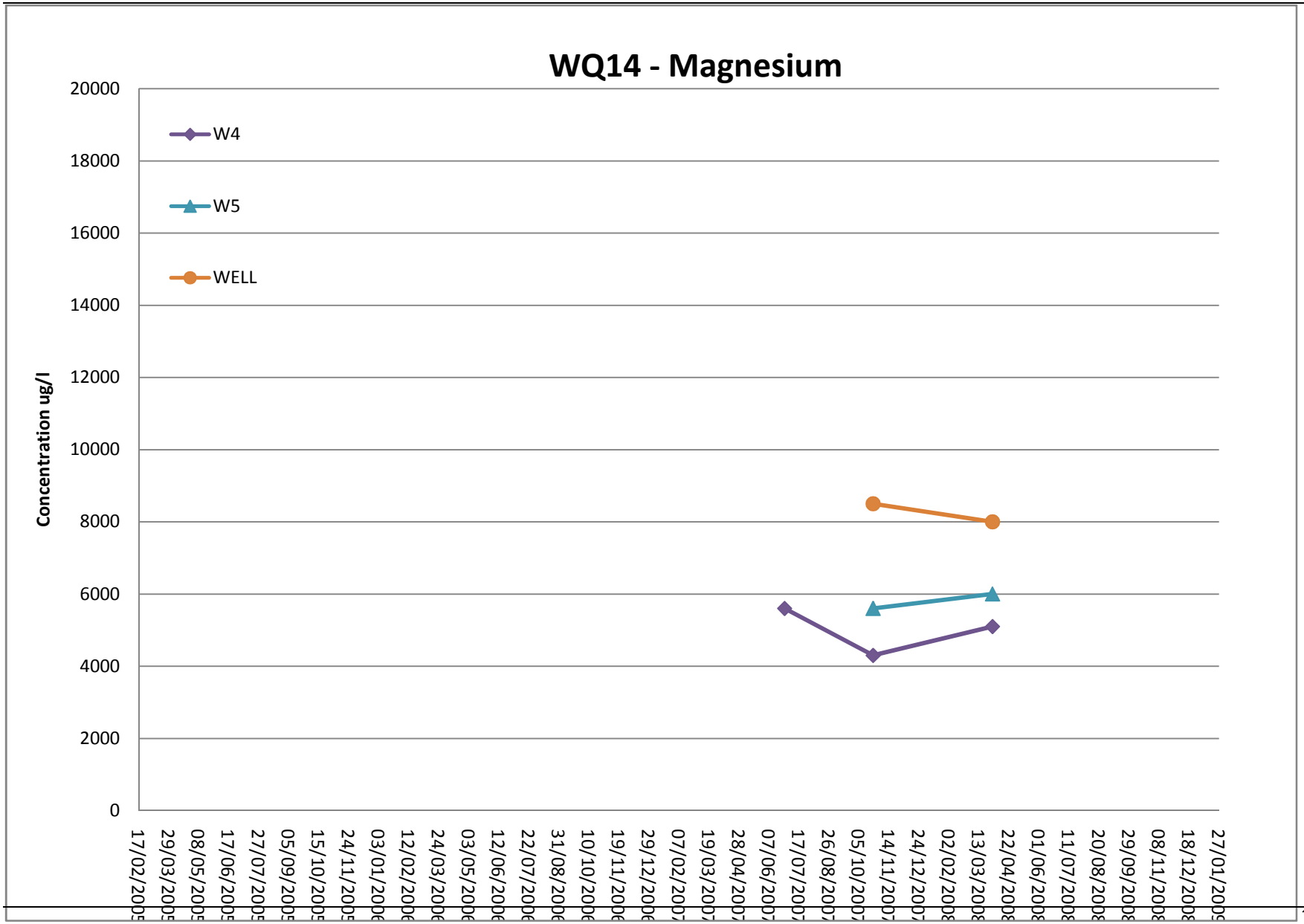
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009


WQ14 - Magnesium
Concentration ug/l
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
W4
W5
WELL
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
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10/10/2006
19/11/2006
29/12/2006
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26/08/2007
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24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
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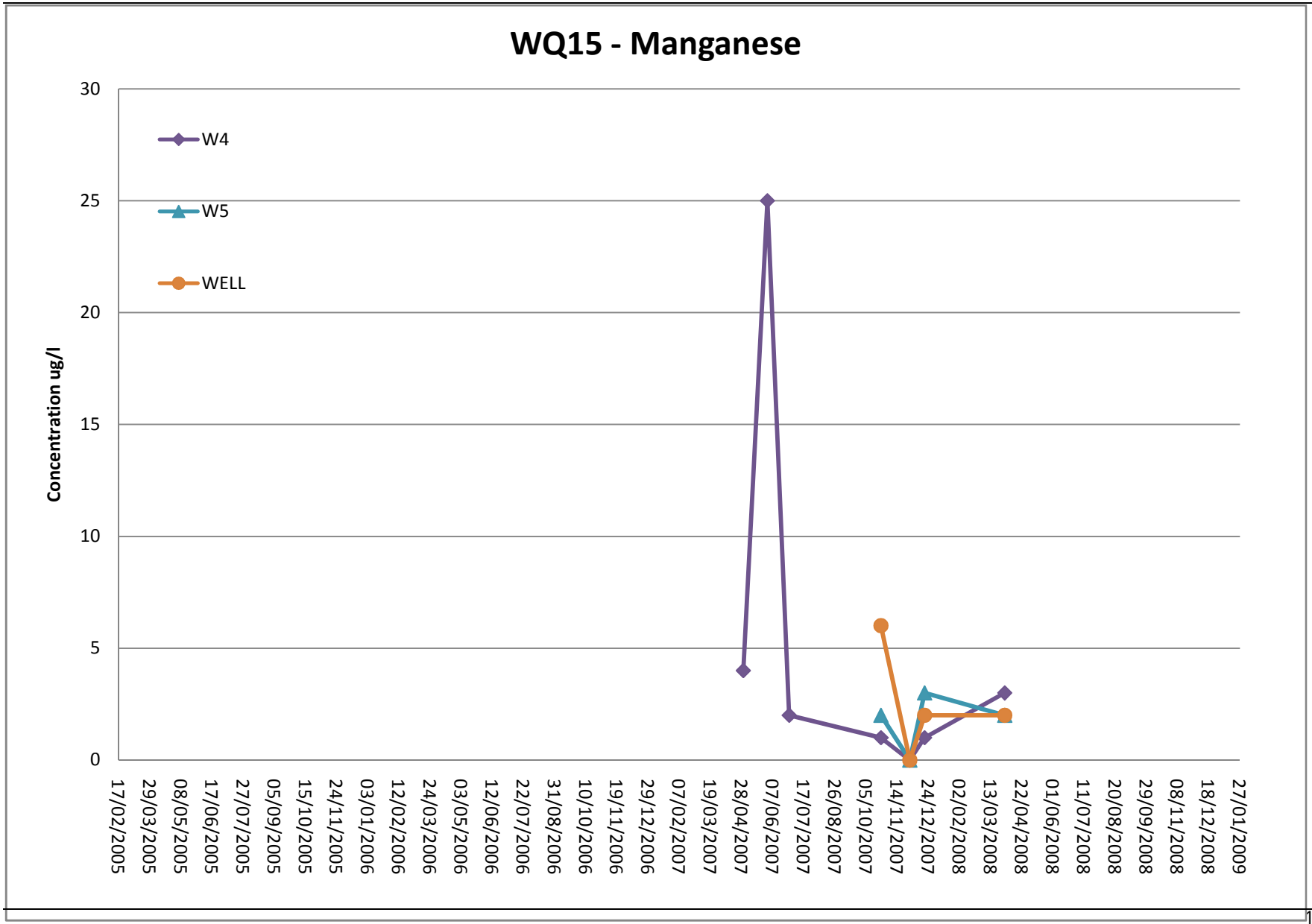
WQ15 - Manganese
Concentration ug/l
30
25
20
15
10
5
0
W4
W5
WELL
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
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14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
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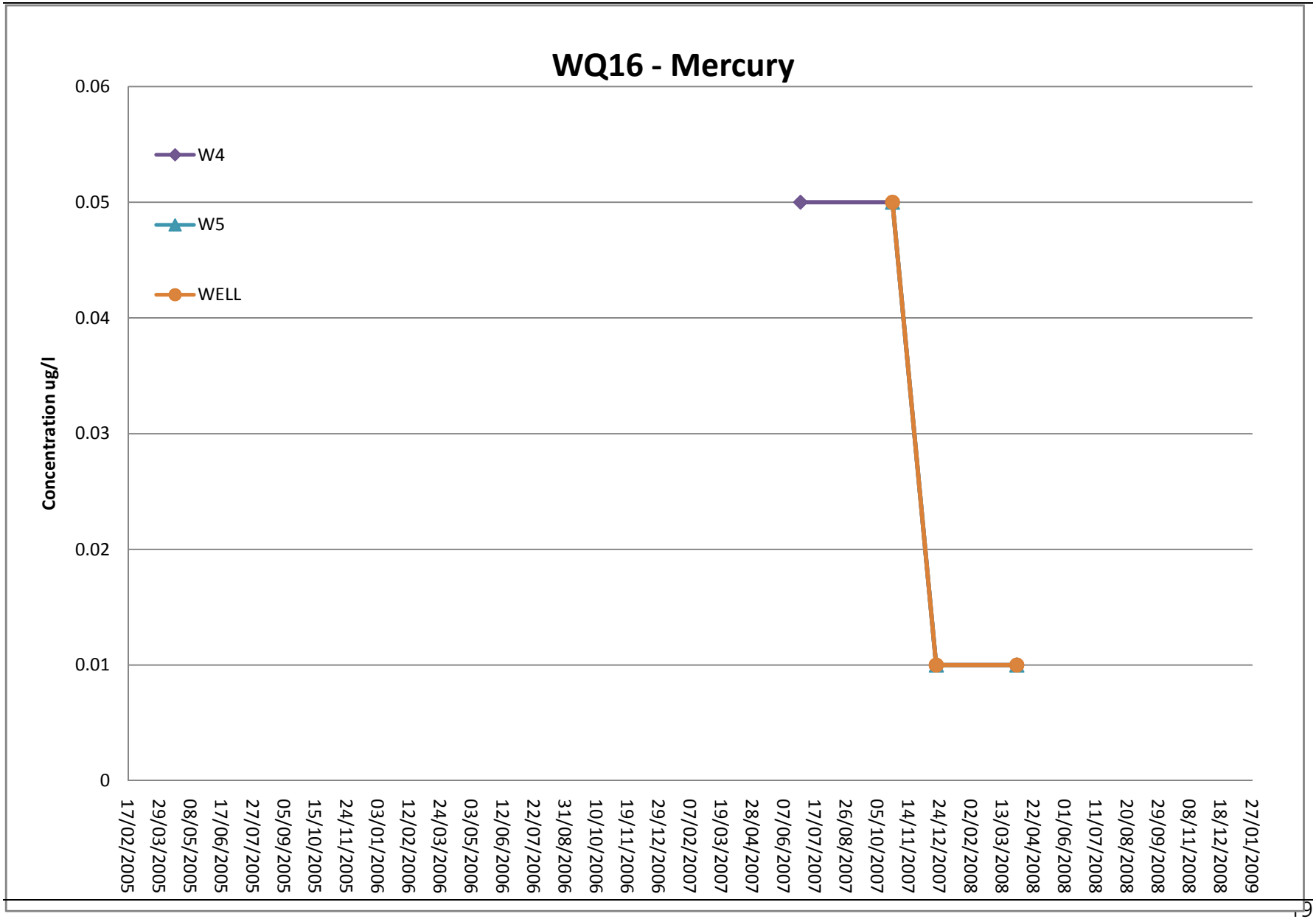
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009


WQ16 - Mercury
Concentration ug/l
0.06
0.05
0.04
0.03
0.02
0.01
0
W4
W5
WELL
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
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24/12/2007
02/02/2008
13/03/2008
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01/06/2008
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29/09/2008
08/11/2008
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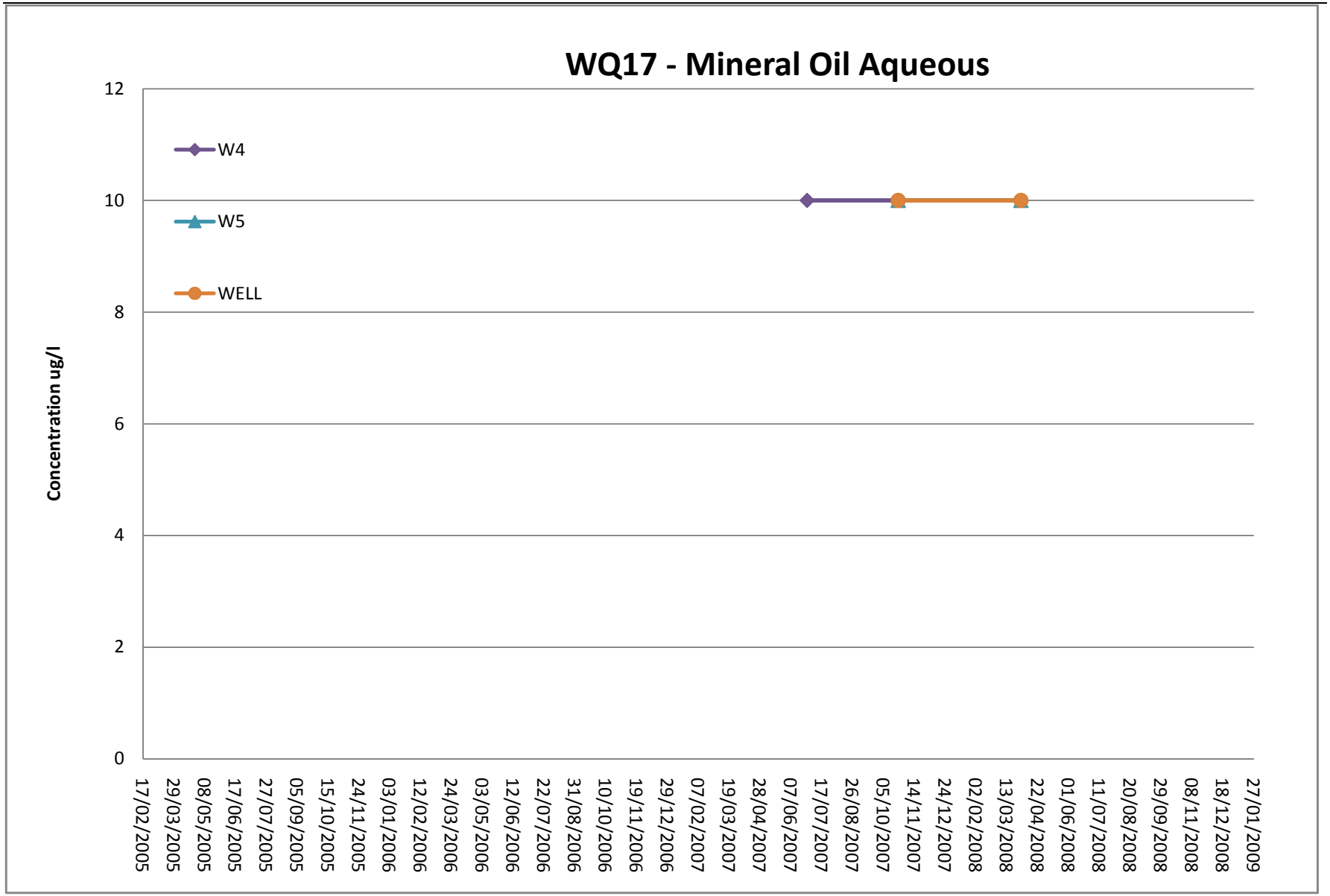
WQ17 - Mineral Oil Aqueous
Concentration ug/l
12
10
8
6
4
2
0
W4
W5
WELL
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
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10/10/2006
19/11/2006
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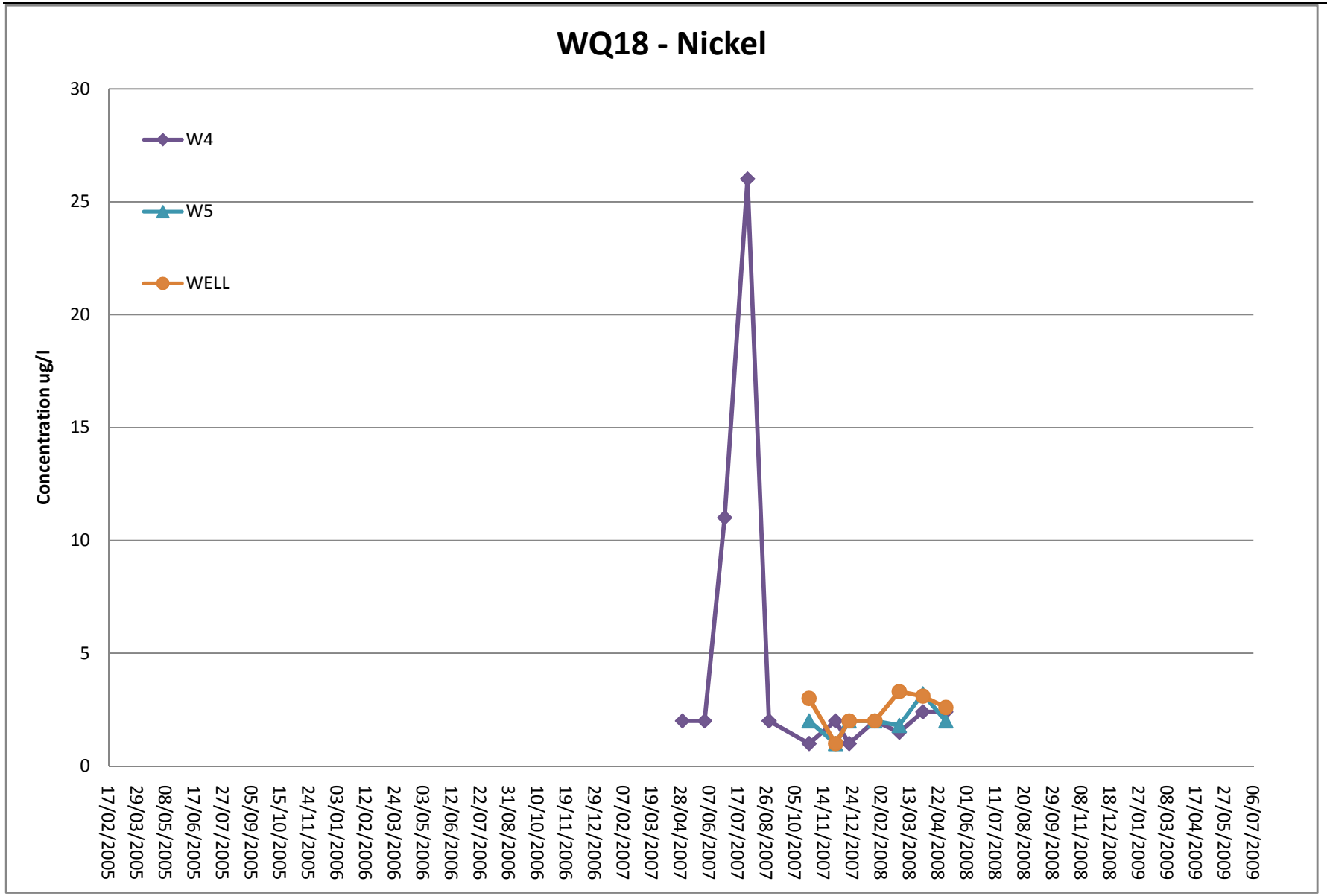
14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009


WQ18 - Nickel
Concentration ug/l
30
25
20
15
10
5
0
W4
W5
WELL
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
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10/10/2006
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26/08/2007
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08/03/2009
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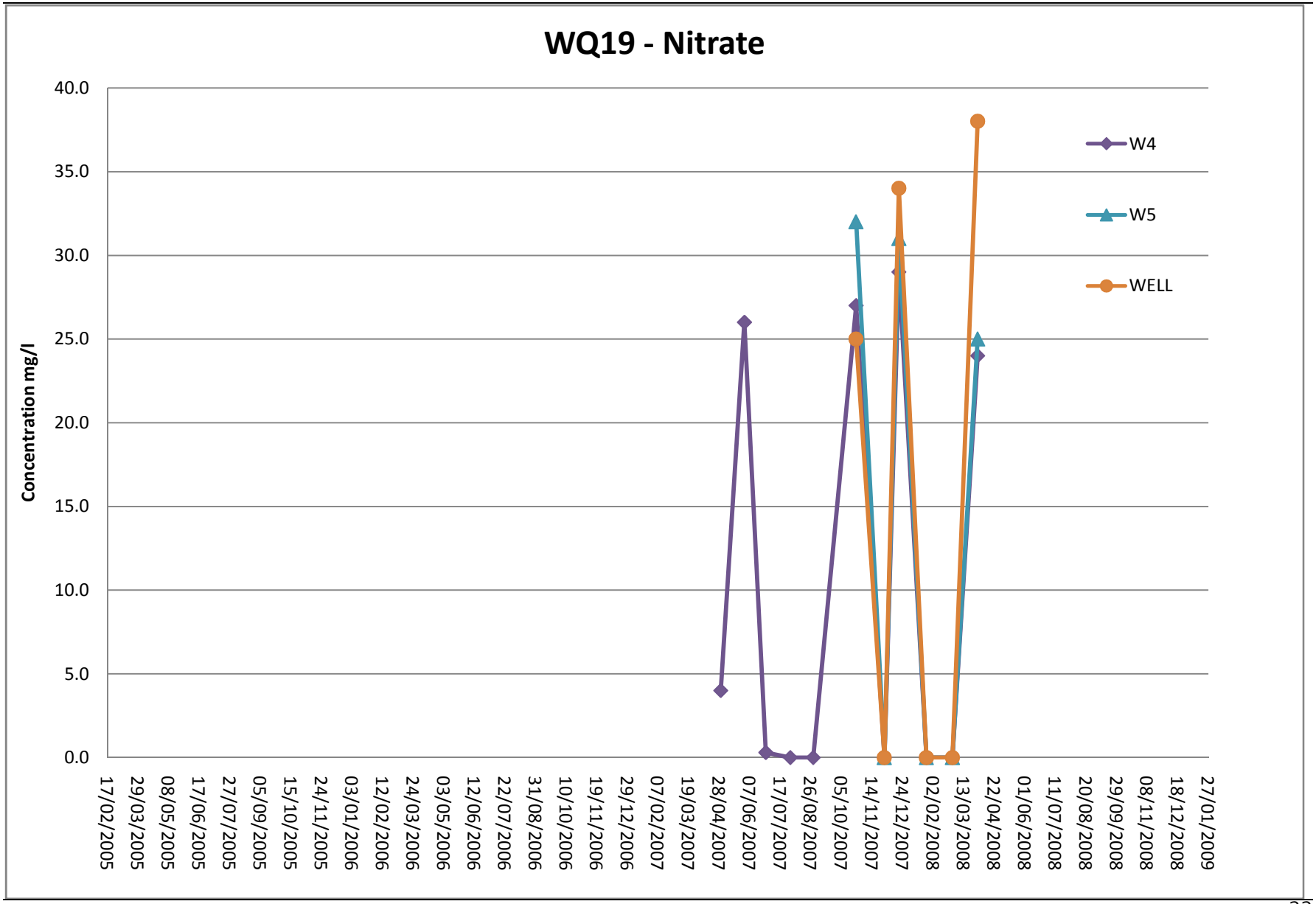
06/07/2009


WQ19 - Nitrate
Concentration mg/l
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
W4
W5
WELL
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
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31/08/2006
10/10/2006
19/11/2006
29/12/2006
07/02/2007
19/03/2007
28/04/2007
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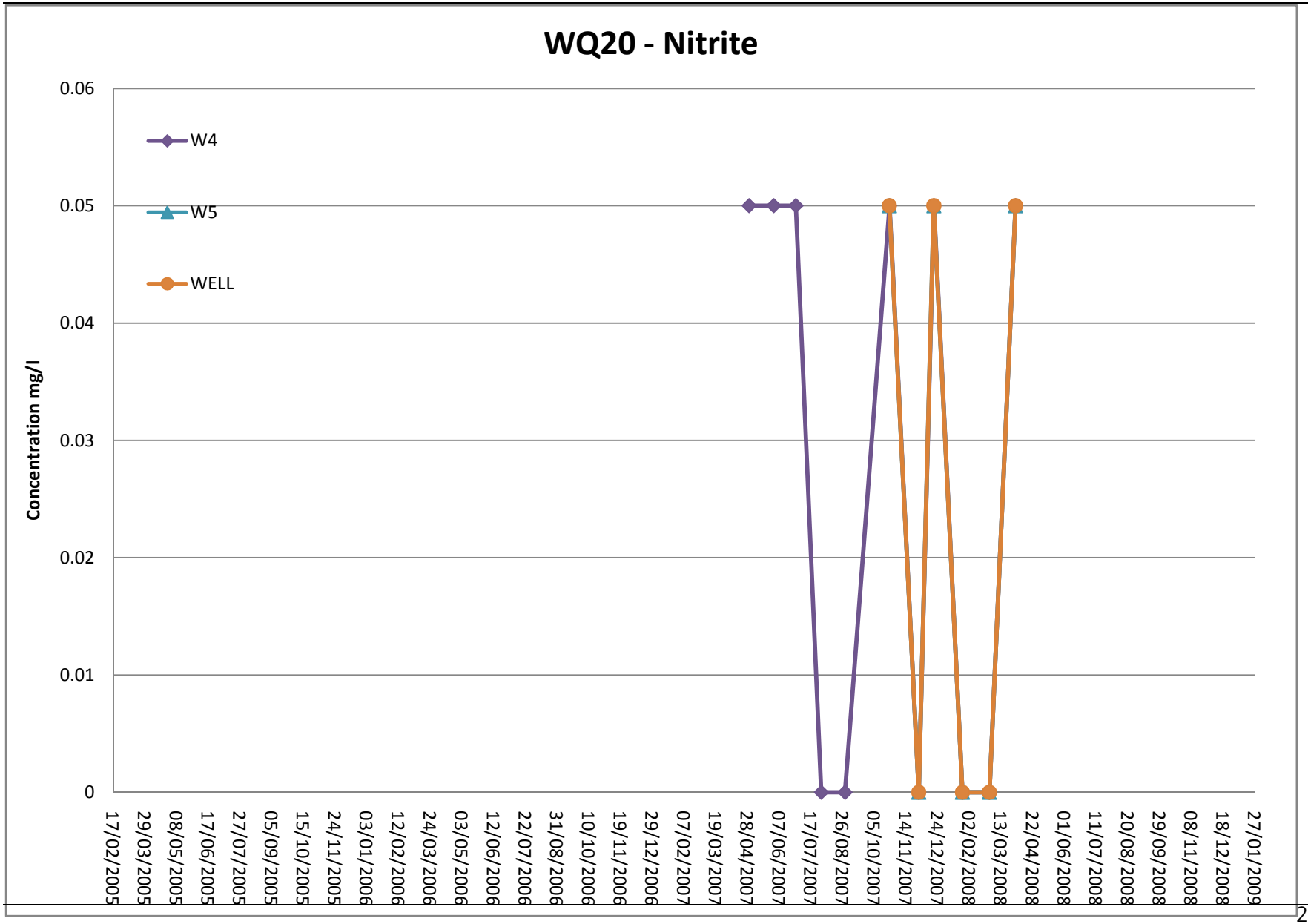
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009


