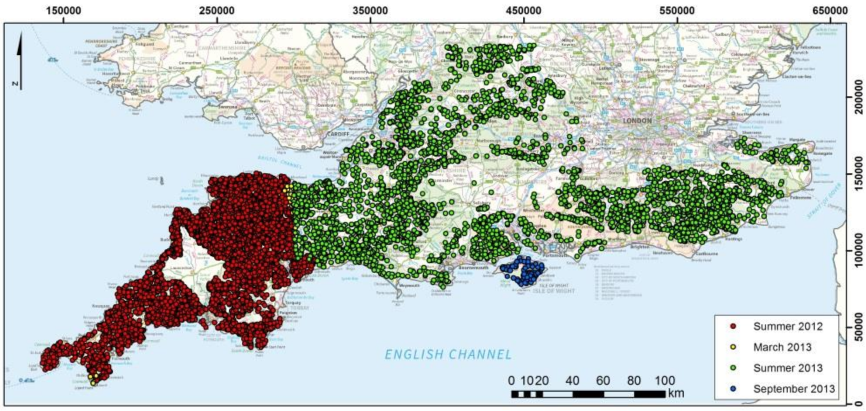
British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Quality control of 2012 and 2013 southern England G-BASE stream water sample data

Geoanalytics and Modelling Programme

Open Report OR/16/019



BRITISH GEOLOGICAL SURVEY

GEOANALYTICS AND MODELLING PROGRAMME

OPEN REPORT OR/16/019

Quality control of 2012 and 2013 southern England G-BASE stream water sample data

J M Bearcock and E L Ander

Keywords

QC, baseline geochemistry.

Front cover

Map showing all samples collected during the 2012 and 2013 field seasons

Bibliographical reference

BEARCOCK, J M AND ANDER, E L. 2016. Quality control of 2012 and 2013 southern England G-BASE stream water sample data. *British Geological Survey Open Report*, OR/16/019. 383pp.

Keyworth, Nottingham British Geological Survey 2016

BRITISH GEOLOGICAL SURVEY

The full range of our publications is available from BGS shops at Nottingham, Edinburgh, London and Cardiff (Welsh publications only) see contact details below or shop online at www.geologyshop.com

The London Information Office also maintains a reference collection of BGS publications, including maps, for consultation.

We publish an annual catalogue of our maps and other publications; this catalogue is available online or from any of the BGS shops.

The British Geological Survey carries out the geological survey of Great Britain and Northern Ireland (the latter as an agency service for the government of Northern Ireland), and of the surrounding continental shelf, as well as basic research projects. It also undertakes programmes of technical aid in geology in developing countries.

The British Geological Survey is a component body of the Natural Environment Research Council.

British Geological Survey offices

BGS Central Enquiries Desk

Tel 0115 936 3143 Fax 0115 936 3276
email enquiries@bgs.ac.uk

Environmental Science Centre, Keyworth, Nottingham NG12 5GG

Tel 0115 936 3241 Fax 0115 936 3488
email sales@bgs.ac.uk

Lyell Centre, Research Avenue South, Riccarton, Edinburgh EH14 4AP

Tel 0131 667 1000
email scotsales@bgs.ac.uk

Natural History Museum, Cromwell Road, London SW7 5BD

Tel 020 7589 4090 Fax 020 7584 8270
Tel 020 7942 5344/45 email bgslondon@bgs.ac.uk

Columbus House, Greenmeadow Springs, Tongwynlais, Cardiff CF15 7NE

Tel 029 2052 1962 Fax 029 2052 1963

Maclean Building, Crowmarsh Gifford, Wallingford OX10 8BB

Tel 01491 838800 Fax 01491 692345

Geological Survey of Northern Ireland, Dundonald House, Upper Newtownards Road, Ballymiscaw, Belfast, BT4 3SB

Tel 028 9038 8462

www.bgs.ac.uk/gsni/

Parent Body

Natural Environment Research Council, Polaris House, North Star Avenue, Swindon SN2 1EU

Tel 01793 411500 Fax 01793 411501
www.nerc.ac.uk

Website www.bgs.ac.uk
Shop online at www.geologyshop.com

Foreword

This report is one of a series reporting quality control (QC) evaluation undertaken on the G-BASE stream water sample data. It provides data users with background information supplied by the laboratories and the further checks applied by the project to assess the data's fitness-for-purpose for regional baseline mapping. The information held in this report is correct as of March 2016.

Acknowledgements

The authors would like to acknowledge the efforts of all field team staff and voluntary workers in contributing to data collection and in-field QC of the water samples and data. Those managing the Geochemistry Database, where these data are uploaded, are thanked. The analysts providing the majority of the data used in this report are acknowledged below. This report has benefitted from the review of Simon Chenery.

Data reporting

Michael Watts, Charlie Gowing, and Simon Chenery

ICP-MS Analysis

Tom Barlow and Elliott Hamilton

IC and DOC analyses

Claire Richardson, Heather Harrison, Joseph Warham, Kaitlin Button, Aurélie Devez, Andy Marriott, Chiara Petrillo, Doris Wagner and Amy Burton.

Contents

FIGURES

TABLES

Summary

This report has been written to accompany the uploading of the 2012 and the 2013 G-BASE southern England stream water data to the BGS corporate Geochemistry Database. A limited number (n = 1473/3633) of the samples collected in 2013 were fully analysed in the laboratory: all available data has been loaded to the database. This report documents the quality control (QC) procedures used to check the data prior to uploading. Where limitations have been identified coded "qualifiers" were appended to the data. The post analysis excess filtered water samples are stored in the BGS Keyworth National Geoscience Data Centre cold-store archive.

Each QC step is described within each chapter of this report, and any specific problems identified. Extensive appendices support these chapters providing more detailed information, graphs and maps. These should be consulted for more specific information about a QC process or specific analyte. Attention is drawn to the particularly wet weather experienced during the 2012 sampling campaign.

As a result of the QC process, information on the 68 analytes determined on the 2012/13 can be summarised as below:

Analytes with no significant limitations identified within the QC process (n=60)	Al, Alkalinity, As, B, Ba, Be, Br, Ca, Cd, Ce, Cl, Co, Conductivity, Cr, Cs, Cu, DOC, Dy, Er, Eu, F, Fe, Gd, Ho, HPO_4, K, La, Li, Lu, Mg, Mn, Mo, Na, Nd, Ni, NO_2, NO_3, P, Pb, pH, Pr, Rb, S, Sb, Se, Si, Sm, SO_4, Sr, Tb, Th, Ti, Tl, Tm, U, V, Y, Yb, Zr
Analytes where the majority (>80%) of data are below the detection limit or limit of quantification	Ag, Bi, Ga, Hf, Nb, Ta, W
Analytes where blank waters compromise sample site data	*None*
Analytes where data are considered unreliable	Sn

1 Introduction

This report describes the quality control of the laboratory analyses of stream water samples collected in south west England during the summer of 2012 and some of those collected in 2013. The samples are part of the Geochemical Baseline Survey of the Environment (G-BASE) project. The analytical work was undertaken in the laboratories at the British Geological Survey (BGS) in Keyworth.

The sample collection and field office methods followed the procedures described in Johnson (2005a), and with updates reported by Johnson (2005b). Stream water sampling methods were unchanged from 2010, the previous field season in which water samples were taken (Ander, 2014; Bearcock et al., 2016; Bearcock and Strutt, 2012).

As the G-BASE project was due for completion by 2014 there were strict time and budget restraints. This meant that stream sediment samples taken by the BGS's Mineral Reconnaissance Program (MRP) in the 1980s, and archived in BGS, could be reanalysed. Where MRP samples had been taken in close proximity to a planned G-BASE sample, only water samples were taken from that site. At all other sites stream sediments, panned concentrates, and water samples were collected as standard. Laboratory analysis for the 2013 samples was restricted due to financial constraints. The samples which were analysed are described more fully in Section 2.

2 Samples submitted

A total of 7398 water samples were collected during the field seasons of 2012 and 2013. Of these 6782 were routine drainage sample sites, 624 were control samples (duplicates, replicates, blanks and standards) and 71 were temporal monitor sites (see Section 8) from 3 locations (see Table 2.1). This report describes the quality control of the data reported from the BGS laboratories during the 2013/2014 and 2014/2015 financial years. These data are presented in bold in Table 2.1.

Samples were taken in batches of 100. Within each "hundred" there were eight control samples, which were submitted "blind" to the analysts: two field collected duplicates which were later split to create two replicates, two blank waters which were inserted in the field and two reference materials which were inserted in the lab. Duplicate A doubles up as a normal sample site for geochemical mapping purposes.

During the main 2012 (batches 4700XX-4737XX) and 2013 (batches 4739XX- 4773XX and 4775XX, 4777XX, 4779XX and 4781XX) field seasons sampling was undertaken by two teams, sampling concurrently. Team A used odd numbered batches, and Team B used even numbered batches. During March 2013 (batch 4738XX) a staff team collected samples missed in 2012. In September 2013 (batch 4774XX) a single team completed sample coverage. Assessment of data for batches 4700XX – 4753XX are presented in this report.

At a drainage sample site the stream water samples were normally accompanied by stream sediment, panned heavy mineral concentrate, and (during 2012 only) vegetation samples (Johnson, 2005b). In some cases, for example after heavy rainfall, the streams were too deep to safely collect stream sediment, so only water samples were collected. Conversely after prolonged dry spells, some low order streams ceased to flow, a water sample was not collected but the remaining sample types were. In the latter instance a full batch of 100 sample numbers were allocated, but fewer than 100 water samples collected.

Table 2.1 summarises the above, while the spatial distribution is shown in Figure 2.1 to Figure 2.5

The samples were submitted to the laboratories at the BGS as ten analytical batches (Section 3), and sample numbering was undertaken using the random number lists (RNL) shown in Johnson (2005b). Team A used RNLs 1 and 3, and Team B used RNLs 2 and 4. Where a single team was sampling (March or September 2013), the RNL associated with the next available "hundred" was used (Table 2.2).

At each drainage site, including monitor sites, two filtered (<0.45 µm) were collected. One sample was collected in a Nalgene® 60mL high density polyethylene (HDPE) bottle, and was labelled with the sample number and "F/A" (filtered/ acidified). An air gap was left in the F/A bottle and at the end of the day the sample was acidified to 1% v/v with 600 µL of concentrated Aristar HNO_3. This process was undertaken using an Eppendorf auto pipette, and each bottle of acid was used for a single batch of 100 samples. The used bottles were labelled with the corresponding "hundred" to ensure traceability in the event of any trace element contamination becoming evident in the samples or the blank waters. After acidification these samples were stored in the fridge. On return to the BGS Keyworth laboratories the samples were further acidified with 300 µL concentrated HCl (0.5% v/v) prior to analysis.

The second filtered water sample was collected in a 30 mL HDPE bottle, which was filled to the brim. It was labelled with the sample number and "F/UA" (filtered unacidified). No preservative was added, and these samples were stored in the fridge after they had been returned from the field. Full details of the sampling and data recording methods can be found in Johnson (2005b)

Unfiltered samples were collected for the analysis of pH, conductivity, and alkalinity at the field base. If for any reason the F/A and F/UA could not be filtered in the field, an additional unfiltered sample was collected in a recycled 250 mL LDPE bottle. These were labelled with the sample number and “TBF” (to be filtered), and filtered on return to the field base. Where a TBF was collected it was indicated on the water sample checklist in case of any apparent perturbation of the trace element chemistry. There were 211 TBF in 2012 and 410 TBF in 2013, of which 150 were in the range of numbers with full analyses.

Table 2.1: Summary of aqueous samples collected during 2012-2013. Those with a full chemical analysis are presented in bold.

Hundred	Total Waters	sample sites*	Duplicates and replicates	Blanks	Standards	Monitor sites	Start date of sampling	last date of sampling
4700XX	**100**	**89**	**4**	**2**	**2**	**4**	**18/06/2012**	**22/06/2012**
4701XX	**100**	**93**	**4**	**2**	**2**	**0**	**11/06/2012**	**22/06/2012**
4702XX	**100**	**88**	**4**	**2**	**2**	**5**	**21/06/2012**	**26/06/2012**
4703XX	**100**	**93**	**4**	**2**	**2**	**0**	**15/06/2012**	**22/06/2012**
4704XX	**100**	**91**	**4**	**2**	**2**	**2**	**25/06/2012**	**30/06/2012**
4705XX	**100**	**93**	**4**	**2**	**2**	**0**	**21/06/2012**	**27/06/2012**
4706XX	**100**	**88**	**4**	**2**	**2**	**5**	**29/06/2012**	**04/07/2012**
4707XX	**100**	**93**	**4**	**2**	**2**	**0**	**26/06/2012**	**04/07/2012**
4708XX	**100**	**88**	**4**	**2**	**2**	**5**	**04/07/2012**	**10/07/2012**
4709XX	**100**	**93**	**4**	**2**	**2**	**0**	**02/07/2012**	**06/07/2012**
4710XX	**100**	**90**	**4**	**2**	**2**	**3**	**10/07/2012**	**13/07/2012**
4711XX	**100**	**93**	**4**	**2**	**2**	**0**	**06/07/2012**	**12/07/2012**
4712XX	**100**	**90**	**4**	**2**	**2**	**3**	**13/07/2012**	**17/07/2012**
4713XX	**100**	**93**	**4**	**2**	**2**	**0**	**11/07/2012**	**16/07/2012**
4714XX	**100**	**90**	**4**	**2**	**2**	**3**	**17/07/2012**	**20/07/2012**
4715XX	**100**	**93**	**4**	**2**	**2**	**0**	**16/07/2012**	**20/07/2012**
4716XX	**100**	**87**	**4**	**2**	**2**	**6**	**20/07/2012**	**26/07/2012**
4717XX	**100**	**93**	**4**	**2**	**2**	**0**	**19/07/2012**	**27/07/2012**
4718XX	**100**	**90**	**4**	**2**	**2**	**3**	**26/07/2012**	**30/07/2012**
4719XX	**100**	**93**	**4**	**2**	**2**	**0**	**24/07/2012**	**30/07/2012**
4720XX	**100**	**89**	**4**	**2**	**2**	**4**	**29/07/2012**	**02/08/2012**
4721XX	**100**	**93**	**4**	**2**	**2**	**0**	**28/07/2012**	**02/08/2012**
4722XX	**100**	**92**	**4**	**2**	**2**	**1**	**02/08/2012**	**07/08/2012**
4723XX	**100**	**93**	**4**	**2**	**2**	**0**	**01/08/2012**	**06/08/2012**
4724XX	**100**	**87****	**4**	**2**	**2**	**7**	**03/08/2012**	**09/08/2012**
4725XX	**100**	**93**	**4**	**2**	**2**	**0**	**06/08/2012**	**09/08/2012**
4726XX	**100**	**90**	**4**	**2**	**2**	**3**	**09/08/2012**	**13/08/2012**
4727XX	**100**	**93**	**4**	**2**	**2**	**0**	**09/08/2012**	**13/08/2012**
4728XX	**100**	**91**	**4**	**2**	**2**	**2**	**13/08/2012**	**15/08/2012**
4729XX	**100**	**93**	**4**	**2**	**2**	**0**	**13/08/2012**	**17/08/2012**
4730XX	**100**	**90**	**4**	**2**	**2**	**3**	**15/08/2012**	**20/08/2012**
4731XX	**100**	**93**	**4**	**2**	**2**	**0**	**16/08/2012**	**21/08/2012**
4732XX	**100**	**89**	**4**	**2**	**2**	**4**	**18/08/2012**	**23/08/2012**
4733XX	**100**	**93**	**4**	**2**	**2**	**0**	**21/08/2012**	**23/08/2012**
4734XX	**100**	**87**	**4**	**2**	**2**	**6**	**22/08/2012**	**27/08/2012**
4735XX	**100**	**93**	**4**	**2**	**2**	**0**	**23/08/2012**	**29/08/2012**
4736XX	**97**	**88**	**4**	**2**	**2**	**2**	**27/08/2012**	**29/08/2012**
4737XX	**66**	**64**	**0**	**0**	**2**	**0**	**27/08/2012**	**29/08/2012**
4738XX	**32**	**27**	**4**	**2**	**0**	**0**	**07/03/2013**	**21/03/2013**
4739XX	**99**	**92**	**4**	**2**	**2**	**0**	**10/06/2013**	**19/06/2013**
4740XX	**100**	**93**	**4**	**2**	**2**	**0**	**10/06/2013**	**19/06/2013**
4741XX	**97**	**90**	**4**	**2**	**2**	**0**	**13/06/2013**	**17/06/2013**
4742XX	**100**	**93**	**4**	**2**	**2**	**0**	**14/06/2013**	**18/06/2013**
4743XX	**98**	**91**	**4**	**2**	**2**	**0**	**17/06/2013**	**21/06/2013**
4744XX	**100**	**93**	**4**	**2**	**2**	**0**	**18/06/2013**	**24/06/2013**

Hundred	Total Waters	sample sites*	Duplicates and replicates	Blanks	Standards	Monitor sites	Start date of sampling	last date of sampling
4745XX	**96**	**89**	**4**	**2**	**2**	**0**	**21/06/2013**	**27/06/2013**
4746XX	**93**	**86**	**4**	**2**	**2**	**0**	**21/06/2013**	**29/06/2013**
4747XX	**90**	**83**	**4**	**2**	**2**	**0**	**26/06/2013**	**01/07/2013**
4748XX	**94**	**87**	**4**	**2**	**2**	**0**	**27/06/2013**	**02/07/2013**
4749XX	**95**	**88**	**4**	**2**	**2**	**0**	**29/06/2013**	**04/07/2013**
4750XX	**100**	**93**	**4**	**2**	**2**	**0**	**01/07/2013**	**08/07/2013**
4751XX	**85**	**78**	**4**	**2**	**2**	**0**	**03/07/2013**	**08/07/2013**
4752XX	**98**	**91**	**4**	**2**	**2**	**0**	**04/07/2013**	**12/07/2013**
4753XX	**96**	**89**	**4**	**2**	**2**	**0**	**08/07/2013**	**11/07/2013**
4754XX	95	88	4	2	2	0	10/07/2013	15/07/2013
4755XX	93	86	4	2	2	0	11/07/2013	16/07/2013
4756XX	95	88	4	2	2	0	15/07/2013	18/07/2013
4757XX	89	82	4	2	2	0	15/07/2013	18/07/2013
4758XX	92	85	4	2	2	0	18/07/2013	25/07/2013
4759XX	99	92	4	2	2	0	18/07/2013	24/07/2013
4760XX	92	85	4	2	2	0	24/07/2013	31/07/2013
4761XX	93	86	4	2	2	0	24/07/2013	30/07/2013
4762XX	94	87	4	2	2	0	01/07/2013	06/08/2013
4763XX	98	91	4	2	2	0	29/07/2013	31/07/2013
4764XX	89	82	4	2	2	0	03/08/2013	09/08/2013
4765XX	97	90	4	2	2	0	31/07/2013	06/08/2013
4766XX	91	84	4	2	2	0	08/08/2013	19/08/2013
4767XX	97	90	4	2	2	0	05/08/2013	07/08/2013
4768XX	93	86	4	2	2	0	14/08/2013	22/08/2013
4769XX	93	86	4	2	2	0	07/08/2013	09/08/2013
4770XX	93	86	4	2	2	0	20/08/2013	27/08/2013
4771XX	70	63	4	2	2	0	09/08/2013	14/08/2013
4772XX	87	80	4	2	2	0	24/08/2013	29/08/2013
4773XX	58	51	4	2	2	0	14/08/2013	20/08/2013
4774XX	76	69	4	2	2	0	22/09/2013	26/09/2013
4775XX	81	74	4	2	2	0	17/08/2013	21/08/2013
4777XX	84	77	4	2	2	0	21/08/2013	26/08/2013
4779XX	83	76	4	2	2	0	23/08/2013	28/08/2013
4781XX	28	21	4	2	2	0	27/08/2013	28/08/2013
Totals in 2012/13								
79	7396	6780	312	156	156	71	11/06/2012	26/09/2013
Totals discussed in this report								
54	**5236**	**4795**	**212**	**106**	**106**	**71**	**11/06/2012**	**12/07/2013**

*note that Duplicate A is also included as a sample site, so is counted twice in this table, **sample number 472421 is a monitor site, but is also included as a sample site so is counted twice in this table.

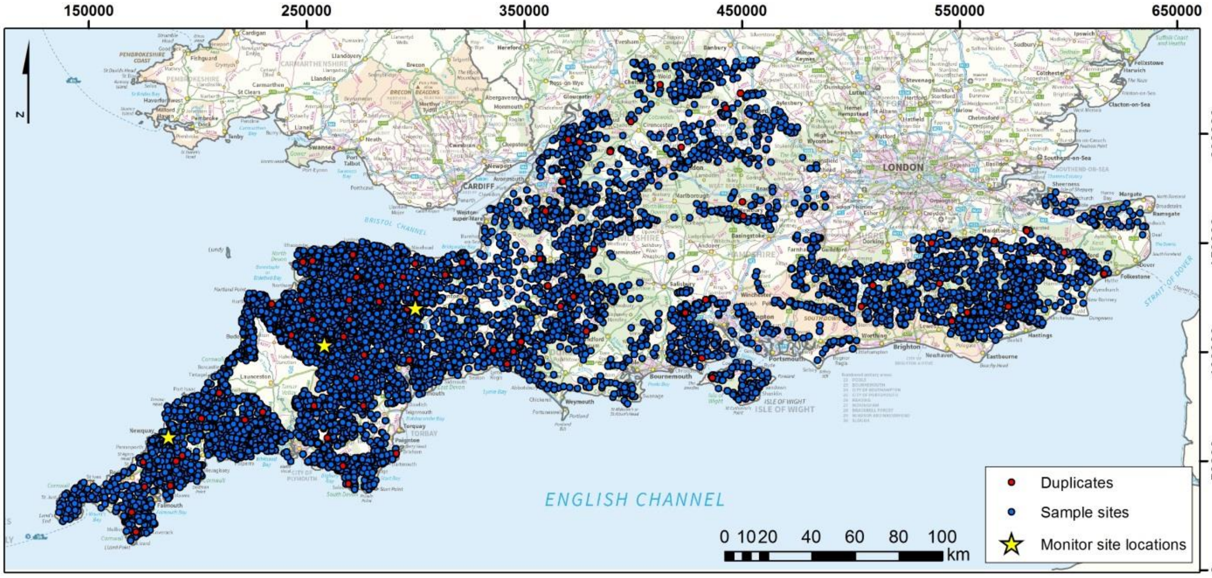


Figure 2.1 Location of samples and control sample sites collected in 2012-2013

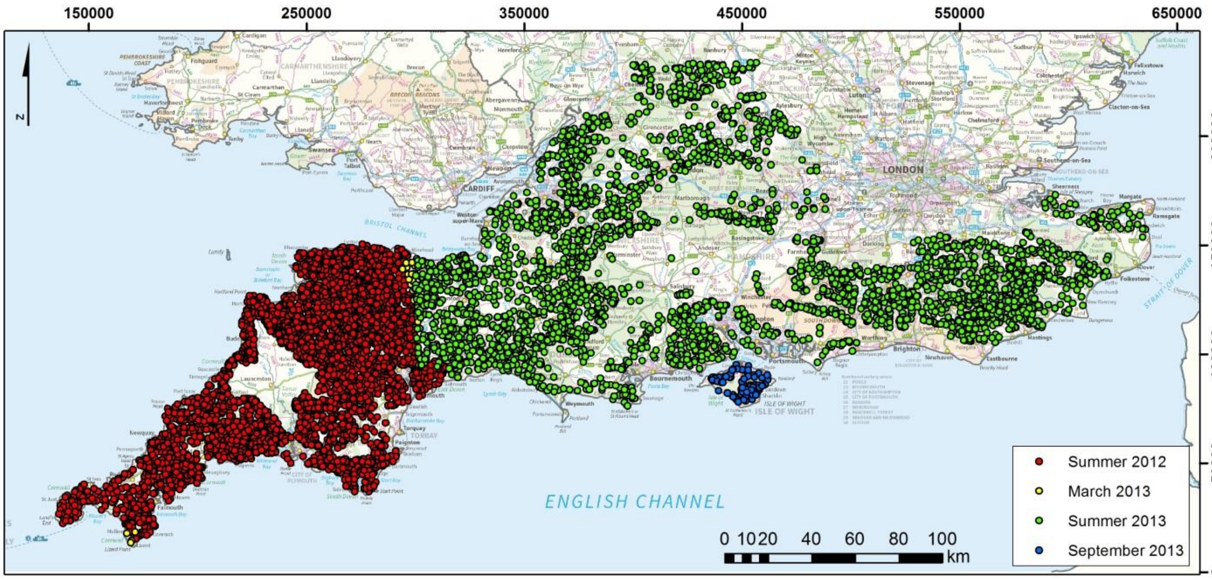


Figure 2.2: Field season of sample collection.

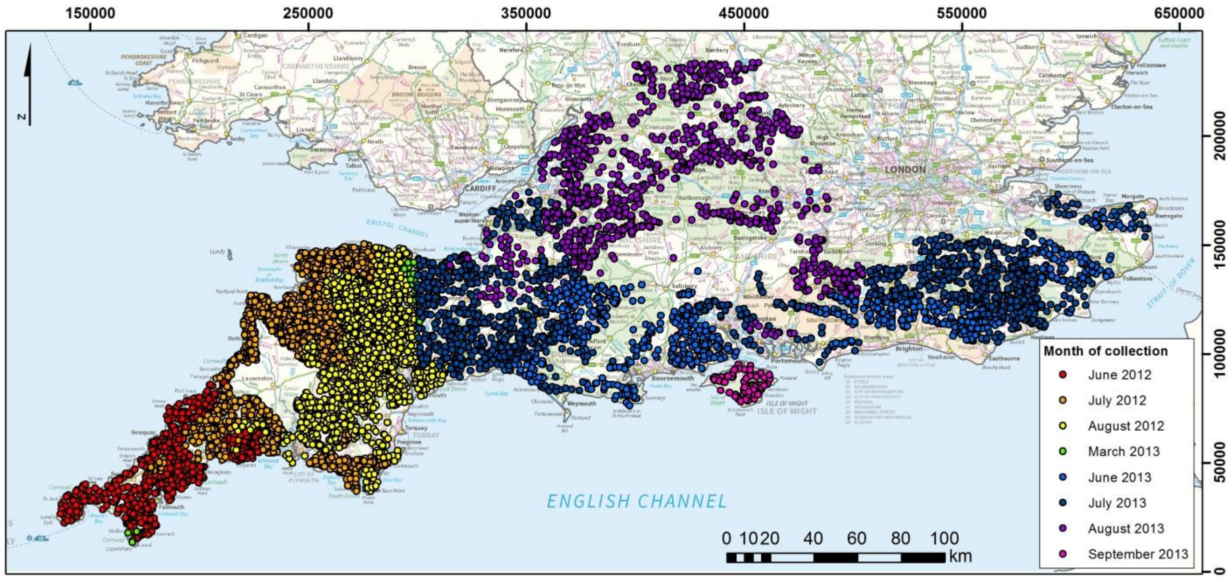


Figure 2.3: Month of sample collection

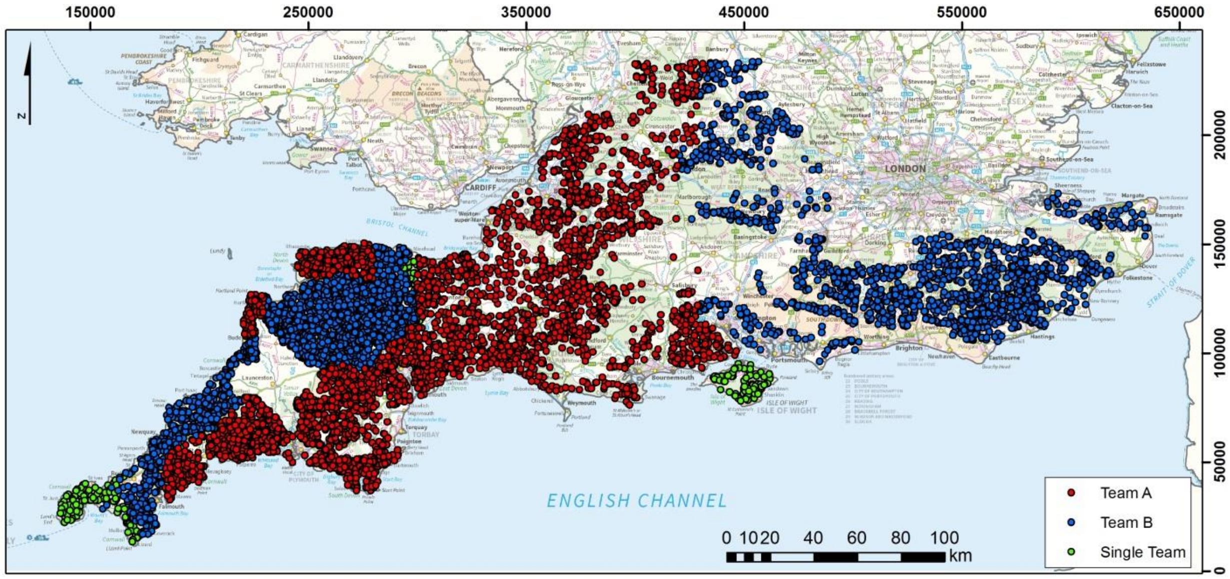


Figure 2.4: Sampling team areas covered.