WQ20 - Nitrite
Concentration mg/l
0.06
0.05
0.04
0.03
0.02
0.01
0
W4
W5
WELL
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
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19/11/2006
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07/02/2007
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28/04/2007
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26/08/2007
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02/02/2008
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20/08/2008
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08/11/2008
18/12/2008
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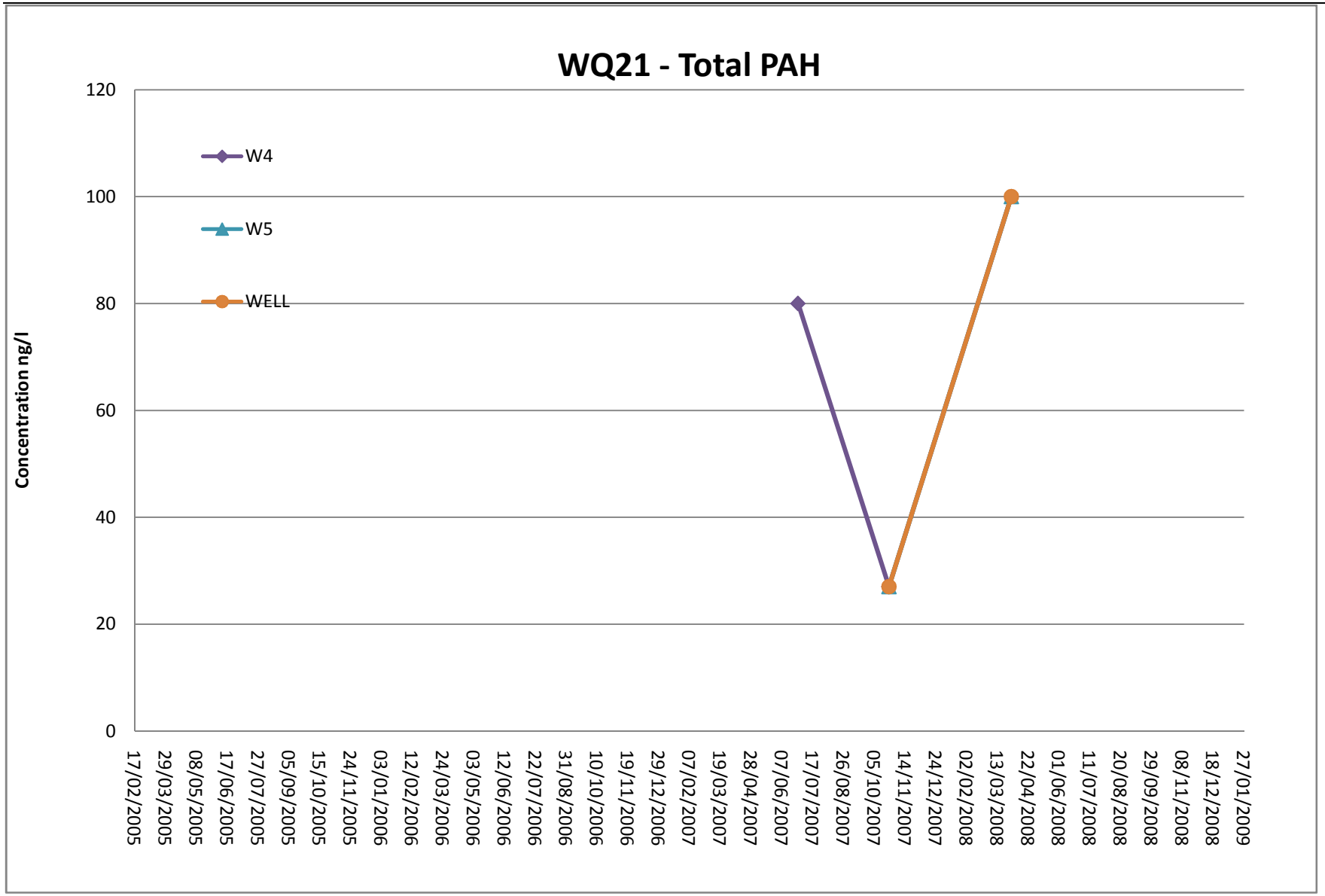
WQ21 - Total PAH
Concentration ng/l
120
100
80
60
40
20
0
W4
W5
WELL
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
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29/12/2006
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19/03/2007
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13/03/2008
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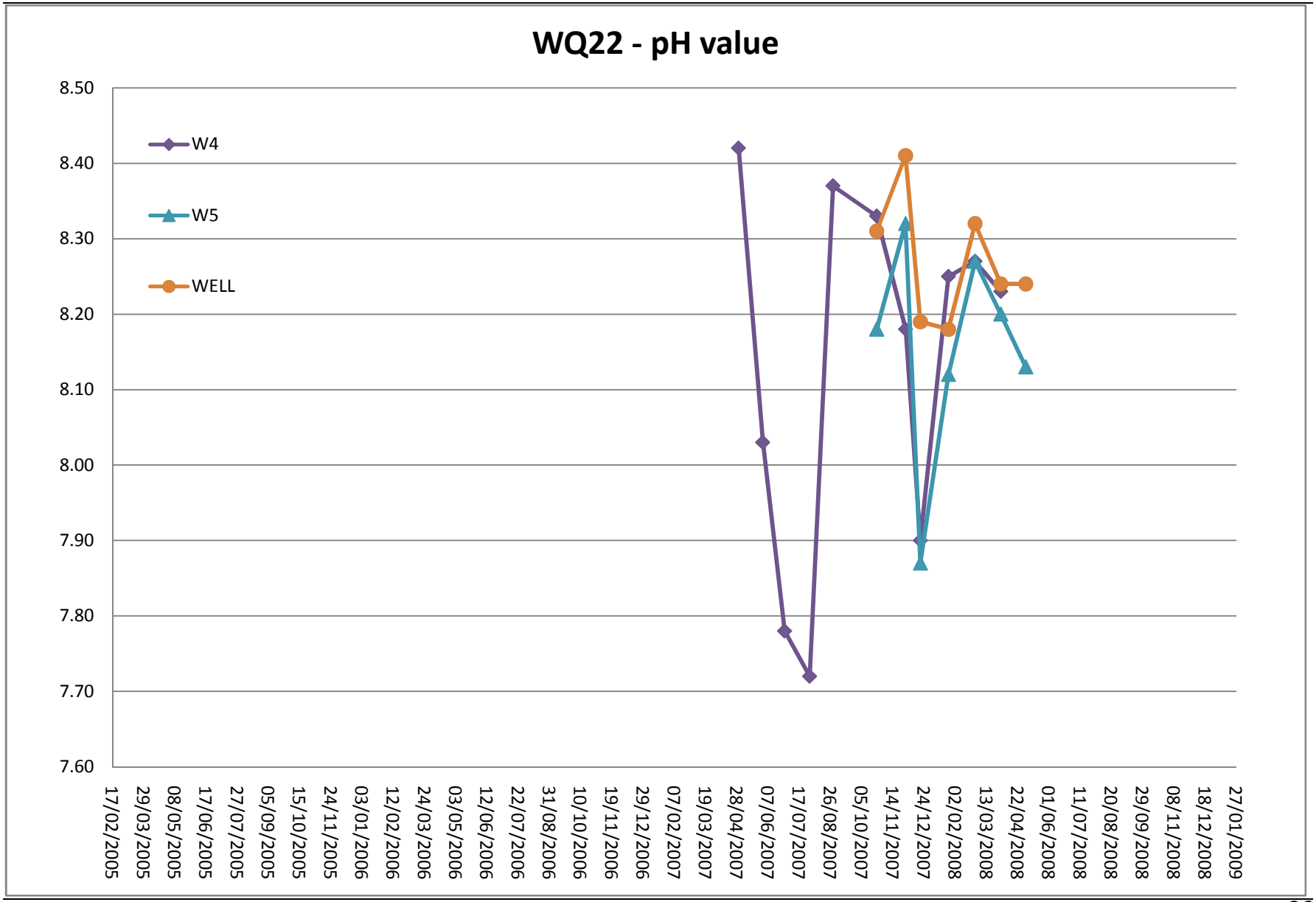
WQ22 - pH value
8.50
8.40
8.30
8.20
8.10
8.00
7.90
7.80
7.70
7.60
W4
W5
WELL
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
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03/05/2006
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31/08/2006
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29/12/2006
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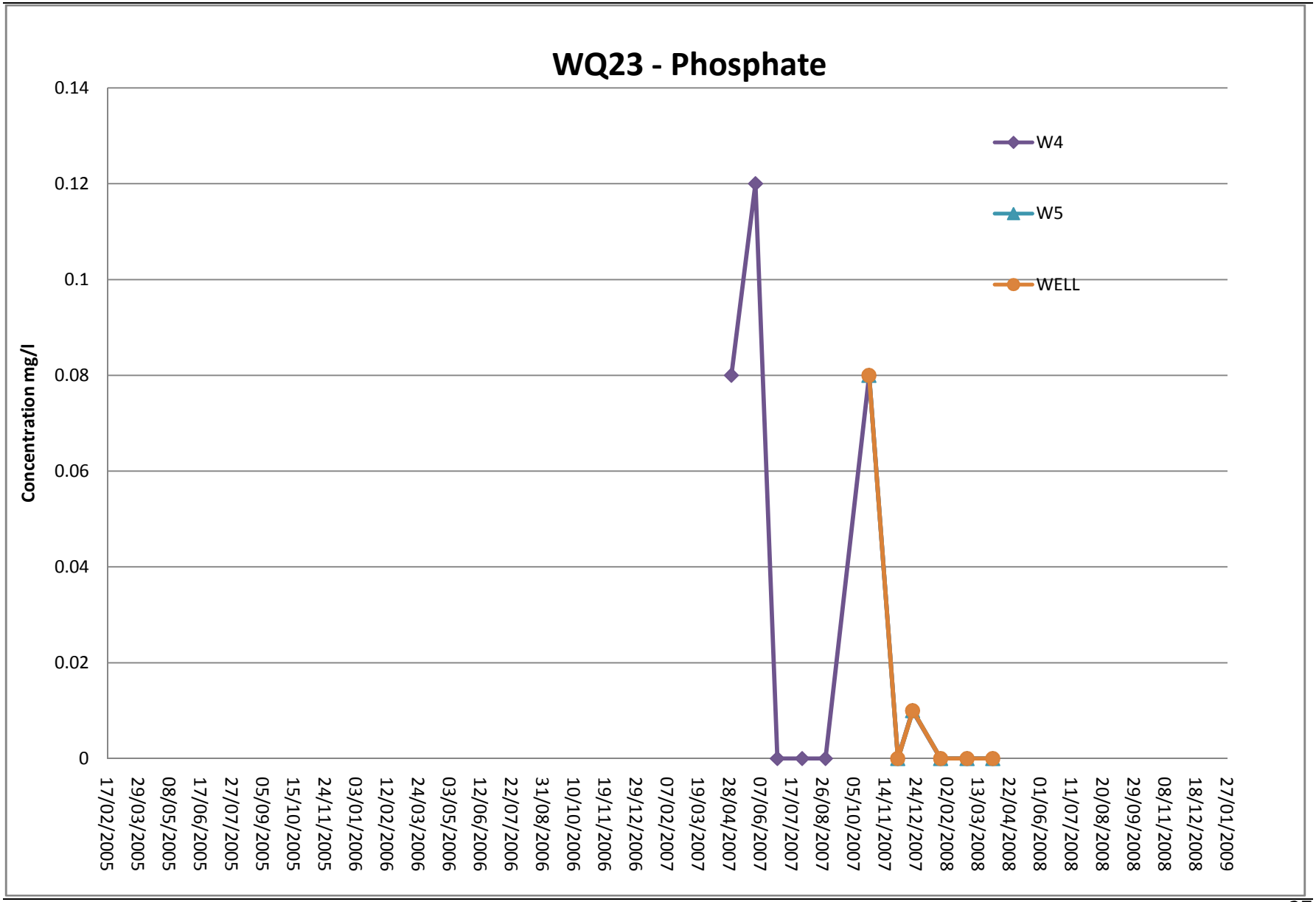
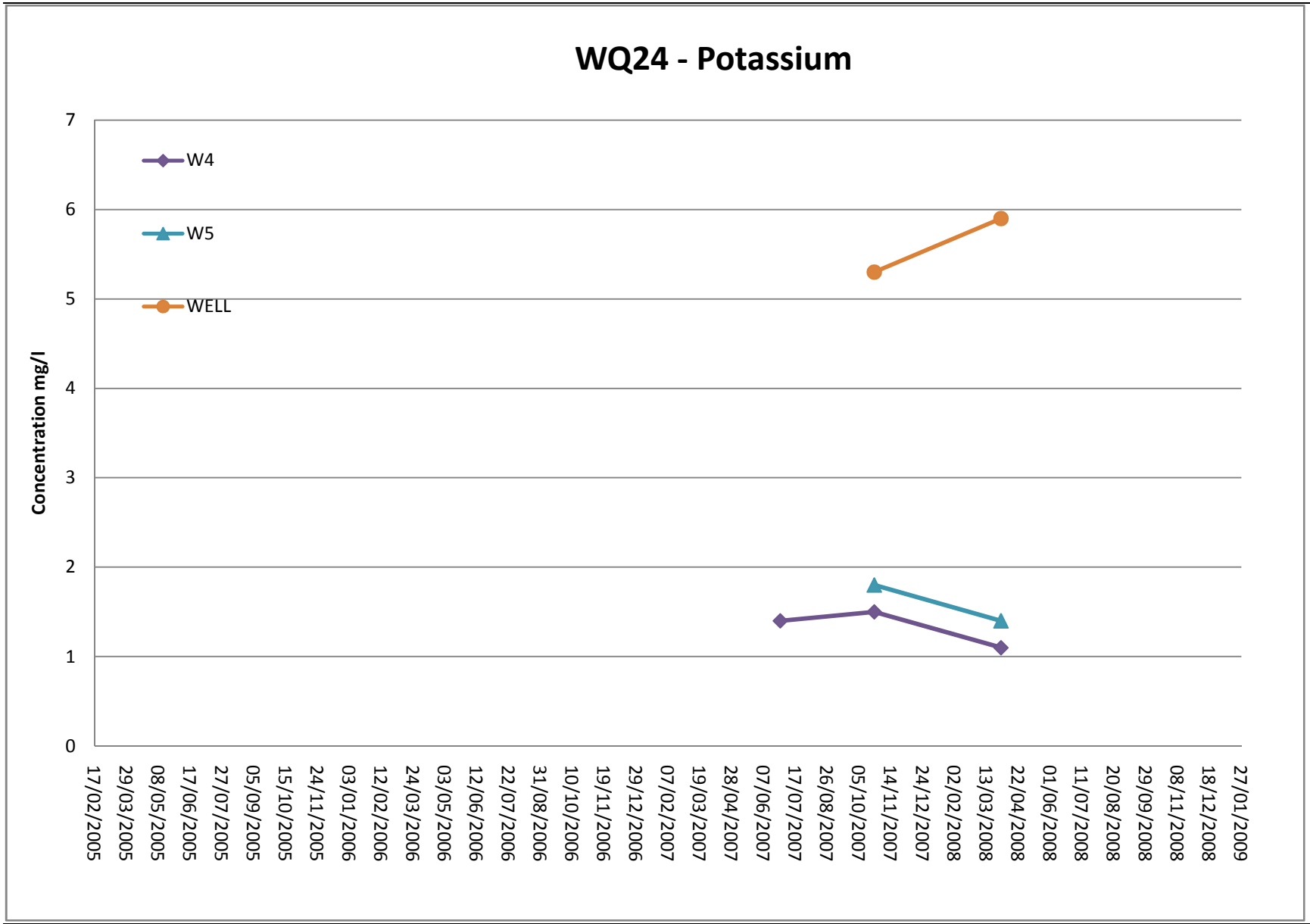
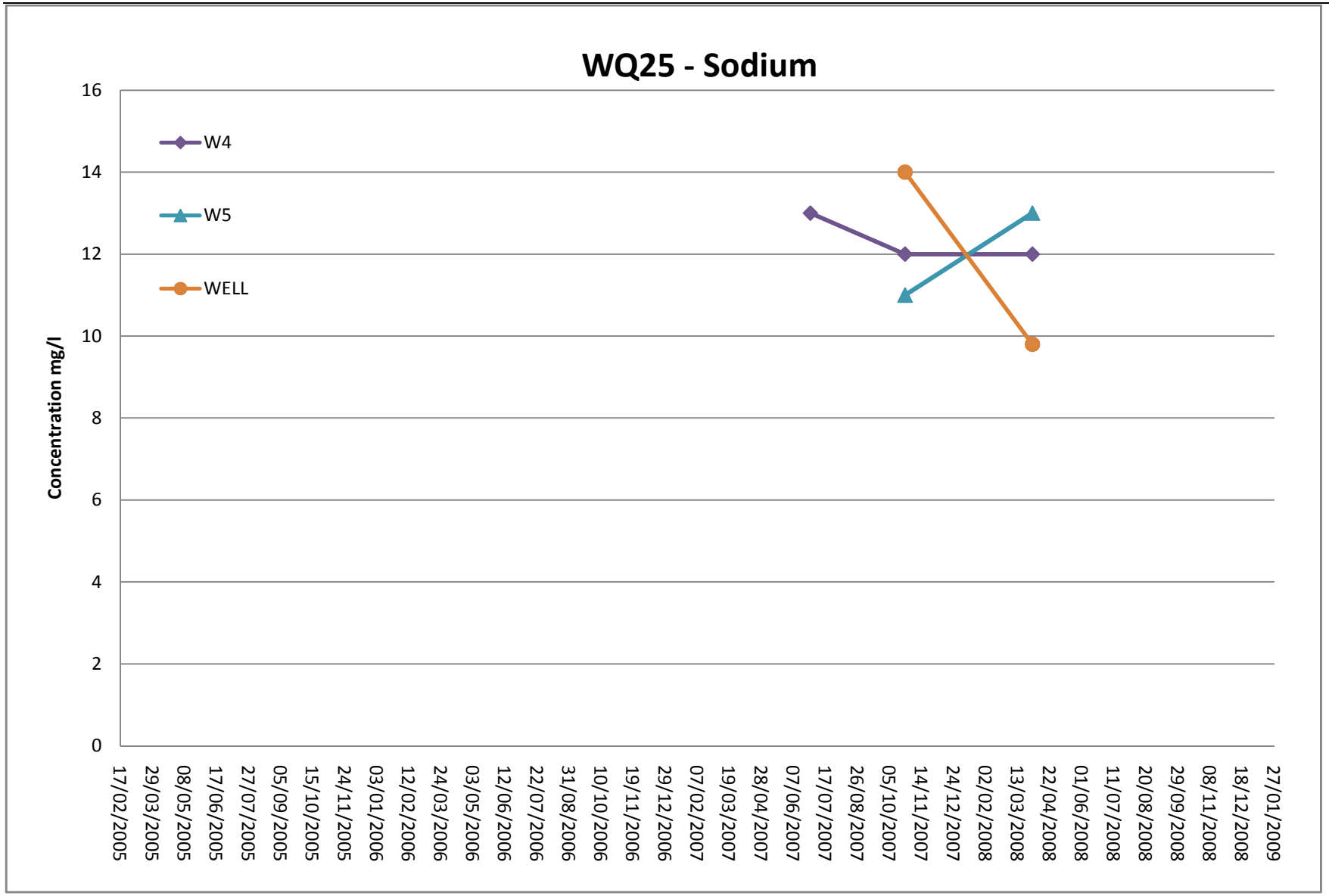
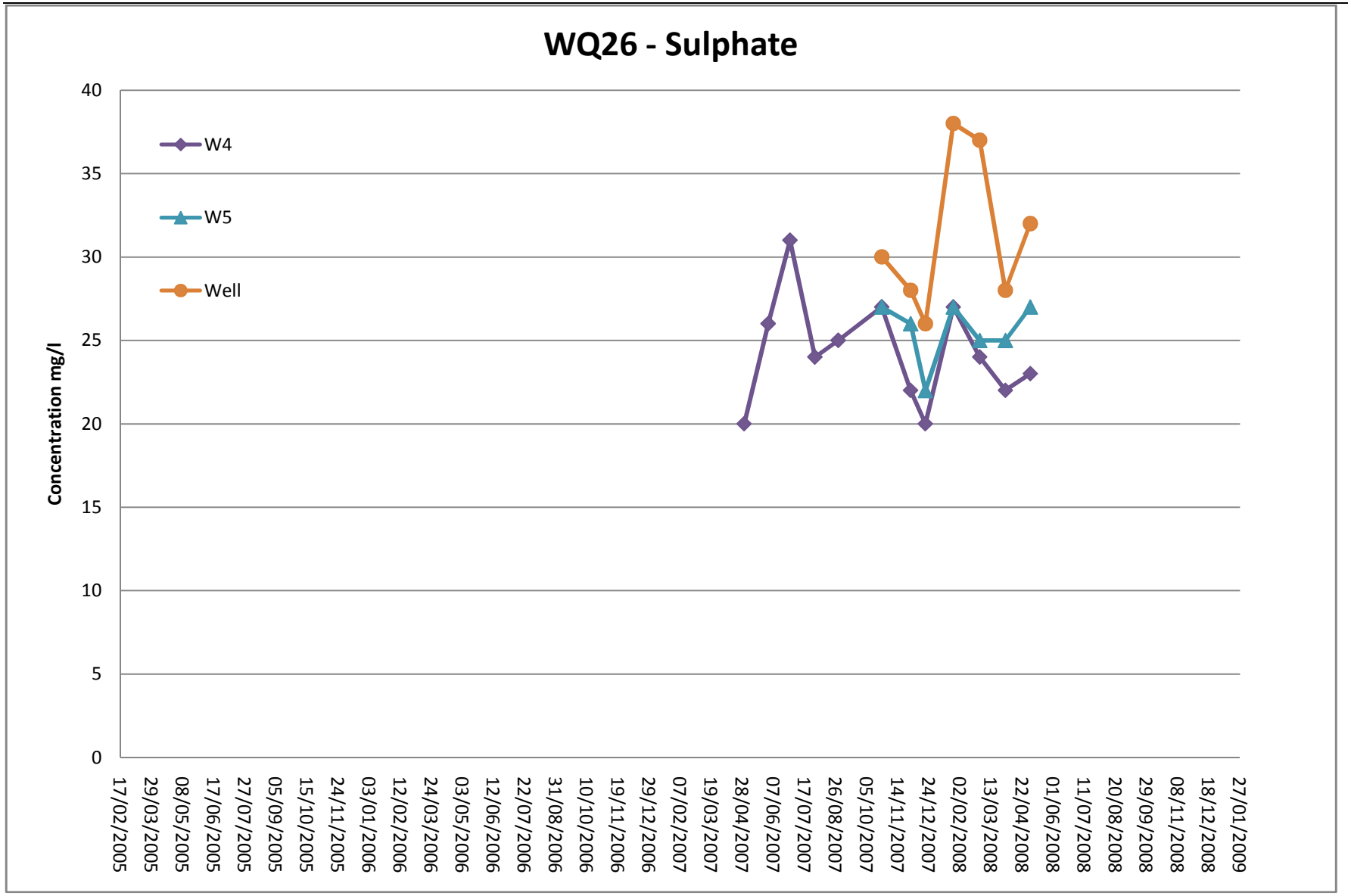
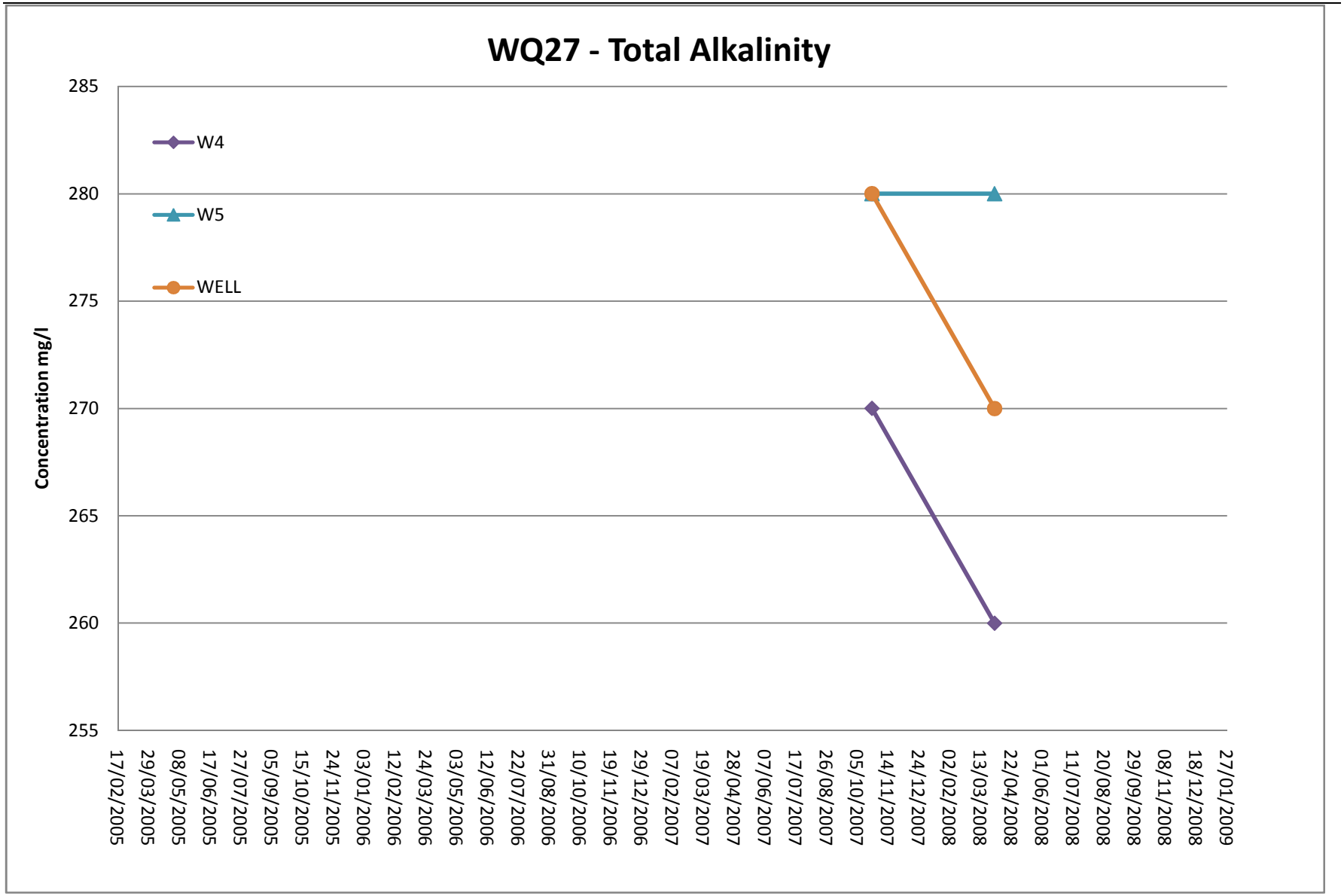
27/01/2009