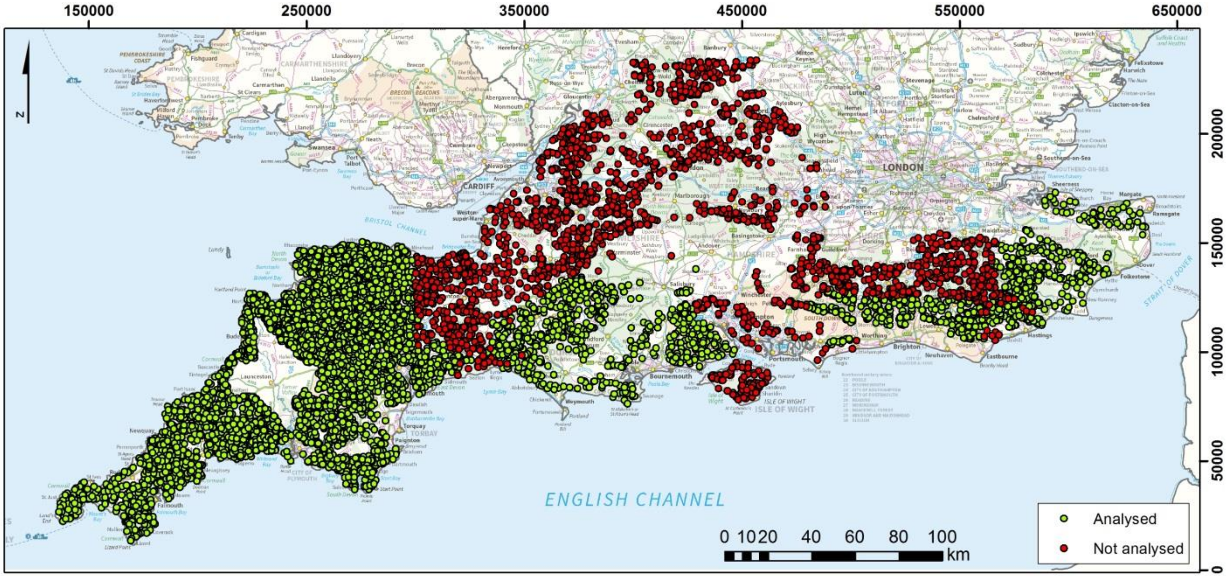


Figure 2.5: Laboratory chemical analysis status of samples.

"Not analysed" refers to sites where water samples have been taken, field parameters have been measured, but there are no laboratory analyses associated with the site. "Analysed" refers to sites where there are complete laboratory analyses.

Table 2.2: Stream water 2012-2013 control samples

Random Number List	**1**	**2**	**3**	**4**
Team	**A**	**B**	**A**	**B**
Filtered Blank Water	10	62	44	03
Unfiltered Blank Water	75	14	75	32
Standards	22, 68	28, 80	17, 87	47, 96
Duplicate A	76	31	04	71
Sub-sample A	86	77	62	60
Duplicate B	81	37	96	66
Sub-sample B	78	58	53	34

3 Sample data receipt from the laboratories

Samples were provided to the BGS laboratories, racked in numerical order with associated paperwork and digital checklists from 14/01/2013 onwards. The laboratory registration was separated for F/UA samples and F/A samples in order that data could be reported as soon as it became available from each analytical method. Details of this information are shown in Table 3.1. The laboratory number provides the unique reference ID for follow up enquiries to the laboratories about these data.

It should be noted there were some considerable delays in the analysis of the samples (up to 1 year, 9 months).

Table 3.1: Sample batches for analysis, and reporting dates.

* Represents reissued data

Batch	Year of Sampling	Method	Sample numbers	n	Laboratory number (batch ID)	Analysis commenced	Data reported
1	2012	F/A	470001 - 470400	400	20041	21/02/13	28/05/15*
1	2012	F/UA	470001 - 470400	400	20037	14/01/13	08/03/13
2	2012	F/A	470401 - 470800	399	20048	25/02/13	28/06/13
2	2012	F/UA	470401 - 470800	399	20042	18/02/13	19/04/13
3	2012	F/A	470801 - 471300	500	20049	25/06/13	10/09/13
3	2012	F/UA	470801 - 471300	500	20043	11/03/13	23/07/13
4	2012	F/A	471301 - 471800	500	20050	31/07/13	05/11/13
4	2012	F/UA	471301 - 471800	500	20044	30/04/13	02/09/13
5	2012	F/A	471801 - 472300	500	20051	14/08/13	09/12/13
5	2012	F/UA	471801 - 472300	500	20045	24/06/13	04/11/13
6	2012	F/A	472301 - 472800	500	20052	21/08/13	18/12/13
6	2012	F/UA	472301 - 472800	500	20046	29/08/13	28/01/15
7	2012	F/A	472801 - 473300	500	20053	17/09/13	19/12/13
7	2012	F/UA	472801 - 473300	500	20047	18/11/13	29/01/15
8	2012	F/A	473301 - 473800	462	20069	13/01/14	12/05/14
8	2012	F/UA	473301 - 473800	462	20070	13/01/14	29/01/15
1	2013	F/A	473801-474400	525	20071	29/01/14	23/05/14
1	2013	F/UA	473901-474400	494	20078	10/06/14	06/02/15
2	2013	F/A	474401 - 474900	473	20072	03/03/14	14/08/14
2	2013	F/UA	474401 - 474900	473	20084	09/09/14	29/01/15
3	2013	F/A	474901 - 475400	474	20073	13/03/14	14/08/14
3	2013	F/UA	474901 - 475400	473	20085	20/10/14	13/02/15
4	2013	F/UA	473801 - 473899	32	20086	08/12/14	13/02/15

4 Analytical Methodologies

A summary of the analytes produced by the laboratories and the field teams is presented in Figure 4.1. This section describes the analyses undertaken on each aliquot collected and the number of samples analysed.

Blue: ICP-MS. Green: IC.

Additional determinands: **conductivity, pH, bicarbonate, DOC**

H																	He
Li	**Be**											**B**	C	**N**	O	**F**	Ne
Na	**Mg**											**Al**	**Si**	**P**	**S**	**Cl**	Ar
K	**Ca**	Sc	**Ti**	**V**	**Cr**	**Mn**	**Fe**	**Co**	**Ni**	**Cu**	**Zn**	**Ga**	Ge	**As**	**Se**	**Br**	Kr
Rb	**Sr**	**Y**	**Zr**	**Nb**	**Mo**	Tc	Ru	Rh	Pd	**Ag**	**Cd**	In	**Sn**	**Sb**	Te	I	Xe
Cs	**Ba**	+**La**	**Hf**	**Ta**	**W**	Re	Os	Ir	Pt	Au	Hg	**Tl**	**Pb**	**Bi**	Po	At	Rn
Fr	Ra	++Ac															

+*Lanthanides*	**Ce**	**Pr**	**Nd**	Pm	**Sm**	**Eu**	**Gd**	**Tb**	**Dy**	**Ho**	**Er**	**Tm**	**Yb**	**Lu**
++*Actinides*	**Th**	Pa	**U**	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr

Figure 4.1 Periodic Table with the analytical suites highlighted

4.1 UNFILTERED WATERS

Two unfiltered water samples were collected at each site. One was collected in a 30 mL bottle and used for the determination of pH on the evening of collection. The other was collected in a 250 mL bottle and used for the determination of conductivity and alkalinity the following day. The samples were analysed according to the methods described in Johnson (2005b) with the methods and units of measurements summarised in Table 4.1

Table 4.1: Field-based analytical methodologies and associated detection limits

Analyte	Analytical method	Accredited?	Units of measurement	Detection limit
pH	Probe	No	pH units	
Conductivity	Probe	No	µS/cm	1
Alkalinity	Titration	No	mg/L as $CaCO_3$	0.01

The conversion of the measured alkalinity to the required bicarbonate (HCO_3) is done by dividing the mg/L as $CaCO_3$- alkalinity result by 0.8202 (Hem, 1992). There are several factors which may affect the efficacy of this method, including high suspended solids in the unfiltered sample which may also buffer the added acid, e.g. amorphous iron oxyhydroxide phases, and/or by obscuring the colour end-point of the titration.

The comparison of the major ions using the charge balance and conductivity/TDS comparison are the most useful ways to identify gross errors in these data (Section 9).

4.2 FILTERED ACIDIFIED (F/A) WATER SAMPLES

The analyses of the filtered water samples collected were all undertaken at the Inorganic Geochemistry Laboratories at BGS Keyworth.

The F/A aliquot was analysed by Inductively Couple Plasma Mass Spectrometry (ICP-MS) for 57 elements. The details of the analytical method used, isotope measured, and laboratory QC are given in the relevant cover notes in Appendix 1. These provide comprehensive analytical information of the ICP-MS analysis. It should be noted that generally the uncertainty associated with measurement by ICP-MS away from the detection limit is ±10%. However the overall uncertainty for Na, Ca, Si, P, S, K, Fe, Zn, Sr and Ba is in the order of ±15% and the Li, B, and Al the overall uncertainty is in the region of ±20%.

All data are supplied uncensored (i.e. without truncation or replacement of sub-detection limit values with a fixed value), meaning the dataset includes negative values. This practice greatly facilitates the QC process and is particularly relevant where an analyte’s natural abundance is low in relation to the detection limit. The reported, uncensored, values are maintained throughout the QC process, and uploaded to the Geochemistry Database.

Table 4.2 summarises the unit of measurement and detection limits for each element analysed by ICP-MS. With the exception of total P, total S, Ag and Bi the analyses were UKAS accredited (procedure AG 2.3.18).

4.3 FILTERED UNACIDIFIED (F/UA) WATER SAMPLES

The F/UA was analysed by Ion Chromatography (IC) for a range of anions and by Total Organic Carbon (TOC) analyser for NPOC (non-purgeable organic carbon). The samples were filtered so this measures dissolved organic carbon (DOC).

Table 4.3 summarises the analytes, the methods used, the units of measurement and the detection limit for each analyte. Much more detail, including laboratory QC, is found in Appendix 1, where the analytical cover note is reproduced, providing comprehensive analytical information for both TOC analyser and ion chromatography. The uncertainty associated with the NPOC analyses is in the region of ±8%, while the IC analyses of Cl^- and SO_4^{2-} have an uncertainty in the order of ±10%, and F^-, NO_2^-, Br^-, NO_3^-, and HPO_4^{2-} have uncertainties in the order of ±20%.

Ion chromatography cannot report un-truncated numbers below the Lower Limit of Detection (LLD) as the instrument cannot integrate under a curve below this concentration. The results are provided numerically, and data below the LLD were identified with "<" prefixed to the LLD. In order to use these data numerically during the QC process the "<" was replaced with a minus sign. This minus sign is removed prior to loading to the Geochemistry Database. The NPOC method reports data below the Limit of Quantification (LoQ) in the same way. Because these data are truncated and numerically similar, it can lead to falsely impressive ANOVA results, even where concentrations are of a high uncertainty due to their proximity to the detection limit (see section 6)

The measurement of total S by ICP-MS was previously (2008 and earlier) converted, and reported as SO_4, but is now reported as S. These data are therefore converted to SO_4 for loading to the Geochemistry Database in order to maintain consistency within the greater dataset (section 9). The IC measurement is directly of SO_4^{2-}.

The NPOC data were UKAS accredited (procedure AG 2.3.8) and with the exception of laboratory batches 20037 and 20042 all IC data were UKAS accredited (procedure AG 2.3.19).

Table 4.2 ICP-MS analytes and detection limits

Analyte	Measurement Unit*	Detection Limit
Li	µg/L	1
Be	µg/L	0.01
B	µg/L	10
Na	mg/L	0.2
Mg	mg/L	0.01
Al	µg/L	1
Si	µg/L	50
P	mg/L	0.01
S	mg/L	1
K	mg/L	0.02
Ca	mg/L	0.3
Ti	µg/L	0.05
V	µg/L	0.1
Cr	µg/L	0.05
Mn	µg/L	0.2
Fe	µg/L	1
Co	µg/L	0.01
Ni	µg/L	0.1
Cu	µg/L	0.4
Zn	µg/L	0.5
Ga	µg/L	0.03
As	µg/L	0.02
Se	µg/L	0.1
Rb	µg/L	0.01
Sr	µg/L	0.1
Y	µg/L	0.005
Zr	µg/L	0.05
Nb	µg/L	0.02
Mo	µg/L	0.03

Analyte	Measurement Unit*	Detection Limit
Ag	µg/L	0.05
Cd	µg/L	0.01
Sn	µg/L	0.02
Sb	µg/L	0.005
Cs	µg/L	0.005
Ba	µg/L	0.1
La	µg/L	0.002
Ce	µg/L	0.002
Pr	µg/L	0.002
Nd	µg/L	0.01
Sm	µg/L	0.002
Eu	µg/L	0.002
Tb	µg/L	0.002
Gd	µg/L	0.002
Dy	µg/L	0.002
Ho	µg/L	0.002
Er	µg/L	0.002
Tm	µg/L	0.002
Yb	µg/L	0.002
Lu	µg/L	0.002
Hf	µg/L	0.01
Ta	µg/L	0.02
W	µg/L	0.05
Tl	µg/L	0.01
Pb	µg/L	0.02
Bi	µg/L	0.01
Th	µg/L	0.005
U	µg/L	0.002

* All concentration data are stored as mg L^{-1} in the Geochemistry Database

Table 4.3 Methodology, analytes and detection limits for the F/UA aliquot

Analyte	Analytical method	Measurement unit	Detection Limit*
Br^-	IC	mg/L	0.01 (LLD)
Cl^-	IC	mg/L	0.05 (LLD)
F^-	IC	mg/L	0.005 (LLD)
HPO_4^{2-}	IC	mg/L	0.01 (LLD)
NO_2^-	IC	mg/L	0.005 (LLD)
NO_3^-	IC	mg/L	0.03 (LLD)
NPOC	TOC	mg/L	0.5 (LoQ)
SO_4^{2-}	IC	mg/L	0.05 (LLD)

*LLD = lower limit of detection, LoQ = limit of quantification

4.4 ANALYTES EXCLUDED FROM FURTHER CONSIDERATION

Preliminary examination of the data showed that several analytes had natural abundances that are at, or below, the detection limit for almost every sample analysed. The criterion for this exclusion is that ≥80% of the stream water samples' data are below the detection limit (Table 4.4). The sample site locations where the concentrations of these analytes were detectable were mapped (Appendix 2) to ensure that useful information was not being lost.

Almost 93% of the Ga data were below the detection limit (0.03 µg/L). There were clusters of samples with detectable Ga at Lands' End [~140000 025000], around the New Forest [425000 105000], and detectable Ga was widespread across south east England. Almost 10% of the Hf data were above the detection limit. Detectable Hf was widespread across Cornwall, and the New Forest. There were clusters of detectable Hf to the east of Tiverton [~ 280000 110000], around Bude [~220000 100000], Bideford [~245000 125000], and north west of Exmouth [~310000 09000]. In the south east of England there were no clear spatial trends. Less than 5% of the W data were detectable, these data were mostly clustered around Cornwall and over Dartmoor [~260000 076000]. The same spatial distribution was evident in the Bi data, of which almost 15% are above the detection limit.

At least 99% percent of Nb, Ag and Ta analyses were below the detection limit. There are no coherent spatial trends of these elements. The elements presented in Table 4.4 have not been considered any further in this document.

Table 4.4: Summary of analytes with >80% of data < the detection limit

Analyte	Analytical Method	Detection limit	Sample sites analysed	Sample sites <detection limit (n)	Sample sites <detection limit (%)
Ga	ICP-MS	0.03 µg/L	4792	4446	92.8
Nb	ICP-MS	0.02 µg/L	4792	4745	99.0
Ag	ICP-MS	0.05 µg/L	4792	4766	99.5
Hf	ICP-MS	0.01 µg/L	4792	4286	89.4
Ta	ICP-MS	0.02 µg/L	4792	4789	99.9
W	ICP-MS	0.05 µg/L	4792	4561	95.2
Bi	ICP-MS	0.01 µg/L	4792	4151	86.6

5 Blank waters

The blank waters (BWs) are used to identify any analytes where an artificially increased concentration is found in blanks and thus, by analogy, samples when compared to the laboratory calculated detection limit (Equation 1). If the concentration in the blanks prepared at the field base, run ‘blind’ within the batch, is below that of the detection limit, this means that this has not identified any source of post-sampling contamination of the sample.

Detection limit = mean + (3 × standard deviation)…..*Equation 1* (Miller and Miller, 2010)

Blank waters were inserted into each ‘hundred’ in two positions (Table 2.2), one of which was filtered in the same way as the samples to check any artefacts introduced by the filtration process. The blank water material was taken to the field base using new HDPE 250 ml Nalgene bottles, each filled with better than 18 MΩ water (provided by the ICP Facility) – one bottle for each pair of blanks (F/A and F/UA). The samples are otherwise labelled identically to all the other samples, to be ‘blind’ to the analysts. The bottles of HNO_3 are used for a specific ‘hundred’ and labelled in that way, so that any systematic contamination that is identified can be traced back to the bottle of acid, if necessary and any levelling adjustment applied to the correct sample site numbers. This type of control sample is only applicable to analyses undertaken post-fieldwork, and thus is not relevant to the determination of pH, conductivity and alkalinity.

The total number of BWs submitted for analysis is shown in Table 2.1, and Table 5.1 shows that out of all the analytes 12 gave cause for further investigation. An analyte was investigated when >5% of BW analyses were at or above the detection limit. The data for analytes with >5% blanks above the detection limit are tabulated and presented graphically in Appendix 3 and discussed below.

Table 5.1: Analytes with >5% of BWs at or above the detection limit

Analytical methods	Number of analyses	Number of analytes	Further investigation
IC	106	7	Cl, SO_4, NO_3, F
ICP-MS	106	57	B, K, Zn, Rb, Sr, Sn, Ce,Nd
TIC/TOC analyser	106	1	NPOC

5.1 FILTERD ACIDIFIED (F/A) BLANK WATERS

Potassium, Rb, Sr Ce and Nd have 6-15% of blank samples which exceed the detection limit (See Appendix 3.). However, they are not far in excess of the detection limit (within 10x), and with the exception of Nd are closer to the concentration of the detection limit than the concentrations of the samples. There is some overlap of Nd blank water data and sample data, but this would be expected given the low natural abundance of Nd. Therefore these results are not considered to be anything other than part of the analytical ‘noise’ of a run, and there is no cause for concern with respect to the interpretation of the sample site data.

Blank water data within batches 4749XX, and 4751XX-4753XX were below the detection limit by around an order of magnitude. The remaining ninety percent of the B data for the BWs had concentrations in excess of the detection limit. These concentrations were never more than 3 times the detection limit, but they are within the same range as sample sites. The B analyses for both filtered and unfiltered blanks were similar within each “hundred” indicating that detectable concentrations are not derived from the addition of acid. Despite the overlap of blank waters and sample site data, the sample site data appears unaffected, as there are no trends observed with increasing sample number that correspond with fluctuations in the blank water data. Nonetheless, when using B data caution should be exercised when considering values close to the detection limit. In particular data should be considered within the context of the surrounding sample sites' data, and less weight should be attributed to a single sample B concentration in isolation.

Thirteen percent of the Zn data for the BWs had concentrations in excess of the detection limit. While the concentrations were generally within 10x the detection limit, 5 BWs had concentrations ranging between 1 and 5 µg/L, which are relatively high in the context of the samples data set. In addition one BW had a Zn concentration of 13 µg/L: 26 times the detection limit. In addition both the blank waters in the 4716XX hundred were detectable, however, a visual inspection does not suggest a contamination problem with the acid as the samples within this hundred do not show systematically higher concentrations compared to other hundreds. The random nature of these high concentration blank water data does give cause for concern with regard to isolated high concentrations in the sample site data, but this is unquantifiable. However, there is no reason to suggest that the Zn data taken in aggregate (the primary purpose of the survey data) is compromised – only that isolated high concentrations should be subject to further investigation before any action is taken on the basis of that single result.

Twenty six percent of the Sn data for the BWs was above the detection limit and despite being within 10x the detection limit; the concentrations in the BWs were in a similar concentration range to that of the samples. The BWs from the 4731XX "hundred" had the highest BW concentrations, and were associated with a cluster of samples from the same "hundred" with similarly high Sn concentrations. These samples are very likely to be contaminated and should be considered so, and the remainder of the Sn data should be treated with caution.

5.2 FILTERD UNACIDIFIED (F/UA) BLANK WATERS

Twenty six percent of the blank waters contained detectable Cl^-, 8% contained detectable SO_4^{2-} , and 26% contained detectable NO_3. However detectable values of these analytes within the blank waters are not far in excess of the detection limit (within 10x), and are closer to the concentration of the detection limit than the concentrations of the samples. Therefore these results are not considered to be anything other than part of the analytical 'noise' of a run, and there is no cause for concern with respect to the interpretation of the sample site data.

Twenty six percent of the blank waters contained detectable F^-, and there was also some overlap with the sample site data. It is worth noting that within the first 20 "hundreds" 63% of the blank waters contain detectable F^-, whereas only 5% of the remaining blank data contains detectable F^-. The F^- data for the sample range 470001 – 472000 should therefore be treated with some caution. However the detectable F^- in the blank waters were close to the detection limit (within an order of magnitude), and therefore these data should not be prevented from usage. The sample site data appear unaffected by any blank water issues as there are no trends observed with increasing sample number that correspond with fluctuations in the blank water data.

5.3 ELEMENTS OF CONCERN

There is no evidence from these blank data that widespread contamination has occurred (which could be mistaken for systematic geochemical effects). Whilst all geochemical baseline samples should not be considered in isolation, rather they should preferably be considered in the context of evidence from groups of samples, this is particularly recommended for these aqueous Zn data. It should also be noted that the laboratory do not consider the overall measurement uncertainty on Zn to be better than ±15%, or the B and F^- uncertainty to be better than ± 20% (Appendix 1).

Sn remains the only element of real concern. It is inadvisable to use this Sn data without a considerable investigation of the QC data. Hence the Sn data are all qualified in the geochemistry database to reflect this (section 11).

6 Duplicate and replicate sample analyses

Samples from the 53 duplicate drainage sites sampled in 2012-2013 covered in this report (Figure 2.2, Table 2.1) were submitted for analysis, giving a total of 212 analyses, with two pairs of duplicate/replicate samples at each site. The relationship of the duplicates and replicates (subsamples) to each other is described in Figure 6.1 and the sampling method described in Johnson (2005b). Figure 6.1a illustrates the samples collected for filtered water samples, whilst Figure 6.1b illustrates the samples collected for the unfiltered water where no replicates are created.

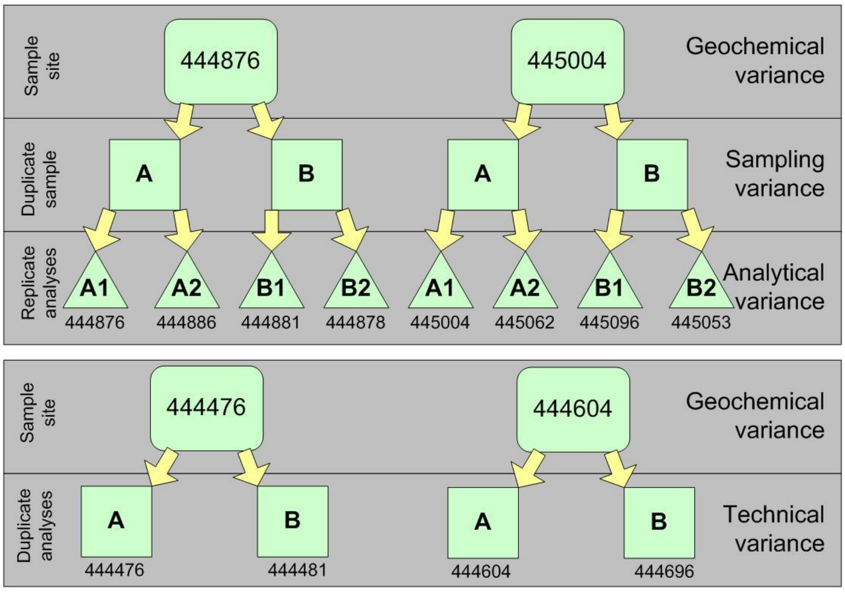


Figure 6.1:Relationship of duplicate and replicate (sub-) samples: (a - top) where subsamples can be created; and (b - bottom) where only duplicates are collected and no subsamples are created

Of the analytes still under consideration conditional formatting of the duplicate and replicate samples is used to rapidly show whether data are ≤0. Where a value is ≤0 the whole set of 4 samples associated with that duplicate site are excluded from the ANOVA analysis. This is because such data cannot be log transformed. In addition samples at or below the detection limit are identified in order to assess the robustness of the ANOVA analysis. Where 20 or fewer duplicate sets were above the detection limit an analyte was excluded from ANOVA analysis, because insufficient samples were above the detection limit to allow the analysis to provide reasonably robust data (Table 6.1)

Table 6.1: Duplicate data where most analyses are below the detection limit

Analyte	All 4 concentrations within duplicate/ replicate set >0	All 4 concentrations within duplicate/ replicate set > detection limit
	Total available duplicate sets = 53*	
Sn	51	14
Tl	48	13
NO2	N/A	6
HPO4	N/A	11

*Total available duplicate sets for field data = 78. NB no replicate samples exist for field data

Initially the data for analytes still under consideration were examined by plotting the data using an Excel macro (Lister and Johnson, 2005). These graphs permit the rapid inspection of the data, and removal of any data which is observed to be of ‘catastrophic’ nature rather than due to systematic or random processes. This obviously biases the dataset, and is one of the subjective decisions in this process; these graphs are shown in Appendix 4. In this instance no data were removed.

The samples are then used within an analysis of variance (ANOVA), processed by an in-house macro which allows rapid batch-processing of the data (Johnson, 2002). This code has been validated against commercially available software to ensure it gives comparable results. The code includes an automatic log-transformation step, as many such geochemical datasets are log-normal. It is suggested that the maximum technical (sampling + analytical) variance is 20% for most geochemical purposes (Ramsey, 1998). Minitab (v16) has been used to calculate the technical variance for the three field parameters.

Table 6.2 shows the results of the ANOVA analyses of the remaining analyte data. Of these all duplicate data sites were initially used that had a minimum value above zero (to allow for log-transformation), 33 analytes in total. However, 15 elements by ICP-MS, and three IC analytes had data which was below zero. The number of duplicate sets (up to a maximum of 53) used in the ANOVA analysis is recorded along with the output in Table 6.2 to indicate where data has been removed from the analysis. In addition the number of duplicate sets where all four analyses are above the detection limit are noted in order to assess data quality

None of the analytes were of poorer than expected quality for data above the detection limit (geochemical variance ≥ 80%).

Table 6.2 ANOVA analysis results

Analyte	Between Site %	Between Sample %	Within Sample %	Hundreds used in ANOVA analysis (all 4 samples in set >0)	Number of hundreds where all 4 samples >DL
Al	95	0	4	53	53
As	99	0	1	53	53
B	96	1	3	51	41
Ba	96	1	3	53	53
Be	94	2	4	50	23
Br	95	0	6	51	51
Ca	100	0	0	53	53
Cd	85	5	10	49	24
Ce	95	1	4	53	52
Cl	100	0	0	53	53
Co	97	1	1	53	52
Cr	97	0	3	53	48
Cs	97	1	2	53	43
Cu	93	6	2	53	38
Dy	97	1	2	53	48
Er	97	1	2	53	43
Eu	91	2	7	50	38
F	94	-1	7	52	52
Fe	97	0	3	53	53
Gd	97	1	2	53	50
Ho	96	0	3	53	34
K	99	0	1	53	53
La	95	1	4	53	53
Li	98	0	2	53	42
Lu	94	2	4	52	24
Mg	100	0	0	53	53
Mn	96	2	2	53	53
Mo	96	-1	4	53	36
Na	100	0	1	53	53
Nd	90	2	8	43	39
Ni	98	0	2	53	53
NO3	89	1	10	51	51
NPOC	99	0	1	53	53
P	96	2	1	52	38
Pb	89	3	8	51	38
Pr	95	1	4	53	44
Rb	99	0	0	53	53
S	99	0	1	53	49
Sb	99	0	0	53	53
Se	99	0	1	53	41
Si	99	0	1	53	53
Sm	94	2	4	52	48
SO4	100	0	0	53	53
Sr	100	0	0	53	53
Tb	96	1	3	52	32
Th	86	3	11	46	21
Ti	90	1	9	50	37
Tm	93	0	6	51	22
U	99	0	1	53	53
V	90	2	8	49	35
Y	98	1	1	53	53
Yb	95	1	4	53	45
Zn	88	7	5	53	44
Zr	94	0	5	52	19
pH	98	2		78	78
Alkalinity	96	4		78	78
Conductivity	99	1		78	78

7 Reference material data

Primary reference materials are inserted by the laboratories as part of their QC process For the ICP-MS data the results are reported in the cover notes (Appendix 1), giving relative standard deviation (RSD) and percentage recovery. Most elements analysed by ICP-MS have an uncertainty of ±10%, while Na, Ca, Si, P, S, K, Fe, Zn, Sr and Ba have an uncertainty of ±15%, and Li, B, and Al have an uncertainty of ±20%.