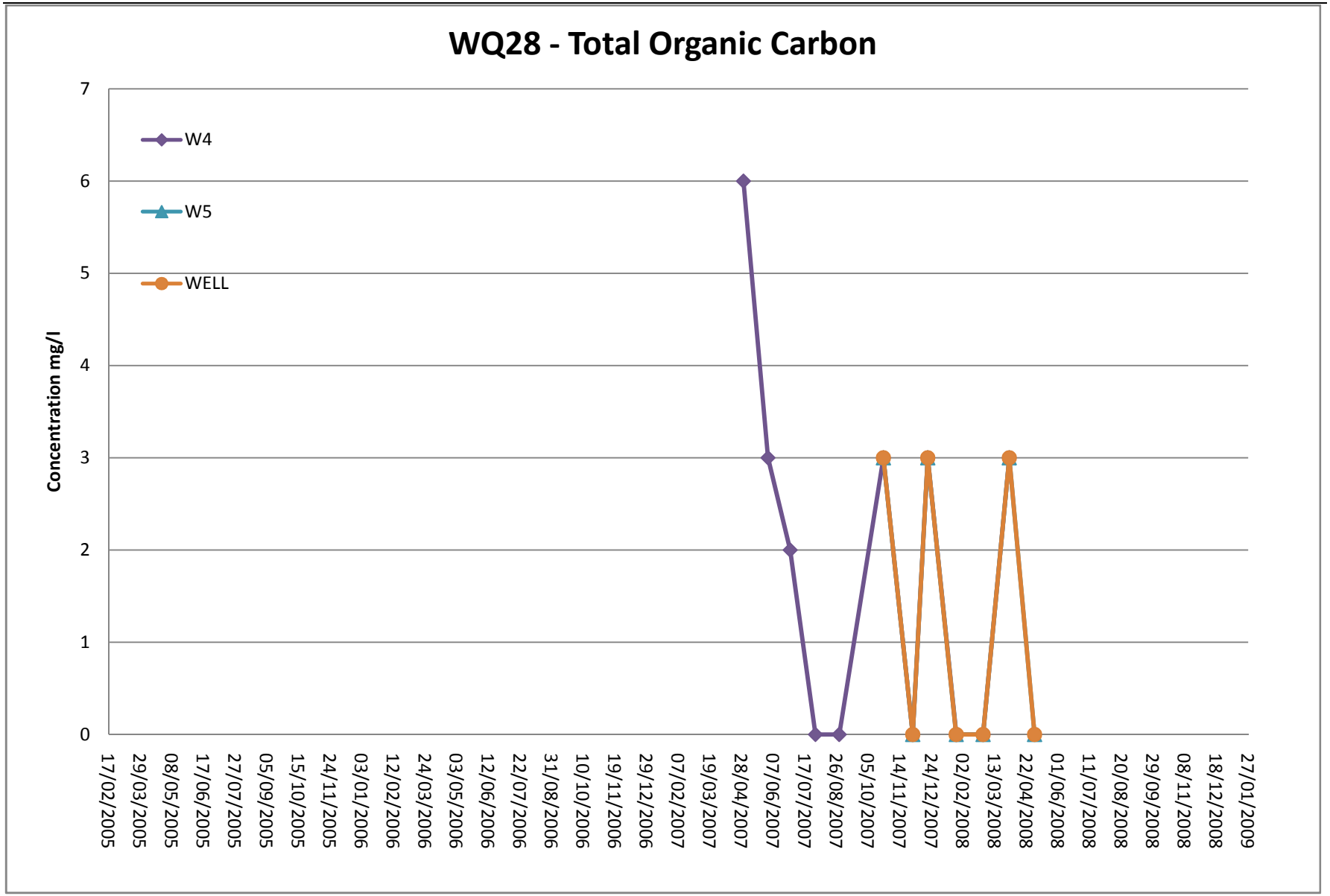

WQ23 - Phosphate
Concentration mg/l
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
W4
W5
WELL
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
19/11/2006
29/12/2006
07/02/2007
19/03/2007
28/04/2007
07/06/2007
17/07/2007
26/08/2007
05/10/2007
14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009

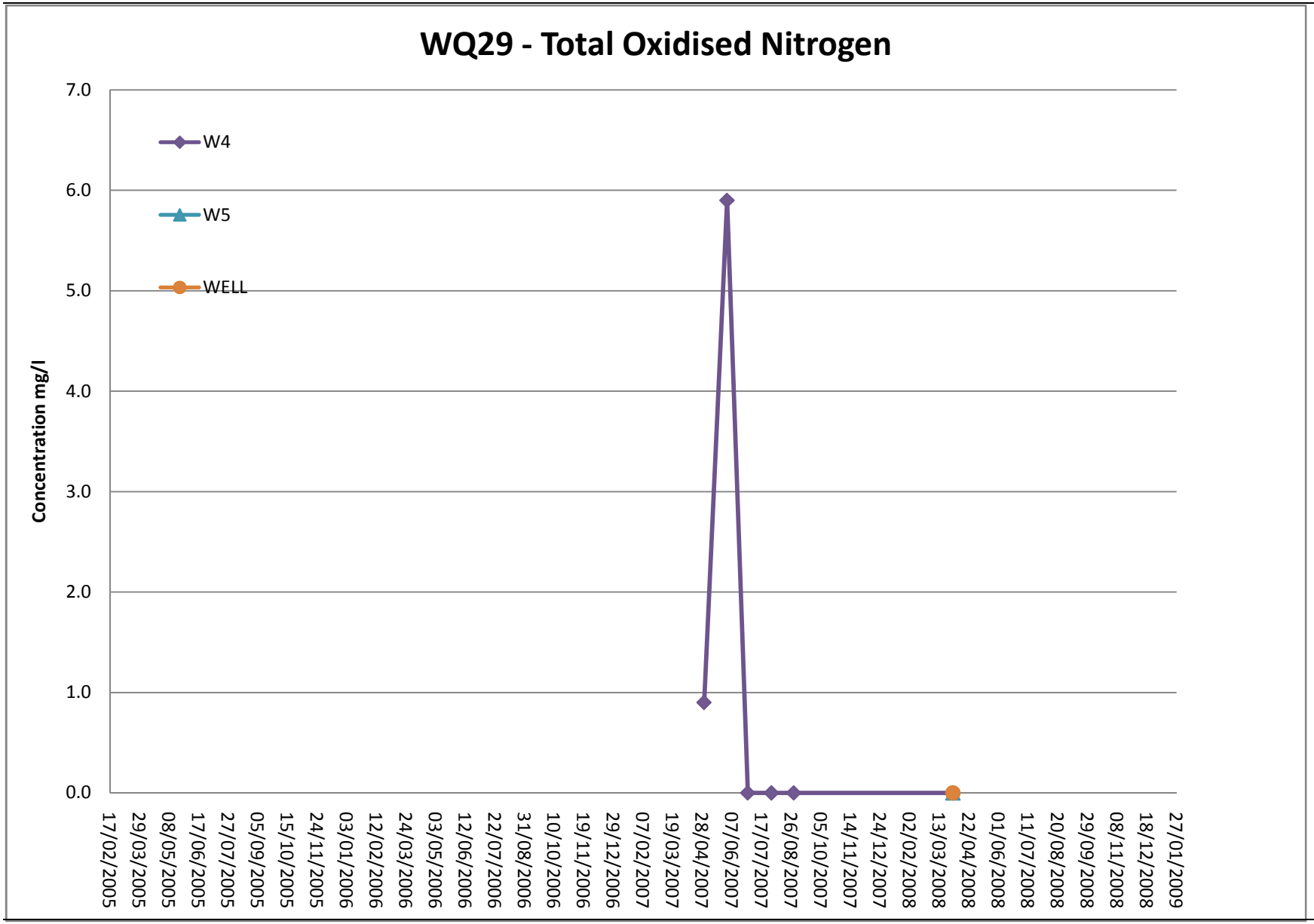

WQ24 - Potassium
Concentration mg/l
0
1
2
3
4
5
6
7
W4
W5
WELL
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
19/11/2006
29/12/2006
07/02/2007
19/03/2007
28/04/2007
07/06/2007
17/07/2007
26/08/2007
05/10/2007
14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009

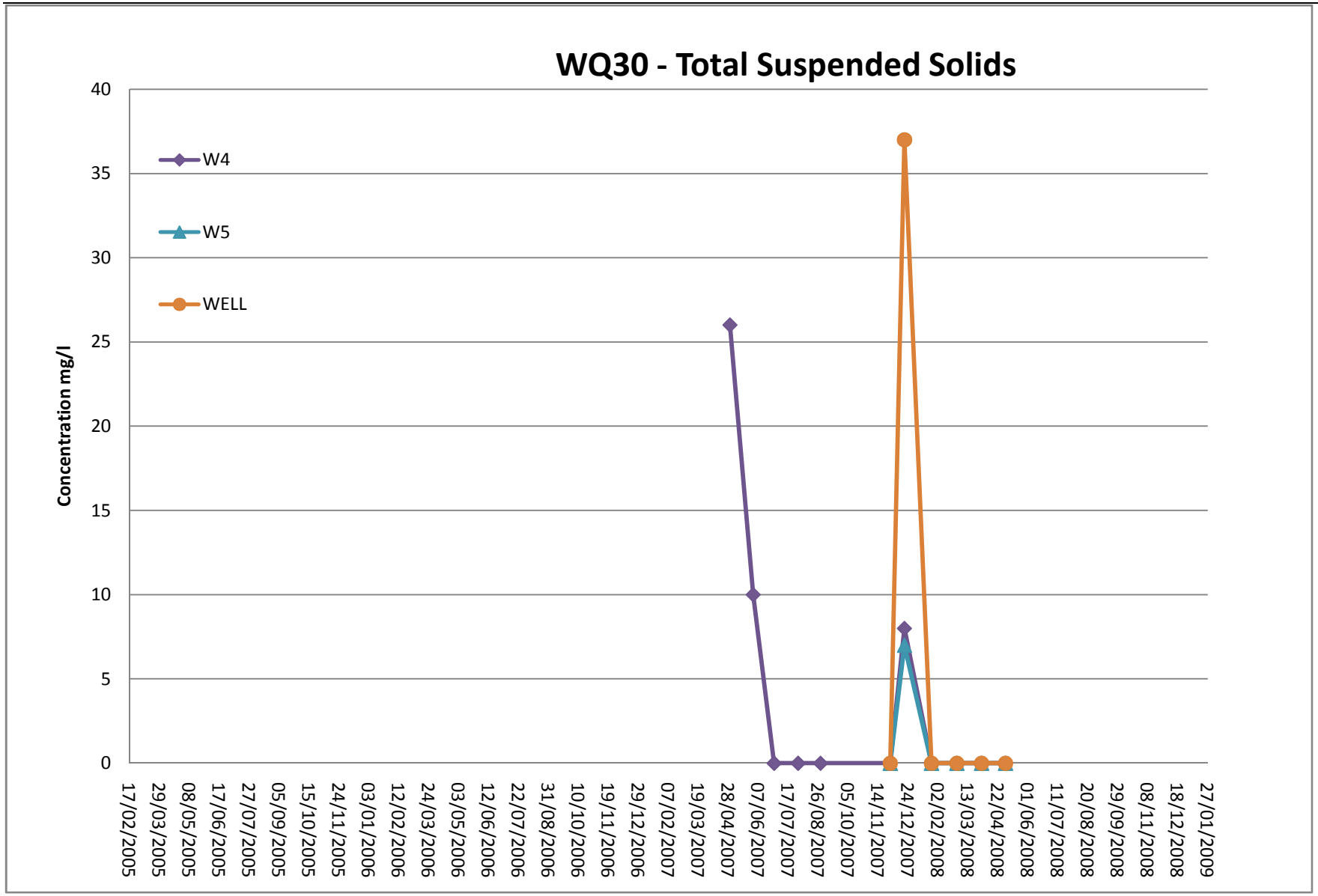

WQ25 - Sodium
Concentration mg/l
16
14
12
10
8
6
4
2
0
W4
W5
WELL
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
19/11/2006
29/12/2006
07/02/2007
19/03/2007
28/04/2007
07/06/2007
17/07/2007
26/08/2007
05/10/2007
14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009

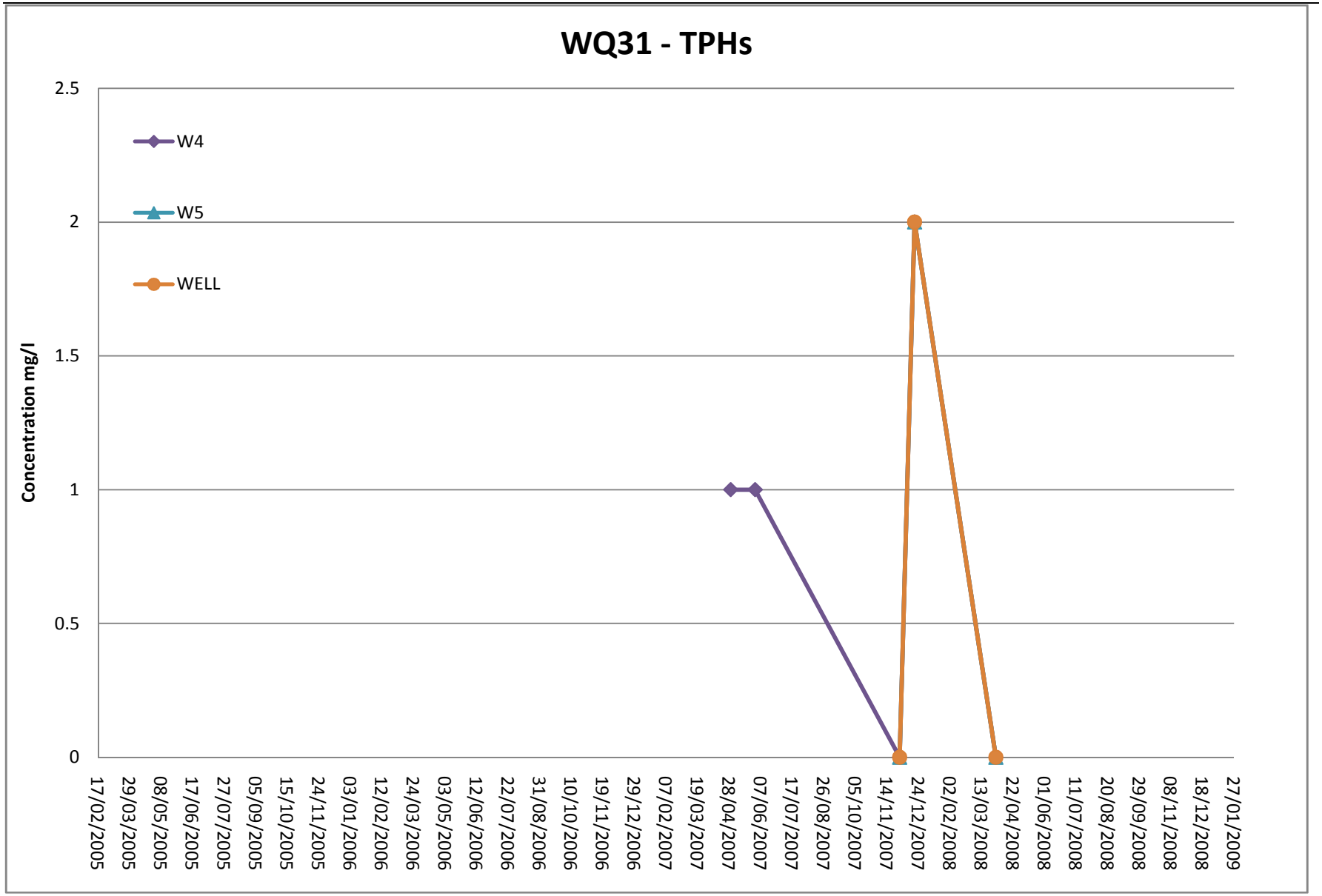

WQ26 - Sulphate
Concentration mg/l
40
35
30
25
20
15
10
5
0
W4
W5
Well
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
19/11/2006
29/12/2006
07/02/2007
19/03/2007
28/04/2007
07/06/2007
17/07/2007
26/08/2007
05/10/2007
14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009

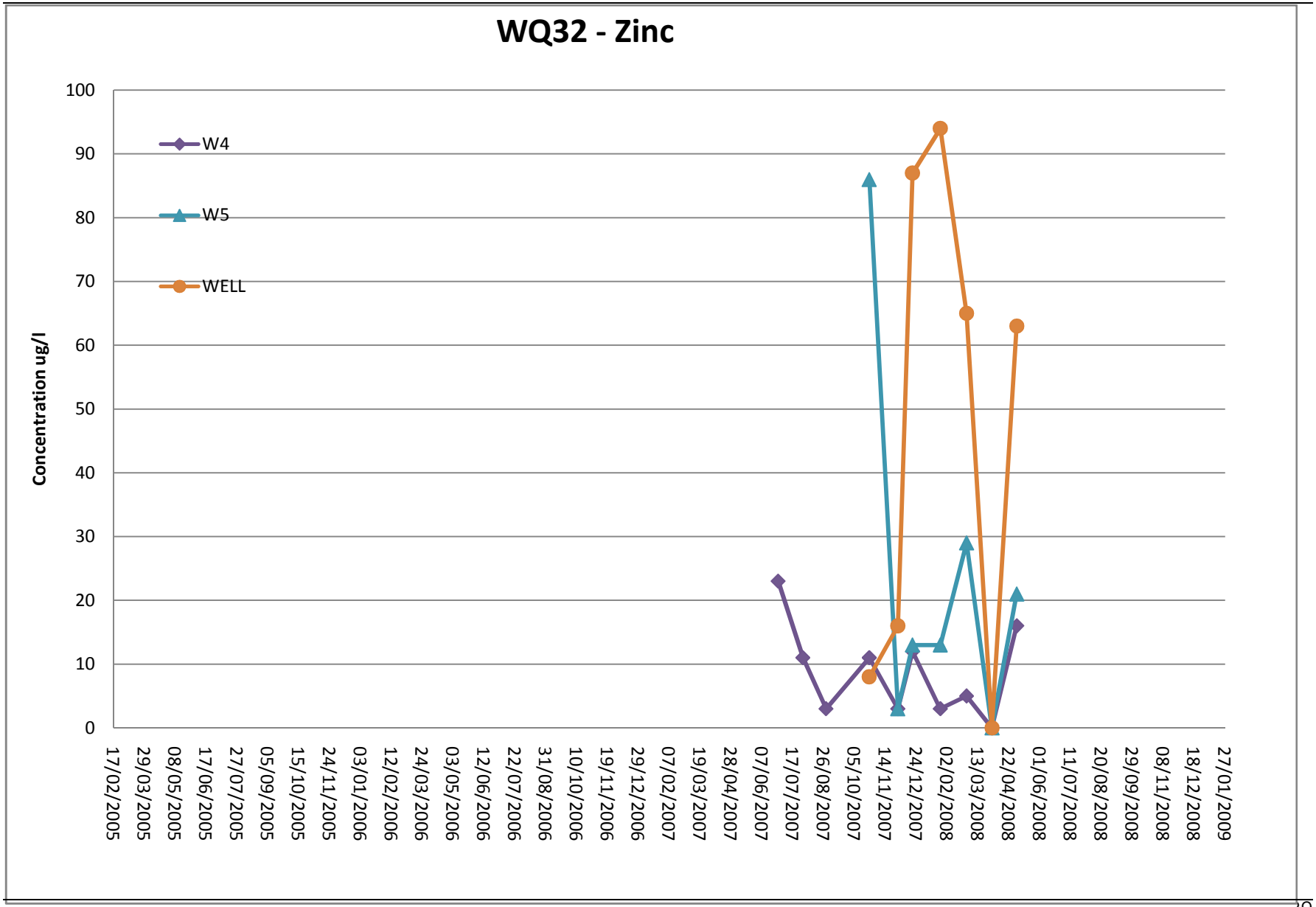

WQ27 - Total Alkalinity
Concentration mg/l
285
280
275
270
265
260
255
W4
W5
WELL
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
19/11/2006
29/12/2006
07/02/2007
19/03/2007
28/04/2007
07/06/2007
17/07/2007
26/08/2007
05/10/2007
14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009

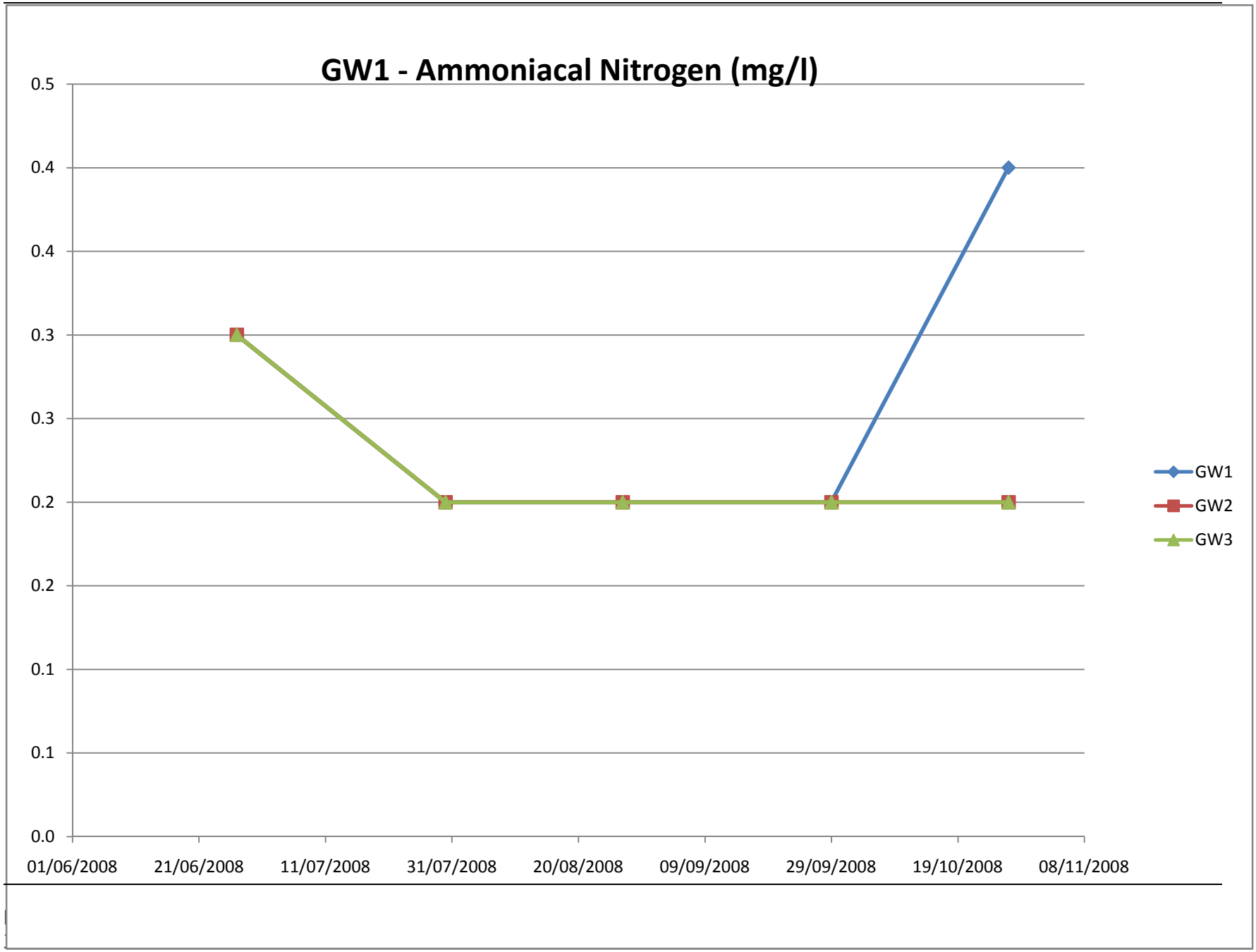

WQ28 - Total Organic Carbon
Concentration mg/l
W4
W5
WELL
0
1
2
3
4
5
6
7
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
19/11/2006
29/12/2006
07/02/2007
19/03/2007
28/04/2007
07/06/2007
17/07/2007
26/08/2007
05/10/2007
14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009