Secondary reference materials (SRMs) and a limited number of certified reference materials (CRMs) were assigned a field number and therefore an analysis slot within the G-BASE field samples and other QC samples. This would enable any bias between analysis runs, which have not been identified by the laboratory QC process, to be assessed. The CRM used was the National Research Council of Canada's SLRS-5, this is an acidified sample so was only used for F/A samples. The SRM used was collected from a stream local to the BGS headquarters, called Fern.

Reference materials have been plotted (e.g. Miller and Miller, 2010) with the CRM and SRM presented on one plot (Appendix 5) and the summary statistics in Table 7.1 and Table 7.2. The CRM table allows for comparison with the certified value (mean and 95% confidence interval). Median values have been presented for the SRMs, as this gives a more appropriate measure of the central tendency of the data because outliers do not bias the data (Miller and Miller, 2010). Mean values have been presented for CRMs for comparison with the mean of the certified values, as well as the bias on the mean value compared to the expected value. Where concentrations were well above the detection limits the precision was reasonable for the majority of the certified parameters, but where many analyses were near or below the detection limit the precision was poor (Table 7.1 and Table 7.2). Three elements (V, Zn and Mo) had bias greater than can be accounted for by the expected variation on the CRM and that of the analytical method (section 4): for V and Zn these biases are also accompanied by a high relative standard deviation (25% and 54% respectively), although that is not the case for Mo (9%). Due to the low number of analyses (n = 5) there has been no correction attempted based on these results, but they should be borne in mind in any detailed interpretation or inter-comparison of data, although other factors, such as long-term storage of the CRM may also play a part. Whilst Mn and Sr mean values are outwith the confidence interval of the expected value, they are within limits which are expected from the analytical technique, as shown by the bias (-6% and -7% respectively) compared to the measurement uncertainty of ±10%.

There were 88 SRM analyses. NPOC exhibited a downwards trend (Appendix 5), however this is not mirrored in the sample site data (Figure 7.1), meaning this most likely represents an issue with the stability of Fern, rather than an analytical problem. Furthermore it represents a very small difference in relation to the natural abundances measured. F/UA sample data (anions and DOC) exhibit a step change between SRMs inserted into the first 3 batches of 100 samples, which is related to an older sample of Fern being used for the F/UAs only (Appendix 5). Otherwise the distribution of SRM analyses do not suggest any problems with the sample site data.

Table 7.1 SRM summary statistics for fern – n=88

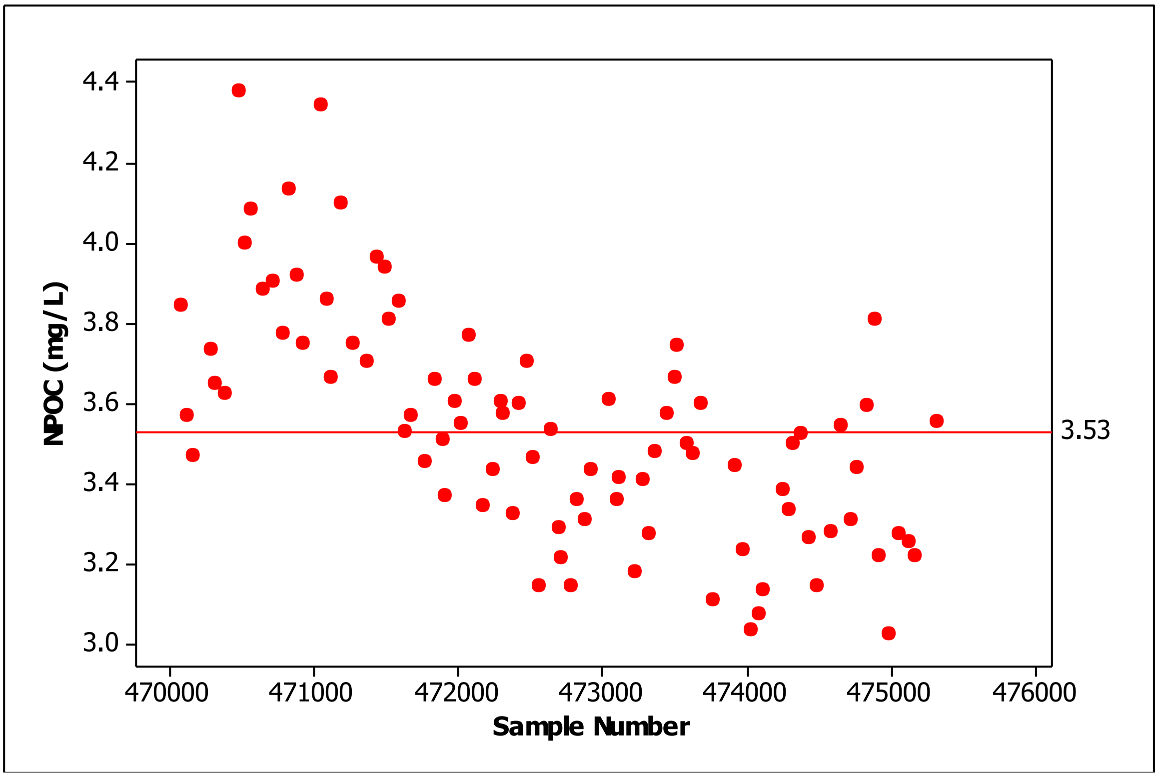
Variable	DL	Units	Average	Median	Min	Max	Std Dev	CV (%)
Li	1	µg/L	39.9	40.1	28.8	49.9	3.90	10
Be	0.01	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01	87
B	10	µg/L	199	205	140	246	20.6	10
Na	0.2	mg/L	35.4	35.7	29.2	38.6	1.95	6
Mg	0.01	mg/L	54.5	54.9	44.3	61.7	3.51	6
Al	1	µg/L	7.52	7.45	6.13	10.3	0.759	10
Si	50	µg/L	8950	8780	7850	11200	686	8
P	0.01	mg/L	2.78	2.76	2.48	3.39	0.139	5
S	1	mg/L	369	372	306	425	23.5	6
K	0.02	mg/L	10.5	10.5	9.34	12.0	0.476	5
Ca	0.3	mg/L	449	448	398	507	21.9	5
Ti	0.05	µg/L	0.182	0.170	0.048	0.477	0.066	37
V	0.1	µg/L	7.99	7.84	6.59	9.63	0.627	8
Cr	0.05	µg/L	0.119	0.112	0.091	0.667	0.060	51
Mn	0.2	µg/L	7.08	6.98	6.26	15.0	0.905	13
Fe	1	µg/L	9.70	8.90	7.53	22.5	2.75	28
Co	0.01	µg/L	0.152	0.153	0.118	0.179	0.014	9
Ni	0.1	µg/L	0.923	0.914	0.724	1.50	0.093	10
Cu	0.4	µg/L	2.49	2.49	2.07	3.84	0.287	12
Zn	0.5	µg/L	15.8	15.9	12.1	22.1	1.36	9
As	0.02	µg/L	10.2	10.2	8.96	10.9	0.395	4
Se	0.10	µg/L	2.90	2.92	2.51	3.30	0.161	6
Rb	0.01	µg/L	4.54	4.53	3.83	5.07	0.222	5
Sr	0.10	µg/L	6350	6250	5590	7520	424	7
Y	0.005	µg/L	0.059	0.059	0.030	0.081	0.009	16
Zr	0.05	µg/L	<0.05	<0.05	<0.05	0.205	0.022	62
Mo	0.03	µg/L	2.32	2.32	1.96	2.59	0.120	5
Cd	0.01	µg/L	<0.03	<0.03	<0.03	0.052	0.006	37
Sn	0.02	µg/L	0.073	0.072	0.058	0.140	0.010	13
Sb	0.005	µg/L	0.178	0.177	0.163	0.200	0.008	5
Cs	0.005	µg/L	0.068	0.017	0.013	4.42	0.469	690
Ba	0.1	µg/L	86.8	87.0	78.6	95.7	3.54	4
La	0.002	µg/L	0.006	0.006	0.002	0.017	0.002	33
Ce	0.002	µg/L	0.005	0.004	<0.002	0.016	0.003	51
Pr	0.002	µg/L	<0.002	<0.002	<0.002	0.003	0.001	122
Nd	0.01	µg/L	<0.01	<0.01	<0.01	0.010	0.015	-88
Sm	0.002	µg/L	0.003	0.002	<0.002	0.008	0.001	53
Eu	0.002	µg/L	<0.002	<0.002	<0.002	0.003	0.001	115
Tb	0.002	µg/L	<0.002	<0.002	<0.002	0.002	0.000	56
Gd	0.002	µg/L	0.005	0.004	0.002	0.009	0.001	25
Dy	0.002	µg/L	0.003	0.003	<0.002	0.006	0.001	32
Ho	0.002	µg/L	<0.002	<0.002	<0.002	0.002	0.000	39
Er	0.002	µg/L	0.003	0.003	<0.002	0.005	0.001	19
Tm	0.002	µg/L	<0.002	<0.002	<0.002	0.002	0.000	40
Yb	0.002	µg/L	0.005	0.005	0.002	0.008	0.001	18
Lu	0.002	µg/L	<0.002	<0.002	<0.002	0.003	0.000	25
Tl	0.01	µg/L	<0.01	<0.01	<0.01	0.017	0.004	84
Pb	0.02	µg/L	0.339	0.337	0.289	0.474	0.021	6
Th	0.005	µg/L	0.006	<0.005	<0.005	0.039	0.006	109
U	0.002	µg/L	8.89	8.87	7.68	10.4	0.415	5
DOC	0.50	mg/L	3.54	3.53	3.03	4.38	0.286	8
Cl	0.05	mg/L	62.5	60.7	48.7	109	8.27	13
SO4	0.05	mg/L	992	1040	463	1500	178	18
NO3	0.03	mg/L	68.7	68.4	47.2	126	8.43	12
Br	0.01	mg/L	<0.01	<0.01	<0.01	0.169	0.202	-279
NO2	0.005	mg/L	<0.005	<0.005	<0.005	1.16	0.206	-5710
HPO4	0.01	mg/L	8.88	8.13	1.62	23.1	4.18	47
F	0.005	mg/L	0.114	0.153	<0.005	0.251	0.137	120

DL = detection limit; Std Dev = standard deviation; CV = Coefficient of Variation (the same as RSD)

Table 7.2 CRM summary statistics for SLRS-5, n=5

Variable[$]	Cert. value	95% CI	Mean	Std Dev	CV (%)	Bias (%)
Li			<1	0.050	13	
Be	0.005*		<0.01	0.001	14	n/a
B			6.42	1.87	29	
Na	5.38	0.1	5.42	0.414	8	1
Mg	2.54	0.16	2.49	0.165	7	-2
Al	49.5	5	48.1	4.28	9	-3
Si			1980	96.6	5	
P			<0.01	0.002	40	
S			2.27	0.222	10	
K	0.839	0.036	0.809	0.070	9	-4
Ca	10.5	0.4	10.1	0.678	7	-4
Ti			1.78	0.141	8	
V	0.317	0.033	0.164	0.041	25	-48
Cr	0.208	0.023	0.216	0.013	6	4
Mn	4.33	0.18	4.05	0.301	7	-6
Fe	91.2	5.8	93.5	5.73	6	2
Co	0.05*		0.053	0.004	8	5
Ni	0.476	0.064	0.459	0.021	5	-4
Cu	17.4	1.3	17.5	0.619	4	1
Zn	0.845	0.095	0.640	0.345	54	-24
As	0.413	0.039	0.397	0.023	6	-4
Se			<0.1	0.007	8	
Rb			1.27	0.041	3	
Sr	53.6	1.3	49.6	1.98	4	-7
Y			0.110	0.006	5	
Zr			<0.05	0.004	18	
Mo	0.270	0.04	0.185	0.017	9	-31
Cd	0.006	0.001	<0.01	0.003	38	n/a
Sn			<0.02	0.011	-144	
Sb	0.300*		0.288	0.016	6	-4
Cs			<0.005	0.003	57	
Ba	14	0.5	14.3	0.538	4	2
La			0.206	0.017	8	
Ce			0.247	0.009	4	
Pr			0.050	0.004	7	
Nd			0.201	0.009	5	
Sm			0.033	0.003	10	
Eu			0.005	0.001	17	
Tb			0.004	0.000	13	
Gd			0.028	0.002	8	
Dy			0.020	0.002	8	
Ho			0.004	0.001	20	
Er			0.012	0.001	11	
Tm			<0.002	0.000	11	
Yb			0.010	0.001	8	
Lu			<0.002	0.000	18	
Tl			<0.01	0.004	64	
Pb	0.081	0.006	0.085	0.024	28	5
Th			<0.005	0.001	20	
U	0.093	0.006	0.090	0.006	6	-3

[$] Detection limits and units as for Table 7.1, omitted here for clarity. *Indicative values only. Std Dev = standard deviation; CV = Coefficient of Variation (the same as RSD), 95% CI = 95% confidence interval.



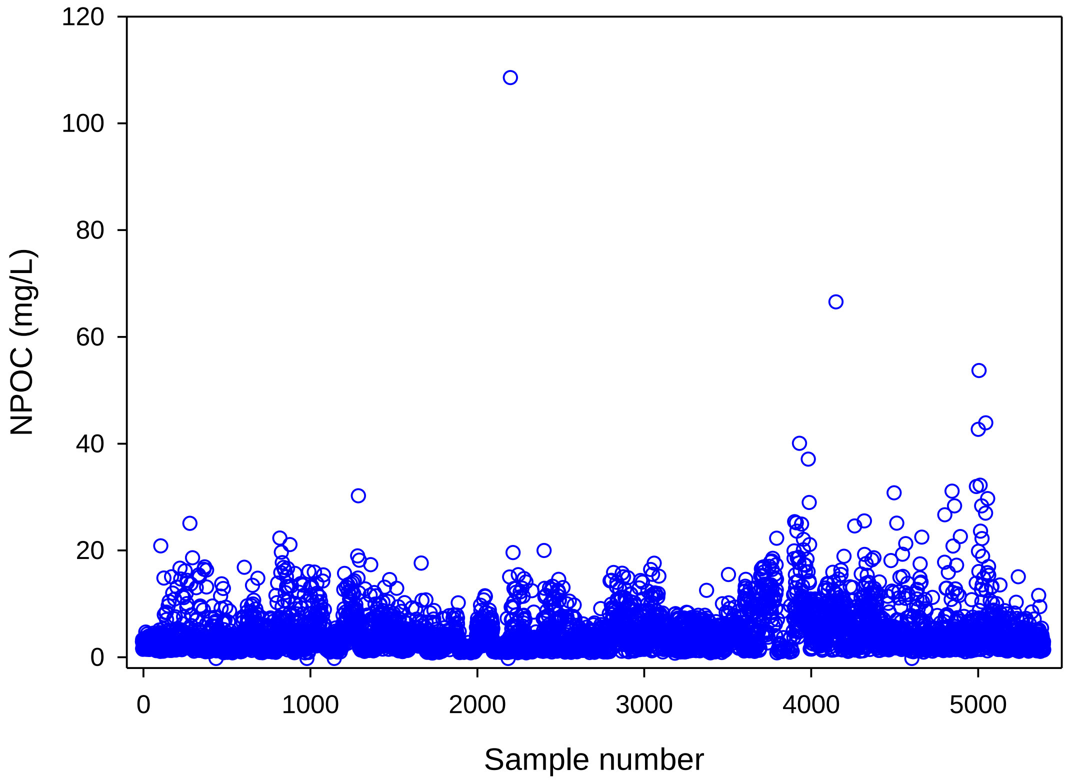
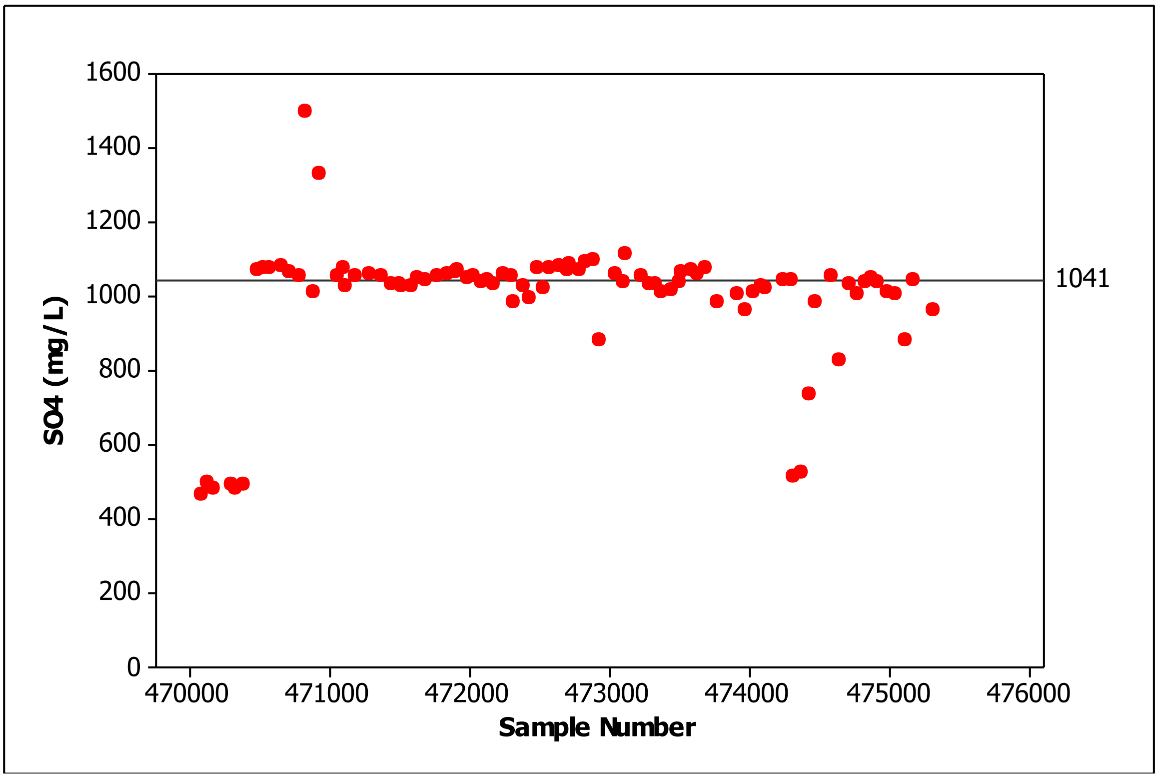


Figure 7.1 DOC (measured as NPOC) concentrations throughout the analytical programme, reference materials (top) with median (3.53) indicated by horizontal line, and sample site data (bottom)



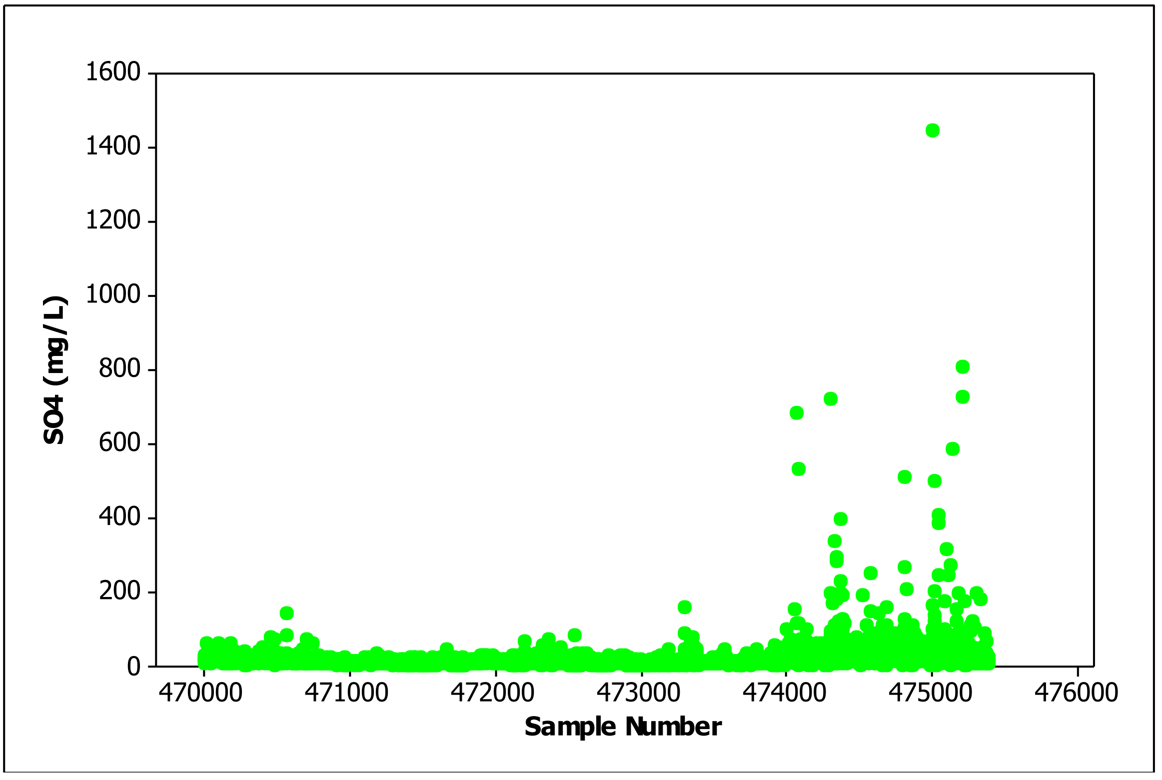


Figure 7.2 SO_4 concentrations throughout the analytical programme, reference materials (top) with median (1041) indicated by horizontal line, and sample site data (bottom)

8 Monitor site data

The G-BASE survey is conducted from temporary field bases, which are typically occupied for 3-4 weeks. The field team moves field base as sampling progresses. At each field base a monitor site is selected to be sampled once a day over the duration of the stay at that base. This provides a temporal context for the spatial data.

The monitor site is chosen to be representative of local drainage characteristics of the streams samples by the field teams. They must also be safe and easy to access to ensure daily sampling is as efficient as possible. In all other ways the samples are collected and handled identically to those of the routine regional baseline sampling, including being allocated a sample number from the random number list. The monitor site samples are therefore analysed alongside the regional samples, and in a random sequence.

Although two separate field teams sampled the south west in 2012, only one team (Team B) took monitor site samples. Chemical data are presented in Appendix 6. No monitor site samples were taken in 2013. The field season of 2012 was typified by unsettled weather. There were few periods of dry weather, with only three days of the entire field season being recorded as “no rain within a week”. Heavy rainfall events were frequently recorded by the teams and on one day one of the teams suspended sampling in response to local flood warnings (Bearcock and Strutt, 2012). As a result the observed stream flow of each monitor site was variable, and did not follow a distinct trend (i.e. the flow was up and down, rather than consistently increasing or decreasing) which can cause concentration changes in the temporal data.

Monitor site 1 (Table 8.1, Figure 8.1) was a small first order stream with a reach of only about 1 km. The stream did not respond dramatically to rainfall events: the observed drainage condition remained at low flow throughout the duration of sampling, although the water colour was brown on one occasion following heavy rain. This lack of change in flow was reflected in the consistent composition of analytes throughout the duration of sampling.

Monitor site 2 (Table 8.2, Figure 8.2) was a third order stream with a catchment area of around 6 km^2. Over the four weeks that this site was sampled the weather was very mixed. During the first two weeks there was rain on most days, the third week was predominantly dry, with a return to wet weather by the fourth week. As a result the observed stream flow fluctuated between low and moderate flow, with strong flow recorded on one day. The concentrations of the analytes consequently vary throughout the duration of sampling. In addition conductivity, total alkalinity, P, S, K, Ca, Mn, Co, Ni, Cu, Zn, As, Rb, Sr, Mo, Cd, Cs, Ba, Bi, U, Br, HPO_4, and NO_3 all have one outlier of elevated concentration on 22/7/12. On this day the flow was observed to be low following 10 days of moderate flow and one day where high flow was recorded. The water was observed to be very cloudy and brown for the only time during sampling at this site. It should be noted that the elements displaying this elevated concentration are consequently presented on a scale, which appears to minimise variations in the remaining data.

Monitor site 3 (Table 8.3, Figure 8.3) was a first order stream with a reach of about 2 km. There was evidence of previously high flow (undercut bank). The weather was variable with rain on most days, but there were occasional periods of dry, sunny weather. The observed flow varied from moderate to strong. As a result of the variable weather the analyte concentrations were also variable throughout the duration of sampling.

The monitor site data illustrate the point that during 2012 the stream flow rates could be very variable and frequently did not represent base flow conditions.

Table 8.1 Site details for Monitor Site 1

Site	MS1B
Dates Sampled	18/6/12 – 06/07/12 (19 samples collected)
Easting, Northing	186526, 61232
Stream name/ place	Colan Barton
Stream order	1
Stream Type	Small stream with low flow
Water Observations	Water Brown with moderate suspended solids after rain on 21st June. Moderate suspended solids on 25th and 26th June. Otherwise water was colourless with low suspended solids.
Local geology	Slate clasts
Catchment geology	Mudstone
Landuse	Rough grazing with mature deciduous trees
Notable comments	Rain recorded 21st June, overnight on 23rd June, 27th June, 2nd July, 3rd July, 4th July, 5th July.