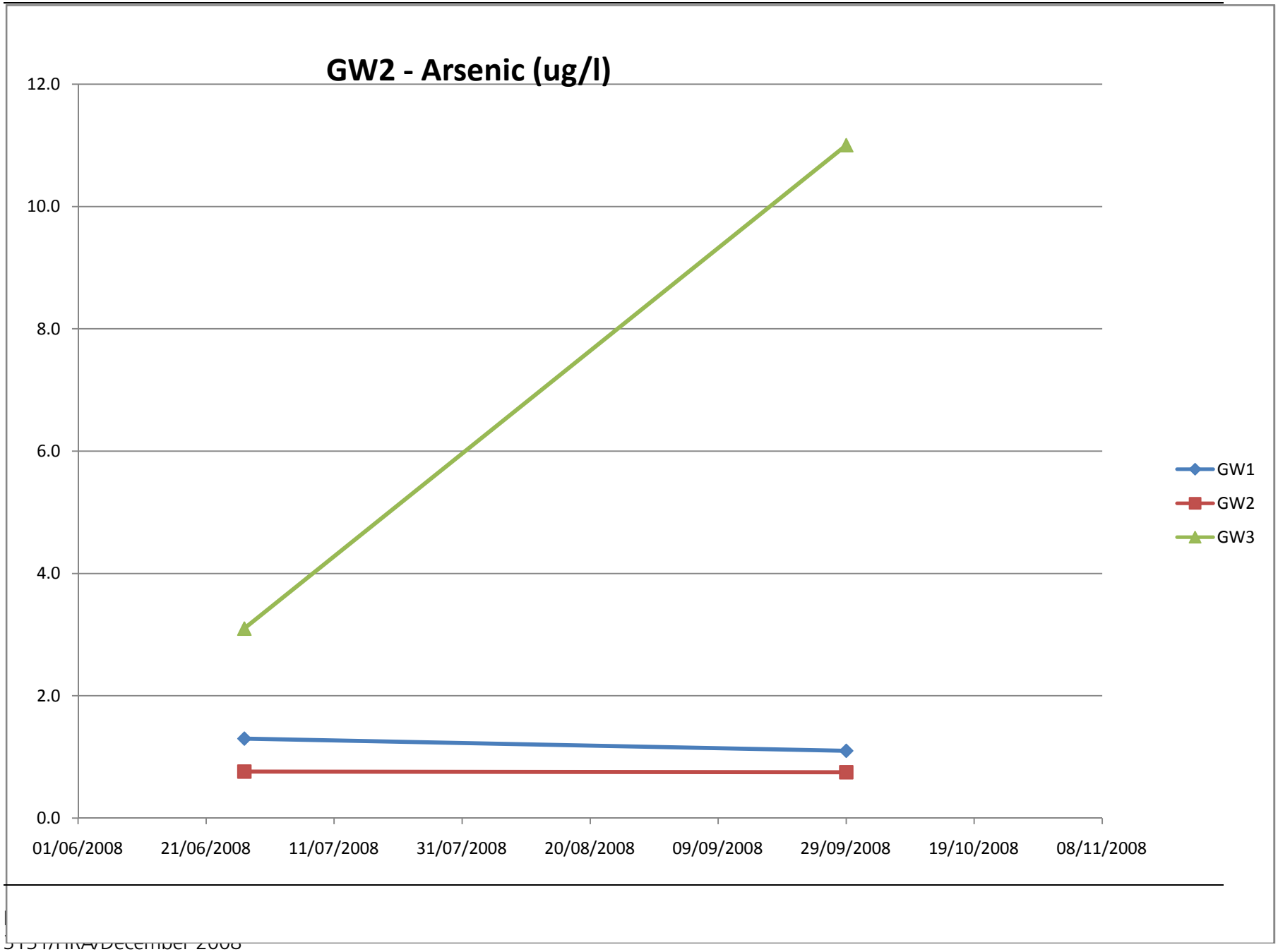

WQ29 - Total Oxidised Nitrogen
Concentration mg/l
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
W4
W5
WELL
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
19/11/2006
29/12/2006
07/02/2007
19/03/2007
28/04/2007
07/06/2007
17/07/2007
26/08/2007
05/10/2007
14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009

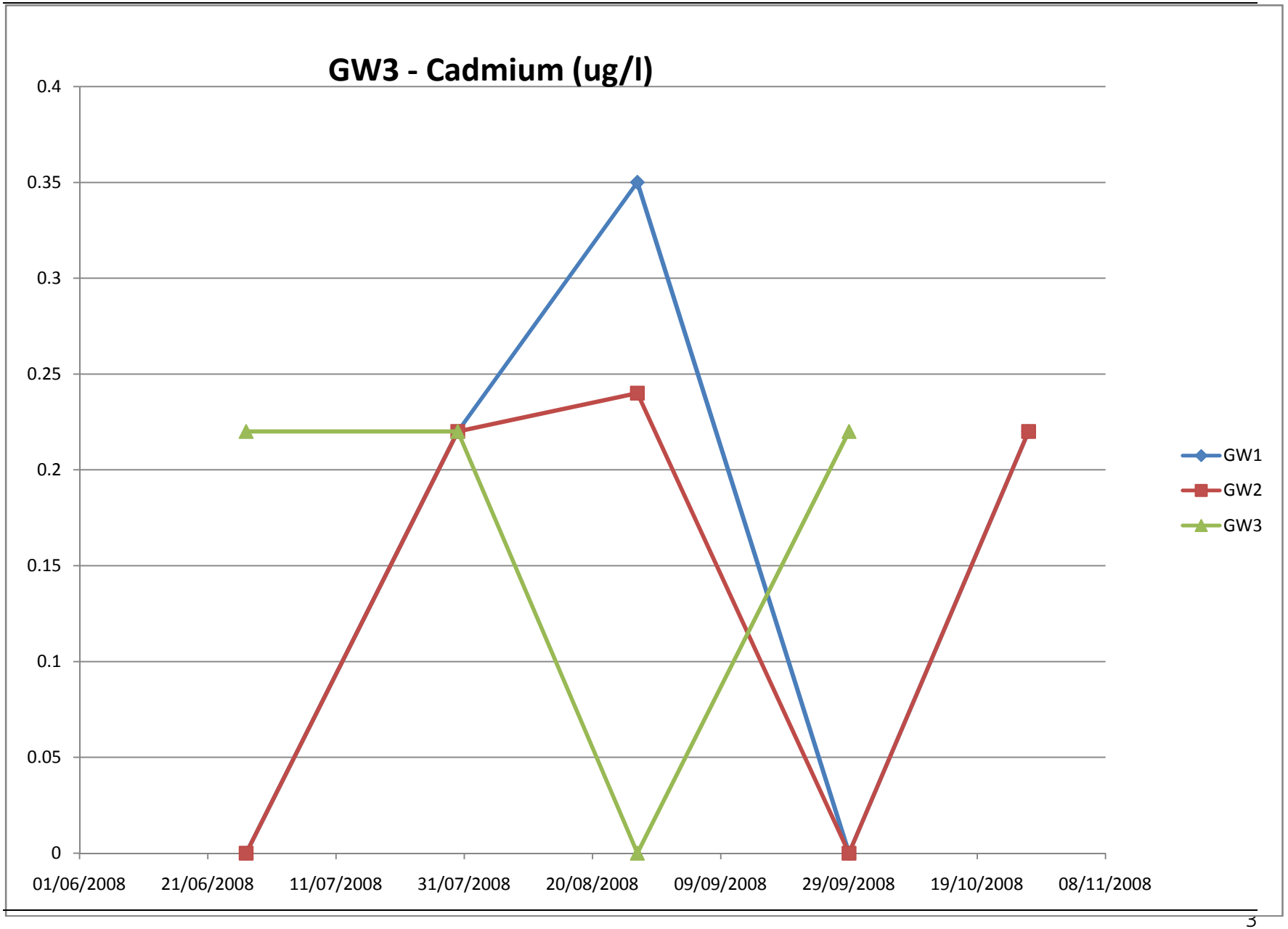

WQ30 - Total Suspended Solids
Concentration mg/l
40
35
30
25
20
15
10
5
0
W4
W5
WELL
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
19/11/2006
29/12/2006
07/02/2007
19/03/2007
28/04/2007
07/06/2007
17/07/2007
26/08/2007
05/10/2007
14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009

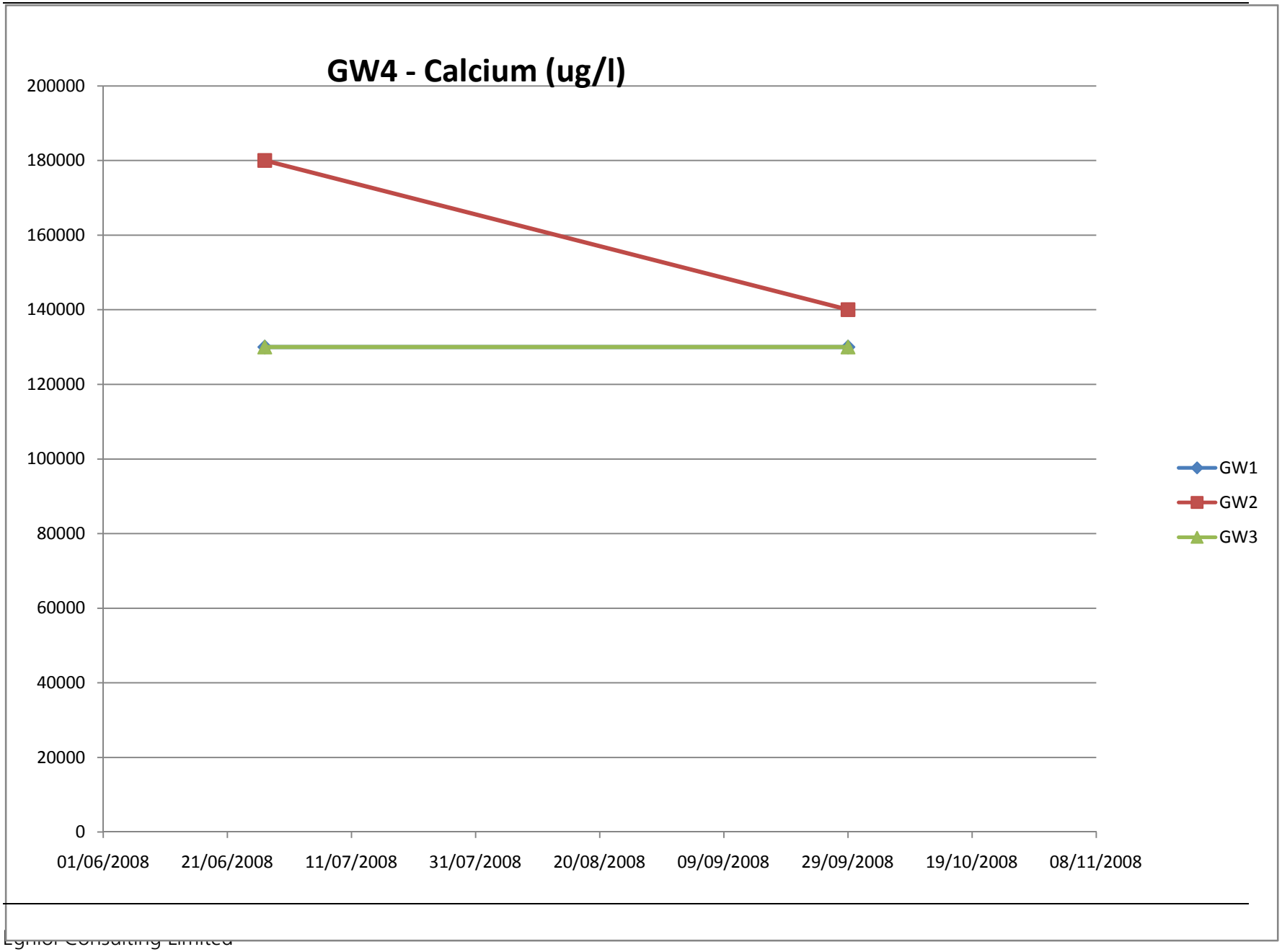

WQ31 - TPHs
Concentration mg/l
2.5
2
1.5
1
0.5
0
W4
W5
WELL
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
19/11/2006
29/12/2006
07/02/2007
19/03/2007
28/04/2007
07/06/2007
17/07/2007
26/08/2007
05/10/2007
14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009

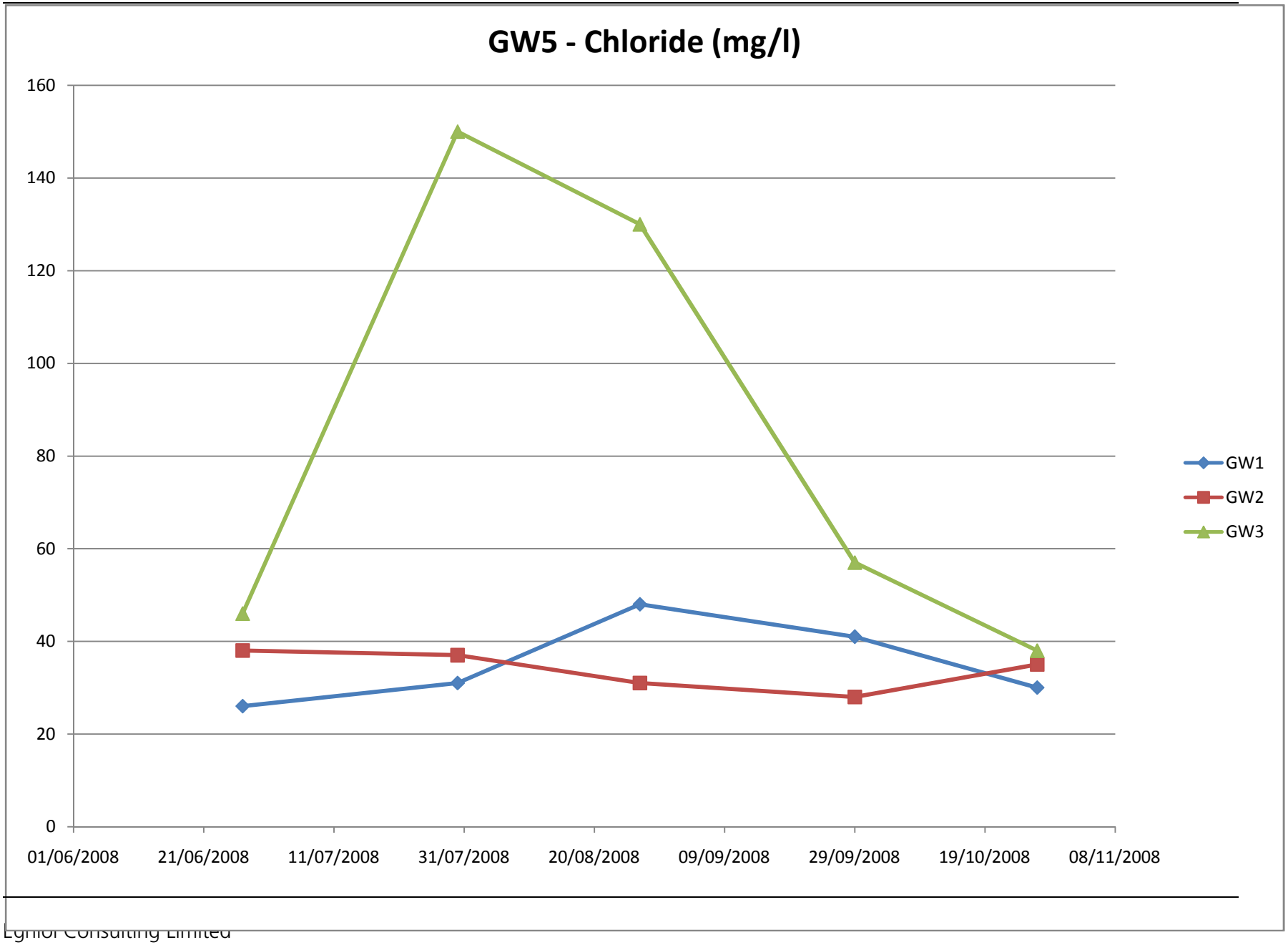

WQ32 - Zinc
Concentration ug/l
100
90
80
70
60
50
40
30
20
10
0
W4
W5
WELL
17/02/2005
29/03/2005
08/05/2005
17/06/2005
27/07/2005
05/09/2005
15/10/2005
24/11/2005
03/01/2006
12/02/2006
24/03/2006
03/05/2006
12/06/2006
22/07/2006
31/08/2006
10/10/2006
19/11/2006
29/12/2006
07/02/2007
19/03/2007
28/04/2007
07/06/2007
17/07/2007
26/08/2007
05/10/2007
14/11/2007
24/12/2007
02/02/2008
13/03/2008
22/04/2008
01/06/2008
11/07/2008
20/08/2008
29/09/2008
08/11/2008
18/12/2008
27/01/2009

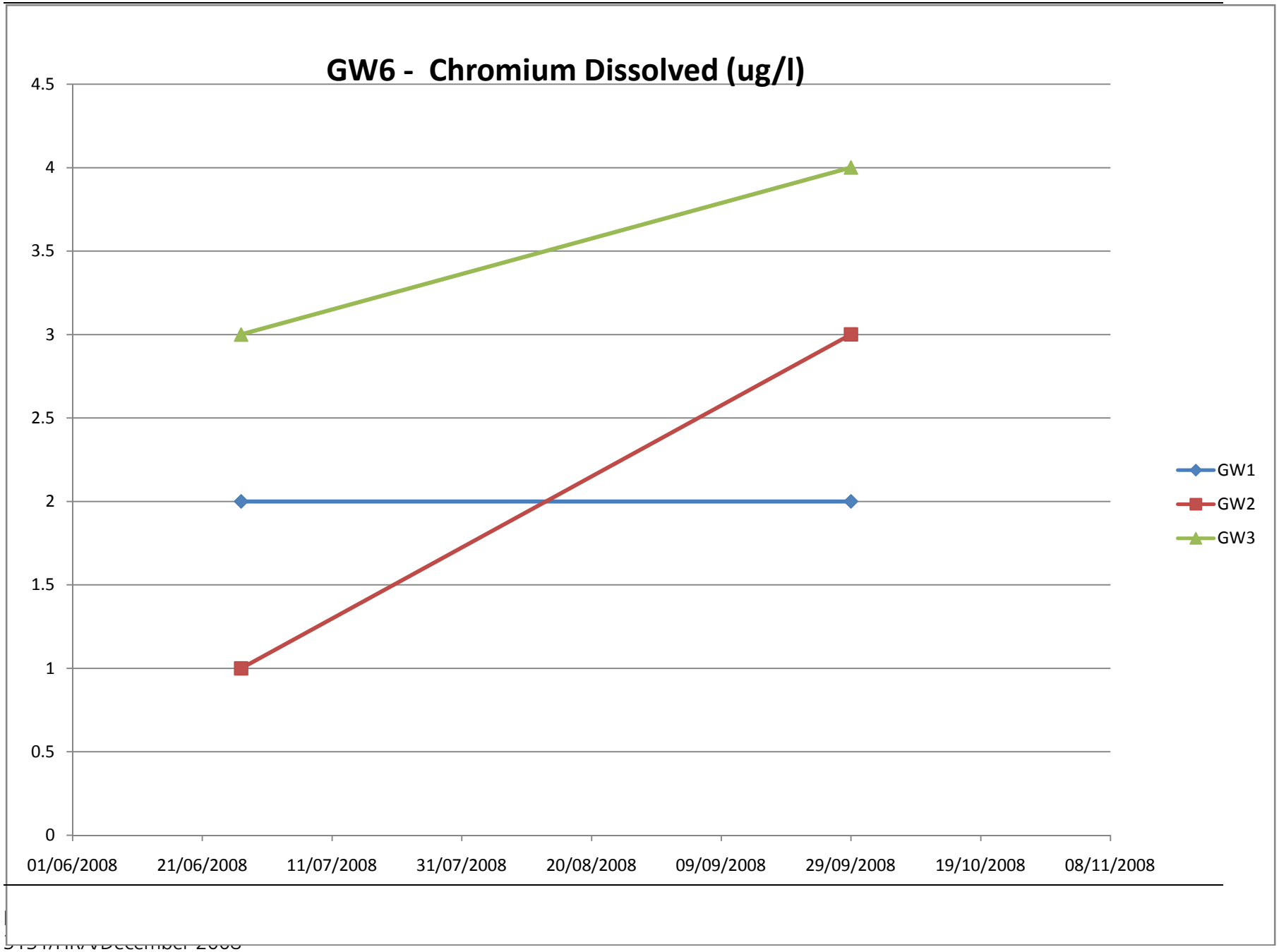

GW1 - Ammoniacal Nitrogen (mg/l)
0.5
0.4
0.4
0.3
0.3
0.2
0.2
0.1
0.1
0.0
01/06/2008
21/06/2008
11/07/2008
31/07/2008
20/08/2008
09/09/2008
29/09/2008
19/10/2008
08/11/2008
GW1
GW2
GW3

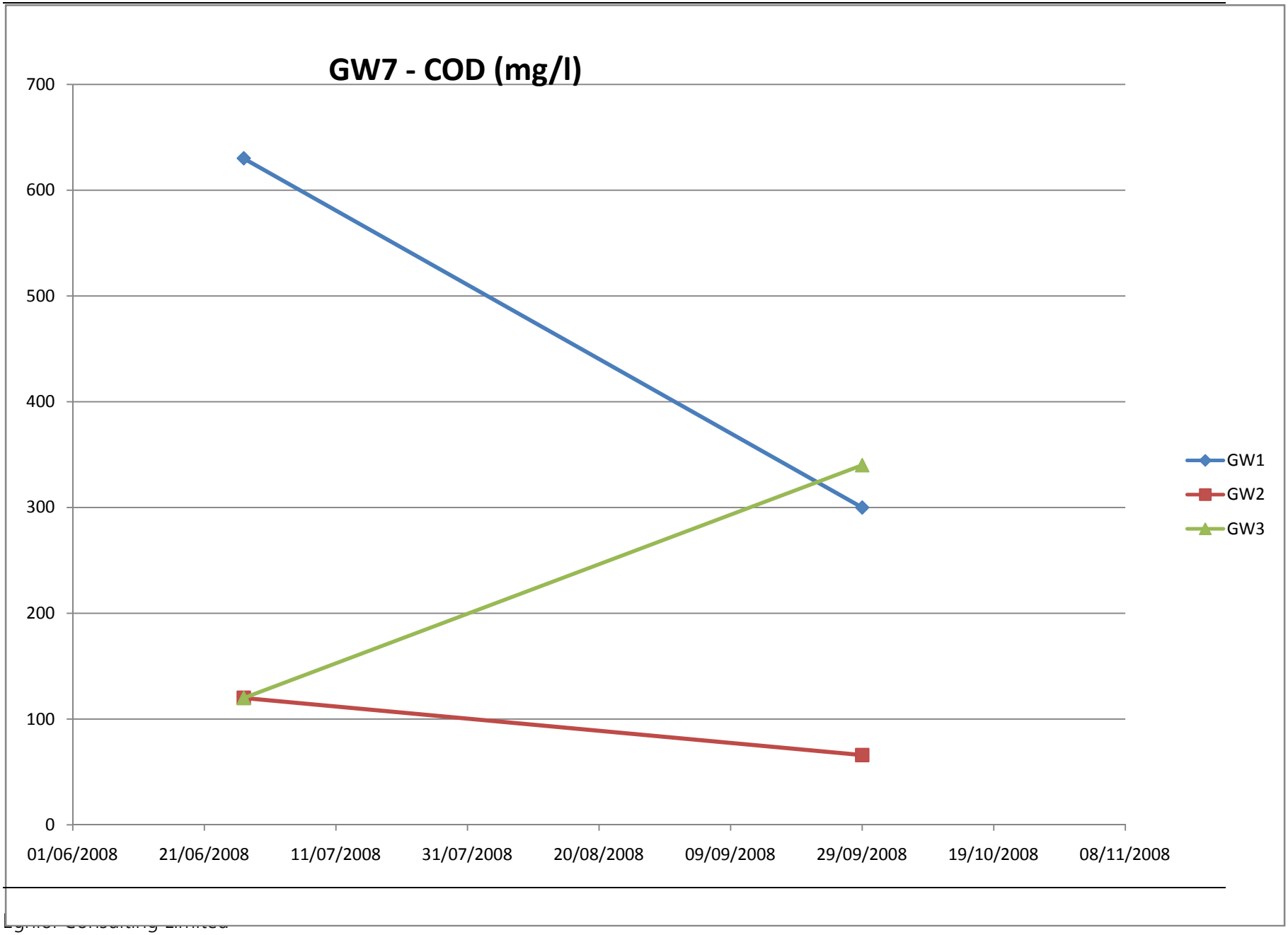

GW2 - Arsenic (ug/l)
12.0
10.0
8.0
6.0
4.0
2.0
0.0
01/06/2008
21/06/2008
11/07/2008
31/07/2008
20/08/2008
09/09/2008
29/09/2008
19/10/2008
08/11/2008
GW1
GW2
GW3

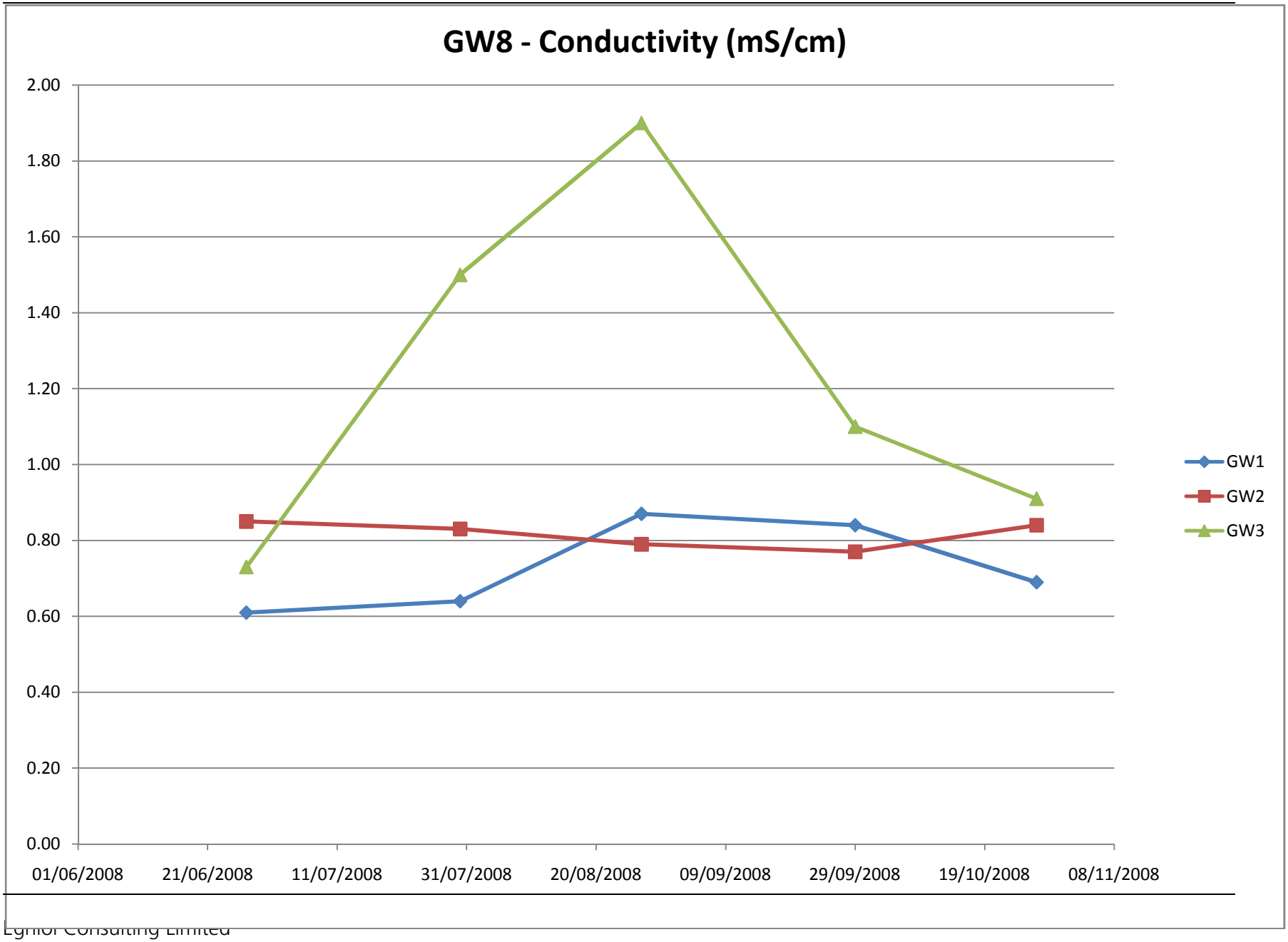

GW3 - Cadmium (ug/l)
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
01/06/2008
21/06/2008
11/07/2008
31/07/2008
20/08/2008
09/09/2008
29/09/2008
19/10/2008
08/11/2008
GW1
GW2
GW3