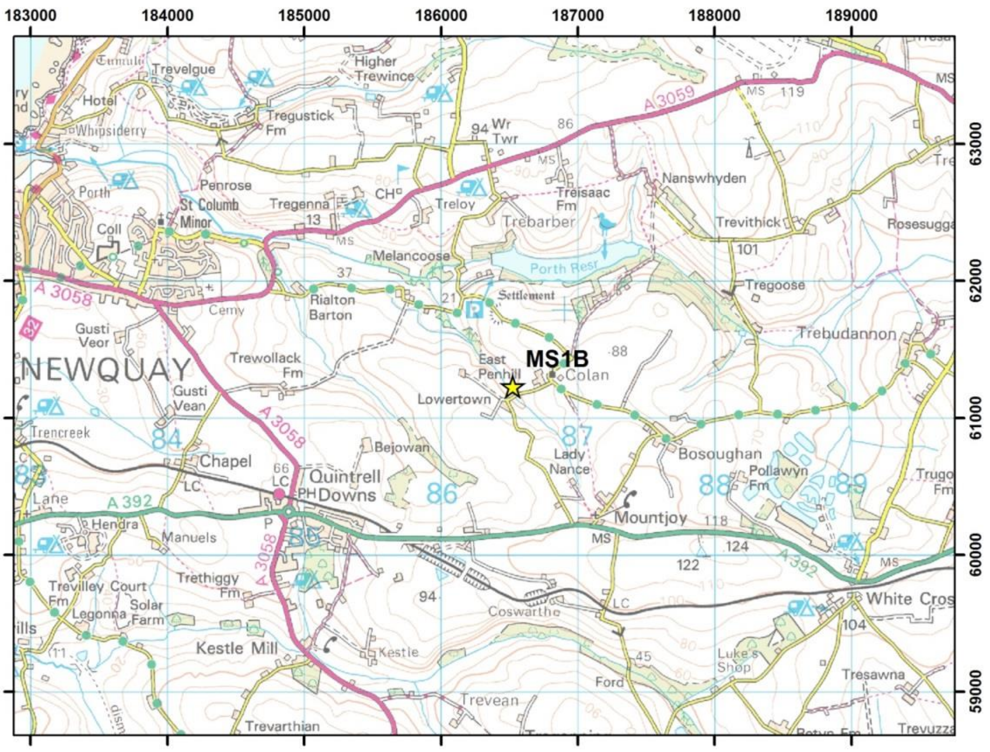


Figure 8.1 Map showing location of Monitor Site 1

Table 8.2 Site details for Monitor Site 2

Site	MS2B
Dates Sampled	9/7/12 – 3/8/12 (26 samples)
Easting, Northing	258199, 103293
Stream name/ place	Woodhall
Stream order	3
Stream Type	Small stream with variable flow (low-strong)
Water Observations	Water predominantly yellow from 9th -21st July with colourless reported on 12th,13th, 20th July. Water reported as brown on 22nd July. Water yellow on 23rd July, then colourless from 24th July-1st August. Water yellow on 2nd – 3rd August. Suspended solids variable from low to high throughout duration, predominantly low during second half. Water reported as being cloudy on 13th -15th July, and 23rd July. Reported as very cloudy on 22nd July
Local geology	Mudstone clasts
Catchment geology	Mudstone
Landuse	Domestic garden, rough grazing, arable
Notable comments	Wire fence crossing 5m upstream. Rain recorded on 7th July (flooding and heavy weather, cancelled sampling), 10th -13th July, 16th July, 19th July, 30th July – 3rd August

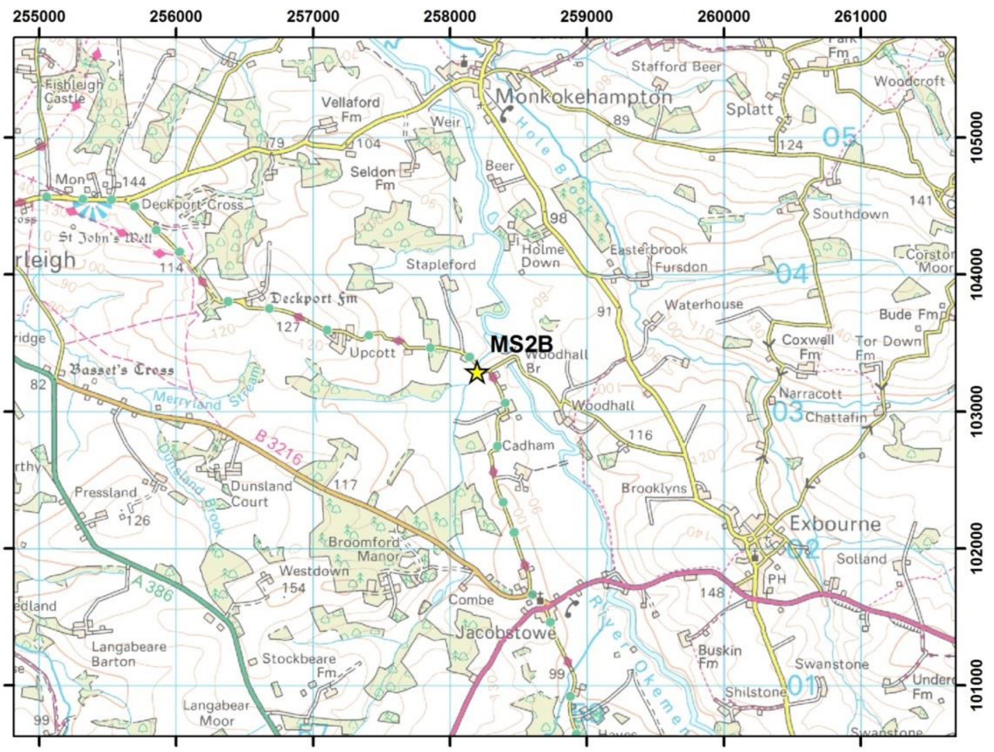


Figure 8.2 Map showing location of Monitor Site 2

Table 8.3 Site details for Monitor Site 3

Site	MS3B
Dates Sampled	4/8/12-29/8/12 (26 samples)
Easting, Northing	300020, 120356
Stream name/ place	Huntsham
Stream order	1
Stream Type	Small stream with moderate to high flow
Water Observations	The stream water colour was highly variable. It was mostly colourless, but on 4th, 5th, 15th, 16th, 18th, 23rd and 28th August it was yellow, and on 21st and 29th August it was brown Suspended solids varied from absent to high, however they were low for 18 of the observations.
Local geology	Mudstone clasts
Catchment geology	Mudstone, limestone
Landuse	Rough grazing, domestic garden, recent deciduous trees
Notable comments	75m upstream of road. Barbed wire fence running parallel to stream. Rain was recorded on 4th, 6th, 7th, 15th, 17th, 21st, 24th, 25th, 27th, 29th August

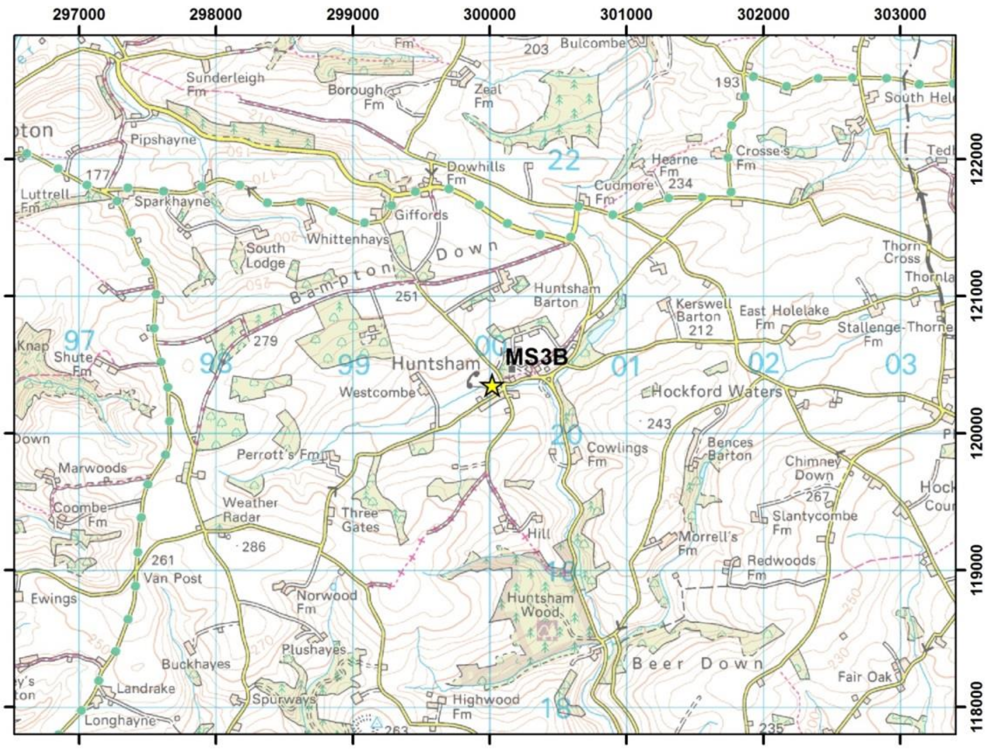


Figure 8.3 Map showing location of Monitor Site 3

9 Charge balance data

Charge balances are calculated on the sample and monitor site data to check the quality of the analyses and to ensure that there are no systematic bias or error between the different sample aliquots which have not been recognised by other methods used earlier in this report. The charge balance is calculated by conversion of the major ion (Ca, Mg, Na, K, HCO_3, SO_4, Cl, NO_3) data to miliequivalents per litre (meq/L) and Equation 2 (Appelo and Postma, 2007)

Charge Balance (%) =

(([sum cations]-[sum anions])/([sum cations]+[sum anions])) × 100 …..*Equation 2*

Convention dictates that with current analytical techniques charge balance errors should be no more than ±5%, however for the purposes of regional geochemical mapping an imbalance of ±10% is acceptable. If these data are to be studied further, at local scale, the results of this equation should be revisited. Where the ionic strength is low (either cations or anions <1 meq/L), a larger charge imbalance may be accepted. This is because small errors in concentration give rise to proportionally larger errors.

After the charge balances were calculated it became apparent that there were some very high negative errors, many of which were dominated by HCO_3. Examination of the field lab books showed that for a number of samples the information had been incorrectly databased. In other cases it appeared that the information had been incorrectly recorded – e.g. the 0.16N H_2SO_4 had been used, but the reading had not been divided by ten to make the reading equivalent to a titration performed with the 1.6N H_2SO_4.Where it was not certain that this was the cause of the excess anions the concentration was not changed. Where below detection limit data were present the artificial negative values were change to half the detection limit.

Of the 4918 full analyses undertaken, once obvious HCO_3 errors had been corrected, 233 were found to have charge balance errors >±10%, of these 60 had low ionic strength. Data with charge balance errors >±10% are presented in Figure 9.1 and reported in Appendix 7. The total dissolved solids (TDS) was calculated as the total absolute value of the major ions listed above in meq/L. Qualifiers are used on any poor analytical results (section 11).

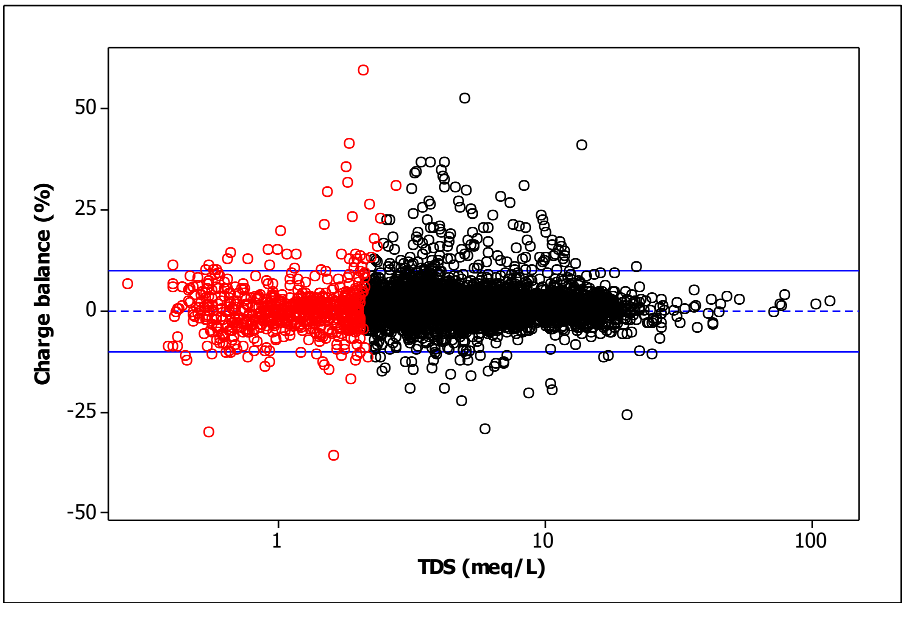


Figure 9.1 Comparison of charge balance errors with TDS concentrations. Red circles represent samples with low TDS (anions and/or cations <1 meq/L). Blue lines represent ±10%

10 Analytical cross-check and interference comparisons

These data are presented in graphical format, as a final check that when the geochemical data is mapped, it will not show spatial relationships related to analytical artefacts, such as analyte-analyte interferences.

10.1 TDS-CONDUCTIVITY

A useful check on the major ions is provided by comparing the measured conductivity with a calculation of the total dissolved solids (TDS) (Appelo and Postma, 2007). In addition this provides a useful check on conductivity, especially where very high measurements have been transposed from mS/cm into µS/cm.

The TDS was calculated as described in Section 9. This was plotted against the measured conductivity. Figure 10.1 shows that most samples follow the same regressional trend. There are few samples lying out with this trend (highlighted in red in Figure 10.1, and presented in Table 10.1), to which qualifiers are applied in the Geochemistry Database (section 11).

10.2 COMPARISSON OF SULPHATE DATA BY IC AND ICP-MS

Sulphate is determined by IC (as the SO_4^{2-} ion), and by ICP-MS (by calculation from S). The ICP-MS data are generally preferred for mapping to provide consistency with previous field campaigns; however IC SO_4^{2-} were used for charge balance calculations (Section 9). .Figure 10.2 demonstrates that there is a good agreement between the two methods with most samples lying on a 1:1 line. The only real exception to this is sample 470444, which is below detection <0.05 mg/L) in the IC data, but measured 143 mg/L in the ICP-MS data. Using the IC data there is a charge imbalance of 30%, which is reduced to 4% when using the ICP-MS data. The IC SO_4^{2-} data should not be used for this sample, and a qualifier has been applied to reflect this.

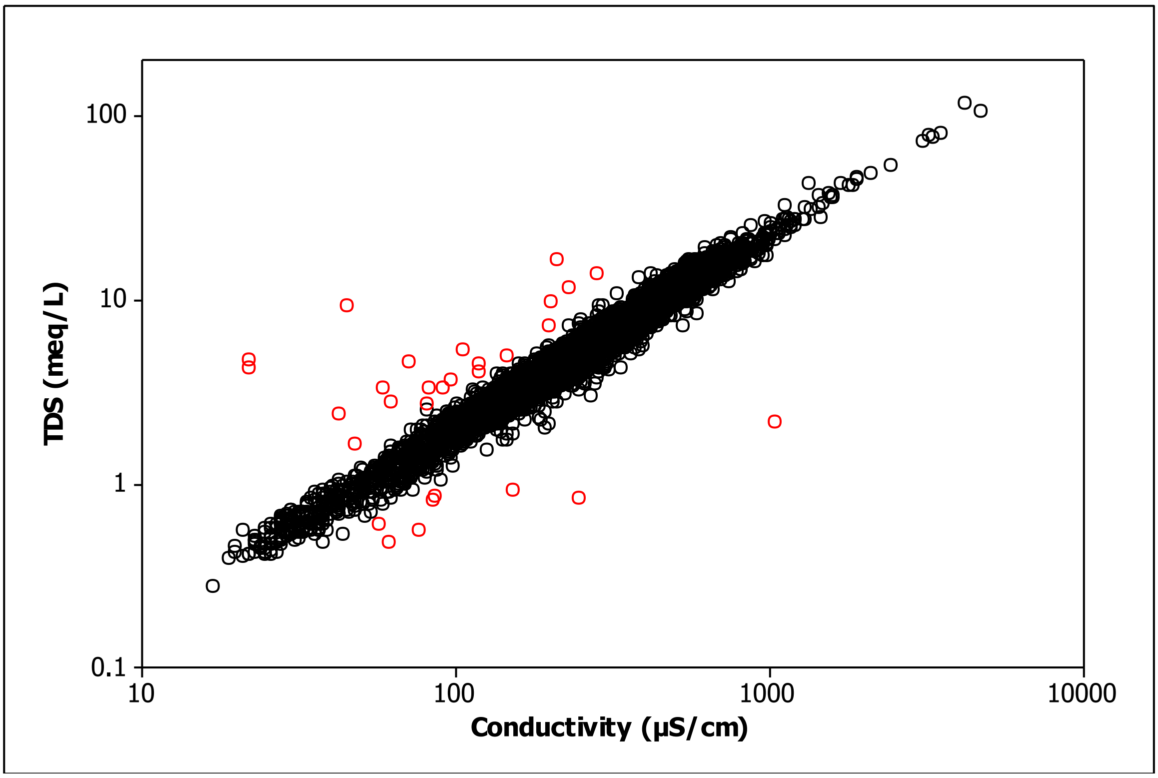


Figure 10.1 Conductivity compared with TDS, outliers presented in red.

Table 10.1 Samples lying out with regressional trend presented in Figure 10.1

Sample number	Conductivity (µS/cm)	TDS (meq/L)	Action
470106	200	7.20	<10% imbalance - Qualify conductivity
470254	22	4.66	<10% imbalance - Qualify conductivity
470356	282	13.82	Qualify HCO_3
470565	230	11.72	<10% imbalance - Qualify conductivity
470967	120	4.07	<10% imbalance - Qualify conductivity
471097	83	3.28	<10% imbalance - Qualify conductivity
471206	22	4.25	<10% imbalance - Qualify conductivity
471360	1051	2.17	<10% imbalance - Qualify conductivity
471706	247	0.84	<10% imbalance - Qualify conductivity
471713	153	0.91	<10% imbalance - Qualify conductivity
471719	81	2.68	<10% imbalance - Qualify conductivity
471754	71	4.62	Qualify HCO_3
471779	59	3.28	<10% imbalance - Qualify conductivity
471794	63	2.78	<10% imbalance - Qualify conductivity
471966	119	4.43	<10% imbalance - Qualify conductivity
472027	92	3.32	<10% imbalance - Qualify conductivity
472182	86	0.85	<10% imbalance - Qualify conductivity
472502	77	0.55	Qualify HCO_3
472554	147	4.90	Qualify HCO_3
472599	48	1.63	Qualify HCO_3
472900	202	9.72	<10% imbalance - Qualify conductivity
472911	62	0.47	<10% imbalance - Qualify conductivity
473166	106	5.28	Qualify HCO_3
473186	57	0.59	<10% imbalance - Qualify conductivity
473203	85	0.81	<10% imbalance - Qualify conductivity
473286	97	3.60	<10% imbalance - Qualify conductivity
473411	43	2.39	<10% imbalance - Qualify conductivity
474419	45	9.17	<10% imbalance - Qualify conductivity
474514	210	16.31	<10% imbalance - Qualify conductivity

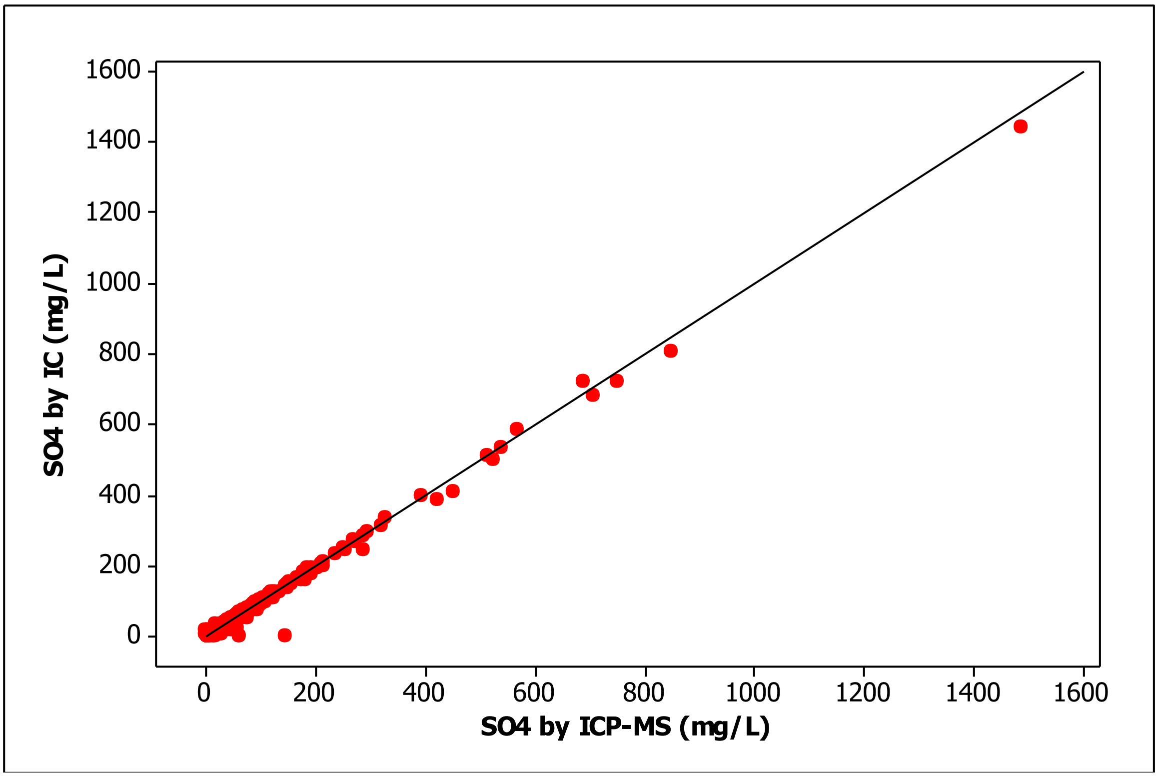


Figure 10.2 Comparison if ICP-MS and IC sulphate data.

10.3 CHECK ON ICP-MS INTERFERENCES

Analytical interferences are corrected as part of the laboratory QC procedure; however as a final check, plots are made of selected analyte pairs, which are known to be subject to interferences This is carried out in order to check that any anomalies noted during mapping are not artefacts of an interference. The comparisons undertaken for this report were: Ni-Ca, Zn-Ca, As-Cl, Cr-NPOC, Eu-Ba as they were identified as identified as problematic in previous QC reports (Ander, 2009, 2014). These graphs are presented in Figure 10.3 to Figure 10.7, and show that there is no cause for concern.

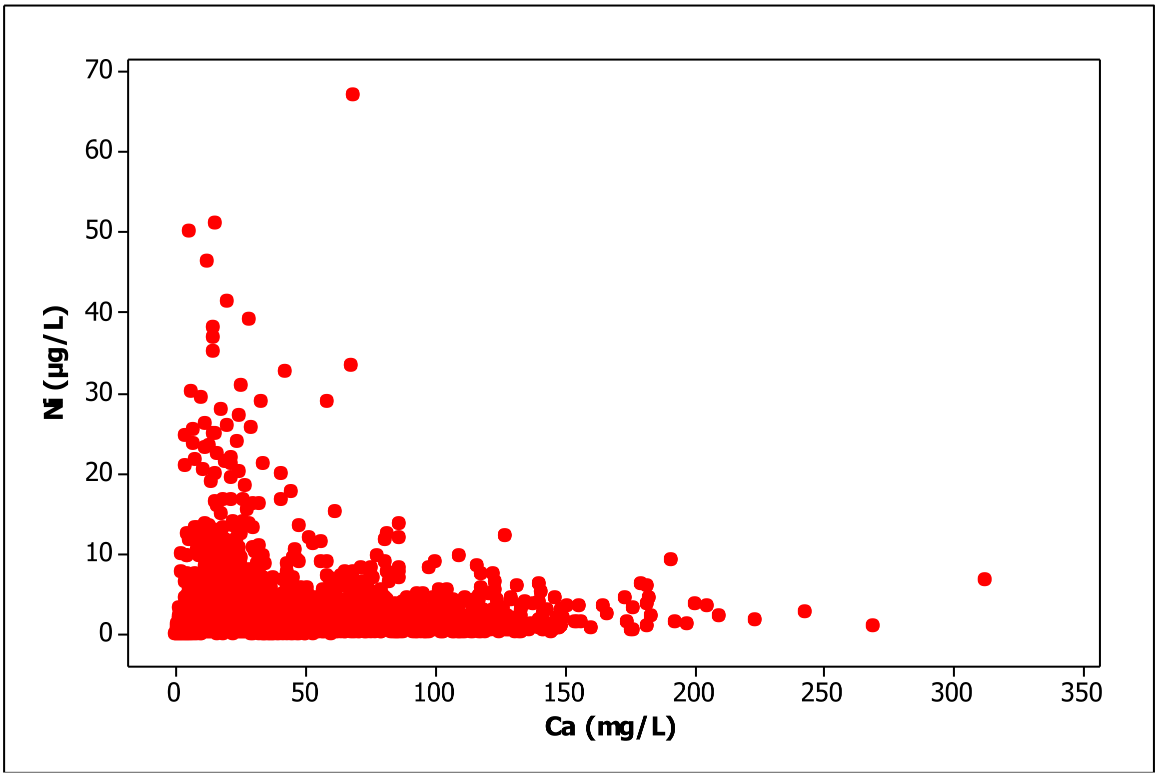


Figure 10.3 Comparison of Ni and Ca

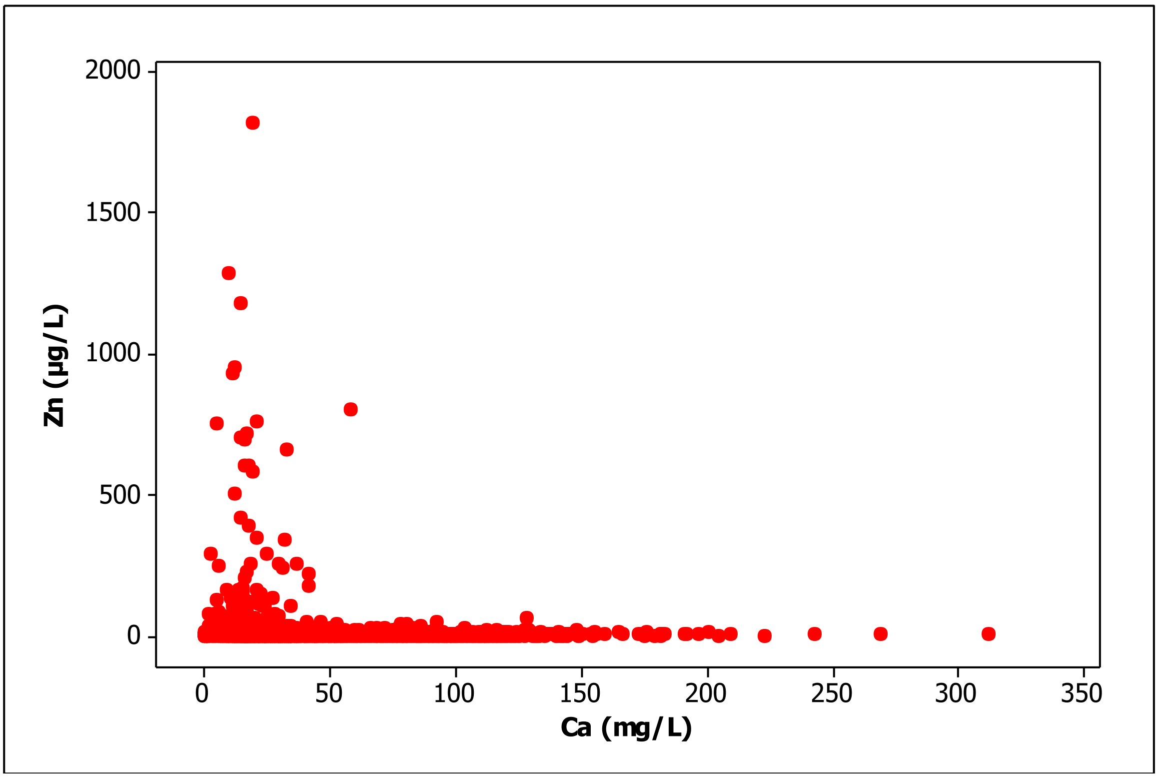


Figure 10.4 Comparison on Zn and Ca

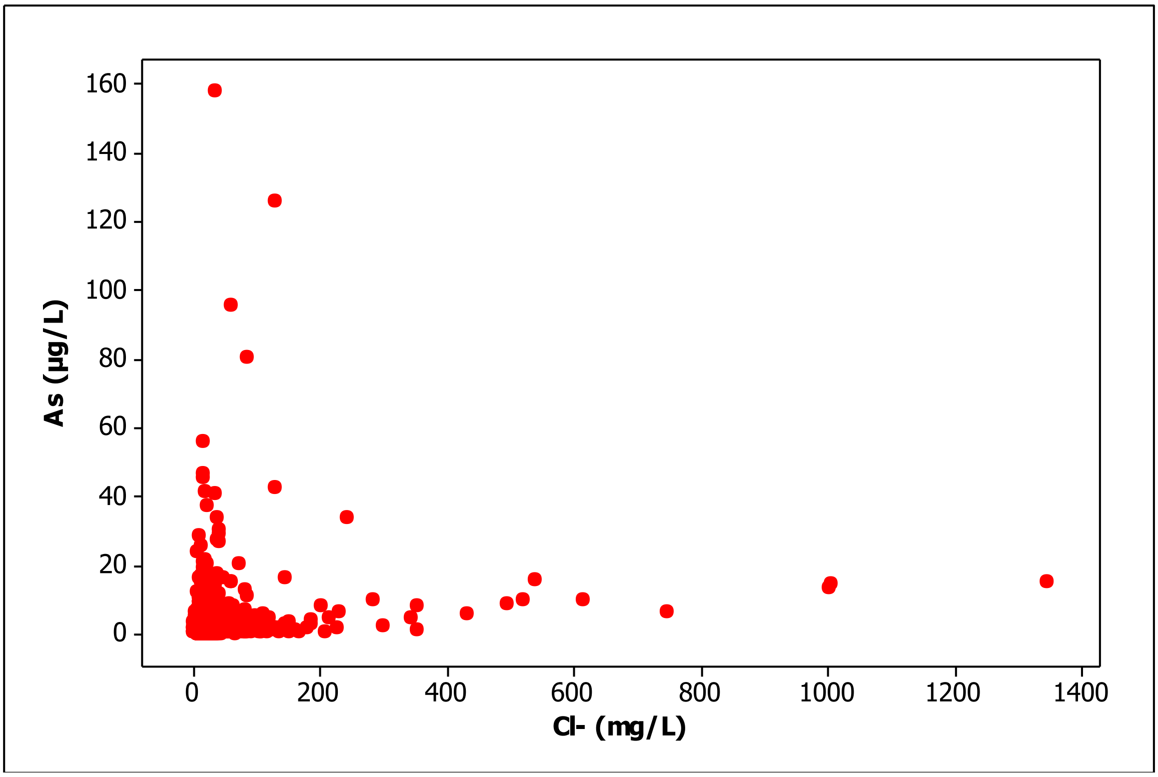


Figure 10.5 Comparison of As and Cl$^-$

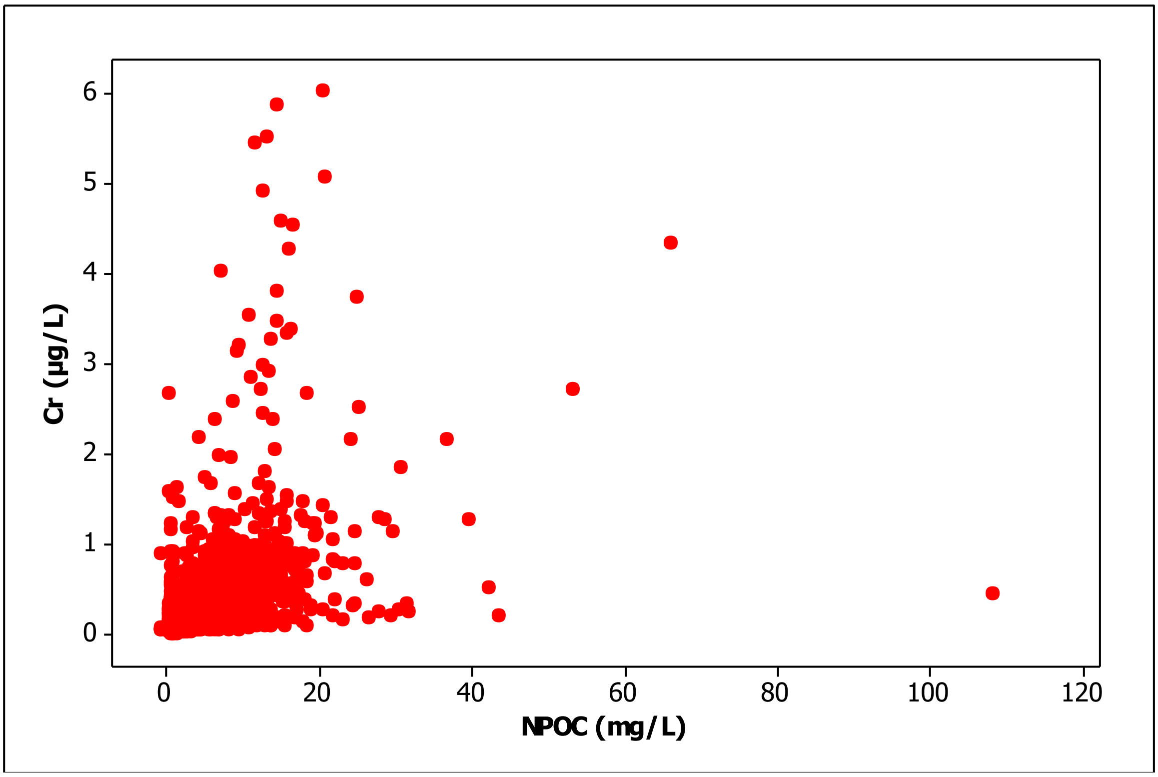


Figure 10.6 Comparison of Cr and NPOC

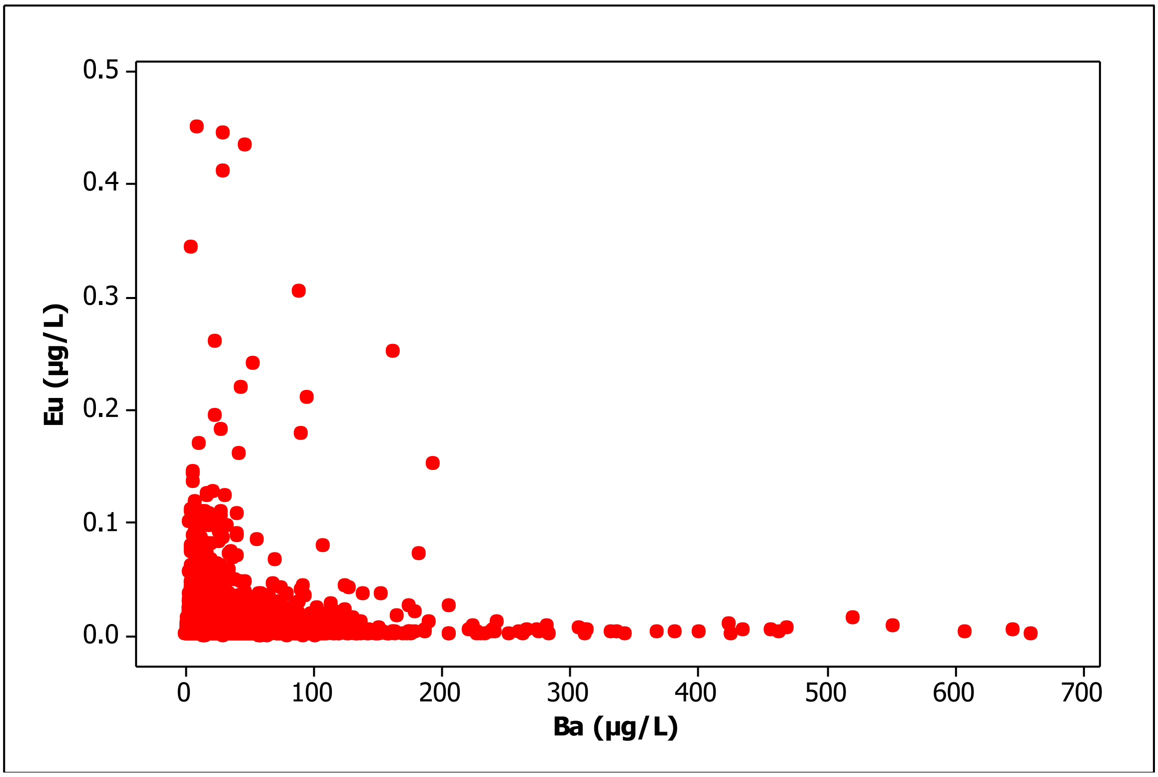


Figure 10.7 Comparison of Ba and Eu

10.4 DILUTION FACTOR CORRECTIONS

Dilution of samples brings the TDS, or a specific analyte into the calibration range, or within operational conditions of the specific analysis method. This is particularly relevant if brackish waters are being sampled or if there are very high concentrations of one analyte (e.g. NO_3^- > 50 mg/L). As a result of dilution there may be analytes which have a value below the lowest quantifiable value in the diluted solution. This may mean they have a larger error associated with them, which propagates when multiplied by the dilution factor, or (in the case of the F/UA analyses) can only be reported as less than a detection limit which is higher than the usual detection limit. This affected the samples considered in this report as detailed below:

- ICP-MS: dilution factors are included in the results file. No samples were diluted.
- IC data: the data file did not report a dilution factor. The cover notes state that samples were diluted, where necessary at higher total concentration loads, and where needed to bring an individual analyte within the range covered by the standards. Samples which have been diluted are reported in Table 10.2.
- NPOC data: the data file did not report a dilution factor. The cover notes state that samples were diluted to bring them within the calibration range (<100 mg/L). Sample 472205 would have been diluted.

Table 10.2: Samples diluted for IC analysis. Numbers in bold indicate upper calibration limit

NB these data are not qualified as after they are diluted they fall within the calibration range.

Cl		SO4						NO3	Br	NO2	HPO4	F
100		**50**						**60**	**5**	**5**	**10**	**5**
470019	475041	470019	474292	474585	474767	475007	475202	470072	475053	470974	474090	N/A
470085	475051	470109	474306	474588	474784	475008	475203	470079		474376	474179	
470156	475053	470182	474307	474601	474802	475010	475208	470100		474485	474292	
473805	475054	470461	474308	474604	474806	475011	475212	470132			474415	
473837	475062	470487	474309	474611	474808	475015	475218	470156			474937	
473971	475064	470565	474312	474613	474809	475019	475227	470180			474941	
474081	475079	470572	474313	474617	474812	475020	475238	470290			475113	
474179	475083	470703	474323	474623	474813	475022	475259	470379			475148	
474221	475084	470748	474327	474636	474815	475024	475267	470587			475202	
474570	475086	472204	474334	474637	474819	475028	475270	470718			475238	
474601	475087	472334	474335	474640	474822	475031	475274	470780				
474640	475089	472366	474336	474642	474823	475045	475290	471126				
474648	475093	472547	474340	474651	474829	475049	475293	471155				
474658	475113	473302	474343	474653	474832	475051	475314	471497				
474674	475148	473311	474351	474655	474833	475053	475343	473340				
474688	475208	473343	474355	474658	474835	475054	475369	474090				
474690	475343	473363	474357	474661	474837	475055	475386	474119				
474692		473925	474361	474663	474839	475064		474179				
474802		473993	474363	474665	474841	475071		474219				
474815		474008	474367	474668	474842	475086		474292				
474820		474026	474370	474671	474843	475091		474367				
474821		474030	474371	474672	474847	475093		474651				
474833		474056	474374	474674	474848	475094		474707				
474843		474065	474383	474677	474859	475099		474752				
474878		474068	474384	474678	474864	475100		474763				
474881		474075	474392	474682	474872	475106		474802				
474883		474081	474393	474685	474883	475112		474809				
474884		474087	474394	474687	474885	475113		474812				
474894		474094	474397	474690	474886	475114		474848				
475008		474095	474398	474691	474889	475133		474937				
475009		474099	474424	474692	474891	475134		474941				
475010		474145	474457	474695	474893	475138		474995				
475011		474147	474474	474705	474895	475140		474997				
475012		474149	474487	474714	474898	475143		475005				
475014		474176	474511	474732	474899	475148		475015				
475019		474177	474531	474734	474922	475161		475105				
475021		474213	474532	474741	474923	475167		475113				
475022		474216	474534	474749	474934	475171		475202				
475027		474226	474538	474752	474937	475173		475208				
475028		474241	474556	474754	474973	475182		475267				
475030		474246	474566	474755	474982	475185		475274				
475033		474248	474572	474759	475002	475187		475290				
475039		474281	474574	474763	475005	475197		475293				

11 Statistical summary of the data

Descriptive statistical values of the data are provided in Table 11.2. These data are summarised in their original measurement units. Where reported in µg/L the data are converted to mg/L for storage in the Geochemistry Database according to the database rules. All data have been loaded irrespective of any concerns identified in this report. Where there are factors reducing the confidence in the data, then a coded “qualifier” is appended, as described in the relevant preceding report sections. It is strongly recommended that the “qualifiers” are always attached to analytical data upon retrieval from the Database.

Table 11.1 shows the “qualifiers” (Mackenzie and Johnson, 2006) used on the data presented in this report, and identifies the circumstances in which they were applied.

Table 11.1 Qualifiers applied to stream water data in the BGS Geochemistry Database.

Qualifier	Where applied
!	No analysis – i.e. applied where data are missing
#	Data < the Limit of Quantification (LoQ) by IC or TOC analyser. Applied as required and the LoQ value halved
$	Data < the stated detection limit (DL) of the ICP-MS method. Applied as necessary
*	Data of dubious quality. Applied systematically to all Sn data, as well as SEC data identified in Table 10.1, and HCO_3 data identified in Appendix 7
D	Uncertain value. The data are both <DL and * applies

Table 11.2 Summary statistics of the data.

"<" indicates that the entire percentile class is below the detection limit. $ (Sn only) denotes wider data problems.

Analyte	**pH**	**Conductivity**	**Alkalinity**	**HCO_3**	**NPOC**	**Cl**	**SO_4**	**NO_3**	**Br**	**NO_2**	**HPO_4**	**F**
unit	N/A	**µS/cm**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**
Method	pH meter	conductivity meter	field titration	field titration	TOC	IC	IC	IC	IC	IC	IC	IC
Detection limit	N/A	10	0.05	0.12	0.5	0.05	0.05	0.03	0.01	0.005	0.01	0.005
Minimum value	4.8	17	1	1	<0.5	<0.05	<0.05	<1.5	<1	<0.5	<1	<0.5
Percentiles: 5	6.3	52	7	8	1.0	7.9	2.5	0.2	0.02	<0.005	<0.01	0.015
10	6.7	86	12	15	1.2	10.2	3.8	0.8	0.03	<0.005	<0.01	0.021
15	6.9	117	19	23	1.4	12.1	5.1	1.6	0.04	<0.005	<0.01	0.026
25	7.2	162	30	37	1.9	15.3	7.2	3.4	0.05	<0.005	<0.01	0.034
50	7.5	238	54	66	3.2	21.8	11.4	9.5	0.08	<0.005	<0.01	0.054
75	7.7	376	109	133	5.5	32.7	19.5	20.0	0.12	0.007	0.03	0.092
90	7.9	574	220	268	9.2	46.2	34.3	30.9	0.17	0.012	0.19	0.147
95	8.1	684	259	315	12.3	60.1	49.4	39.7	0.21	0.020	0.47	0.200
99	8.2	1010	332	405	18.6	110.1	120.1	58.2	0.40	0.094	2.16	0.357
Maximum value	9.5	4720	634	773	108	1347	1444	281	6.3	19.1	23	2.34
Mean	7.4	298	84	103	4.4	28.1	18.9	13.7	0.10	0.01	0.13	0.08
Count (n)	6776	6773	6771	6771	4793	4793	4793	4793	4793	4793	4793	4793
Samples <DL (n)	N/A	0	0	0	5	4	7	133	76	3347	3107	29
Samples <DL (%)	N/A	0	0	0	<1	<1	<1	3	2	70	65	<1

Table 11.2 Continued

Analyte	**Li**	**Be**	**B**	**Na**	**Mg**	**Al**	**Si**	**P**	**S**	**K**	**Ca**	**Ti**	**V**	**Cr**
unit	**µg/L**	**µg/L**	**µg/L**	**mg/L**	**mg/L**	**µg/L**	**µg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**µg/L**	**µg/L**	**µg/L**
Method	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS
Detection limit	1	0.01	10	0.2	0.01	1	50	0.01	1	0.02	0.3	0.05	0.1	0.05
Minimum value	<1	<0.01	<10	<0.2	<0.01	<1	<50	<0.01	<1	<0.02	<0.3	<0.05	<0.1	<0.05
Percentiles: 5	<1	<0.01	<10	5.49	1.07	2.56	1631	<0.01	<1	0.56	2.23	<0.05	<0.1	<0.05
10	<1	<0.01	<10	6.91	1.87	3.95	1967	<0.01	1.33	0.88	5.46	<0.05	<0.1	0.06
15	<1	<0.01	10.62	7.98	2.49	5.23	2203	<0.01	1.76	1.17	8.27	<0.05	<0.1	0.07
25	1.14	<0.01	13.5	9.76	3.44	7.71	2564	0.02	2.51	1.60	12.1	0.07	<0.1	0.10
50	2.24	<0.01	19.5	13.3	5.32	17.3	3335	0.03	4.13	2.55	20.8	0.20	0.18	0.16
75	4.63	0.03	31.8	19.6	7.88	43.2	4308	0.07	6.98	4.02	43.5	0.51	0.37	0.25
90	9.00	0.11	55.6	29.1	11.2	104	5637	0.16	12.2	6.68	94.1	1.06	0.71	0.45
95	13.3	0.22	82.0	40.5	14.4	159	6747	0.28	17.5	9.24	115	1.65	1.09	0.66
99	30.0	0.41	224	88.4	25.7	281	9527	0.99	42.1	18.6	143	3.50	2.45	1.49
Maximum value	719	2.13	1113	829	334	1797	18748	7.93	496	98.6	312	18.8	7.75	6.01
Mean	4.28	0.039	31	18.24	6.47	40.4	3640	0.09	6.67	3.51	34.6	0.46	0.32	0.24
Count (n)	4792	4792	4792	4792	4792	4792	4792	4792	4792	4792	4792	4792	4792	4792
Samples <DL (n)	981	2493	639	1	1	49	2	775	335	1	5	888	1410	336
Samples <DL (%)	20	52	13	<1	<1	1	<1	16	7	<1	<1	19	29	7

Table 11.2 Continued

Analyte	Mn	Fe	Co	Ni	Cu	Zn	Ga	As	Se	Rb	Sr	Y	Zr	Nb
unit	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
Method	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS
Detection limit	0.2	1	0.01	0.1	0.4	0.5	0.03	0.02	0.1	0.01	0.1	0.005	0.05	0.02
Minimum value	<0.2	<1	<0.01	<0.1	<0.4	<0.5	<0.03	<0.02	<0.1	<0.01	<0.1	<0.005	<0.05	<0.02
Percentiles: 5	1.91	8.10	0.03	0.15	<0.4	<0.5	<0.03	0.22	<0.1	0.52	9.77	0.01	<0.05	<0.02
10	3.32	13.8	0.05	0.22	<0.4	<0.5	<0.03	0.28	<0.1	0.74	17.9	0.02	<0.05	<0.02
15	4.64	20.4	0.06	0.31	<0.4	0.61	<0.03	0.33	<0.1	0.91	27.0	0.03	<0.05	<0.02
25	7.95	35.9	0.08	0.51	0.47	0.92	<0.03	0.41	0.11	1.15	39.4	0.04	<0.05	<0.02
50	18.7	122	0.17	1.27	0.84	1.85	<0.03	0.68	0.18	1.76	71.6	0.09	0.05	<0.02
75	47.0	350	0.41	2.68	1.49	3.96	<0.03	1.30	0.29	2.90	152	0.22	0.12	<0.02
90	154	733	1.02	4.82	2.61	11.2	<0.03	2.74	0.49	5.10	295	0.50	0.23	<0.02
95	414	1058	1.83	6.73	3.90	20.7	0.04	4.32	0.65	7.68	393	0.72	0.35	<0.02
99	2410	2934	7.27	16.4	12.5	111	0.14	12.8	1.05	14.4	758	1.53	0.68	<0.02
Maximum value	25260	54951	76.9	67.0	421	1814	1.02	158	6.62	57.0	3335	7.39	3.41	0.12
Mean	134	339	0.59	2.23	1.72	8.5	<0.03	1.48	0.24	2.59	125	0.20	0.10	<0.02
Count (n)	4792	4792	4792	4792	4792	4792	4792	4792	4792	4792	4792	4792	4792	4792
Samples <DL (n)	3	1	11	103	901	529	4446	1	1027	1	1	12	2373	4745
Samples <DL (%)	<1	<1	<1	2	19	11	93	<1	21	<1	<1	<1	50	99

Table 11.2 Continued

Analyte	Mo	Ag	Cd	Sn	Sb	Cs	Ba	La	Ce	Pr	Nd	Sm	Eu	Tb
unit	**µg/l**	**µg/l**	**µg/l**	**µg/l**	**µg/l**	**µg/l**	**µg/l**	**µg/l**	**µg/l**	**µg/l**	**µg/l**	**µg/l**	**µg/l**	**µg/l**
Method	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS
Detection limit	0.03	0.05	0.01	0.02	0.005	0.005	0.1	0.002	0.002	0.002	0.01	0.002	0.002	0.002
Minimum value	-0.01	<0.05	<0.01	$<0.02	<0.005	<0.005	<0.1	<0.002	<0.002	<0.002	<0.01	<0.002	<0.002	<0.002
Percentiles: 5	0.01	<0.05	<0.01	$<0.02	0.02	<0.005	2.15	0.004	0.01	<0.002	<0.01	0.002	<0.002	<0.002
10	0.02	<0.05	<0.01	$<0.02	0.03	<0.005	2.72	0.01	0.01	<0.002	<0.01	0.003	<0.002	<0.002
15	0.03	<0.05	<0.01	$<0.02	0.03	<0.005	3.35	0.01	0.01	0.002	<0.01	0.004	<0.002	<0.002
25	0.04	<0.05	0.01	$<0.02	0.04	0.01	4.46	0.01	0.02	0.004	0.01	0.01	0.002	<0.002
50	0.08	<0.05	0.01	$<0.02	0.07	0.03	8.81	0.04	0.06	0.01	0.06	0.02	0.005	0.003
75	0.17	<0.05	0.02	$<0.02	0.12	0.19	20.3	0.10	0.18	0.04	0.16	0.05	0.01	0.01
90	0.39	<0.05	0.04	$<0.02	0.22	0.52	48.8	0.24	0.42	0.08	0.34	0.09	0.02	0.01
95	0.64	<0.05	0.07	$<0.02	0.32	0.92	80.9	0.42	0.69	0.13	0.58	0.14	0.03	0.02
99	2.14	<0.05	0.31	$<0.02	0.73	2.79	182	1.21	2.37	0.42	1.79	0.39	0.09	0.05
Maximum value	14.7	0.17	5.54	1.03	16.7	63.57	661	10.8	17.9	2.85	11.5	2.24	0.45	0.27
Mean	0.20	<0.05	0.03	0.02	0.12	0.23	21.1	0.12	0.20	0.04	0.16	0.04	0.01	0.01
Count (n)	4792	4792	4792	4792	4792	4792	4792	4792	4792	4792	4792	4792	4792	4792
Samples <DL (n)	797	4766	2200	2909	1	835	1	38	25	647	1208	319	1383	1869
Samples <DL (%)	17	99	46	61	<1	17	<1	1	1	14	25	7	29	39

Table 11.2 Continued

Analyte	Gd	Dy	Ho	Er	Tm	Yb	Lu	Hf	Ta	W	Tl	Pb	Bi	Th	U
unit	**µg/l**	**µg/l**	**µg/l**	**µg/l**	**µg/l**	**µg/l**	**µg/l**	**µg/l**	**µg/l**	**µg/l**	**µg/l**	**µg/l**	**µg/l**	**µg/l**	**µg/l**
Method	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS
Detection limit	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.01	0.02	0.05	0.01	0.02	0.01	0.005	0.002
Minimum value	<0.00	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.01	<0.02	<0.05	<0.01	<0.02	<0.01	<0.005	<0.002
Percentiles: 5	0.002	0.002	<0.002	<0.002	<0.002	0.002	<0.002	<0.01	<0.02	<0.05	<0.01	<0.02	<0.01	<0.005	0.01
10	0.003	0.003	<0.002	0.002	<0.002	0.002	<0.002	<0.01	<0.02	<0.05	<0.01	<0.02	<0.01	<0.005	0.01
15	0.004	0.004	<0.002	0.003	<0.002	0.003	<0.002	<0.01	<0.02	<0.05	<0.01	0.02	<0.01	<0.005	0.02
25	0.01	0.01	<0.002	0.004	<0.002	0.004	<0.002	<0.01	<0.02	<0.05	<0.01	0.03	<0.01	<0.005	0.02
50	0.02	0.02	0.003	0.01	<0.002	0.01	0.002	<0.01	<0.02	<0.05	<0.01	0.08	<0.01	<0.005	0.07
75	0.05	0.04	0.01	0.02	0.003	0.02	0.004	0.01	<0.02	<0.05	0.01	0.18	<0.01	0.01	0.31
90	0.10	0.08	0.02	0.05	0.01	0.04	0.01	0.01	<0.02	<0.05	0.02	0.37	0.01	0.02	0.66
95	0.14	0.11	0.02	0.07	0.01	0.06	0.01	0.02	<0.02	0.05	0.03	0.57	0.01	0.04	1.07
99	0.37	0.27	0.05	0.15	0.02	0.13	0.02	0.03	<0.02	0.17	0.10	1.50	0.02	0.09	2.89
Maximum value	2.00	1.43	0.28	0.82	0.11	0.64	0.11	0.18	0.11	14.6	2.34	221	0.17	0.55	13.67
Mean	0.05	0.03	0.01	0.02	0.003	0.02	0.003	0.005	0.001	0.02	0.01	0.24	<0.01	0.01	0.29
Count (n)	4792	4792	4792	4792	4792	4792	4792	4792	4792	4792	4792	4792	4792	4792	4792
Samples <DL (n)	184	310	1734	483	2980	421	2739	4286	4789	4561	3749	701	4151	2538	5
Samples <DL (%)	4	6	36	10	62	9	57	89	100	95	78	15	87	53	<1

References

British Geological Survey holds most of the references listed below, and copies may be obtained via the library service subject to copyright legislation (contact libuser@bgs.ac.uk for details). The library catalogue is available at: http://geolib.bgs.ac.uk.

ANDER, E L. 2009. Quality control of regional geochemical stream water samples collected in 2005 in Northern Ireland for the Tellus project. *British Geological Survey Commissioned Report*, CR/06/200N (Keyworth).

ANDER, E L. 2014. Quality control of 2010 Clyde catchment stream and river water sample data. *British Geological Survey Open Report*, OR/14/034 (Keyworth).

APPELO, C A J, AND POSTMA, D. 2007. *Geochemistry, Groundwater and Pollution, 2nd Edition*. (Lieden: A. A. Balkema Publishers.)

BEARCOCK, J M, EVERETT, P A, MATHER, J M, AND LISTER, T R. 2016. A report on the G-BASE field campaign of 2013: southern England. *British Geological Survey, Open Report*, OR/16/016 (Keyworth).

BEARCOCK, J M, AND STRUTT, M H. 2012. A report on the G-BASE field campaign of 2012: south west England. *British Geological Survey, Open Report*, OR/12/072 (Keyworth).

HEM, J D. 1992. *Study and Interpretation of the Chemical Characteristics of Natural Water* (Third Edition edition). US Geological Survey Water-Supply Paper 2254. (Washington: United StatesGovernment Printing Office.)

JOHNSON, C C. 2002. Within site and between site nested analysis of variance (ANOVA) for geochemical surveys using Excel. *British Geological Survey Internal Report*, IR/02/043 (Keyworth, Nottingham).

JOHNSON, C C. 2005a. The G-BASE Field Procedures Manual. *British Geological Survey*, Internal Report IR/05/097 (Keyworth).

JOHNSON, C C. 2005b. The G-BASE Field Procedures Manual (second revision used from 2009). *British Geological Survey*, Internal Report IR/05/097 (Keyworth).

LISTER, T R, AND JOHNSON, C C. 2005. G-BASE data conditioning procedures for stream sediment and soil chemical analyses. *British Geological Survey*, IR/05/150 (Keyworth).

MACKENZIE, A C, AND JOHNSON, C C. 2006. Loading analyte results to the Geochemistry Database using the MS ACCESS LOADER application. *British Geological Survey Internal Report IR/06/097*.

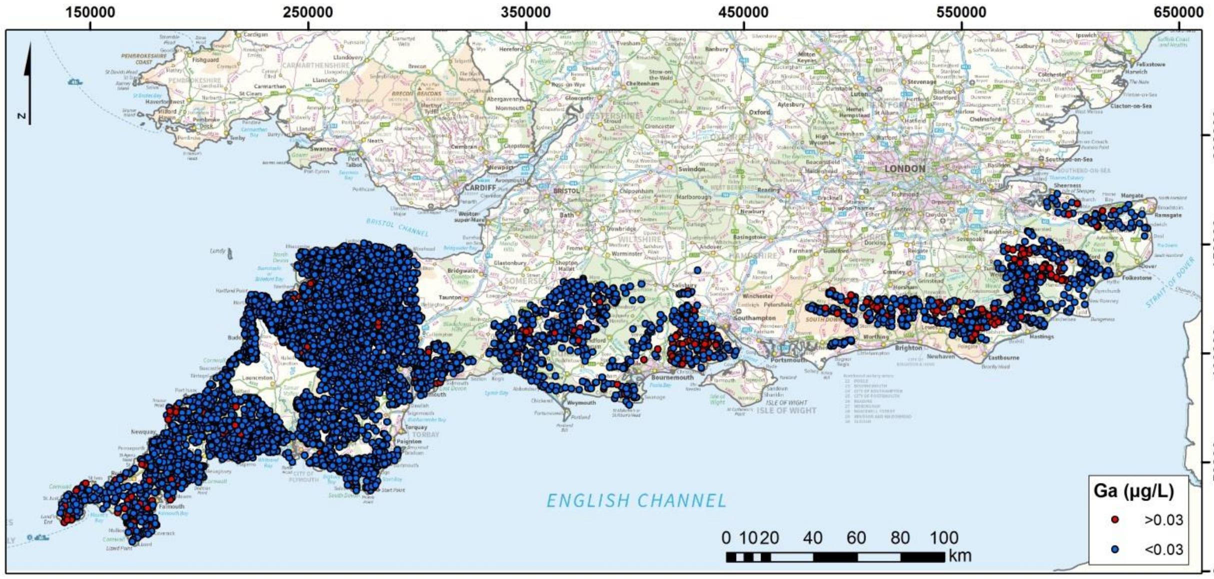
MILLER, J N, AND MILLER, J C. 2010. *Statistics and Chemometrics for Analytical Chemistry Sixth Edition*. (Harlow, Essex: Pearson Education Limited.)