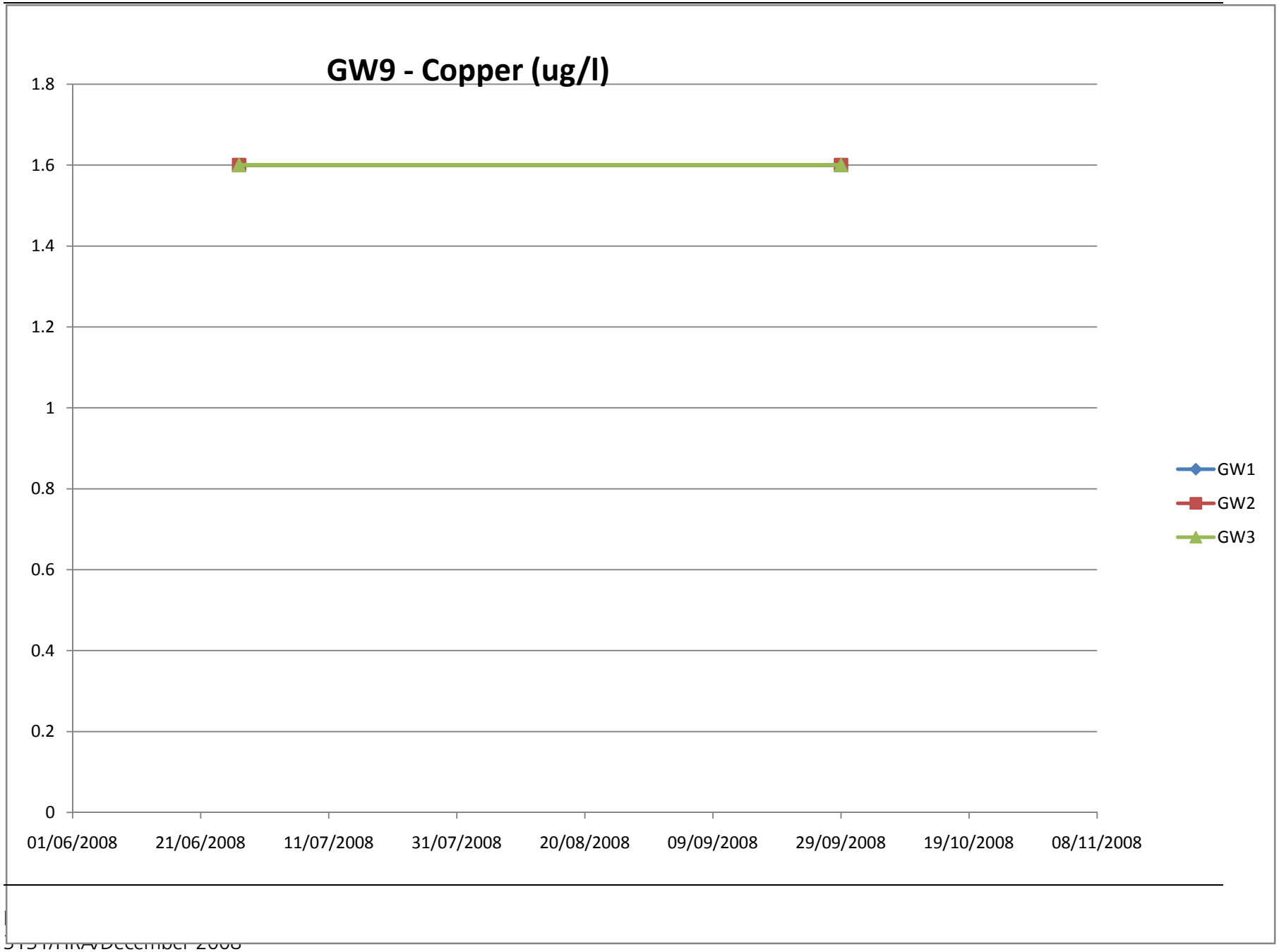

GW4 - Calcium (ug/l)
200000
180000
160000
140000
120000
100000
80000
60000
40000
20000
0
01/06/2008
21/06/2008
11/07/2008
31/07/2008
20/08/2008
09/09/2008
29/09/2008
19/10/2008
08/11/2008
GW1
GW2
GW3

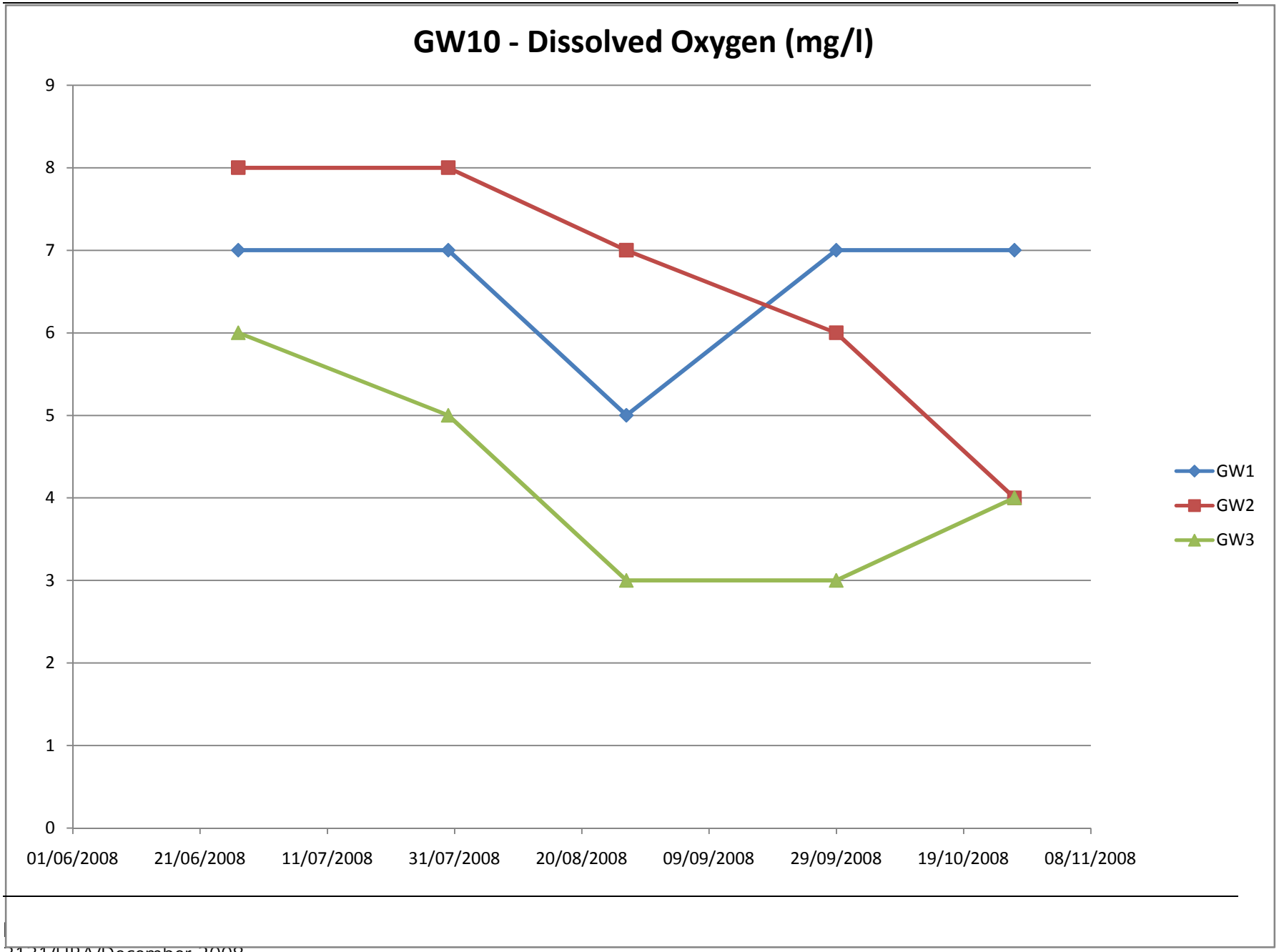

GW5 - Chloride (mg/l)
160
140
120
100
80
60
40
20
0
01/06/2008
21/06/2008
11/07/2008
31/07/2008
20/08/2008
09/09/2008
29/09/2008
19/10/2008
08/11/2008
GW1
GW2
GW3

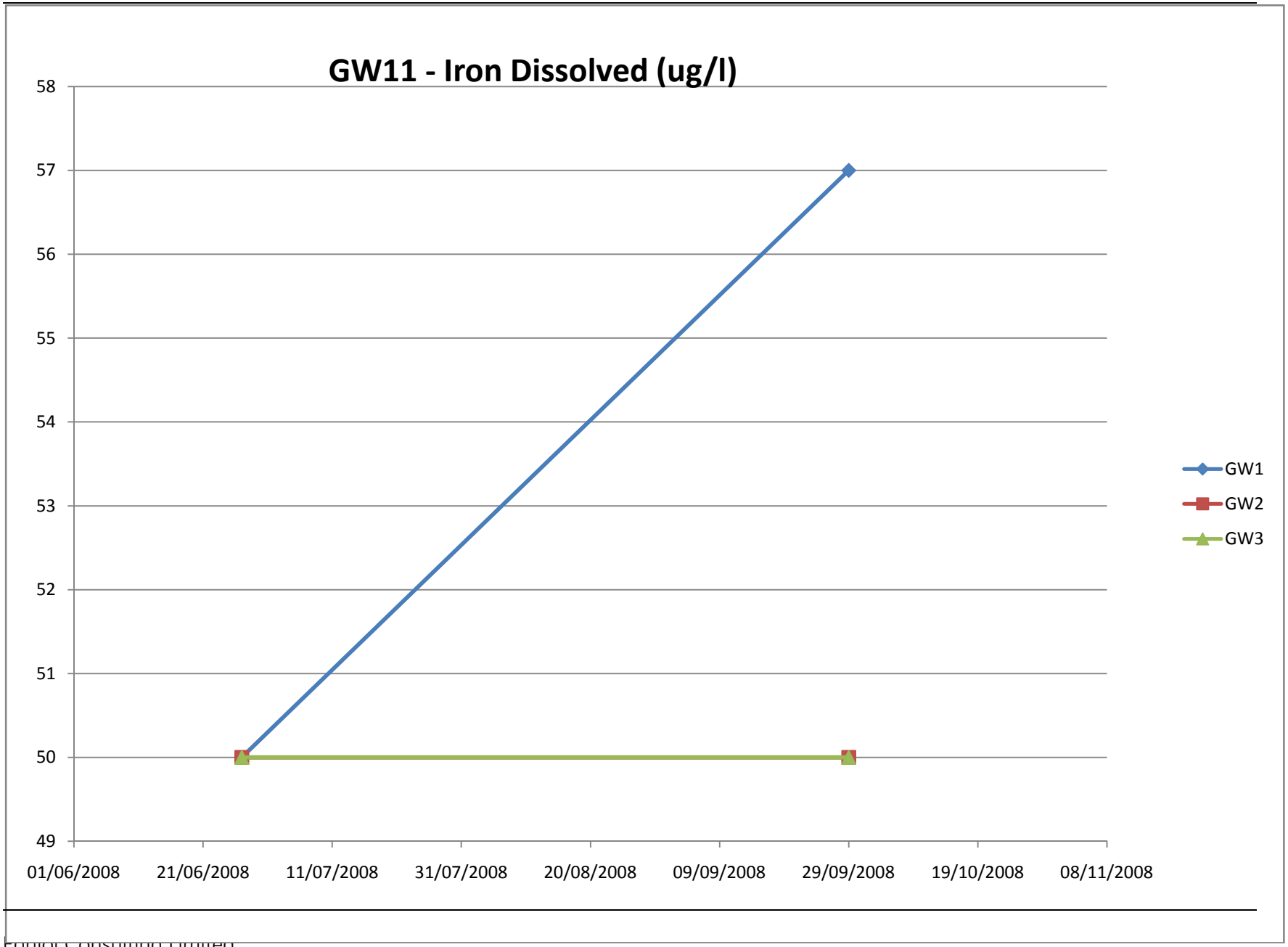

GW6 - Chromium Dissolved (ug/l)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
01/06/2008
21/06/2008
11/07/2008
31/07/2008
20/08/2008
09/09/2008
29/09/2008
19/10/2008
08/11/2008
GW1
GW2
GW3

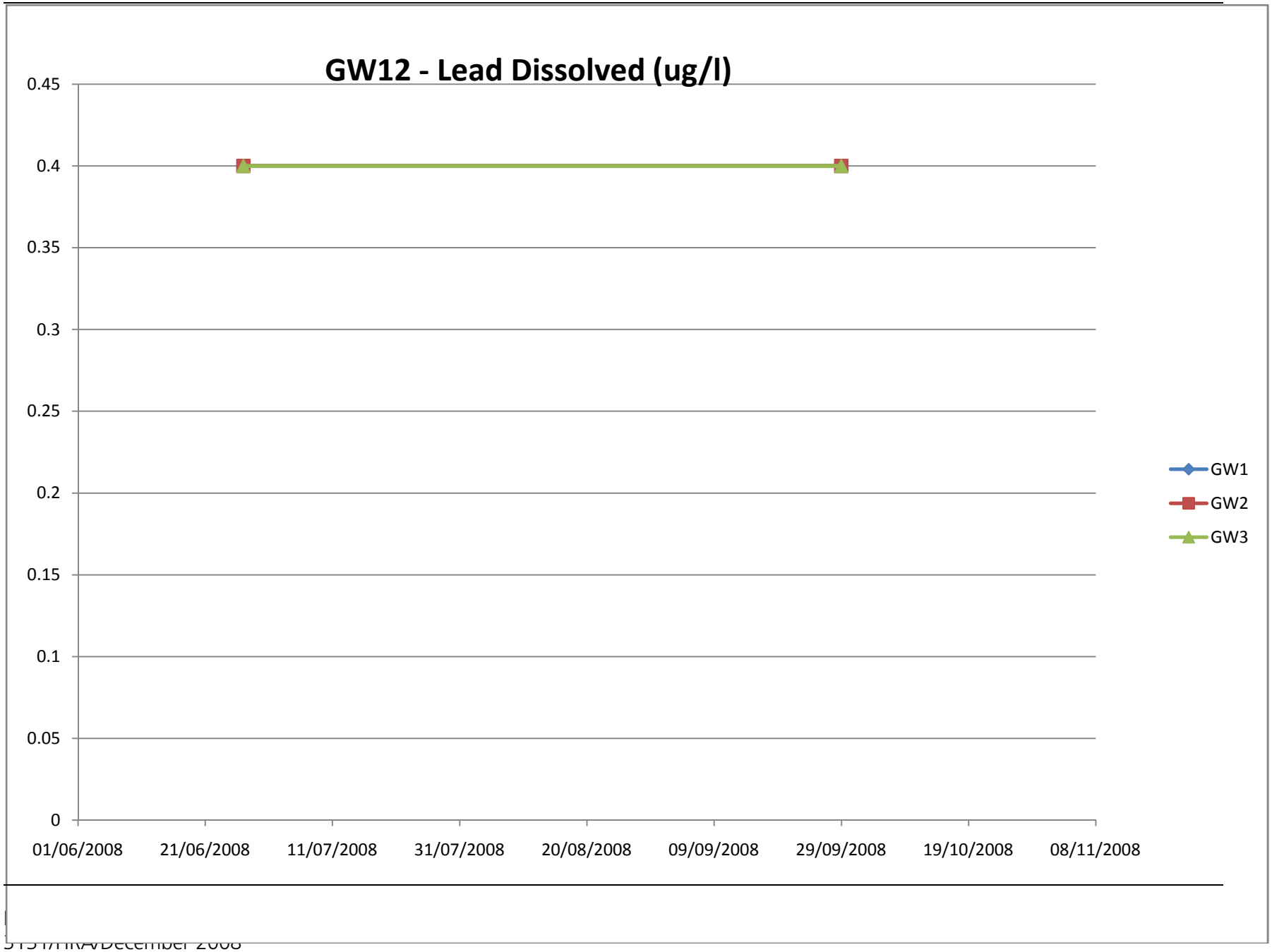

GW7 - COD (mg/l)
700
600
500
400
300
200
100
0
01/06/2008
21/06/2008
11/07/2008
31/07/2008
20/08/2008
09/09/2008
29/09/2008
19/10/2008
08/11/2008
GW1
GW2
GW3

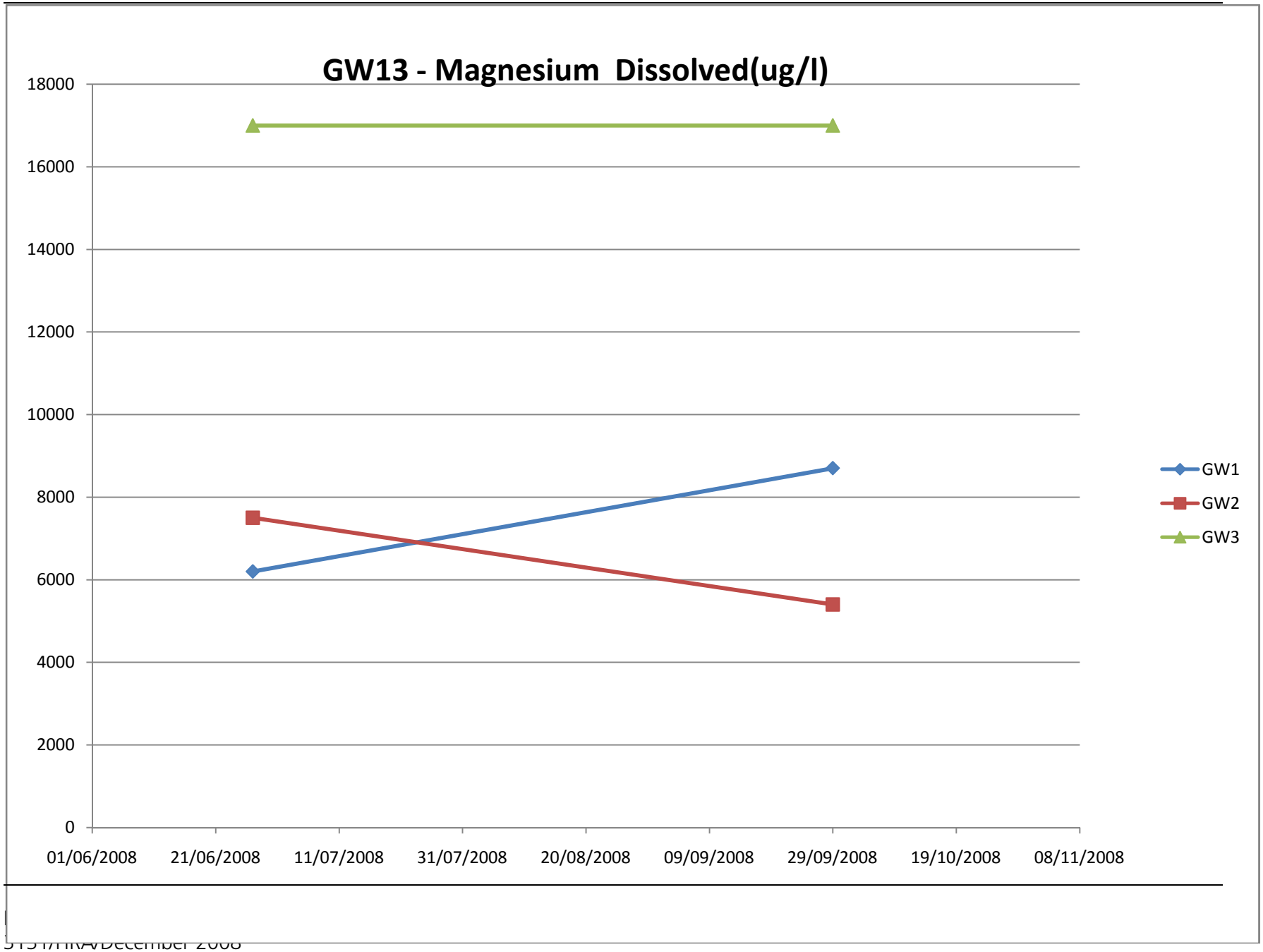

GW8 - Conductivity (mS/cm)
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
01/06/2008
21/06/2008
11/07/2008
31/07/2008
20/08/2008
09/09/2008
29/09/2008
19/10/2008
08/11/2008
GW1
GW2
GW3

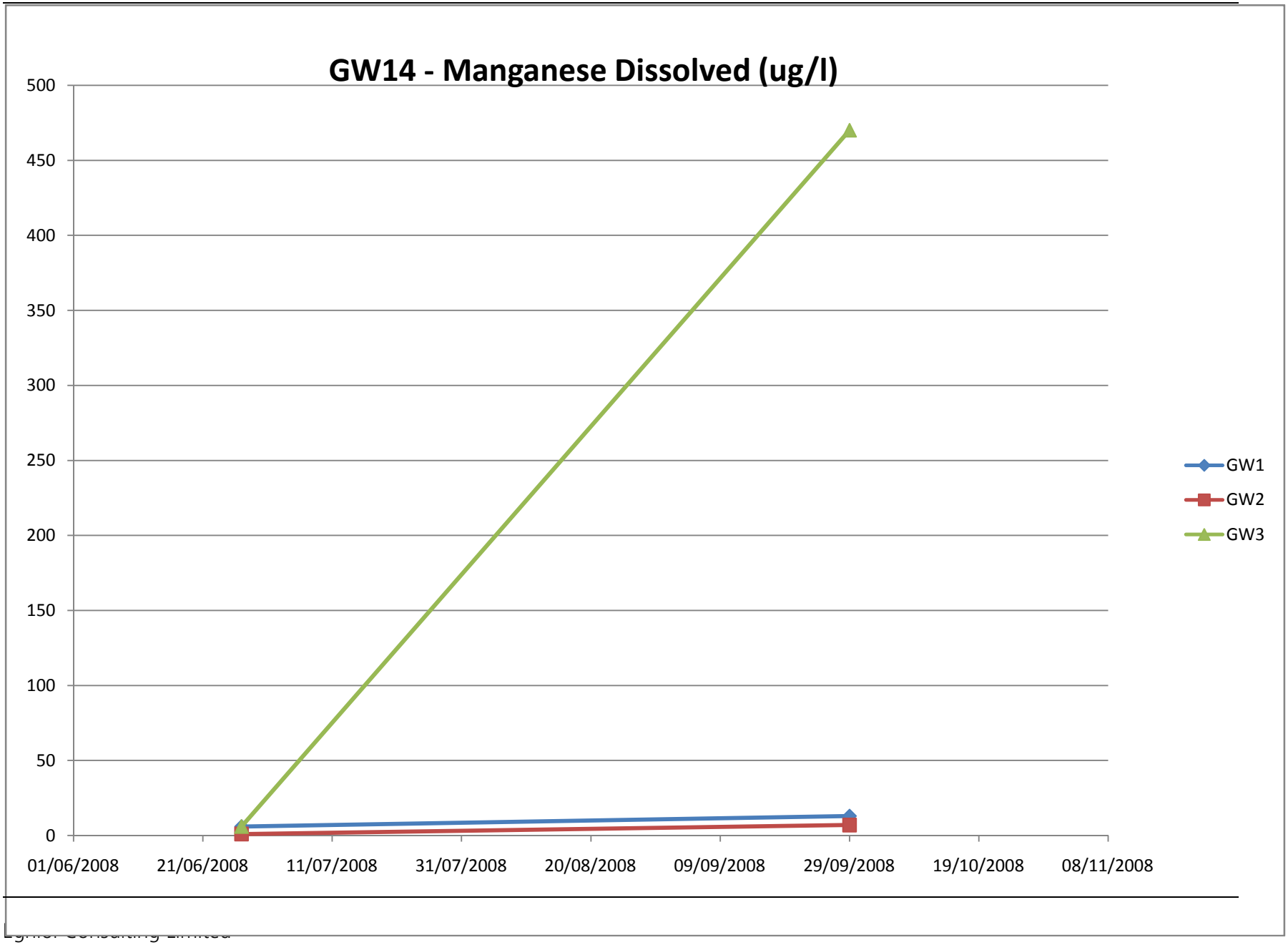

GW9 - Copper (ug/l)
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
01/06/2008
21/06/2008
11/07/2008
31/07/2008
20/08/2008
09/09/2008
29/09/2008
19/10/2008
08/11/2008
GW1
GW2
GW3

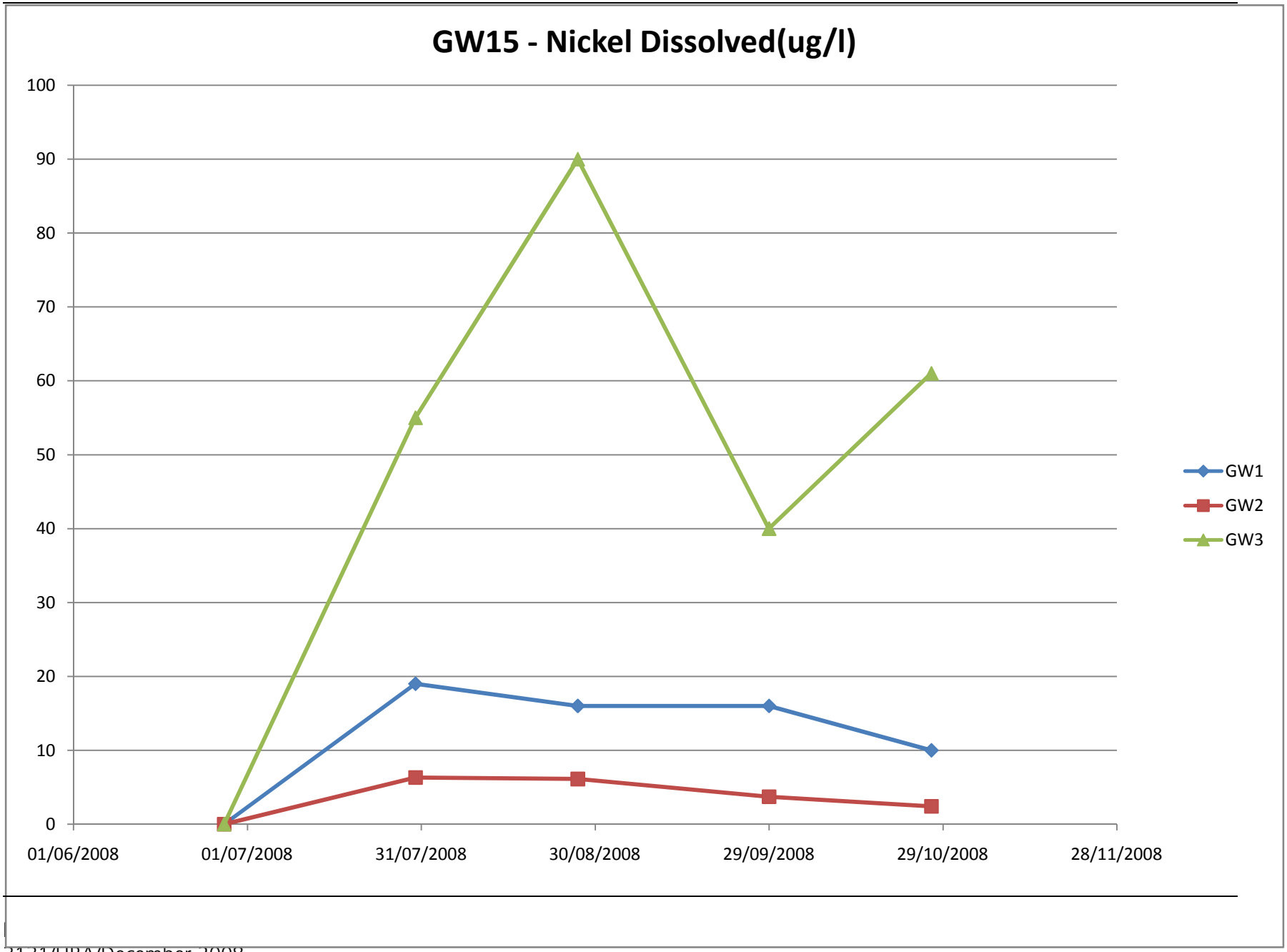

GW10 - Dissolved Oxygen (mg/l)
9
8
7
6
5
4
3
2
1
0
01/06/2008
21/06/2008
11/07/2008
31/07/2008
20/08/2008
09/09/2008
29/09/2008
19/10/2008
08/11/2008
GW1
GW2
GW3

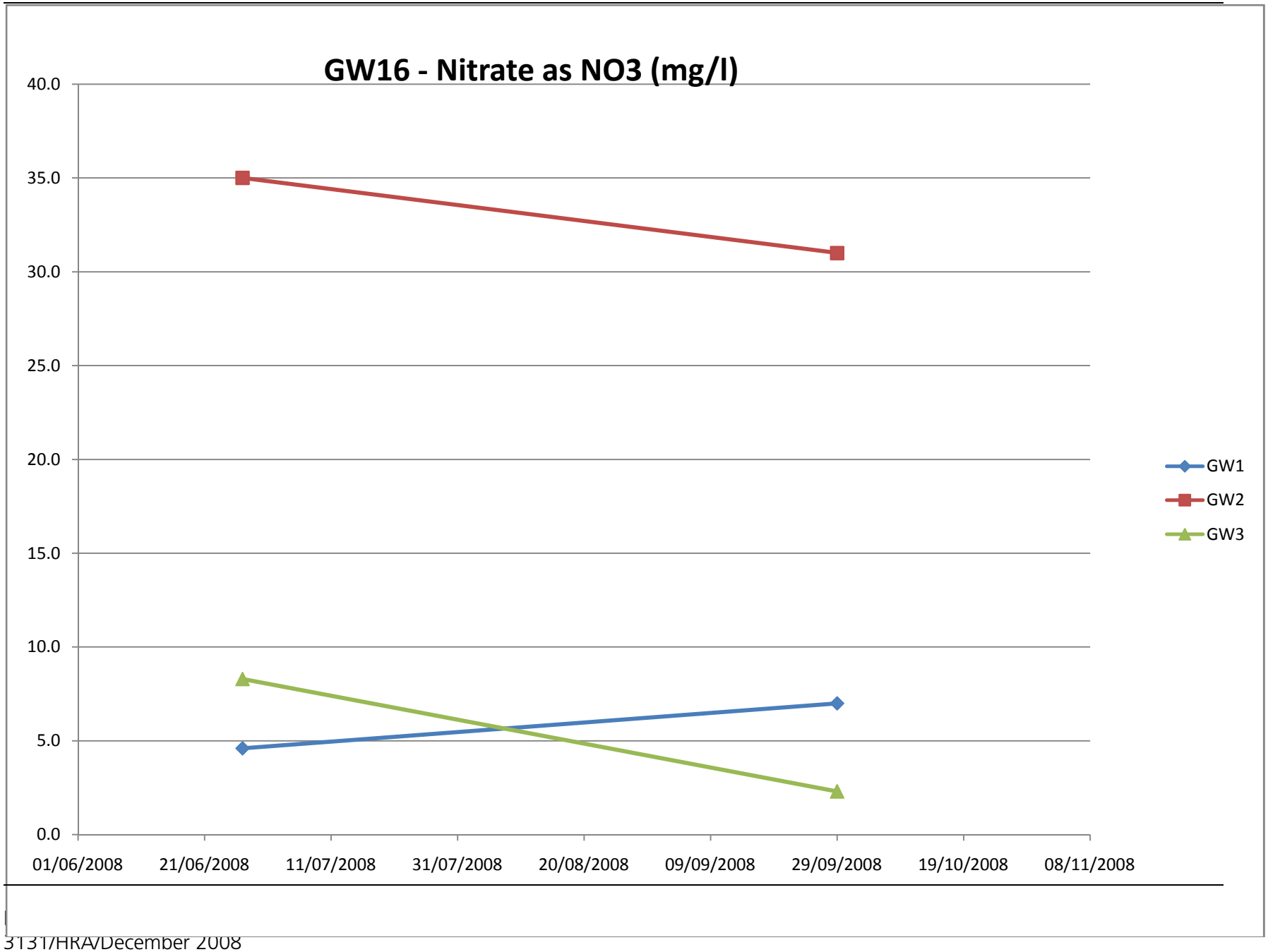

GW11 - Iron Dissolved (ug/l)
58
57
56
55
54
53
52
51
50
49
01/06/2008
21/06/2008
11/07/2008
31/07/2008
20/08/2008
09/09/2008
29/09/2008
19/10/2008
08/11/2008
GW1
GW2
GW3

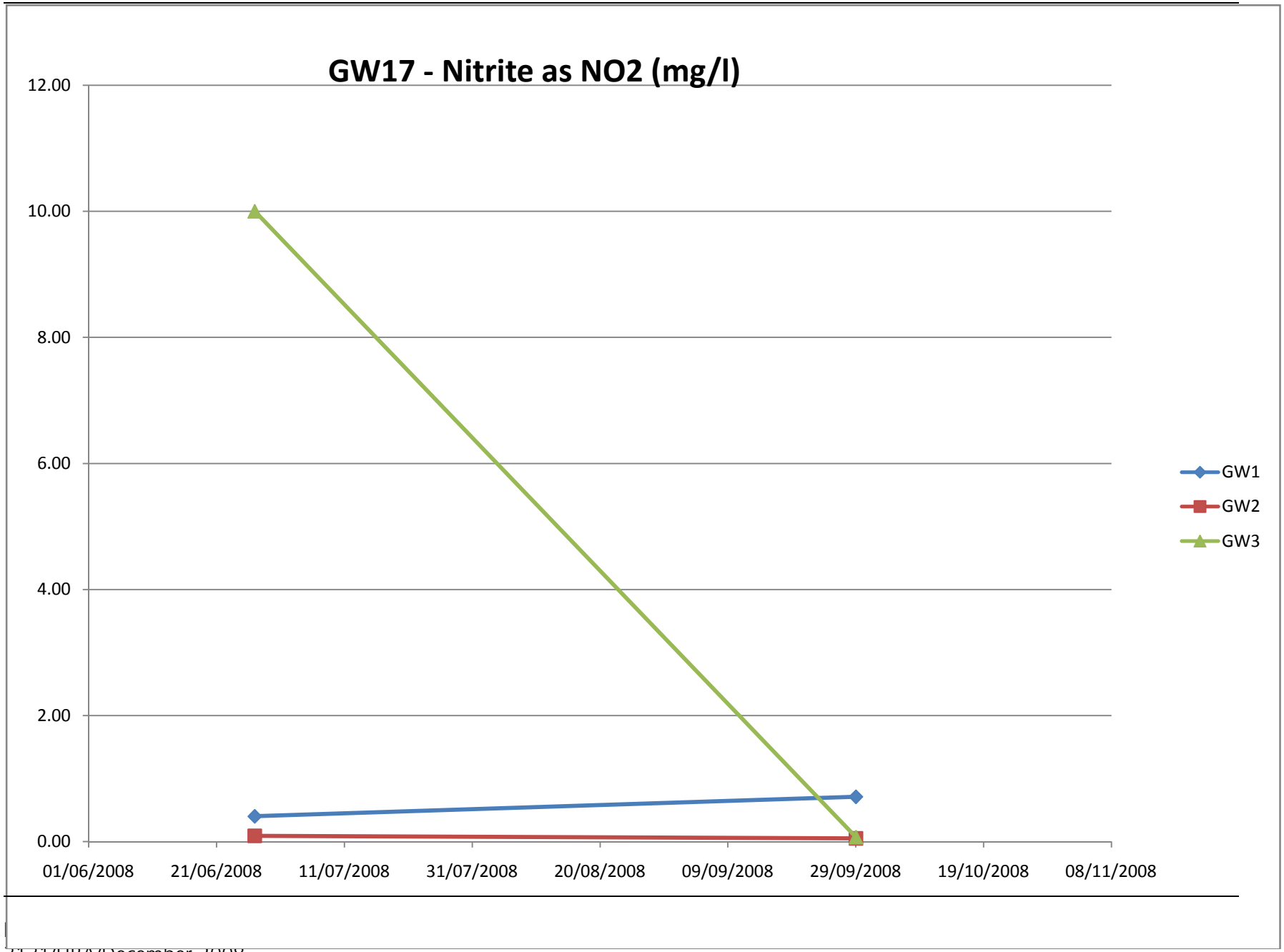

GW12 - Lead Dissolved (ug/l)
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
01/06/2008
21/06/2008
11/07/2008
31/07/2008
20/08/2008
09/09/2008
29/09/2008
19/10/2008
08/11/2008
GW1
GW2
GW3

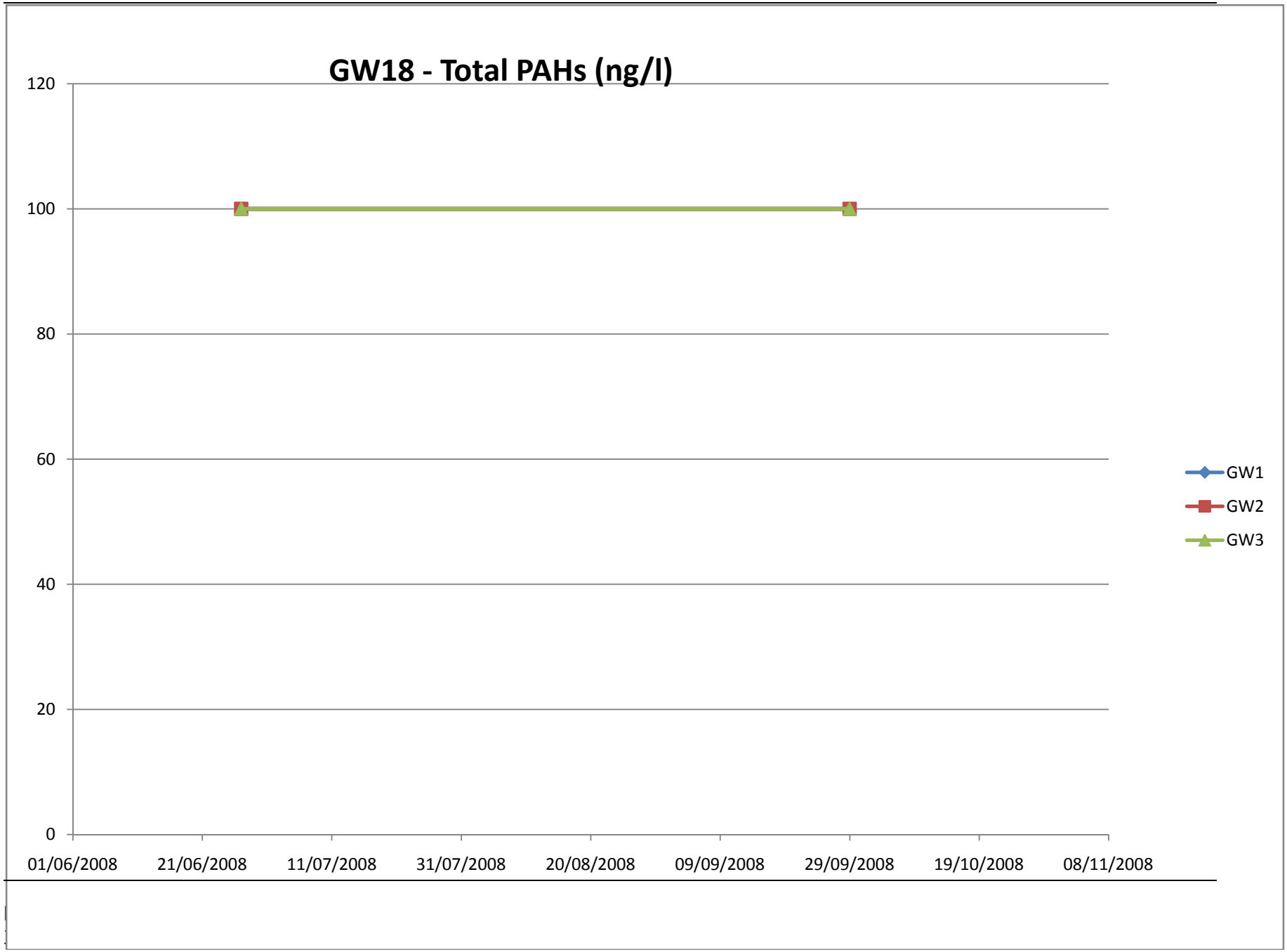

GW13 - Magnesium Dissolved(ug/l)
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
01/06/2008
21/06/2008
11/07/2008
31/07/2008
20/08/2008
09/09/2008
29/09/2008
19/10/2008
08/11/2008
GW1
GW2
GW3

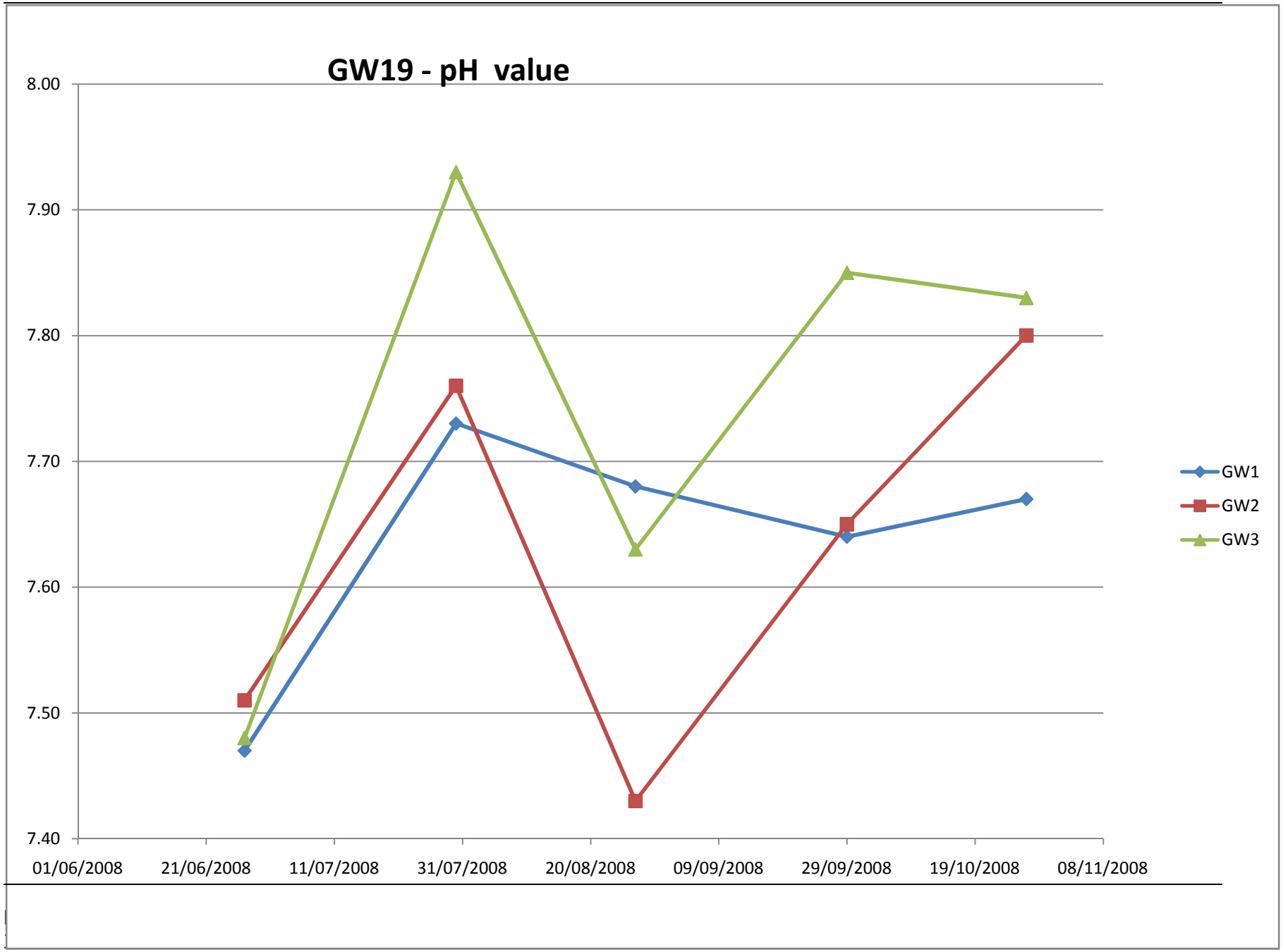

GW14 - Manganese Dissolved (ug/l)
500
450
400
350
300
250
200
150
100
50
0
01/06/2008
21/06/2008
11/07/2008
31/07/2008
20/08/2008
09/09/2008
29/09/2008
19/10/2008
08/11/2008
GW1
GW2
GW3

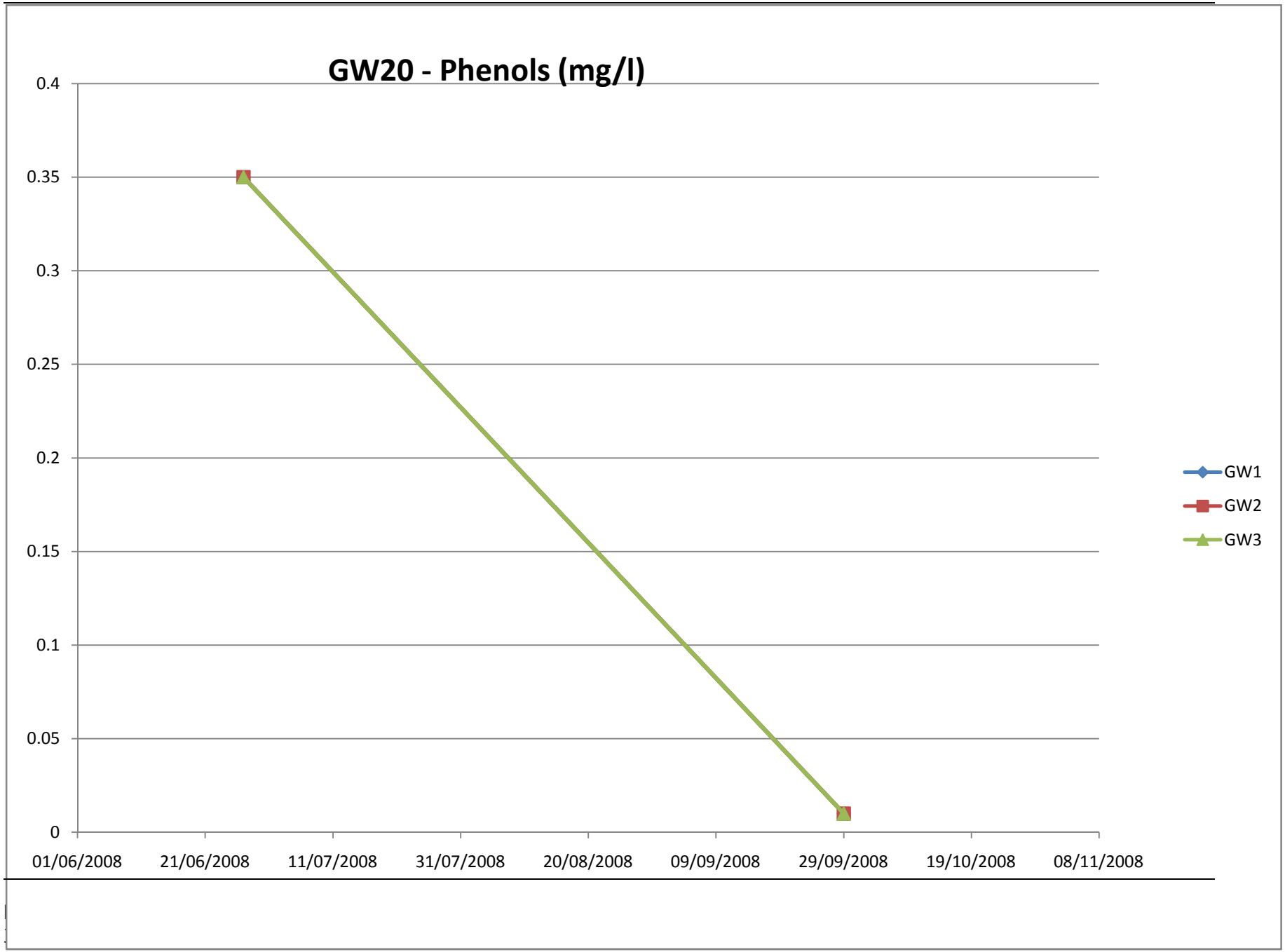

GW15 - Nickel Dissolved(ug/l)
100
90
80
70
60
50
40
30
20
10
0
01/06/2008
01/07/2008
31/07/2008
30/08/2008
29/09/2008
29/10/2008
28/11/2008
GW1
GW2
GW3

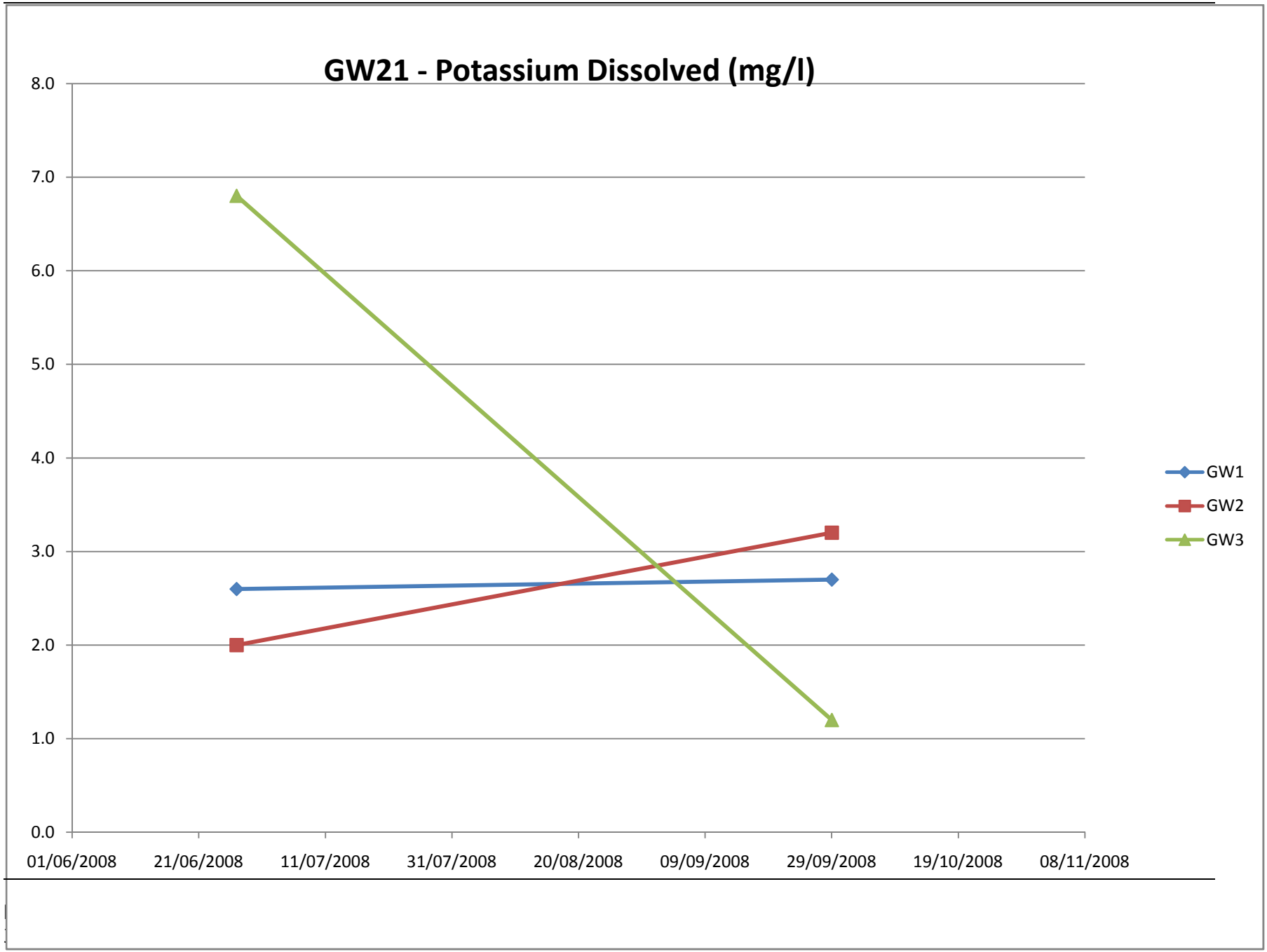

GW16 - Nitrate as NO3 (mg/l)
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
01/06/2008
21/06/2008
11/07/2008
31/07/2008
20/08/2008
09/09/2008
29/09/2008
19/10/2008
08/11/2008
GW1
GW2
GW3