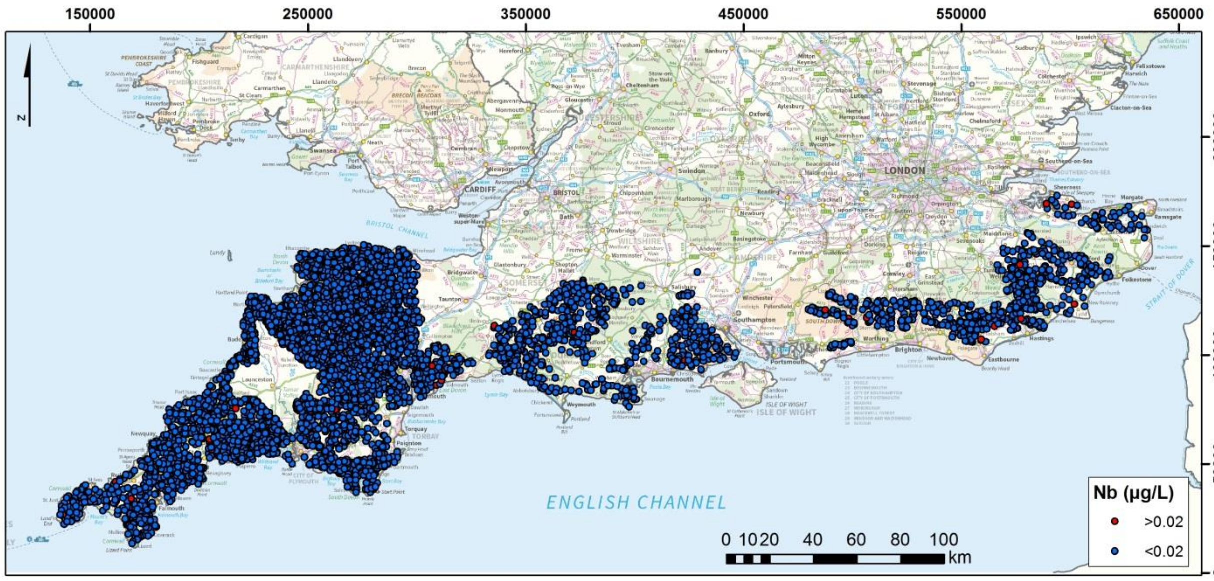
RAMSEY, M H. 1998. Sampling as a source of measurement uncertainty: techniques for quantification and comparison with analytical sources. *Journal of Analytical Atomic Spectrometry*, Vol. 13, 97-104.

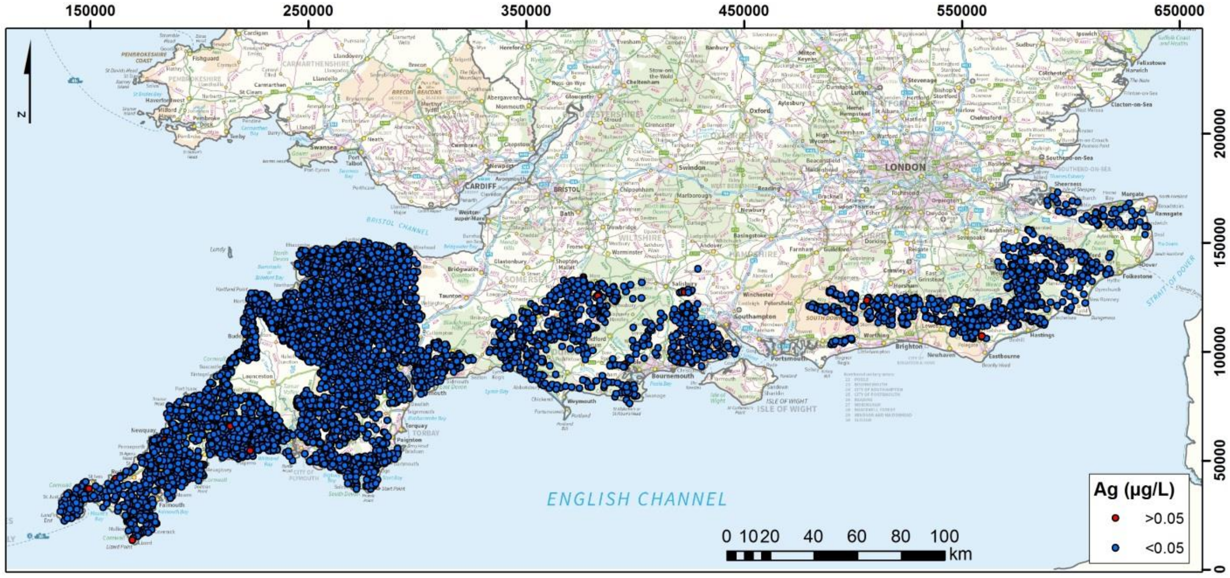
Appendix 1 Analytical Cover Notes provided by the laboratories

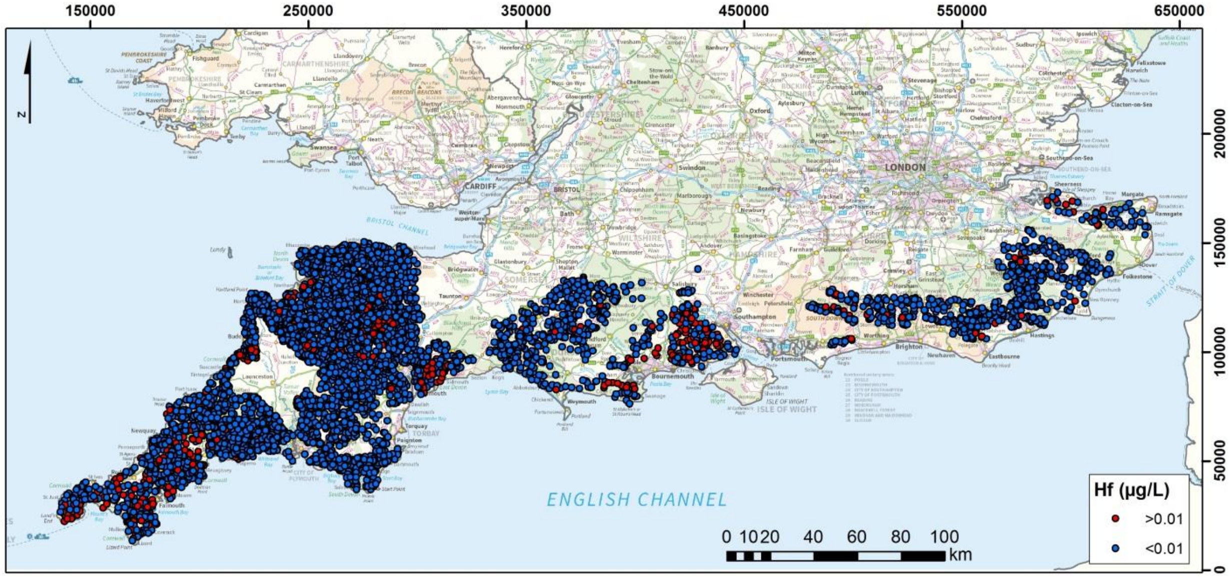
Commercial-in-confidence, not for external release.

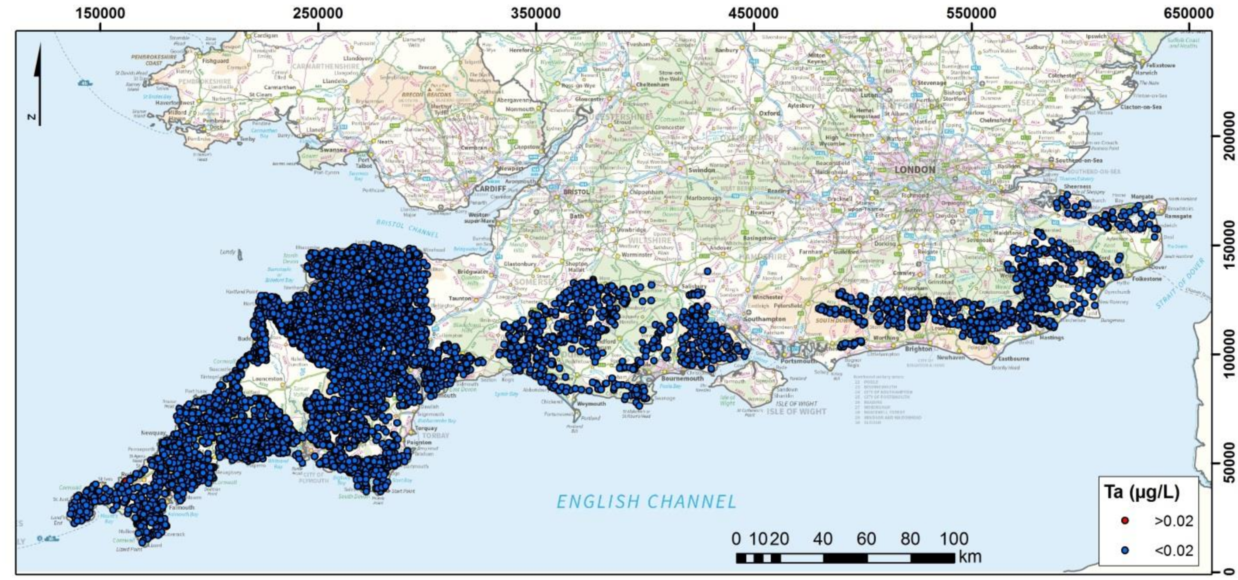
Appendix 2 Plots of data where most analyses are below the detection limit

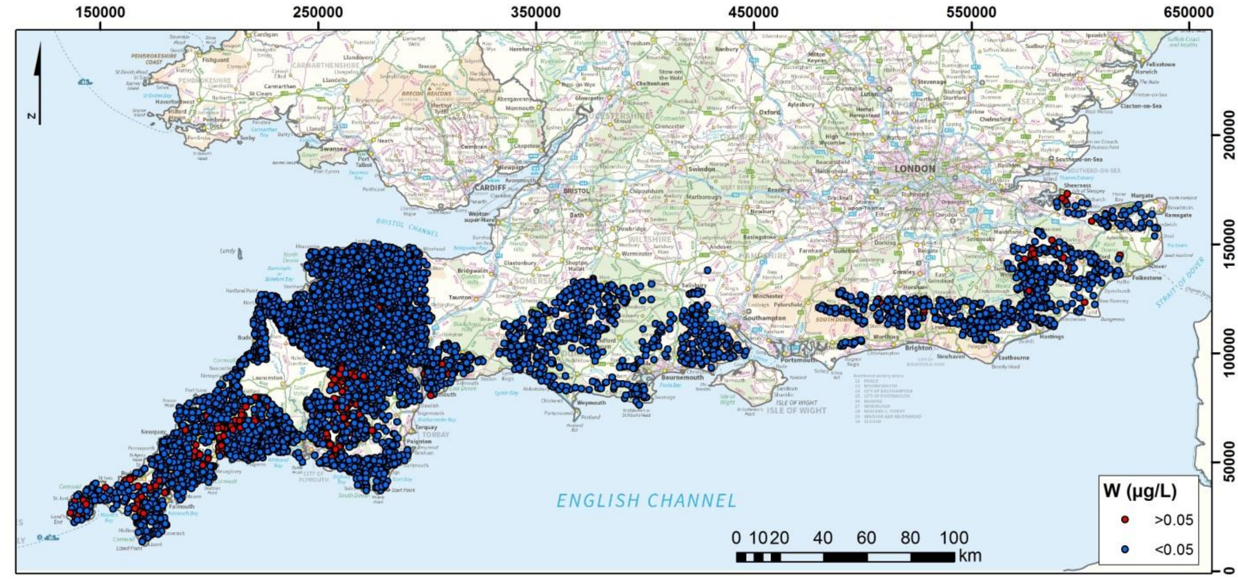


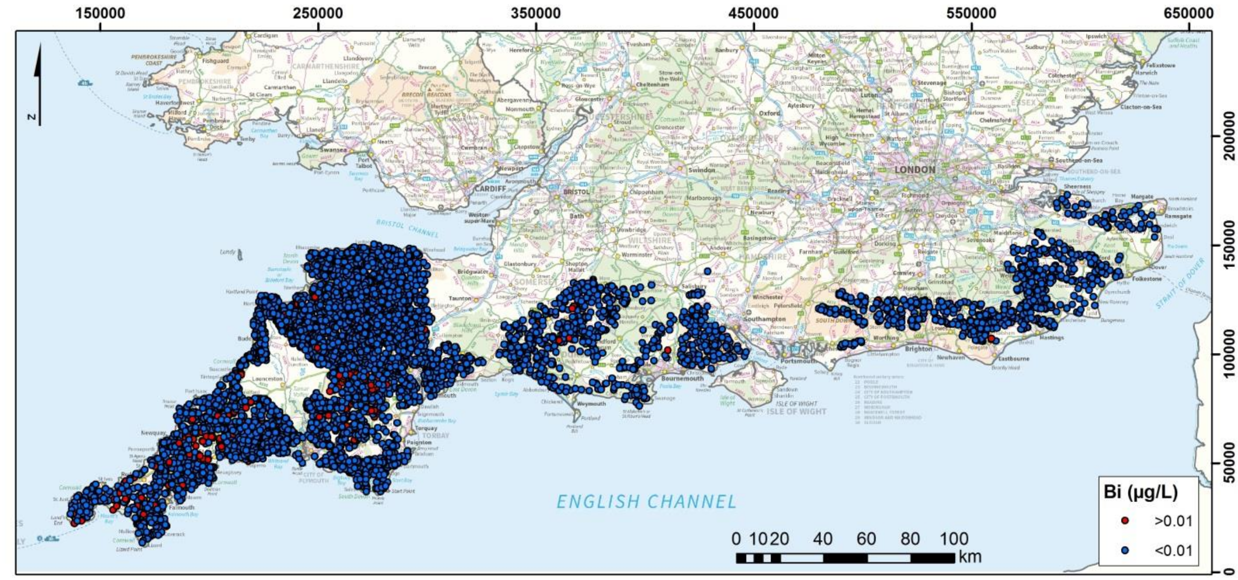



150000
250000
350000
450000
550000
650000
ENGLISH CHANNEL
Ag (µg/L)
>0.05
<0.05
0 10 20 40 60 80 100
km


150000
250000
350000
450000
550000
650000
ENGLISH CHANNEL
Hf (µg/L)
>0.01
<0.01
0 10 20 40 60 80 100
km


150000
250000
350000
450000
550000
650000
200000
150000
100000
50000
0
ENGLISH CHANNEL
LONDON
Ta (µg/L)
>0.02
<0.02
0 10 20 40 60 80 100
km


150000
250000
350000
450000
550000
650000
200000
150000
100000
50000
0
ENGLISH CHANNEL
LONDON
W (µg/L)
>0.05
<0.05
0 10 20 40 60 80 100
km


150000
250000
350000
450000
550000
650000
200000
150000
100000
50000
0
ENGLISH CHANNEL
LONDON
Bi (µg/L)
>0.01
<0.01
0 10 20 40 60 80 100
km

Appendix 3 Blank water data and graphs

SELECTED F/A SAMPLE ANALYSES

Highlighted cells show data above the detection limit

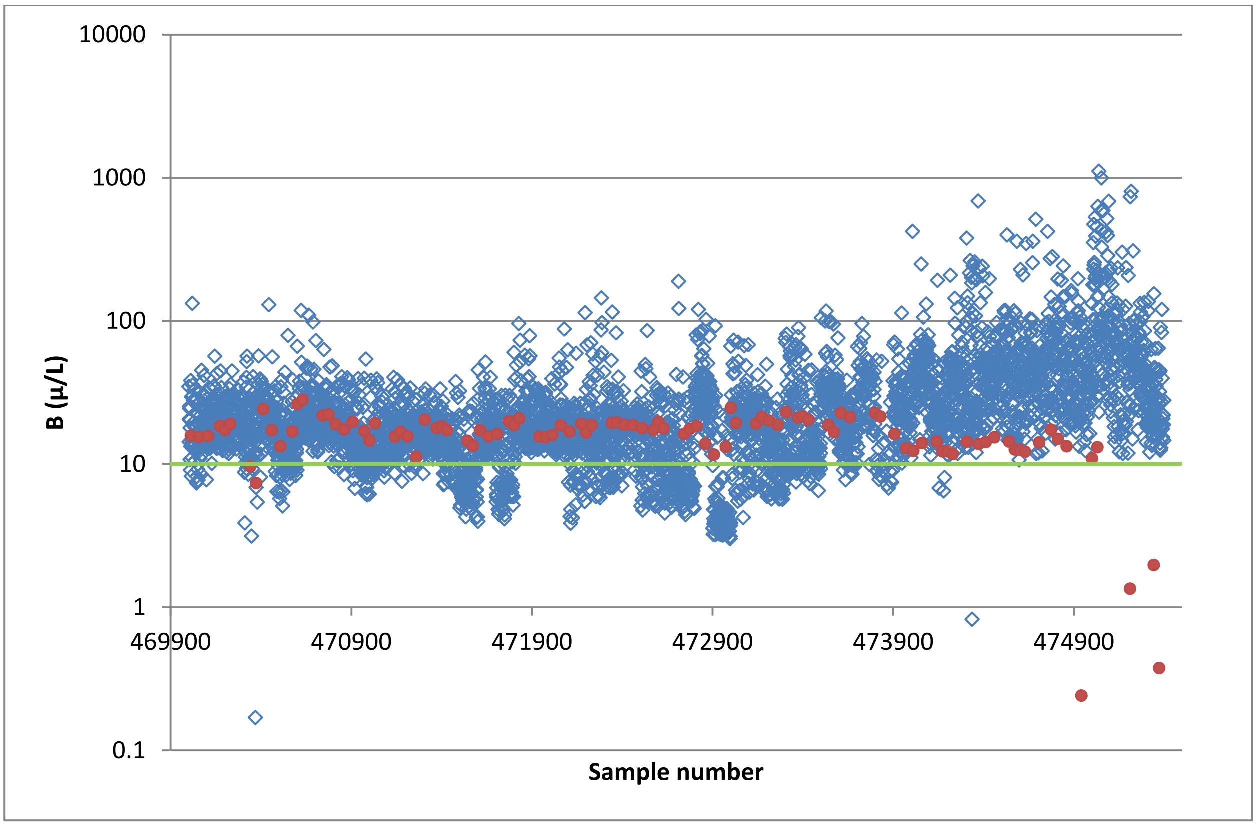
Sample Number	B (μg/L)	K_mg/L	Zn (μg/L)	Rb (μg/L)	Sr (μg/L)	Sn (μg/L)	Ce (μg/L)	Nd (μg/L)
Detection Limit	**10**	**0.02**	**0.5**	**0.01**	**0.1**	**0.02**	**0.002**	**0.010**
470014	15.6901	-0.005235	0.201044	-0.000683	-0.002642	0.009653	-0.000453	-0.008856
470062	15.4093	-0.002106	0.336922	-0.001654	-0.056994	0.026636	-0.000085	-0.002692
470110	15.6742	0.002227	0.296117	0.004352	-0.035178	0.015006	-0.000132	0.002538
470175	18.3878	0.004083	13.805276	0.003994	0.020726	0.015871	0.000304	0.001162
470203	17.2408	0.001619	0.113267	0.002393	0.001566	0.011720	-0.000252	-0.002587
470232	18.9987	0.011632	0.177352	0.006051	0.034749	0.002843	-0.000275	0.001403
470344	9.6050	0.000322	0.113253	0.001195	0.000396	0.015742	-0.000537	0.008667
470375	7.3336	-0.002744	-0.095263	-0.000362	-0.006969	0.001959	0.000276	-0.006582
470414	24.090102	0.036214	0.375482	0.028517	0.092532	0.011607	0.000064	0.002455
470462	17.125814	0.000276	0.019442	0.003097	-0.003110	0.023049	-0.000629	-0.002050
470510	13.261592	0.004326	0.137889	0.003928	-0.007960	0.033976	0.000523	-0.003557
470575	16.813791	-0.000043	-0.015044	-0.001435	-0.000767	0.029366	-0.000385	0.001149
470603	26.126966	-0.033090	-0.755845	-0.026074	-0.011122	0.020453	-0.000126	-0.009322
470632	28.051272	-0.026374	-0.691020	-0.022318	0.191896	-0.015653	-0.000245	0.000352
470744	21.767081	-0.022079	-0.656530	-0.025555	0.023631	0.000702	-0.000866	0.006981
470775	22.048223	0.000407	-0.077535	-0.000168	0.018467	0.008523	0.000012	-0.004617
470814	18.973539	0.014385	2.728369	0.018115	-0.006355	0.024851	0.000280	-0.004488
470862	17.439690	0.002048	0.186644	0.001065	-0.026971	0.029016	-0.000001	0.001153
470910	19.627683	0.004851	0.507209	0.001917	-0.036870	0.034086	0.000314	0.004533
470975	16.912243	-0.003117	-0.043559	0.004215	0.004916	0.012649	0.000748	0.005363
471003	14.528931	-0.003623	-0.076206	0.001758	-0.045400	0.018123	0.000375	0.000272
471032	19.237943	0.005237	0.106433	0.004074	0.023640	0.010621	0.000540	-0.004178
471144	15.465933	0.000738	0.349667	0.000466	0.009406	0.016499	-0.000020	-0.010406
471175	16.703029	-0.000969	-0.096419	-0.002027	-0.008655	0.007636	-0.001149	-0.015494
471214	15.572240	-0.002212	-0.044965	-0.002970	0.007189	0.012154	0.000023	0.015788
471262	11.179286	-0.018426	-0.552161	-0.007258	-0.017016	0.020546	-0.000287	0.002803
471310	20.318371	-0.000864	-0.016897	0.003053	0.003862	0.020190	-0.000439	-0.010955
471375	17.827403	0.000047	-0.073315	0.000448	0.049183	0.003861	0.000034	0.004777
471403	18.306379	0.004254	-0.046081	0.000428	0.038492	0.018556	-0.000364	0.006171
471432	17.181354	0.033907	0.600315	0.025593	0.000849	0.007050	-0.000135	0.007999
471544	14.453647	0.005932	-0.001436	0.002348	0.030843	0.019679	-0.000190	0.000592
471575	13.411534	0.009771	0.059402	0.007537	0.006798	0.025121	0.000155	0.002728
471614	17.128372	0.089796	5.140434	0.073194	0.022939	0.031654	0.001209	0.002333
471662	15.584897	0.046437	2.056776	0.039082	0.004042	0.039693	0.000329	0.002211
471710	16.153010	0.045139	0.449366	0.033485	0.006394	0.023448	0.000852	-0.009292
471775	19.878521	0.012795	0.212649	0.013826	0.003954	0.015384	0.000048	0.001578
471803	18.676393	-0.001182	-0.103621	0.001012	-0.000666	0.025090	-0.000204	0.002285
471832	20.810750	0.018961	1.477176	0.014109	0.010331	0.016435	0.000024	-0.008466
471944	15.495996	-0.003285	-0.174906	0.002451	-0.000884	0.020577	0.000291	0.011018
471975	15.290583	-0.002808	-0.224663	-0.000396	0.003570	0.002639	-0.000126	0.007066

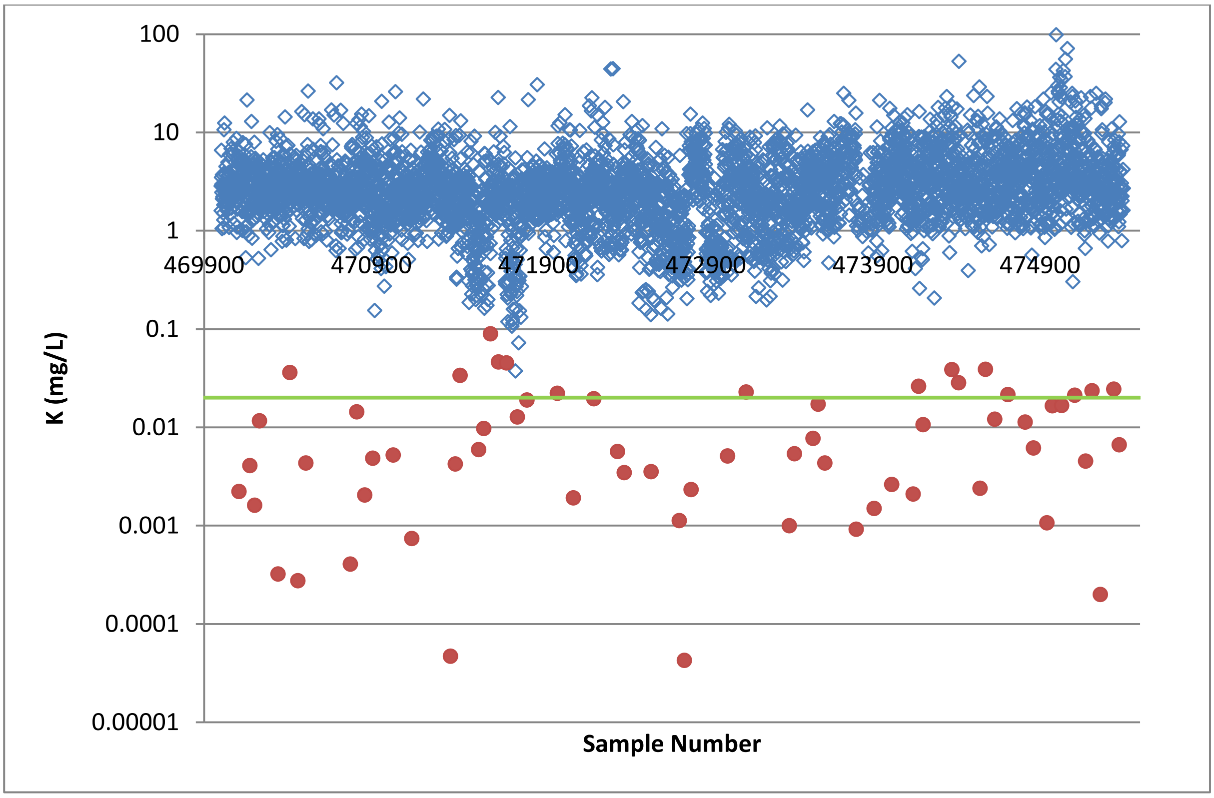
Sample Number	B (µg/L)	K_mg/L	Zn (µg/L)	Rb (µg/L)	Sr (µg/L)	Sn (µg/L)	Ce (µg/L)	Nd (µg/L)
Detection Limit	**10**	**0.02**	**0.5**	**0.01**	**0.1**	**0.02**	**0.002**	**0.010**
472014	15.871330	0.022228	0.136575	0.018232	0.043134	0.002868	-0.000072	0.001699
472062	18.555589	-0.001542	0.056950	0.004295	-0.011976	0.011087	0.005190	-0.005154
472110	16.789578	0.001922	-0.045040	0.001326	0.003999	0.011641	-0.000395	-0.001513
472175	19.022105	-0.004887	0.014760	0.002836	0.037180	0.001531	0.000340	0.003149
472203	16.572005	-0.002355	-0.038079	0.006565	0.001792	0.016536	0.001050	-0.000900
472232	18.680536	0.019606	0.846681	0.013360	0.007764	0.013271	-0.000124	-0.005691
472344	19.289542	-0.001970	0.000875	0.001742	0.006751	0.008699	-0.000067	-0.003732
472375	19.464717	0.005692	0.133491	0.007134	-0.005435	0.002973	0.000265	0.001983
472414	18.704474	0.003468	-0.013876	0.001699	-0.000285	0.005293	0.000377	-0.003212
472462	18.657547	-0.004328	-0.231697	0.001249	0.022067	0.011271	-0.000315	-0.001709
472510	17.808571	-0.002438	-0.202678	0.001288	-0.007142	0.007514	-0.000180	-0.001452
472575	17.267616	0.003544	-0.139817	0.003745	0.047648	0.001719	0.000290	-0.002759
472603	19.669033	-0.002944	0.017708	0.000651	0.006626	0.015744	0.000612	-0.007819
472632	17.667605	-0.000615	0.013179	0.004727	-0.000557	0.007825	-0.000188	-0.003426
472744	16.254825	0.001128	0.049574	0.001793	-0.004721	0.004920	0.000442	0.001663
472775	17.537252	0.000043	0.104915	-0.000172	-0.002588	0.001714	-0.000051	-0.004495
472814	18.378075	0.002336	0.005226	0.002258	0.017713	0.007708	-0.000013	-0.002398
472862	13.814907	-0.001015	-0.021210	0.000886	-0.016230	0.017475	0.000559	-0.001133
472910	11.625329	-0.000274	0.056522	0.000827	-0.019159	0.005397	0.002033	-0.001591
472975	13.218614	-0.002400	0.194130	0.003438	-0.000007	0.008106	0.006655	-0.002066
473003	24.641898	-0.004655	-0.091888	0.001663	-0.030988	0.024750	-0.000204	-0.008150
473032	19.365573	0.005109	0.347141	0.006899	0.005326	0.008315	0.000589	-0.005620
473144	19.103840	0.022862	-0.092966	0.002559	0.028332	0.196032	-0.000137	0.001651
473175	21.213257	-0.000612	-0.171597	0.000623	-0.048752	0.184102	-0.000082	-0.001531
473214	20.003432	-0.001058	-0.122883	0.000752	-0.058319	0.007146	-0.000078	0.004030
473262	18.751699	-0.003731	-0.136678	-0.000397	-0.067173	0.019610	0.000244	0.004453
473310	23.036350	-0.009543	0.009697	0.000876	0.018307	0.006943	0.000298	0.003970
473375	20.933728	-0.001048	-0.047114	0.001178	0.014539	-0.000753	0.000165	0.005652
473403	21.412925	0.001003	-0.047136	-0.000179	0.002211	0.016661	0.000043	-0.003752
473432	20.307708	0.005386	0.656219	0.001066	-0.005299	0.007321	-0.000047	-0.006068
473544	18.677840	0.007708	0.090394	0.001625	0.002041	0.005888	0.000203	0.000596
473575	16.709890	0.017239	0.368010	0.002958	-0.000367	0.002207	0.000139	0.005043
473614	22.652226	0.004327	0.145403	0.009307	-0.003492	0.004293	-0.000268	-0.006992
473662	21.172360	-0.005186	-0.002439	-0.000195	-0.002080	0.009753	0.000222	-0.002677
473803	22.651579	0.000918	0.073701	0.003910	-0.005130	0.022074	-0.001934	-0.060630
473832	21.471305	-0.004593	-0.012642	-0.000377	-0.008989	0.006988	-0.001844	-0.060256
473910	16.137929	0.001500	0.102988	0.001577	-0.080813	0.017747	-0.000304	-0.042180
473975	12.876886	-0.003115	-0.003137	0.002171	0.144307	0.005528	0.000770	0.003352
474014	12.317306	0.002623	0.570838	0.000618	0.087584	0.007399	0.000218	0.023517
474062	13.960253	-0.000950	-0.110731	0.002783	0.013115	0.016796	-0.001737	-0.032119
474144	14.306347	0.002091	0.470243	0.000722	0.055269	0.014689	0.000522	0.023966
474175	12.195975	0.026213	0.488817	0.018525	0.021446	0.013656	0.001063	0.041235
474203	12.239838	0.010654	0.175222	0.000252	0.003064	0.016423	0.001474	0.070307
474232	11.756574	-0.001184	0.240505	0.001856	0.015513	0.009244	-0.001188	-0.047537
474310	14.233653	-0.011346	0.093115	0.001917	-0.031512	0.022847	-0.001665	-0.035529

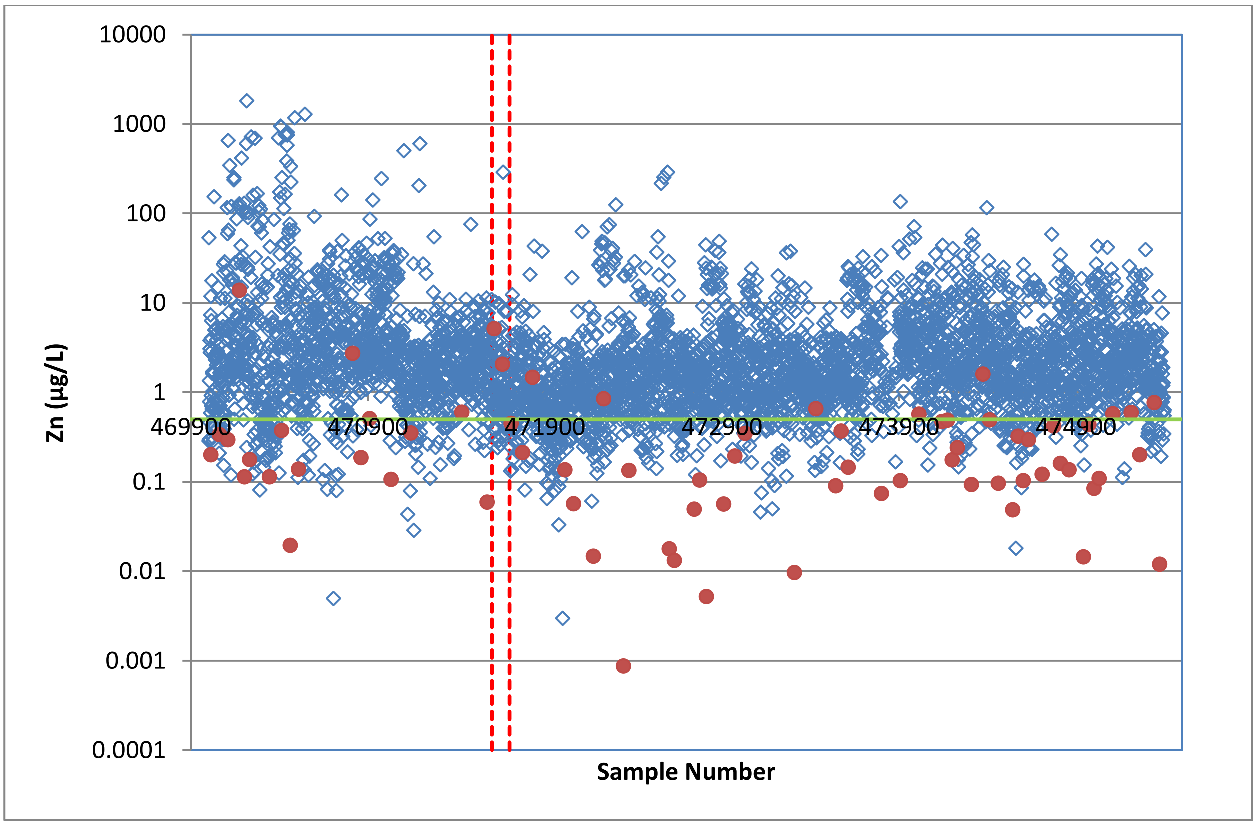
Sample Number	B (µg/L)	K_mg/L	Zn (µg/L)	Rb (µg/L)	Sr (µg/L)	Sn (µg/L)	Ce (µg/L)	Nd (µg/L)
Detection Limit	**10**	**0.02**	**0.5**	**0.01**	**0.1**	**0.02**	**0.002**	**0.010**
474375	13.793035	0.038755	1.600507	0.033132	0.148797	0.035425	0.001025	-0.007725
474414	14.224713	0.028536	0.493328	0.015974	0.197944	0.038871	0.002666	0.070779
474462	15.356688	-0.009264	0.096007	-0.000576	-0.158851	0.035736	-0.002154	0.005398
474544	14.307113	0.002393	0.048706	0.001297	-0.044847	0.018328	0.000846	0.005816
474575	12.625023	0.038941	0.322806	0.021103	-0.029389	0.007209	0.003669	0.008042
474603	12.561751	-0.009063	0.102991	0.001444	0.039293	0.054778	-0.000427	-0.000103
474632	12.151870	0.012127	0.296051	0.008730	0.031551	0.046370	0.000246	-0.016664
474710	14.082828	0.021536	0.120918	0.008380	0.015048	0.018778	0.001315	0.002391
474775	17.327577	-0.006375	0.419909	0.000865	0.032046	0.008224	-0.000844	0.009362
474814	14.947011	0.011320	0.160245	0.013018	0.035602	0.004683	-0.000029	0.008173
474862	13.305370	0.006190	0.135772	0.001148	0.009930	0.008871	0.000100	-0.007821
474944	0.240383	0.001066	0.014493	0.002561	-0.044426	0.012236	0.000236	-0.012882
474975	-0.579667	0.016579	0.437111	0.010012	-0.012856	0.012024	0.001210	-0.000602
475003	10.927152	-0.004229	0.084205	-0.000078	-0.002905	0.014197	0.000194	0.006127
475032	13.046344	0.016703	0.109011	0.012960	0.011513	0.007362	-0.000104	0.005928
475110	-0.019091	0.021190	0.575216	0.018597	0.031333	0.023892	-0.000072	-0.073189
475175	-0.791069	0.004533	-0.053310	0.001610	0.002431	0.003735	0.002118	0.038727
475214	1.345935	0.023580	0.594425	0.018548	-0.018604	0.005124	-0.000453	-0.040119
475262	-1.296640	0.000200	0.200162	-0.000275	0.018991	0.025397	-0.000215	0.005376
475344	1.961312	0.024444	0.770512	0.006225	0.900798	0.003662	0.000011	-0.005141
475375	0.374156	0.006642	0.011999	0.000909	0.397982	0.000509	-0.000368	-0.004266
Number >DL	**96**	**15**	**14**	**19**	**6**	**28**	**6**	**8**
Percentage >DL	**91**	**14**	**13**	**18**	**6**	**26**	**6**	**8**

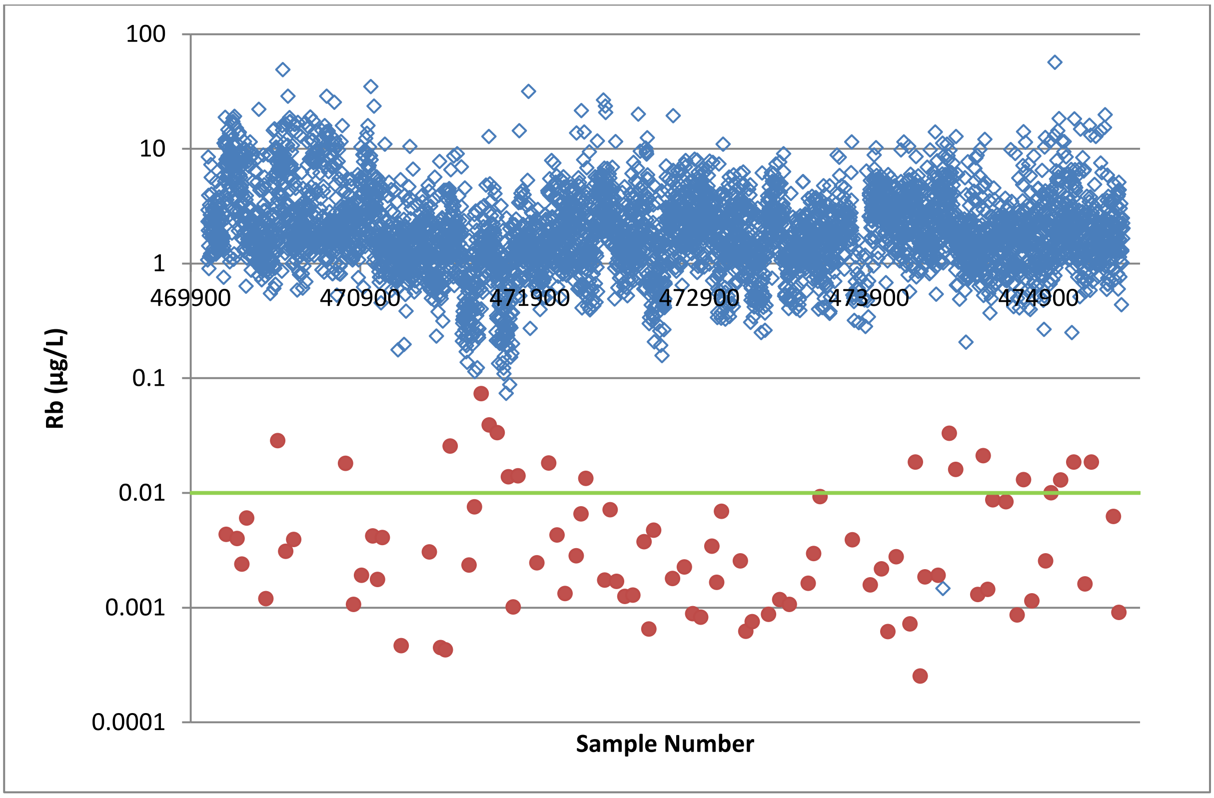
Comparison graphs of blank water samples and sample site data for F/A analytes highlighted in Error! Reference source not found.

Red circles are blanks, blue diamonds are samples and the green horizontal line indicates the detection limit. Missing data are those where the reported value is negative and cannot be plotted on a log-transformed axis. Samples collected during 2013 commence at sample number 473801. The vertical red lines on the Zn map identify the batch of 100 samples where both blanks were above the detection limit.

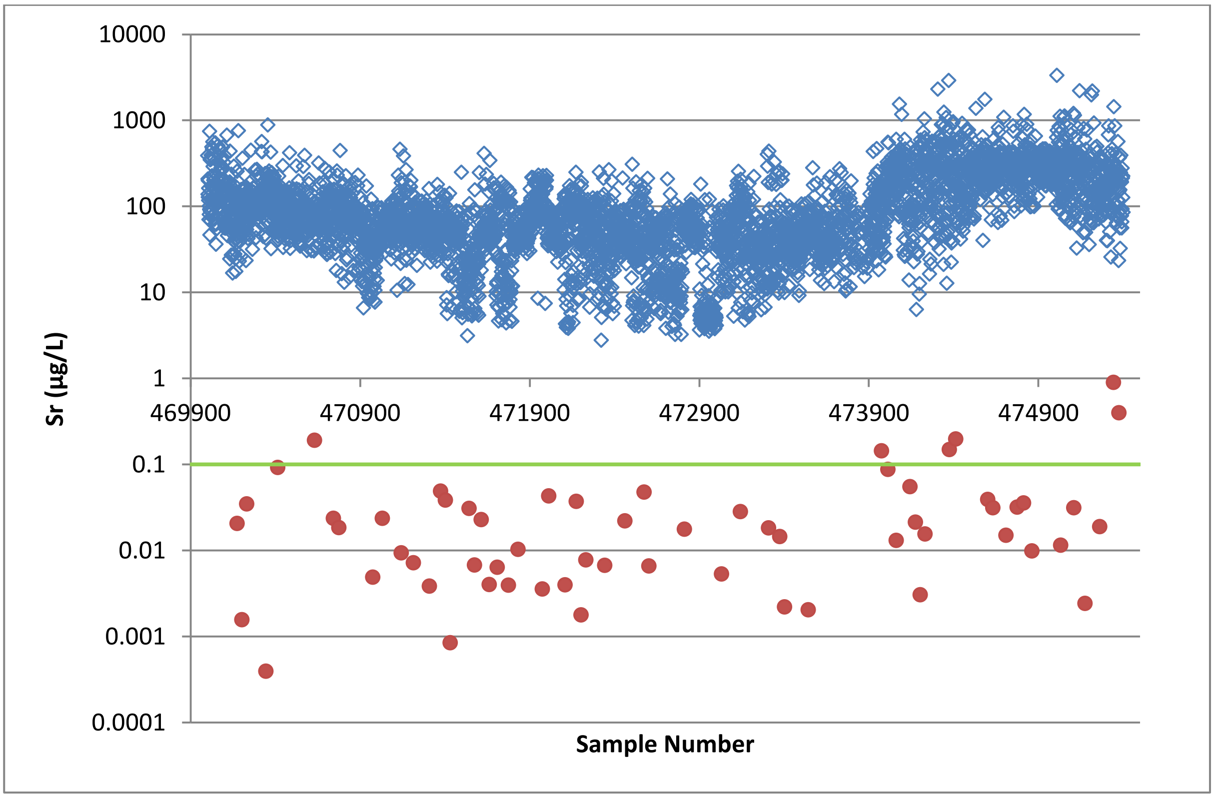



100
10
1
0.1
0.01
0.001
0.0001
0.00001
469900
470900
471900
472900
473900
474900
K (mg/L)
Sample Number

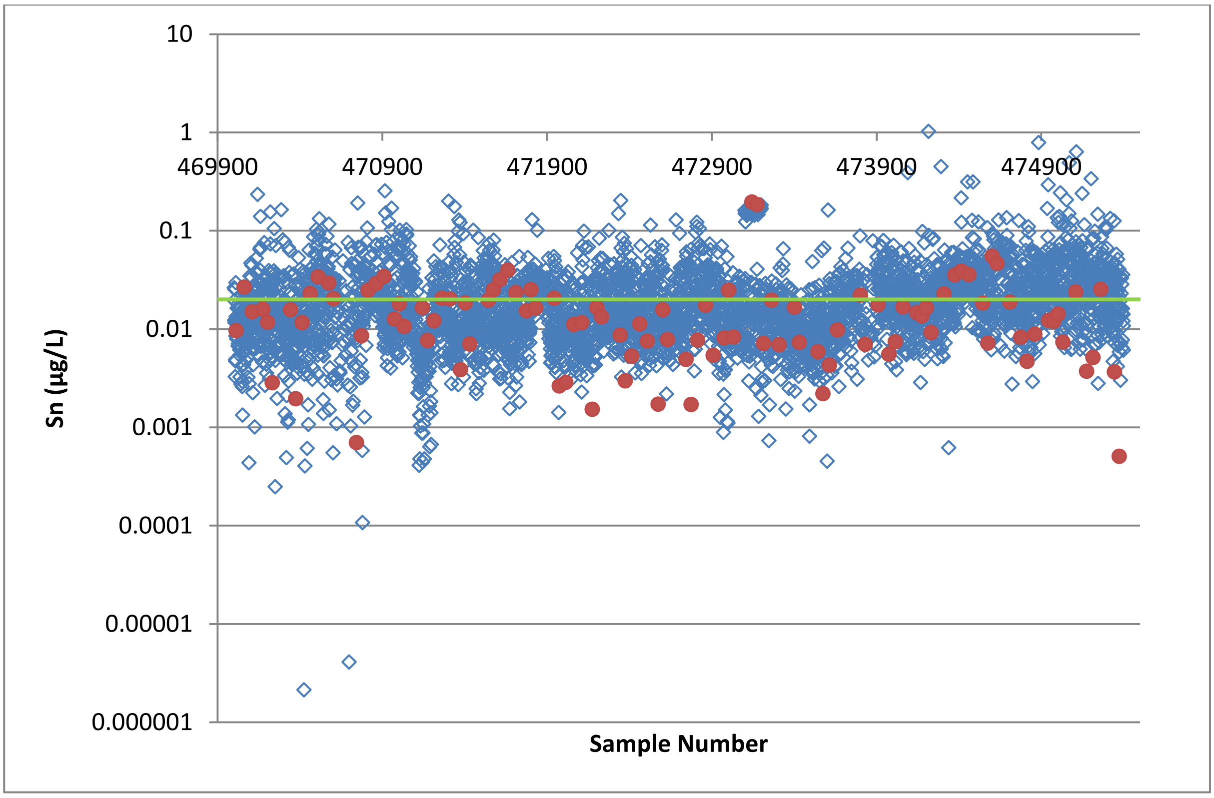

10000
1000
100
10
1
0.1
0.01
0.001
0.0001
469900
470900
471900
472900
473900
474900
Zn (µg/L)
Sample Number

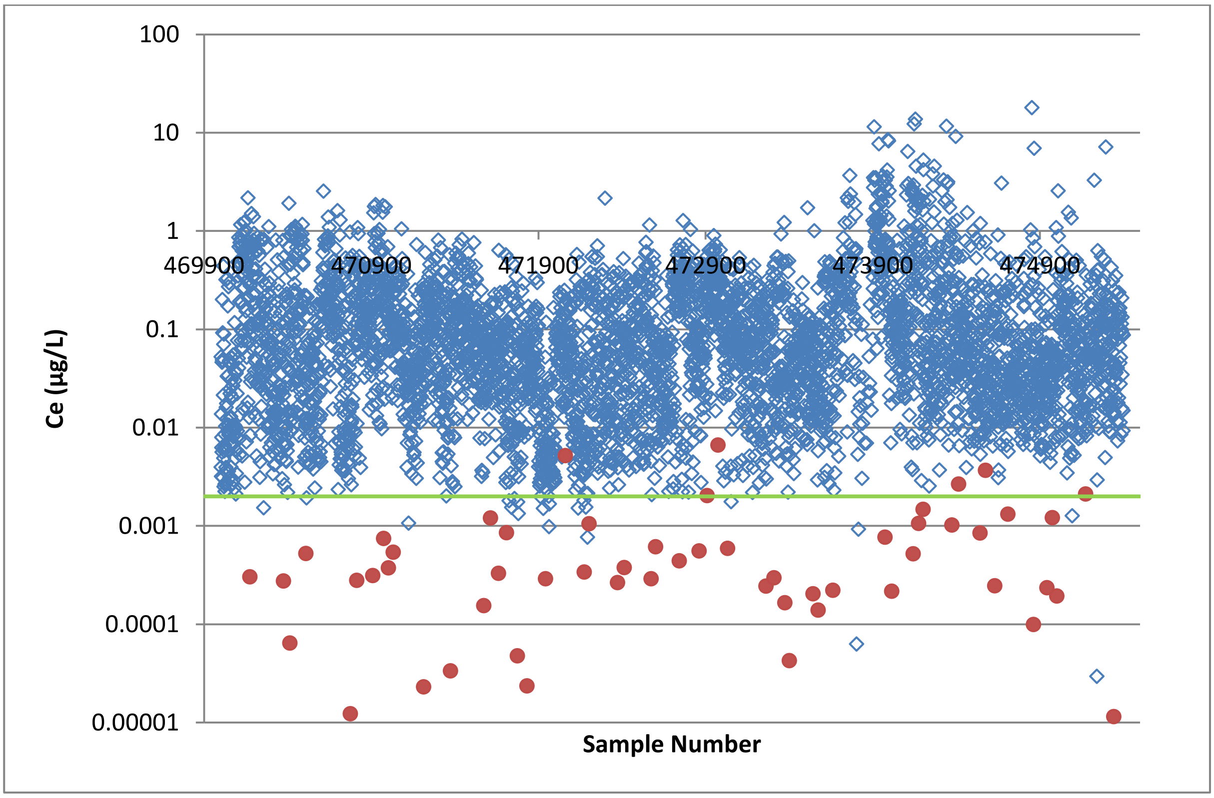


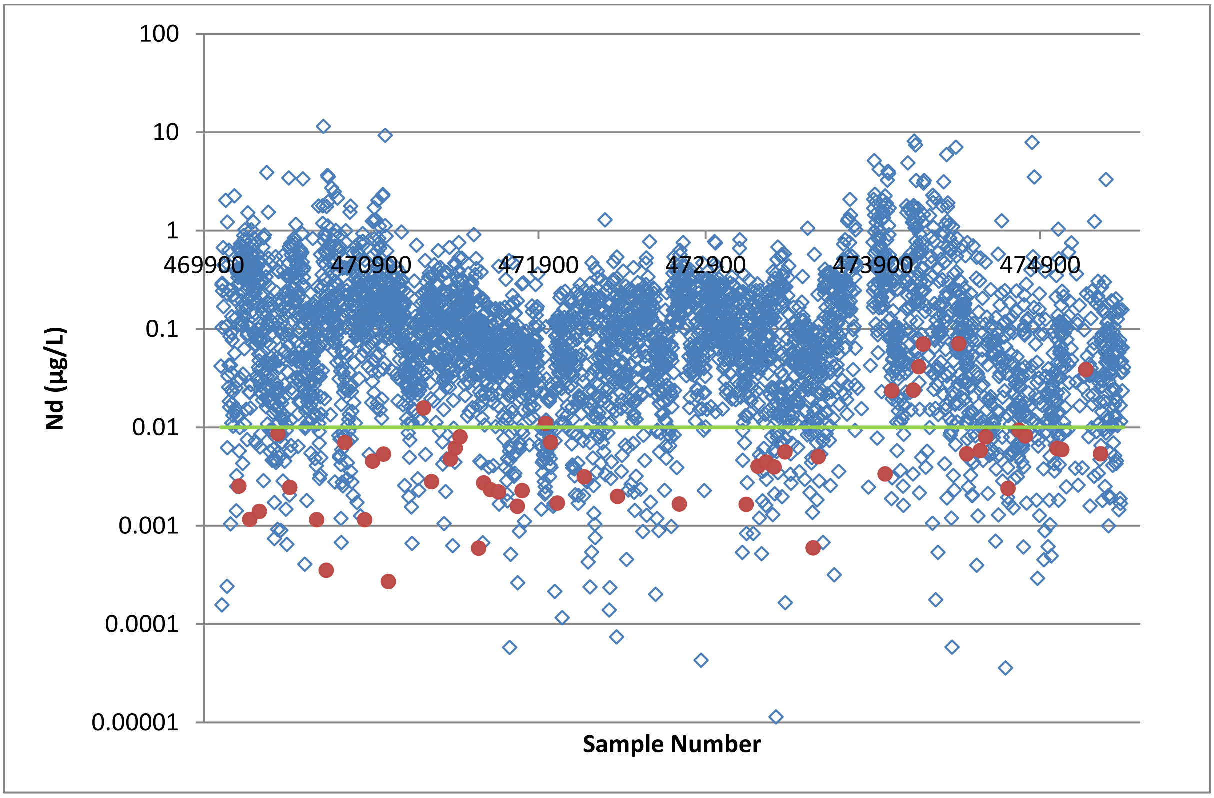
100
10
1
0.1
0.01
0.001
0.0001
469900
470900
471900
472900
473900
474900
Rb (µg/L)
Sample Number



10000
1000
100
10
1
0.1
0.01
0.001
0.0001
469900
470900
471900
472900
473900
474900
Sr (µg/L)
Sample Number


10
1
0.1
0.01
0.001
0.0001
0.00001
0.000001
469900
470900
471900
472900
473900
474900
Sn (µg/L)
Sample Number


100
10
1
0.1
0.01
0.001
0.0001
0.00001
469900
470900
471900
472900
473900
474900
Ce (µg/L)
Sample Number



SELECTED F/UA SAMPLE ANALYSES

Highlighted cells show data above the detection limit

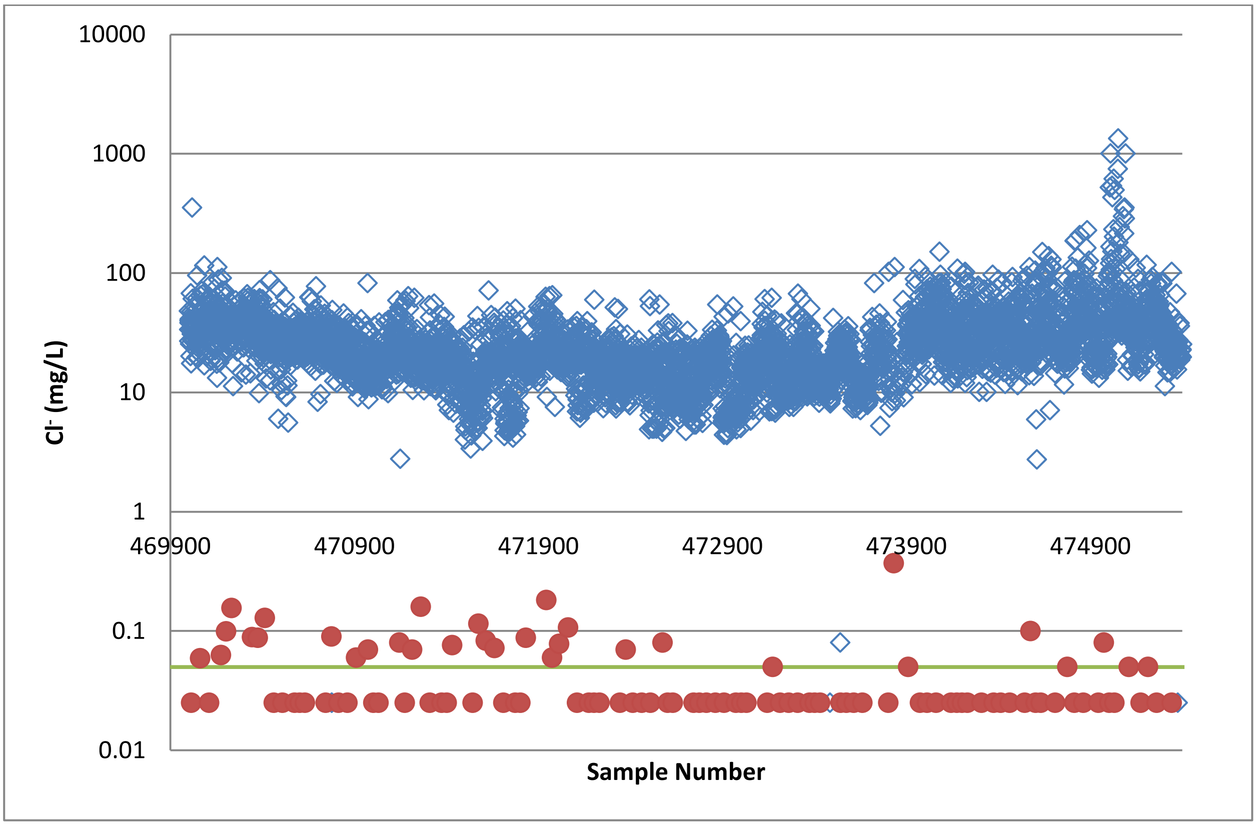
Sample Number	Cl^-	SO_4^{2-}	NO_3^-	F^-
Detection Limit	**0.05**	**0.05**	**0.03**	**0.005**
470014	-0.05	-0.05	-0.03	-0.005
470062	0.059	0.101	0.032	0.008
470110	-0.05	-0.05	-0.03	-0.005
470175	0.063	-0.05	0.03	0.022
470203	0.099	-0.05	-0.03	0.042
470232	0.156	-0.05	0.031	0.049
470344	0.089	-0.05	-0.03	-0.005
470375	0.088	-0.05	-0.03	0.033
470414	0.129	0.094	0.05	0.014
470462	-0.05	-0.05	0.061	-0.005
470510	-0.05	-0.05	-0.03	0.009
470575	-0.05	-0.05	-0.03	0.022
470603	-0.05	0.086	-0.03	0.012
470632	-0.05	-0.05	-0.03	-0.005
470744	-0.05	-0.05	0.042	-0.005
470775	0.09	0.068	-0.03	0.005
470814	-0.05	-0.05	-0.03	0.01
470862	-0.05	-0.05	-0.03	0.01
470910	0.06	-0.05	-0.03	0.02
470975	0.07	0.11	-0.03	0.02
471003	-0.05	-0.05	-0.03	0.02
471032	-0.05	-0.05	-0.03	-0.01