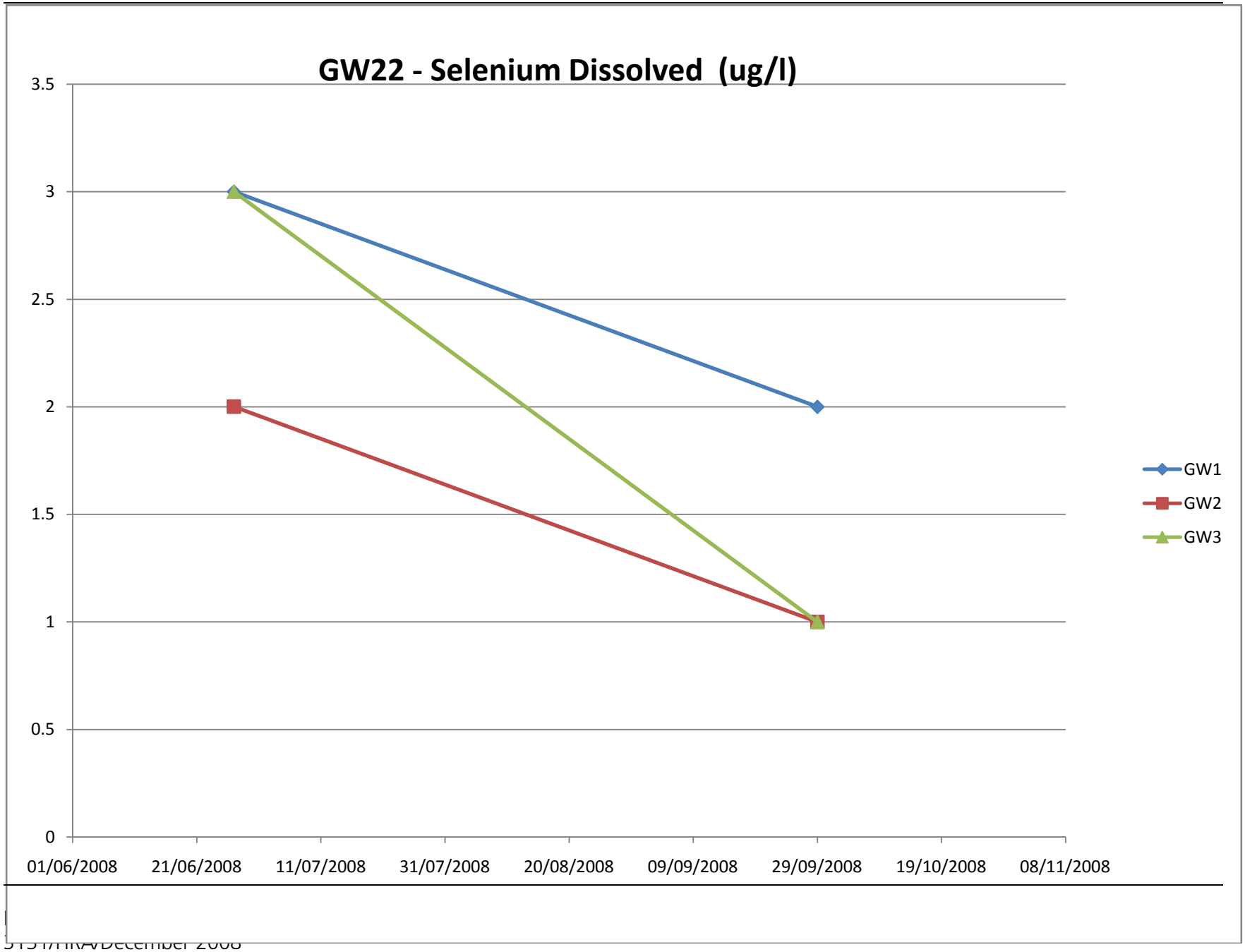

GW17 - Nitrite as NO2 (mg/l)
12.00
10.00
8.00
6.00
4.00
2.00
0.00
01/06/2008
21/06/2008
11/07/2008
31/07/2008
20/08/2008
09/09/2008
29/09/2008
19/10/2008
08/11/2008
GW1
GW2
GW3

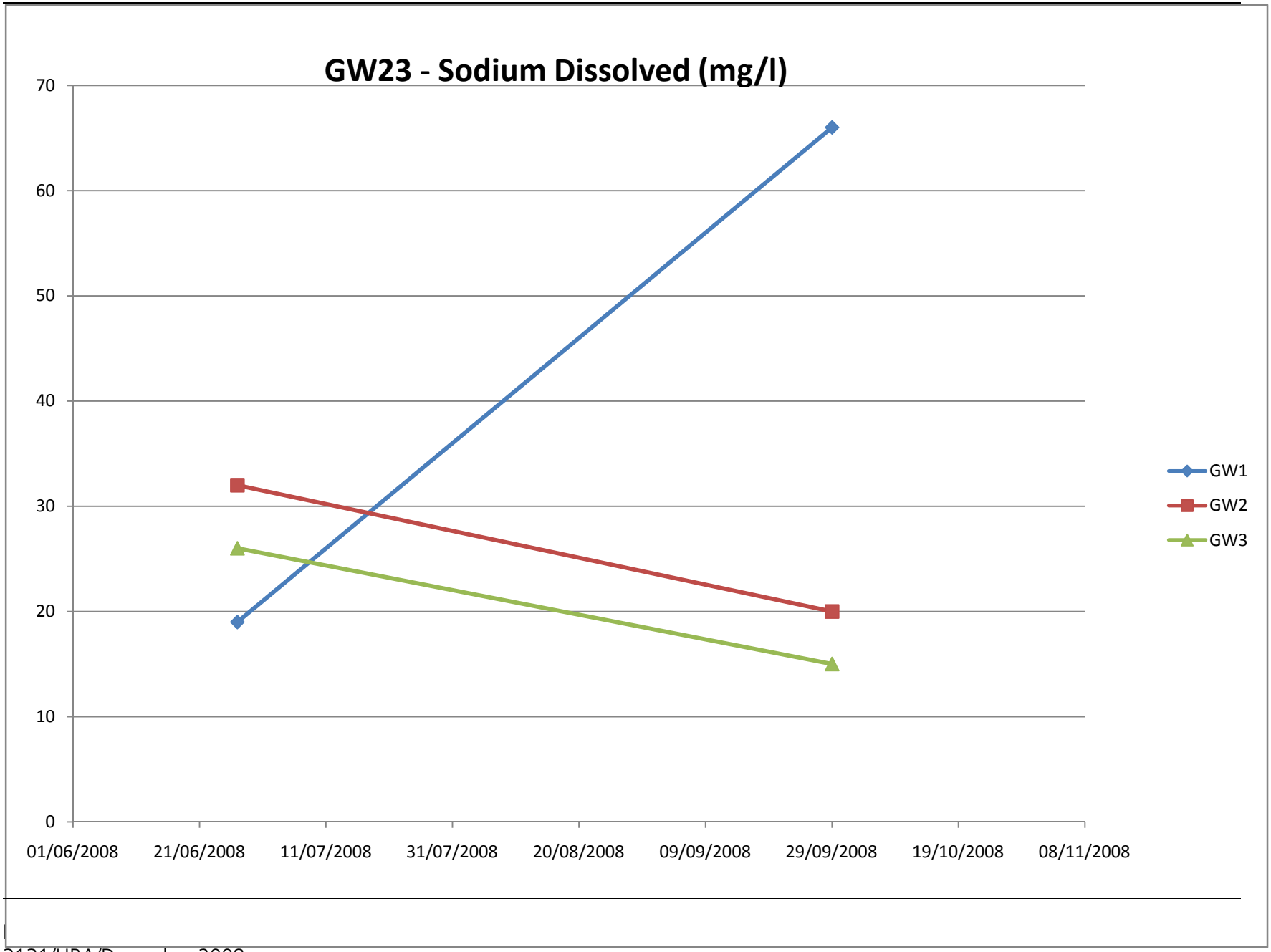

GW18 - Total PAHs (ng/l)
120
100
80
60
40
20
0
01/06/2008
21/06/2008
11/07/2008
31/07/2008
20/08/2008
09/09/2008
29/09/2008
19/10/2008
08/11/2008
GW1
GW2
GW3

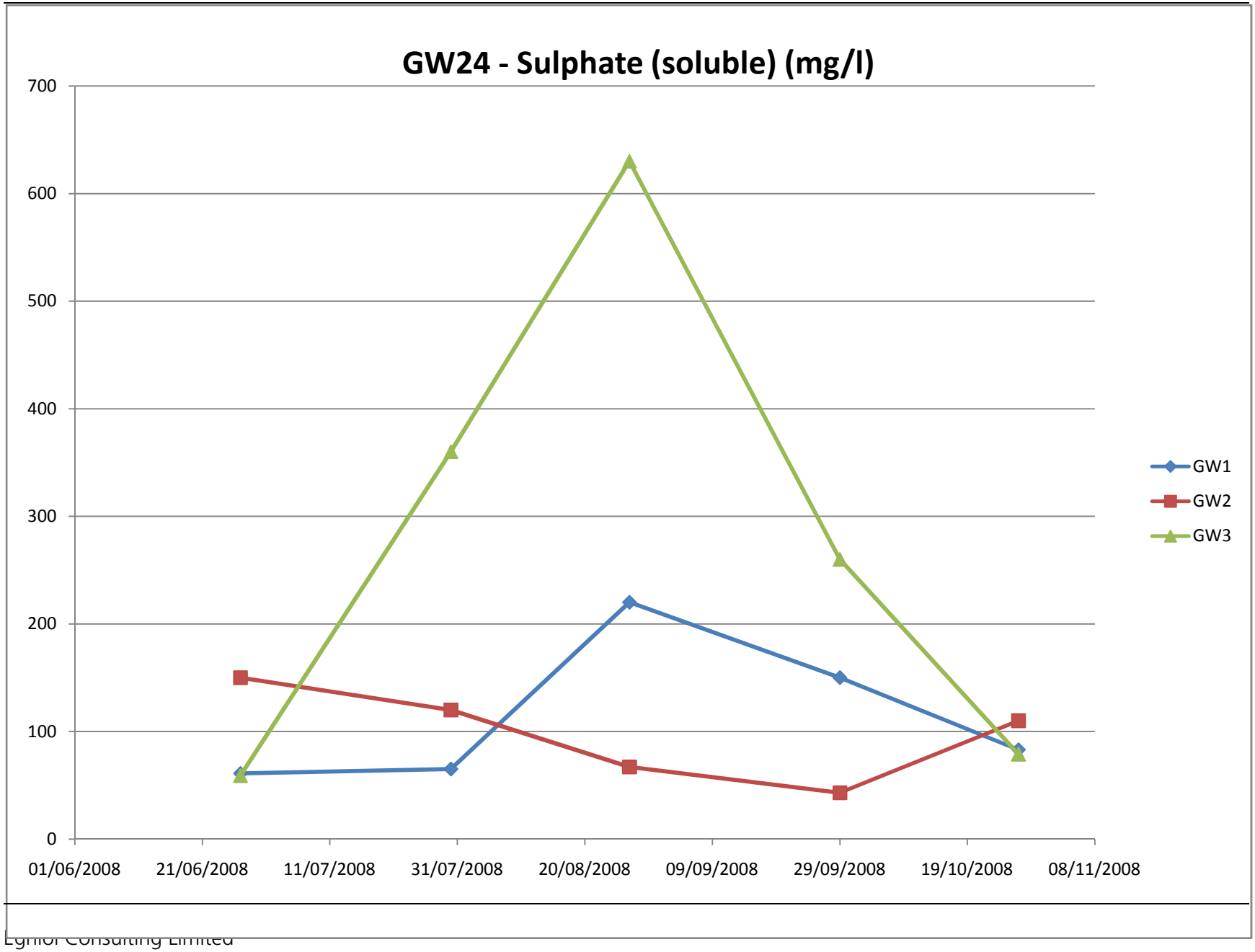

GW19 - pH value
8.00
7.90
7.80
7.70
7.60
7.50
7.40
01/06/2008
21/06/2008
11/07/2008
31/07/2008
20/08/2008
09/09/2008
29/09/2008
19/10/2008
08/11/2008
GW1
GW2
GW3

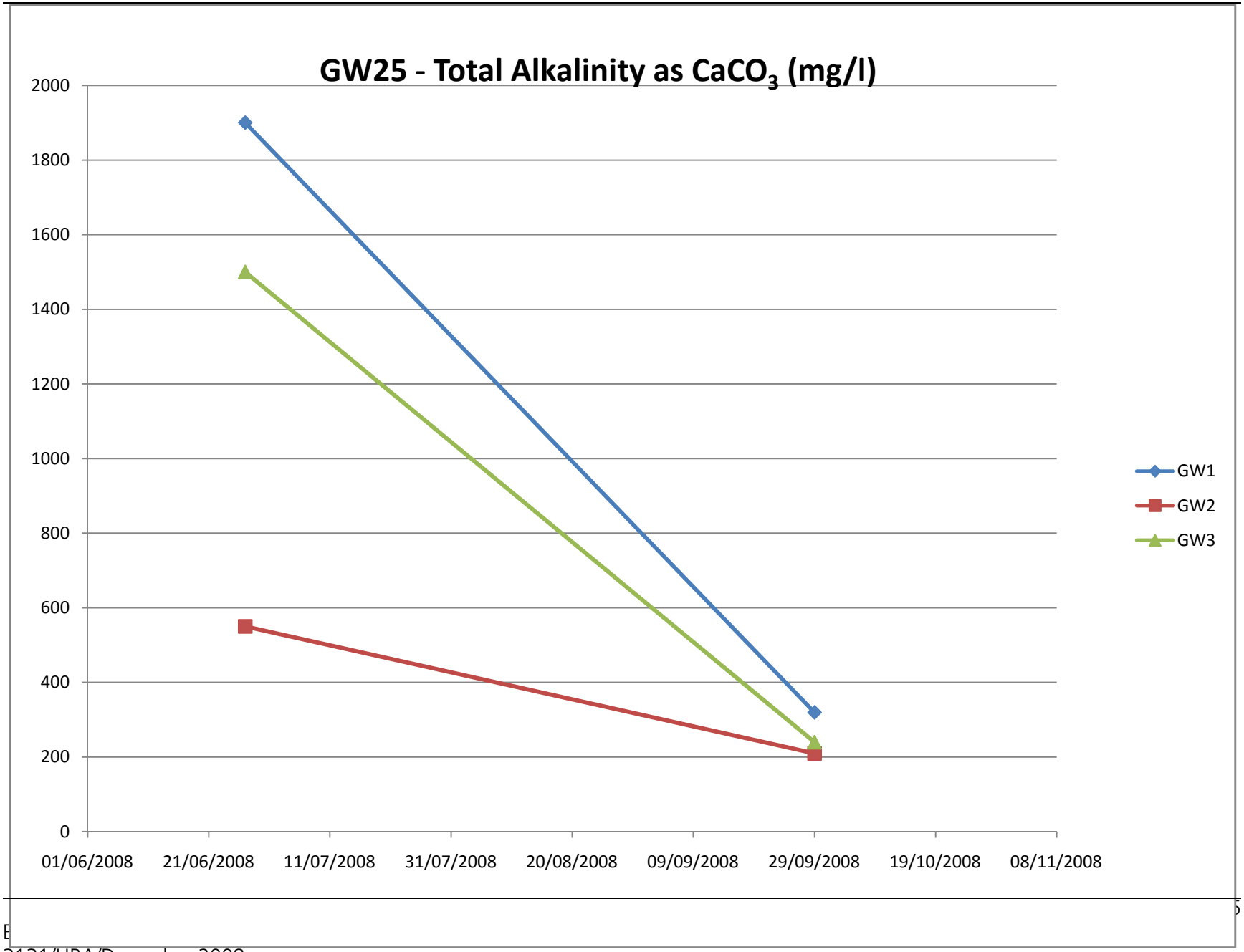

GW20 - Phenols (mg/l)
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
01/06/2008
21/06/2008
11/07/2008
31/07/2008
20/08/2008
09/09/2008
29/09/2008
19/10/2008
08/11/2008
GW1
GW2
GW3

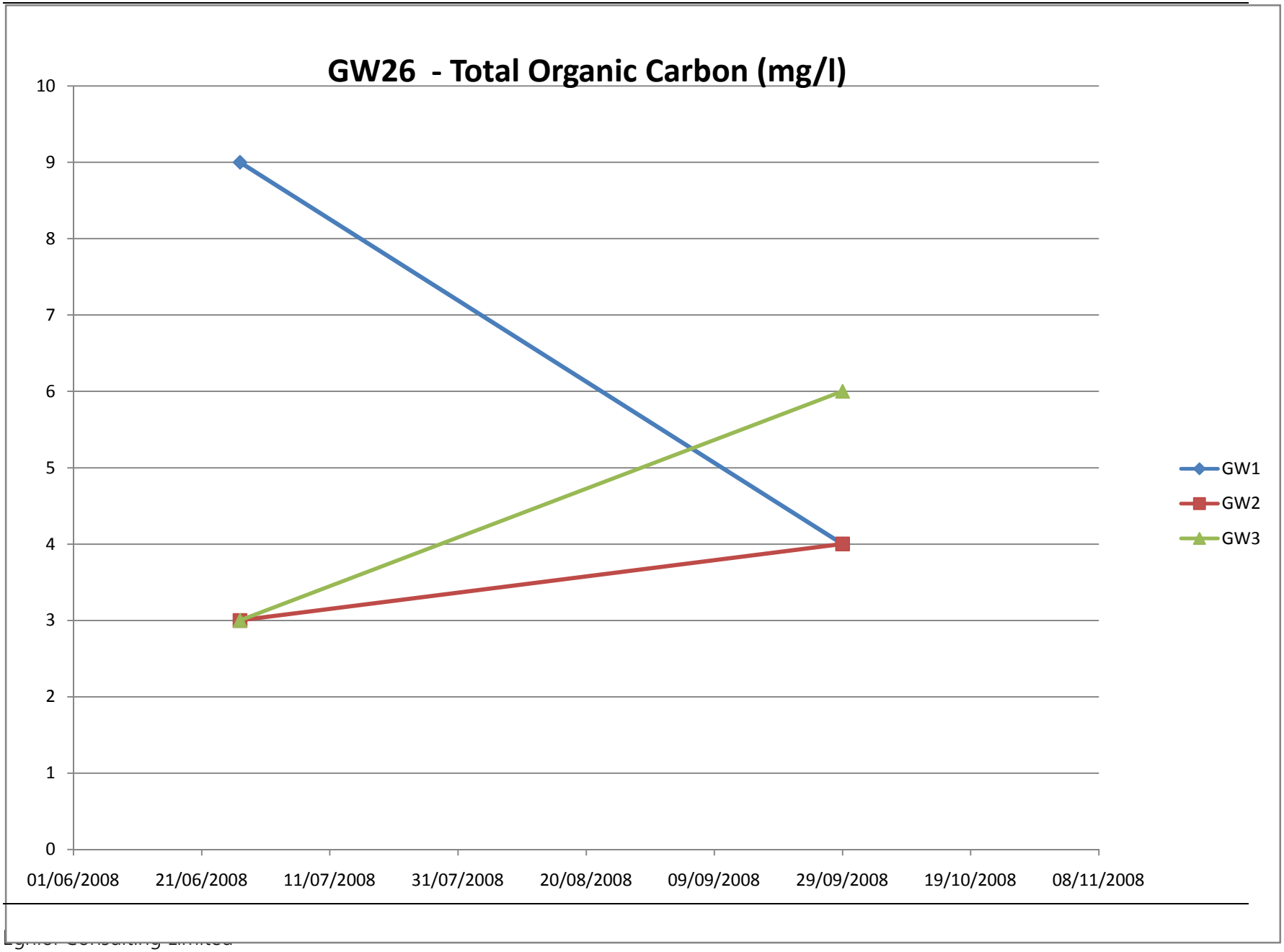

GW21 - Potassium Dissolved (mg/l)
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
01/06/2008
21/06/2008
11/07/2008
31/07/2008
20/08/2008
09/09/2008
29/09/2008
19/10/2008
08/11/2008
GW1
GW2
GW3

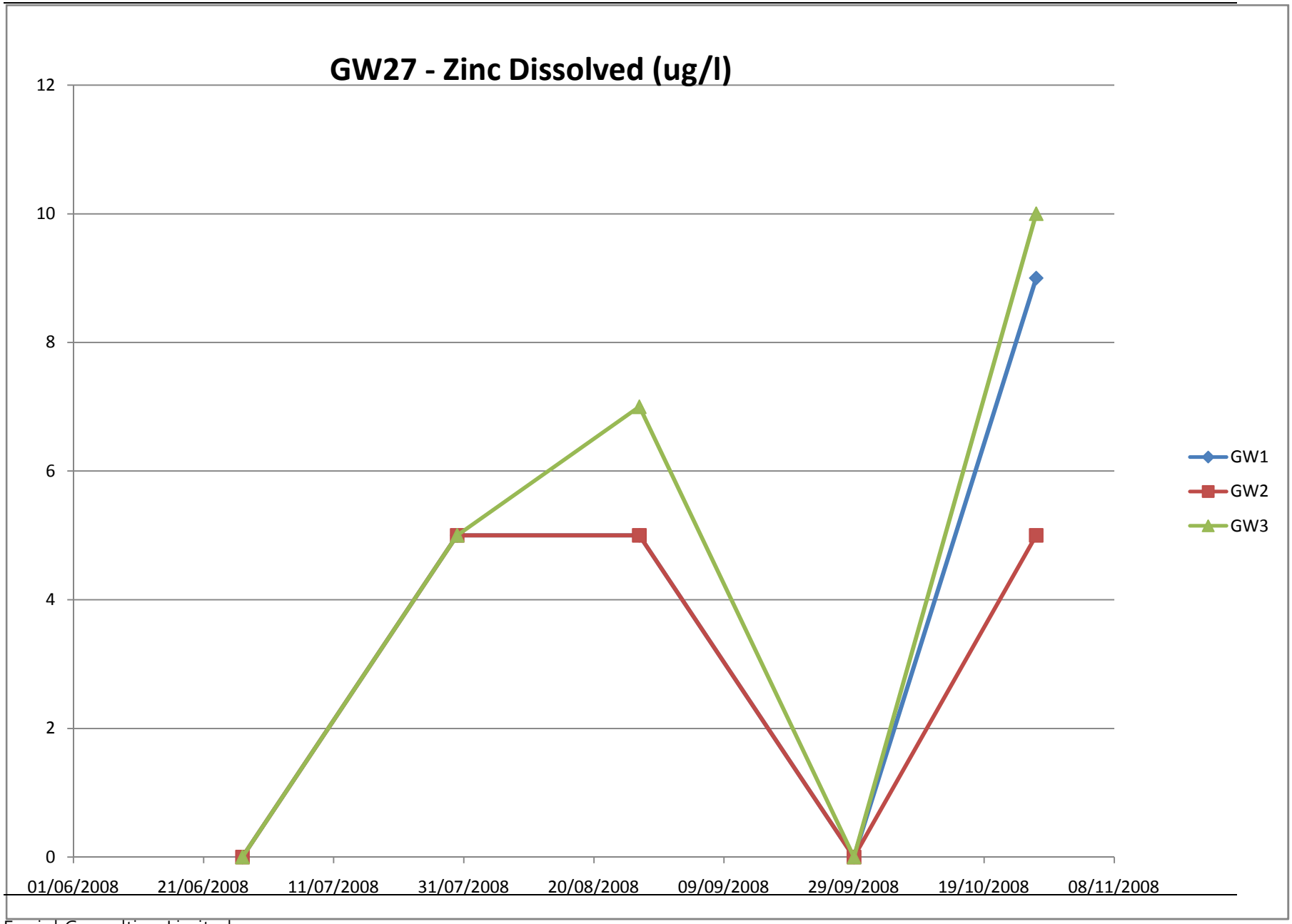

GW22 - Selenium Dissolved (ug/l)
3.5
3
2.5
2
1.5
1
0.5
0
01/06/2008
21/06/2008
11/07/2008
31/07/2008
20/08/2008
09/09/2008
29/09/2008
19/10/2008
08/11/2008
GW1
GW2
GW3


GW23 - Sodium Dissolved (mg/l)
70
60
50
40
30
20
10
0
01/06/2008
21/06/2008
11/07/2008
31/07/2008
20/08/2008
09/09/2008
29/09/2008
19/10/2008
08/11/2008
GW1
GW2
GW3


GW24 - Sulphate (soluble) (mg/l)
700
600
500
400
300
200
100
0
01/06/2008
21/06/2008
11/07/2008
31/07/2008
20/08/2008
09/09/2008
29/09/2008
19/10/2008
08/11/2008
GW1
GW2
GW3


GW25 - Total Alkalinity as CaCO3 (mg/l)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
01/06/2008
21/06/2008
11/07/2008
31/07/2008
20/08/2008
09/09/2008
29/09/2008
19/10/2008
08/11/2008
GW1
GW2
GW3


GW26 - Total Organic Carbon (mg/l)
10
9
8
7
6
5
4
3
2
1
0
01/06/2008
21/06/2008
11/07/2008
31/07/2008
20/08/2008
09/09/2008
29/09/2008
19/10/2008
08/11/2008
GW1
GW2
GW3


GW27 - Zinc Dissolved (ug/l)
12
10
8
6
4
2
0
01/06/2008
21/06/2008
11/07/2008
31/07/2008
20/08/2008
09/09/2008
29/09/2008
19/10/2008
08/11/2008
GW1
GW2
GW3

		Cadmium D	Chromium I	Iron Dissolv	Lead Dissol	Manganese	Nickel Diss	Zinc Dissolv	BOD	COD	Dissolved O	Conductivity	Nitrate as N	Nitrite as N	Sulphate (sc	Chloride	Phosphate (
mple Identi	**Sampled Date**	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	mg/l	mg/l	mg/l	mS/cm	mg/l	mg/l	mg/l	mg/l	mg/l
		<0.4	<1	<5	<1	<1	<1	<3	<1	<5	<1	<0.014	<0.3	<0.05	<3	<1	<0.08
GW1	27/06/2008	-	2	<50	<0.4	6	-	-	-	630	7	0.61	4.6	0.40	61	26	-
GW1	30/07/2008	<0.22					19	<5			7	0.64			65	31	
GW1	27/08/2008	0.35					16	<5			5	0.87			220	48	
GW1	29/09/2008	-	2	57	<0.4	13	16	-	-	300	7	0.84	7.0	0.71	150	41	
GW1	27/10/2008	<0.22					10	9			7	0.69			83	30	
GW2	27/06/2008	-	1	<50	<0.4	<1	-	-	-	120	8	0.85	35	0.09	150	38	-
GW2	30/07/2008	<0.22					6.3	<5			8	0.83			120	37	
GW2	27/08/2008	0.24					6.1	<5			7	0.79			67	31	
GW2	29/09/2008	-	3	<50	<0.4	7	3.7	-	-	66	6	0.77	31	<0.05	43	28	
GW2	27/10/2008	<0.22					2.4	<5			4	0.84			110	35	
GW3A	27/06/2008	-	3	<50	<0.4	6	-	-	-	120	6	0.73	8.3	10	59	46	-
GW3A	30/07/2008	<0.22					55	<5			5	1.5			360	150	
GW3A	27/08/2008	<0.22					90	7			3	1.9			630	130	
GW3A	29/09/2008	-	4	<50	<0.4	470	40	-	-	340	3	1.1	2.3	0.07	260	57	
GW3A	27/10/2008	<0.22					61	10			4	0.91			79	38	
W 1	30/04/2007		<1	87	2	350	34		<1	21	9	1.1	<0.3	<0.05	290	38	<0.08
W 2	30/04/2007		3	30	<1	<1	2		<1	14	8	0.60	9.5	0.09	24	27	0.18
W 3	30/04/2007		<1	87	<1	210	25		<1	19	9	1.0	0.8	<0.05	280	37	<0.08
W 4	30/04/2007		1	68	<1	4	2		2	21	9	0.55	4.0	<0.05	20	23	<0.08
W1	19/08/2005												3.2		216	36	<0.1
W1	01/12/2005												10.7		237	32	<0.1
W1	17/02/2006												28		227	15.8	<0.1
W1	17/03/2006												16.3		277	34	<0.1
W1	18/04/2006												34		221	11	<0.1
W1	20/07/2006											0.964	1.4		254	32	<0.1
W1	16/08/2006												3.4		167	32	<0.1
W1	26/09/2006											1.112	16.2		258	34	<0.3 *
W1	17/10/2006												15.6		237	31	<0.1
W1	09/11/2006											0.968	8.9		224	27	<0.1
W1	21/12/2006											1.006	20.2		249	28	
W1	15/01/2007												20.3		214	36	
W1	15/02/2007												7.3		340	39	<1.0
W1	16/03/2007											0.967	15.5		300	32	
W1	31/05/2007		3	120	<1	140	32		2	19	12	1.0	<0.3	<0.05	280	38	<0.08
W1	28/06/2007	<0.4	5	26	<1	390	30	<3			9	1.1	<0.3	<0.05	300	38	<0.08
W1	30/07/2007	-	2	64	<1	170	28	-	3	12	11	0.94	5.7	0.06	210	29	<0.08
W1	29/08/2007	-	<1	75	<1	66	41	-	1	20	10	1.0	7.7	0.07	270	32	<0.08
W1	24/10/2007	<0.4	<1	110	<1	250	35	58	3	10	11	1.1	3.8	<0.05	190	41	<0.08
W1	24/01/2008	-	2	36	<1	220	29	-	3	42	9	1.1	21	0.09	290	42	<0.08
W1	27/02/2008	-	<1	<50	<0.5	9	2.7	-	3	140	10	0.69	12	0.12	68	42	<0.08
W1	31/03/2008	<0.22	22	86	<0.4	170	54	15	NDP	11	10	1.0	9.9	0.05	280	34	<0.08
W1	02/05/2008	-					-	-			13	1.0			270	36	
W1	27/06/2008	<0.22	1	<50	<0.4	75	57	71	1	12	9	1.0	4.5	<0.05	440	25	<0.08
W1	30/07/2008	-					-	-			9	0.90			270	30	
W1	27/08/2008	-					-	-			11	0.97			230	32	

		Cadmium D	Chromium I	Iron Dissolv	Lead Dissol	Manganese	Nickel Diss	Zinc Dissolv	BOD	COD	Dissolved O	Conductivity	Nitrate as N	Nitrite as N	Sulphate (sc	Chloride	Phosphate (
mple Identi	**Sampled Date**	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	mg/l	mg/l	mg/l	mS/cm	mg/l	mg/l	mg/l	mg/l	mg/l
W1	29/09/2008	<0.22	1	<50	<0.4	340	30	10	4	33	12	1.0	5.3	<0.05	270	43	
W1	27/10/2008	-					-	-			9	0.91			290	29	
W1	05/01/2006												11.4		331	30	<0.1
W1	05/06/2006											0.995	8		199	34	<0.1
W2	09/06/2005												8.7		24	23	1.2
W2	19/08/2005												<1.0		21	42	8.5
W2	17/02/2006												25		27	19.5	<0.1
W2	11/05/2006											0.635	26		19	13.2	<0.1
W2	16/08/2006												<1.0		23	70	14.1
W2	09/11/2006											0.636	11.9		35	20	0.3
W2	15/02/2007												15		24	27	<1.0
W2	31/05/2007		3	73	<1	130	2		1	23	7	0.73	2.0	0.23	27	33	0.77
W2	28/06/2007	<0.4	4	27	<1	1	2	<3			7	0.65	<0.3	0.06	31	31	0.21
W2	30/07/2007	-	3	61	<1	6	1	-	2	<10	8	0.63	13	0.22	24	22	<0.08
W2	29/08/2007	-	1	58	<1	2	2	-	<1	<10	6	0.63	18	0.50	23	21	0.33
W2	24/10/2007	<0.4	<1	<5	<1	8	2	24	2	<10	10	0.67	14	0.16	27	27	0.12
W2	24/01/2008	-	1	26	<1	8	2	-	1	6	9	0.59	17	<0.05	37	27	<0.08
W2	27/02/2008	-	1	<50	1.1	3	4.6	-	2	21	10	0.62	12	0.07	25	33	<0.08
W2	31/03/2008	<0.22	15	80	1.1	25	2.2	5	NDP	<10	10	0.63	11	0.08	23	30	<0.08
W2	02/05/2008	-					-	-			10	0.64			23	28	
W2	27/06/2008	<0.22	3	<50	<0.4	1	2.9	15	2	19	9	0.53	8.9	0.20	33	27	<0.08
W2	30/07/2008	-					-	-			8	0.60			32	33	
W2	27/08/2008	-					-	-			7	0.62			26	25	
W2	29/09/2008	<0.22	3	<50	<0.4	3	2.1	6	2	8	7	0.63	9.2	<0.05	23	23	
W2	27/10/2008	-					-	-			8	0.52			18	23	
W3	09/06/2005												10.1		24	25	1.2
W3	19/08/2005												<1.0		18	47	9.4
W3	17/02/2006												26		70	18.5	<0.1
W3	11/05/2006											0.64	27		20	12.5	<0.1
W3	16/08/2006												9.5		34	67	10.6
W3	09/11/2006											0.646	11.8		39	21	0.3
W3	15/02/2007												12.1		18	30	<1.0
W3	31/05/2007		3	61	<1	3	3		2	19	9	0.72	13	0.80	32	36	0.64
W3	28/06/2007	<0.4	3	42	<1	110	23	<3			9	1.1	<0.3	<0.05	300	35	<0.08
W3	30/07/2007	-	<1	77	<1	20	11	-	3	<10	10	0.77	9.8	0.05	110	25	<0.08
W3	29/08/2007	-	<1	67	<1	13	24	-	<1	13	9	0.88	11	0.10	190	28	0.10
W3	24/10/2007	<0.4	2	<5	<1	4	12	22	2	<10	10	0.92	6.7	0.06	130	37	<0.08
W3	24/01/2008	-	<1	68	<1	11	8	-	2	18	10	0.71	19	0.07	80	31	<0.08
W3	27/02/2008	-	1	<50	1.5	4	2.0	-	1	10	10	0.62	13	0.05	28	32	<0.08
W3	31/03/2008	<0.22	<1	57	<0.4	28	11	15	NDP	<10	10	0.71	11	0.07	78	32	<0.08
W3	02/05/2008	-					-	-			9	0.63			23	28	
W3	27/06/2008	<0.22	2	<50	<0.4	6	32	11	1	14	9	0.85	6.1	0.09	290	26	<0.08
W3	30/07/2008	-					-	-			9	0.74			140	31	
W3	27/08/2008	-					-	-			9	0.80			150	29	
W3	29/09/2008	<0.22	1	<50	<0.4	72	12	16	2	9	9	0.77	7.9	<0.05	100	30	
W3	27/10/2008	-					-	-			10	0.58			61	24	

		Cadmium D	Chromium I	Iron Dissolv	Lead Dissol	Manganese	Nickel Diss	Zinc Dissolv	BOD	COD	Dissolved O	Conductivity	Nitrate as N	Nitrite as N	Sulphate (so	Chloride	Phosphate (
mple Identi	**Sampled Date**	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	mg/l	mg/l	mg/l	mS/cm	mg/l	mg/l	mg/l	mg/l	mg/l
W4	31/05/2007		3	120	2	25	2		<1	10	9	0.65	26	<0.05	26	24	0.12
W4	28/06/2007	<0.4	5	110	1	2	11	23			7	0.66	<0.3	<0.05	31	25	-
W4	30/07/2007	<0.4	-	-	-	-	26	11	-	-	8	0.64	-	-	24	22	-
W4	29/08/2007	<0.4	-	-	-	-	2	<3	-	-	7	0.62	-	-	25	20	-
W4	24/10/2007	<0.4	6	<5	<1	<1	<1	11	-	<10	8	0.67	27	<0.05	27	27	<0.08
W4	24/01/2008	<0.4	-	-	-	-	2	<3	-	-	9	0.63	-	-	27	26	-
W4	27/02/2008	<0.5	-	-	-	-	<1.5	<5	-	-	9	0.64	-	-	24	26	-
W4	31/03/2008	-	<1	<50	<0.4	3	2.4	-	-	<10	9	0.63	24	<0.05	22	25	-
W4	02/05/2008	<0.22					2.4	16			6	0.65			23	25	
W5	24/10/2007	<0.4	8	<5	<1	2	2	86	-	<10	9	0.71	32	<0.05	27	26	<0.08
W5	24/01/2008	<0.4	-	-	-	-	2	13	-	-	8	0.69	-	-	27	31	-
W5	27/02/2008	<0.5	-	-	-	-	1.8	29	-	-	8	0.68	-	-	25	29	-
W5	31/03/2008	-	<1	54	0.4	2	3.2	-	-	14	9	0.68	25	<0.05	25	27	-
W5	02/05/2008	<0.22					2.0	21			4	0.70			27	26	
WELL	24/10/2007	<0.4	8	<5	1	6	3	8	-	<10	8	0.70	25	<0.05	30	33	<0.08
WELL	24/01/2008	<0.4	-	-	-	-	2	94	-	-	8	0.73	-	-	38	37	-
WELL	27/02/2008	<0.5	-	-	-	-	3.3	65	-	-	5	0.77	-	-	37	43	-
WELL	31/03/2008	-	<1	<50	0.5	2	3.1	-	-	<10	8	0.71	38	<0.05	28	36	-
WELL	02/05/2008	<0.22					2.6	63			3	0.72			32	37	

Ammoniaca	Total Organ	Total Suspe	pH Value	Total Oxidised N	TPH	TEM	Sulphide	Arsenic Dis	Calcium Dis	Arsenic Dis	Boron Dissc	Copper Diss	Magnesium	Phosphorus
mple I mg/l	mg/l	mg/l	pH Units	mg/l	mg/l	mg/l	mg/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
<0.2	<3	<6	<1.00											
GW 0.3	9	-	7.47	-					130000	1.3		<1.6	6200	<105
GW <0.2	-	-	7.73											
GW <0.2	-	-	7.68											
GW <0.2	4	-	7.64						130000	1.1		<1.6	8700	
GW 0.4	-	-	7.67											
GW 0.3	3	-	7.51	-					180000	0.76		<1.6	7500	<105
GW <0.2	-	-	7.76											
GW <0.2	-	-	7.43											
GW 0.2	4	-	7.65						140000	<0.75		<1.6	5400	
GW <0.2	-	-	7.80											
GW: 0.3	3	-	7.48	-					130000	3.1		<1.6	17000	<105
GW: <0.2	-	-	7.93											
GW: 0.2	-	-	7.63											
GW: <0.2	6	-	7.85						130000	11		<1.6	17000	
GW: <0.2	-	-	7.83											
W 0.2	9	10	8.11	<0.3	2									
W <0.2	6	<10	8.65	2.2	4									
W <0.2	8	14	8.13	<0.3	6									
W <0.2	6	26	8.42	0.9	<1									
W 0.2		<5				138								
w <0.1		129				<10	<0.1							
W 0.1		40				<10	<0.1							
W 0.2		874				<10	<0.1							
W <0.1		26				13	<0.1							
W <0.1		15	7.9			<10	<0.1							
w <0.1		29				<10	<0.1							
W 0.1		34	7.5			<10	<0.1							
w <0.1		107				<10	<0.1							
w 0.4		521	7.9			<10	<0.1							
w <0.1		98	7.7			<10	<0.1							
W 0.2		27				<10	<0.1							
W 2.2		27				<10	<0.1							
W <0.1		13	8.1			<10	<0.1							
W <0.2	6	19	8.22	<0.3	<1									
W <0.2	5	53	8.15	<0.3					230000	-		<1	16000	-
W <0.2	5	16	7.97	1.3										
W <0.2	6	24	7.96	1.8										
W 0.5	7		8.09						200000	2	13	<1	14000	
W 0.4	7	280	8.06											
W <0.2	4	580	8.20											
W 0.2	4	16	8.15	<0.3	4				200000	-		<1.6	-	-
W <0.2	6	15	8.04											
W <0.2	4	39	7.80	1.0					220000	-		3.6	-	-
W 0.4	6	280	8.14											
W <0.2	6	14	8.07											

	Ammoniaca	Total Organ	Total Suspe	pH Value	Total Oxidised N	TPH	TEM	Sulphide	Arsenic Dis	Calcium Dis	Arsenic Dis	Boron Dissc	Copper Diss	Magnesium	Phosphorus
mple I	mg/l	mg/l	mg/l	pH Units	mg/l	mg/l	mg/l	mg/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
W	0.3	7	74	8.00						180000	-		<1.6	-	
W	0.2	6	190	8.18											
W	<0.1		165				<10	<0.1							
W	<0.1		129				<10	<0.1							
W	0.2		10				12	<0.1							
W	24.8		22				106								
W	<0.1		23				<10	<0.1							
W	<0.1		38	8.1			<10	<0.1							
W	55.1		22				<10	<0.1							
W	<0.1		<5	8.1			<10	<0.1							
W	<0.1		5				<10	<0.1							
W	12	7	<10	8.27	0.5	<1									
W	<0.2	5	10	8.24	<0.3					130000	-		<1	4100	-
W	<0.2	4	12	8.14	3.1										
W	0.3	5	55	8.60	4.1										
W	0.2	5		8.47						130000	<1	<10	<1	4600	
W	<0.2	4	<6	8.60											
W	<0.2	3	33	8.39											
W	<0.2	5	8	8.29	2.5	2				110000	-		4.2	-	-
W	<0.2	4	<6	8.27											
W	0.3	<3	<6	8.00	2.1					110000	-		3.0	-	-
W	1.2	6	<6	8.33											
W	<0.2	5	<6	8.20											
W	<0.2	5	<6	8.26						120000	-		<1.6	-	
W	<0.2	5	<6	8.57											
W	<0.1		17				<10	<0.1							
W	29.4		210				134								
W	<0.1		21				<10	<0.1							
W	0.2		77	8			<10	<0.1							
W	42.6		15				<10	<0.1							
W	<0.1		24	8.2			<10	<0.1							
W	0.2		21				<10	<0.1							
W	8.8	7	<10	8.34	3.1	<1									
W	<0.2	5	14	8.19	<0.3					200000	-		<1	18000	-
W	<0.2	5	<10	8.21	9.8										
W	<0.2	6	<10	8.23	2.5										
W	0.2	6		8.25						170000	2	<10	<1	10000	
W	0.3	6	88	8.24											
W	<0.2	<3	23	8.33											
W	<0.2	3	17	8.26	2.6	3				120000	-		<1.6	-	-
W	0.2	5	<6	8.23											
W	0.3	7	10	7.96	1.4					180000	-		<1.6	-	-
W	0.3	6	30	8.23											
W	<0.2	5	<6	8.20											
W	<0.2	5	13	8.27						140000	-		<1.6	-	
W	<0.2	6	<6	8.56											

	Ammoniaca	Total Organ	Total Suspe	pH Value	Total Oxidised N	TPH	TEM	Sulphide	Arsenic Dis	Calcium Dis	Arsenic Dis	Boron Dissc	Copper Diss	Magnesium	Phosphorus
mple I	mg/l	mg/l	mg/l	pH Units	mg/l	mg/l	mg/l	mg/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
W	<0.2	3	<10	8.03	5.9	<1									
W	<0.2	2	-	7.78	-					120000	<1		31	5600	940
W	<0.2	-	-	7.72	-										
W	<0.2	-	-	8.37	-										
W	<0.2	3		8.33						98000	<1	<10	1	4300	
W	<0.2	-	-	8.25											
W	<0.2	-	-	8.27											
W	<0.2	3	-	8.23	-	-				120000	1.7		<1.6	5100	310
W	<0.2	-	-	8.07											
W	0.2	3		8.18						130000	<1	<10	<1	5600	
W	<0.2	-	-	8.12											
W	<0.2	-	-	8.27											
W	<0.2	<3	-	8.20	-	-				120000	2.9		<1.6	6000	<105
W	<0.2	-	-	8.13											
WE	<0.2	3		8.31						110000	<1	46	3	8500	
WE	<0.2	-	-	8.18											
WE	0.4	-	-	8.32											
WE	<0.2	<3	-	8.24	-	-				130000	1.5		9.4	8000	240
WE	0.2	-	-	8.24											

Selenium D	Mercury Dis	Total Alkali	Carbonate A	Bicarbonate	Potassium D	Sodium Dis	Phenols Mo	Mineral Oil	Naphthalene	Acenaphthy	Acenaphthe	Fluorene Ac	Phenanthren	Anthracene	Fluoranthen
mple I ug/l	ug/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	ug/l	ng/l	ng/l	ng/l	ng/l	ng/l	ng/l	ng/l
GW 3	<0.01	1900			2.6	19	<0.35	<10	<100	<11	<15	<14	36	<15	<17
GW															
GW															
GW 2		320			2.7	66	<0.01		<100	<11	<15	<14	<22	<15	<17
GW															
GW 2	<0.01	550			2.0	32	<0.35	<10	<100	<11	<15	<14	<22	<15	<17
GW															
GW															
GW <1		210			3.2	20	<0.01		<100	<11	<15	<14	<22	<15	<17
GW															
GW: 3	<0.01	1500			6.8	26	<0.35	1400	<100	<11	<15	<14	<22	<15	<17
GW:															
GW:															
GW: <1		240			1.2	15	<0.01		<100	<11	<15	<14	<22	<15	18
GW:															
W															
W															
W															
W															
W															
w															
W															
W															
W															
W															
w															
W															
w															
w															
w															
W															
W															
W															
W															
W -	<0.05		-	-	6.6	29	-	<10	<26	<11	<15	<14	<22	<15	<17
W															
W															
W 4	<0.05	290	<2	290	7.4	29	<0.01	<10	<26	<11	<15	<14	<22	<15	<17
W															
W															
W -	<0.01	210			4.8	15	-	<10	<100	<11	<15	<14	<22	<15	<17
W															
W -	<0.01	140			7.4	20	-	<10	<100	<11	<15	<14	<22	<15	<17
W															
W															

	Selenium D	Mercury Dis	Total Alkali	Carbonate A	Bicarbonate	Potassium D	Sodium Dis	Phenols Mo	Mineral Oil	Naphthalene	Acenaphthy	Acenaphthe	Fluorene Ac	Phenanthren	Anthracene	Fluoranthen
mple I	ug/l	ug/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	ug/l	ng/l	ng/l	ng/l	ng/l	ng/l	ng/l	ng/l
W	-		250			6.3	100	-		<100	<11	<15	<14	<22	<15	38
W																
W																
W																
W																
W																
W																
W																
W																
W																
W																
W																
W	-	<0.05		-	-	0.5	20	-	<10	<26	<11	<15	<14	<22	<15	<17
W																
W																
W	2	<0.05	290	<2	290	2.7	15	<0.01	<10	<26	<11	<15	<14	<22	<15	<17
W																
W																
W	-	<0.01	260			2.1	11	-	<10	<100	<11	<15	<14	<22	<15	<17
W																
W	-	<0.01	250			2.7	18	-	370	<100	<11	<15	<14	<22	<15	<17
W																
W																
W	-		220			6.3	33	-		<100	<11	<15	<14	<22	<15	<17
W																
W																
W																
W																
W																
W																
W																
W																
W	-	<0.05		-	-	6.0	26	-	<10	43	<11	<15	<14	<22	<15	<17
W																
W																
W	3	<0.05	310	<2	310	5.4	23	<0.01	<10	<26	<11	<15	<14	<22	<15	<17
W																
W																
W	-	<0.01	250			2.7	11	-	<10	<100	<11	<15	<14	<22	<15	<17
W																
W	-	<0.01	180			5.6	20	-	<10	<100	<11	<15	<14	<22	<15	<17
W																
W																
W	-		220			1.7	14	-		<100	<11	<15	<14	<22	<15	<17
W																

	Selenium D	Mercury Dis	Total Alkali	Carbonate A	Bicarbonate	Potassium D	Sodium Dis	Phenols Mo	Mineral Oil	Naphthalene	Acenaphthy	Acenaphthe	Fluorene Ac	Phenanthren	Anthracene	Fluoranthen
mple I	ug/l	ug/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	ug/l	ng/l	ng/l	ng/l	ng/l	ng/l	ng/l	ng/l
W																
W	<1	<0.05		<2	220	1.4	13	<0.01	<10	80	<11	<15	<14	<22	<15	<17
W																
W																
W	<1	<0.05	270	<2	270	1.5	12	<0.01	<10	<26	<11	<15	<14	<22	<15	<17
W																
W																
W	4	<0.01	260			1.1	12	0.01	<10	<100	<11	<15	<14	<22	<15	<17
W																
W:	<1	<0.05	280	<2	280	1.8	11	<0.01	<10	<26	<11	<15	<14	<22	<15	<17
W:																
W:																
W:	5	<0.01	280			1.4	13	0.01	<10	<100	<11	<15	<14	<22	<15	<17
W:																
WE	<1	<0.05	280	<2	280	5.3	14	<0.01	<10	<26	<11	<15	<14	<22	<15	<17
WE																
WE																
WE	3	<0.01	270			5.9	9.8	0.01	<10	<100	<11	<15	<14	<22	<15	<17
WE																

Pyrene Aqu	Benz(a)anth	Chrysene A	Benzo(b)flu	Benzo(k)flu	Benzo(a)pyr	Indeno(123	Dibenzo(ah	Benzo(ghi)p	PAH 16 Total Aqueous		
mple I ng/l	ng/l	ng/l	ng/l	ng/l	ng/l	ng/l	ng/l	ng/l	ng/l		
GW <15	<17	<13	<23	<27	<9	<14	<16	<16	<100		
GW											
GW											
GW <15	<17	<13	<23	<27	<9	<14	<16	<16	<100		
GW											
GW <15	<17	<13	<23	<27	<9	<14	<16	<16	<100		
GW											
GW											
GW <15	<17	<13	<23	<27	<9	<14	<16	<16	<100		
GW											
GW: 17	<17	<13	<23	<27	<9	<14	<16	<16	<100		
GW:											
GW:											
GW: 51	<17	15	<23	<27	<9	<14	<16	<16	<100		
GW:											
W											
W											
W											
W											
W											
w											
W											
W											
W											
W											
w											
W											
w											
w											
w											
W											
W											
W											
W											
W <15	<17	<13	<23	<27	<9	<14	<16	<16	<27		
W											
W											
W 16	<17	<13	<23	<27	<9	<14	<16	<16	<27		
W											
W											
W <15	<17	<13	<23	<27	<9	<14	<16	<16	<100		
W											
W <15	<17	<13	<23	<27	<9	<14	<16	<16	<100		
W											
W											

	Pyrene Aqu	Benz(a)anth	Chrysene A	Benzo(b)flu	Benzo(k)flu	Benzo(a)pyr	Indeno(123	Dibenzo(ah	Benzo(ghi)p	PAH 16 Total Aqueous		
mple I	ng/l	ng/l	ng/l	ng/l	ng/l	ng/l	ng/l	ng/l	ng/l	ng/l		
W	64	19	20	38	29	35	20	<16	29	290		
W												
W												
W												
W												
W												
W												
W												
W												
W												
W												
W												
W	<15	<17	<13	<23	<27	<9	<14	<16	<16	<27		
W												
W												
W	<15	<17	<13	<23	<27	<9	<14	<16	<16	<27		
W												
W												
W	<15	<17	<13	<23	<27	<9	<14	<16	<16	<100		
W												
W	<15	<17	<13	<23	<27	<9	<14	<16	<16	<100		
W												
W												
W	<15	<17	<13	<23	<27	<9	<14	<16	<16	<100		
W												
W												
W												
W												
W												
W												
W												
W												
W	25	<17	<13	<23	<27	<9	<14	<16	<16	68		
W												
W												
W	<15	<17	<13	<23	<27	<9	<14	<16	<16	<27		
W												
W												
W	15	<17	<13	<23	<27	<9	<14	<16	<16	<100		
W												
W	<15	<17	<13	<23	<27	<9	<14	<16	<16	<100		
W												
W												
W	<15	<17	<13	<23	<27	<9	<14	<16	<16	<100		
W												

	Pyrene Aqu	Benz(a)anth	Chrysene A	Benzo(b)flu	Benzo(k)flu	Benzo(a)pyr	Indeno(123	Dibenzo(ah	Benzo(ghi)p	PAH 16 Total Aqueous		
mple I	ng/l	ng/l	ng/l	ng/l	ng/l	ng/l	ng/l	ng/l	ng/l	ng/l		
W												
W	<15	<17	<13	<23	<27	<9	<14	<16	<16	80		
W												
W												
W	<15	<17	<13	<23	<27	<9	<14	<16	<16	<27		
W												
W												
W	<15	<17	<13	<23	<27	<9	<14	<16	<16	<100		
W												
W:	<15	<17	<13	<23	<27	<9	<14	<16	<16	<27		
W:												
W:												
W:	<15	<17	<13	<23	<27	<9	<14	<16	<16	<100		
W:												
WE	<15	<17	<13	<23	<27	<9	<14	<16	<16	<27		
WE												
WE												
WE	<15	<17	<13	<23	<27	<9	<14	<16	<16	<100		
WE												