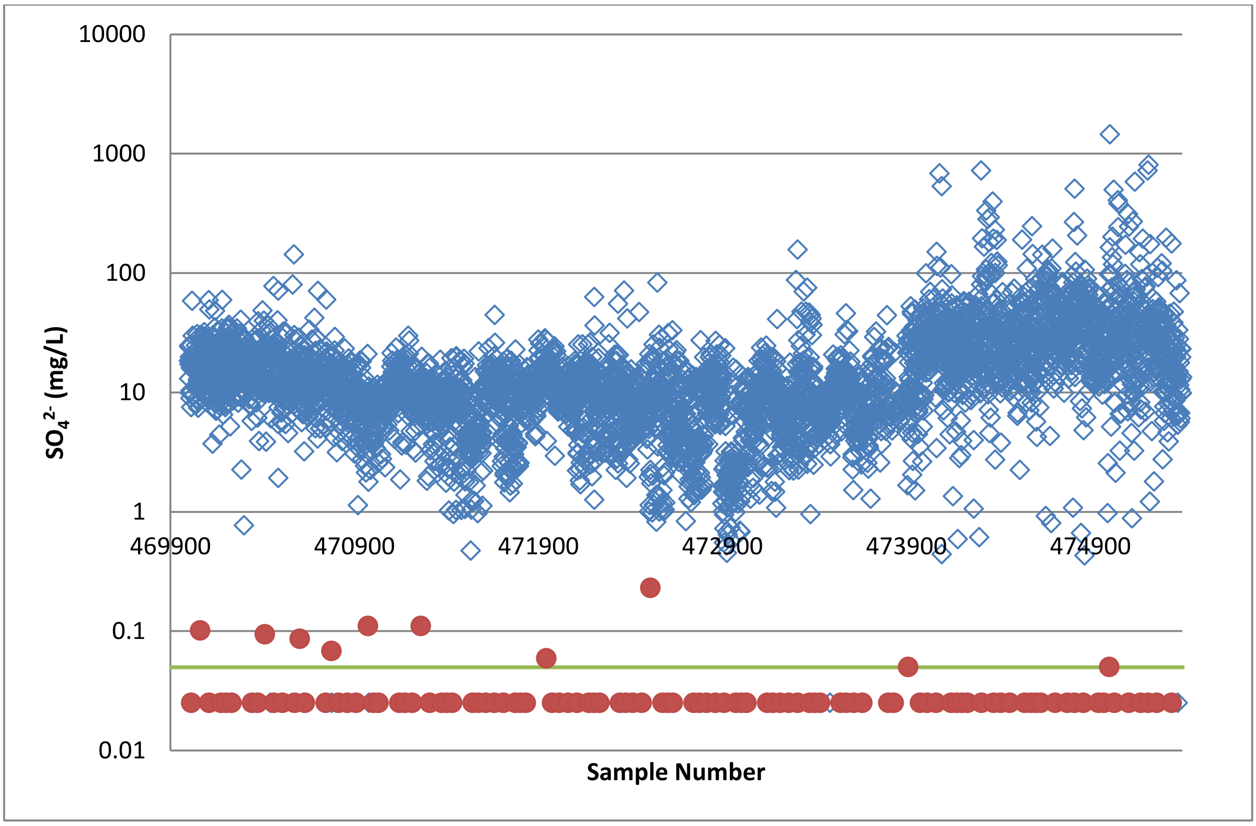
Sample Number	Cl^-	SO_4^{2-}	NO_3^-	F^-
Detection Limit	**0.05**	**0.05**	**0.03**	**0.005**
471144	0.08	-0.05	-0.03	0.02
471175	-0.05	-0.05	-0.03	-0.01
471214	0.07	-0.05	-0.03	0.02
471262	0.16	0.11	0.06	0.01
471310	-0.05	-0.05	-0.03	0.011
471375	-0.05	-0.05	-0.03	0.008
471403	-0.05	-0.05	-0.03	-0.005
471432	0.076	-0.05	-0.03	0.035
471544	-0.05	-0.05	-0.03	0.007
471575	0.115	-0.05	-0.03	0.022
471614	0.083	-0.05	-0.03	-0.005
471662	0.072	-0.05	-0.03	-0.005
471710	-0.05	-0.05	-0.03	0.014
471775	-0.05	-0.05	-0.03	-0.005
471803	-0.05	-0.05	-0.03	-0.005
471832	0.088	-0.05	-0.03	-0.005
471944	0.182	0.059	0.048	0.025
471975	0.06	-0.05	-0.03	-0.005
472014	0.078	-0.05	-0.03	-0.005
472062	0.107	-0.05	-0.03	-0.005
472110	-0.05	-0.05	-0.03	-0.005
472175	-0.05	-0.05	0.045	-0.005
472203	-0.05	-0.05	-0.03	-0.005
472232	-0.05	-0.05	-0.03	-0.005
472344	-0.05	-0.05	-0.03	-0.005
472375	0.07	-0.05	-0.03	-0.005
472414	-0.05	-0.05	-0.03	-0.005
472462	-0.05	-0.05	-0.03	-0.005
472510	-0.05	0.23	-0.03	-0.005
472575	0.08	-0.05	-0.03	-0.005
472603	-0.05	-0.05	-0.03	-0.005
472632	-0.05	-0.05	-0.03	-0.005
472744	-0.05	-0.05	-0.03	-0.005
472775	-0.05	-0.05	-0.03	-0.005
472814	-0.05	-0.05	-0.03	-0.005
472862	-0.05	-0.05	-0.03	-0.005
472910	-0.05	-0.05	-0.03	-0.005
472975	-0.05	-0.05	-0.03	-0.005
473003	-0.05	-0.05	-0.03	-0.005
473032	-0.05	-0.05	-0.03	0.007
473144	-0.05	-0.05	-0.03	-0.005
473175	-0.1	-0.05	-0.03	-0.005
473214	-0.05	-0.05	-0.03	-0.005
473262	-0.05	-0.05	-0.03	-0.005
473310	-0.05	-0.05	-0.03	-0.005
473375	-0.05	-0.05	-0.03	-0.005
473403	-0.05	-0.05	-0.03	-0.005
473432	-0.05	-0.05	-0.03	-0.005
473544	-0.05	-0.05	-0.03	-0.005
473575	-0.05	-0.05	-0.03	-0.005
473614	-0.05	-0.05	-0.03	-0.005
473662	-0.05	-0.05	-0.03	-0.005
473803	-0.05	-0.05	-0.03	-0.01
473832	0.37	-0.05	0.06	-0.01
473910	-0.1	-0.1	0	0
473975	-0.05	-0.05	-0.03	-0.005
474014	-0.05	-0.05	-0.03	-0.005
474062	-0.05	-0.05	-0.03	-0.005
474144	-0.05	-0.05	0.06	-0.005
474175	-0.05	-0.05	0.06	0.011

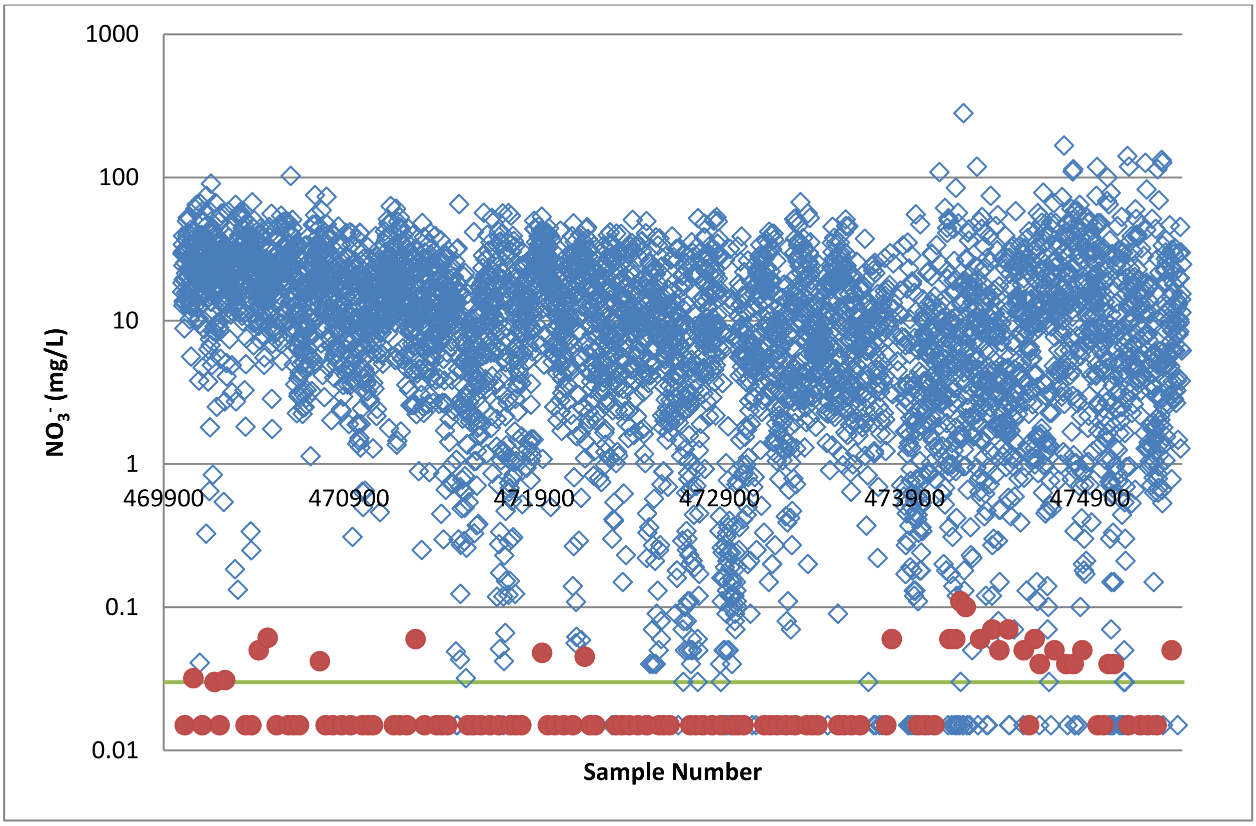
Sample Number	Cl^-	SO_4^{2-}	NO_3^-	F^-
Detection Limit	**0.05**	**0.05**	**0.03**	**0.005**
474203	-0.05	-0.05	0.11	-0.005
474232	-0.05	-0.05	0.1	-0.005
474310	-0.05	-0.05	0.06	-0.005
474375	-0.05	-0.05	0.07	-0.005
474414	-0.05	-0.05	0.05	-0.005
474462	-0.05	-0.05	0.07	-0.005
474544	-0.05	-0.05	0.05	-0.005
474575	0.1	-0.05	-0.03	0.022
474603	-0.05	-0.05	0.06	-0.005
474632	-0.05	-0.05	0.04	-0.005
474710	-0.05	-0.05	0.05	-0.005
474775	0.05	-0.05	0.04	-0.005
474814	-0.05	-0.05	0.04	-0.005
474862	-0.05	-0.05	0.05	-0.005
474944	-0.05	-0.05	-0.03	-0.005
474975	0.08	-0.05	-0.03	-0.005
475003	-0.05	-0.1	0.04	-0.005
475032	-0.05	-0.05	0.04	-0.005
475110	0.05	-0.05	-0.03	-0.005
475175	-0.05	-0.05	-0.03	-0.005
475214	0.05	-0.05	-0.03	-0.005
475262	-0.05	-0.05	-0.03	-0.005
475344	-0.05	-0.05	0.05	-0.005
Number >DL	**27**	**8**	**11**	**27**
Percentage >DL	**25.7**	**7.6**	**10.5**	**25.7**

Comparison graphs of blank water samples and sample site data for F/A analytes highlighted in Error! Reference source not found.

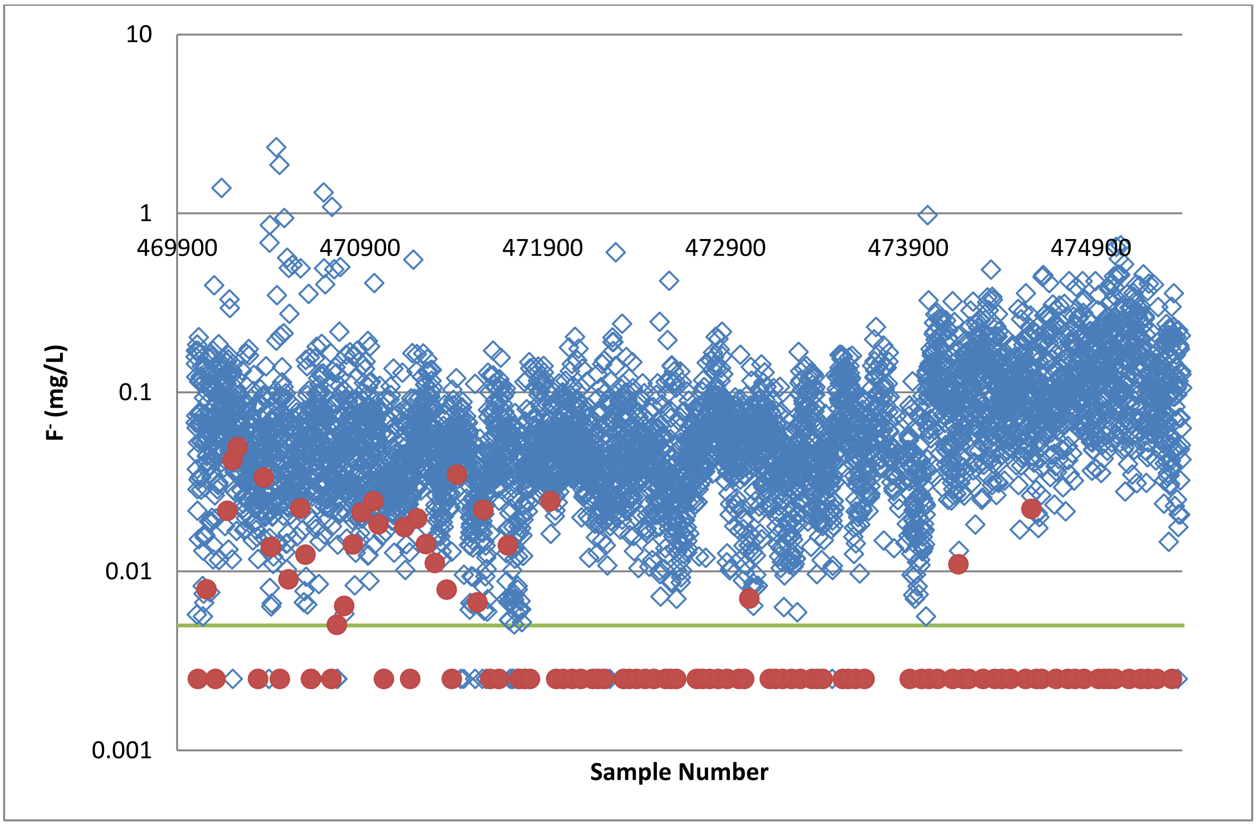
Red circles are blanks, blue diamonds are samples and the green horizontal line indicates the detection limit. As the data are censored and all negative data denotes samples at or below the detection limit these have been changed to half the detection limit for the purposes of graphing the data.







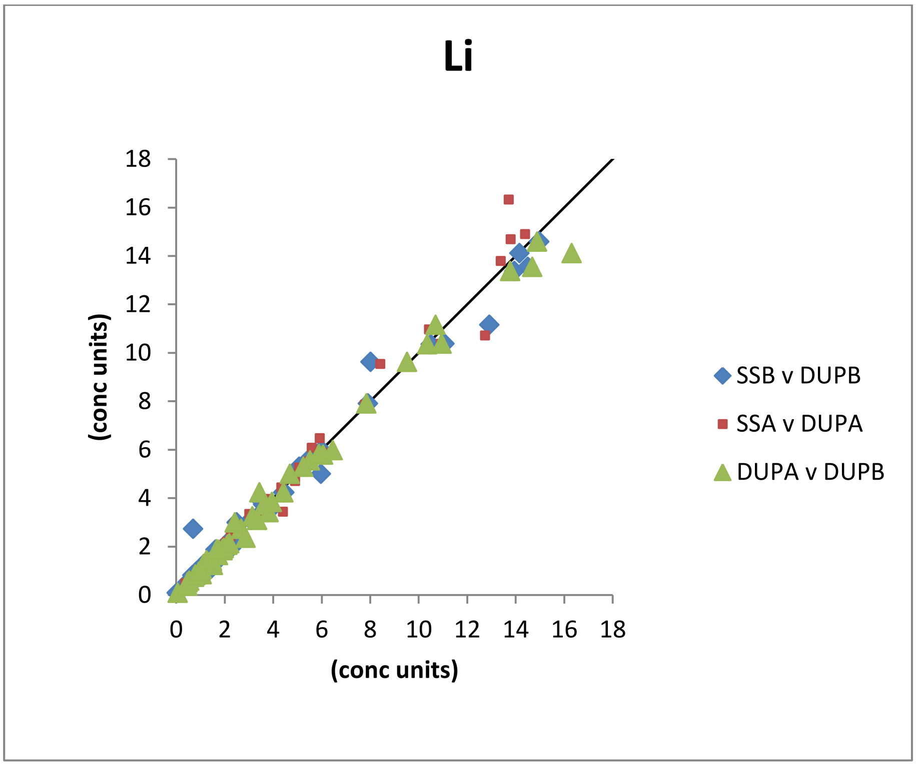
1000
100
10
1
0.1
0.01
NO_3^- (mg/L)
469900
470900
471900
472900
473900
474900
Sample Number

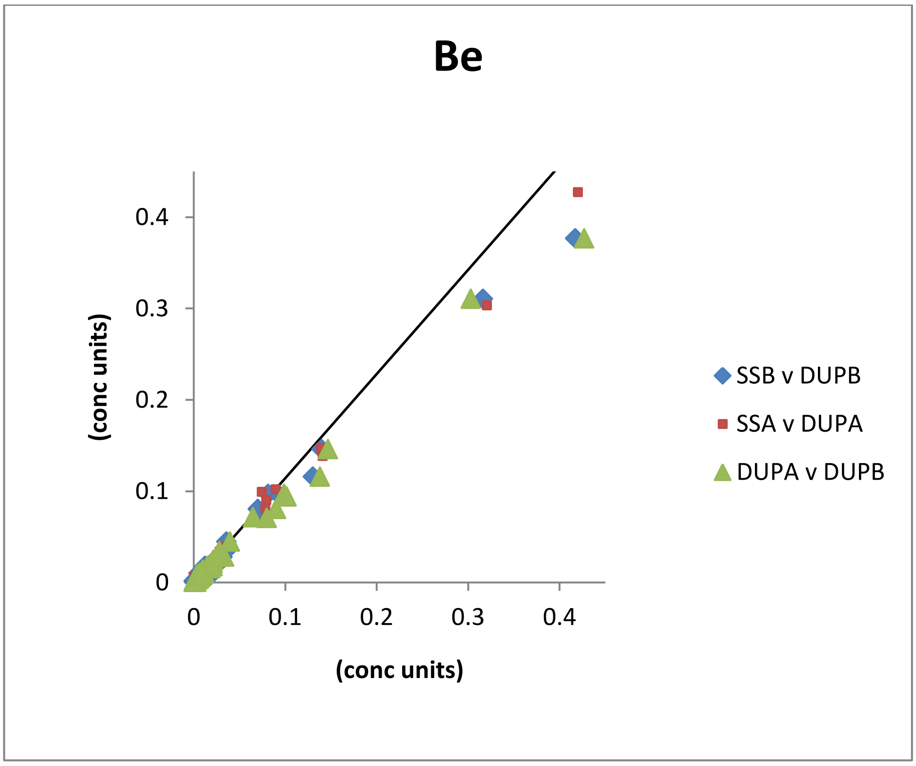


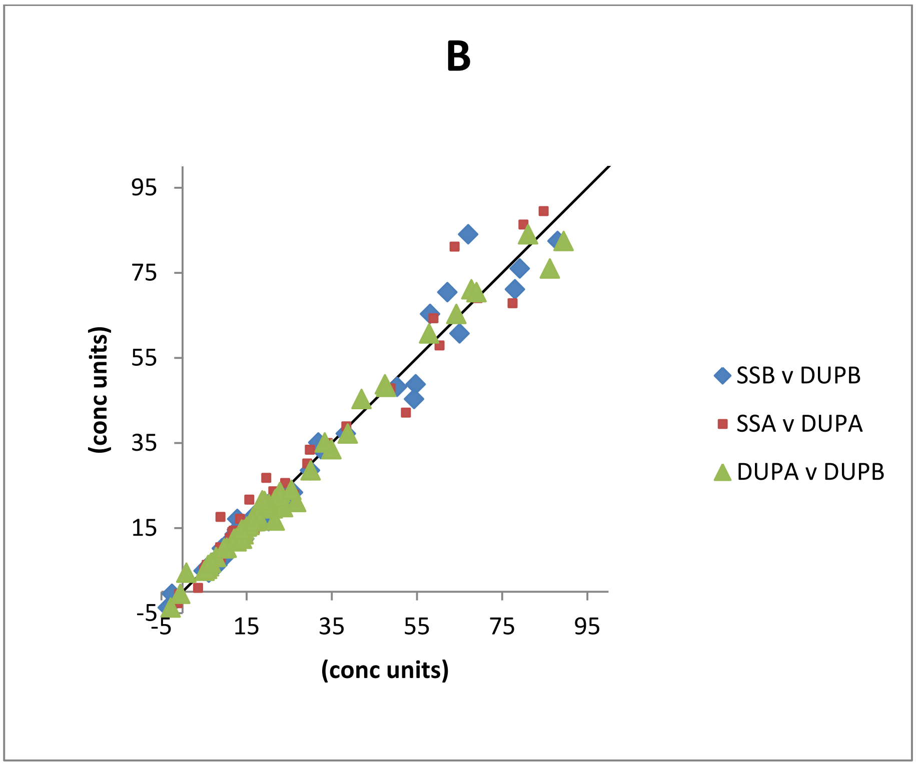
10
1
0.1
0.01
0.001
F^- (mg/L)
469900
470900
471900
472900
473900
474900
Sample Number

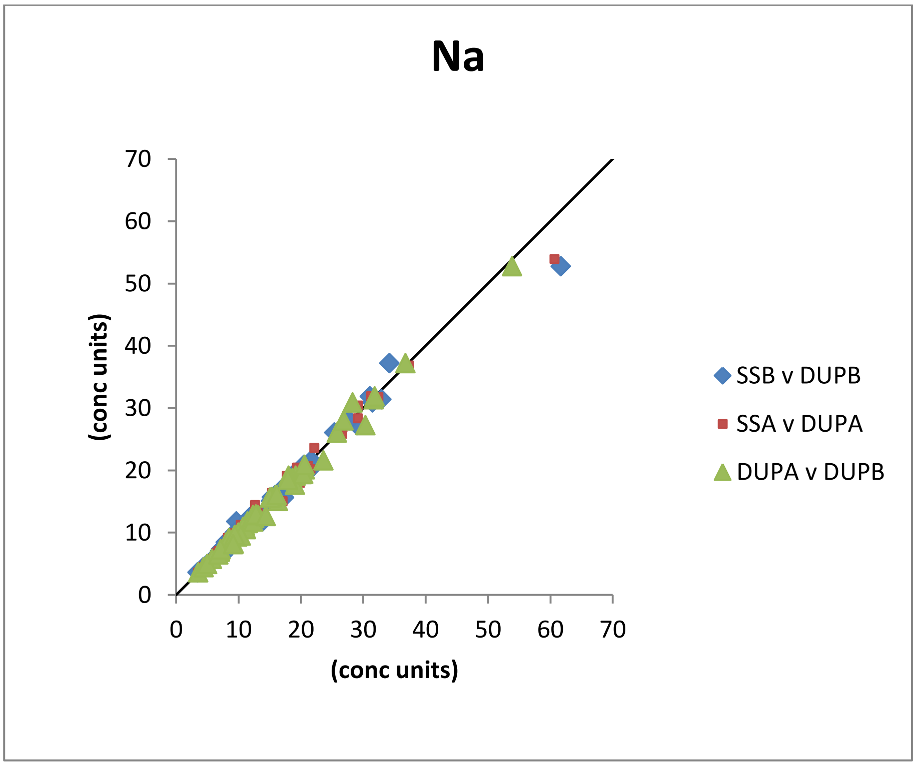
Appendix 4 Duplicate-replicate data plots

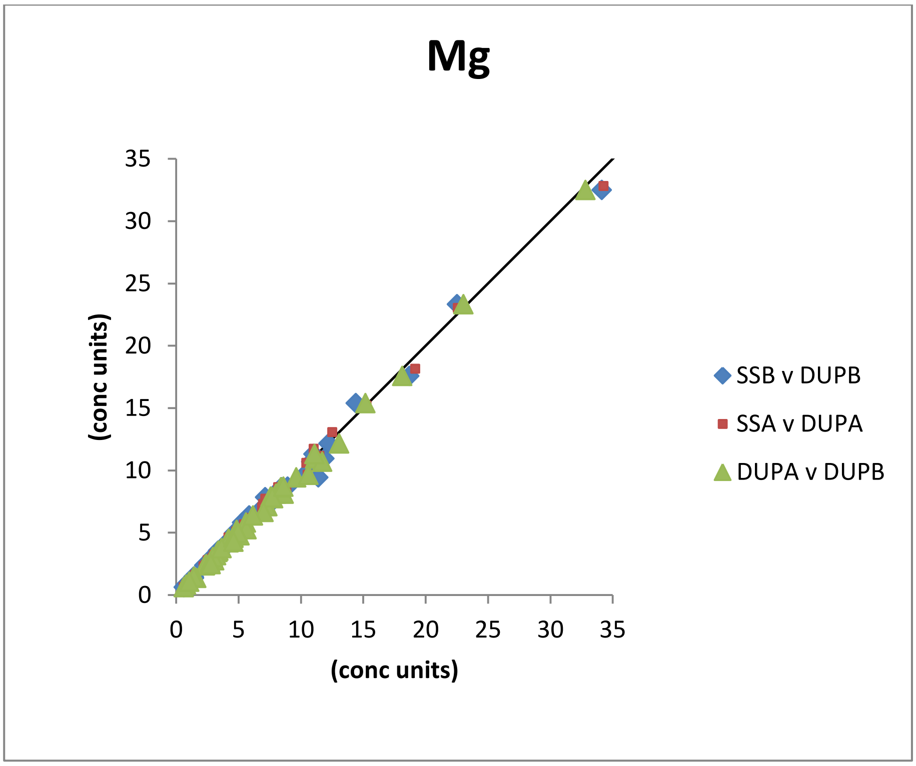
Axis units in plots are as listed for each analytical parameter in Table 5 and Table 6. Black line represents 1:1 relationship

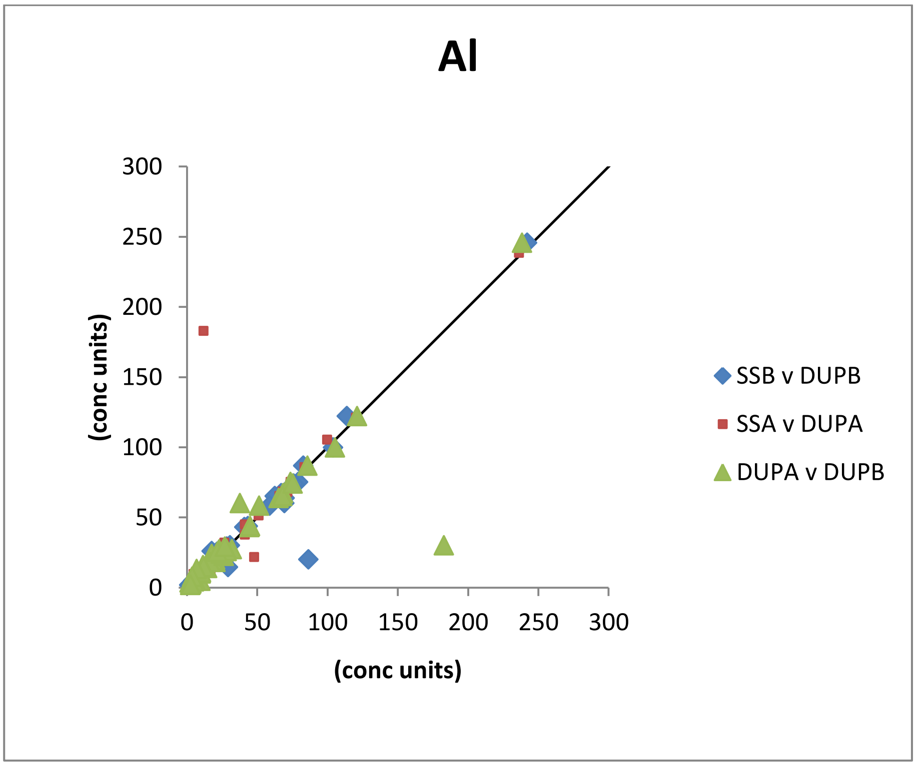


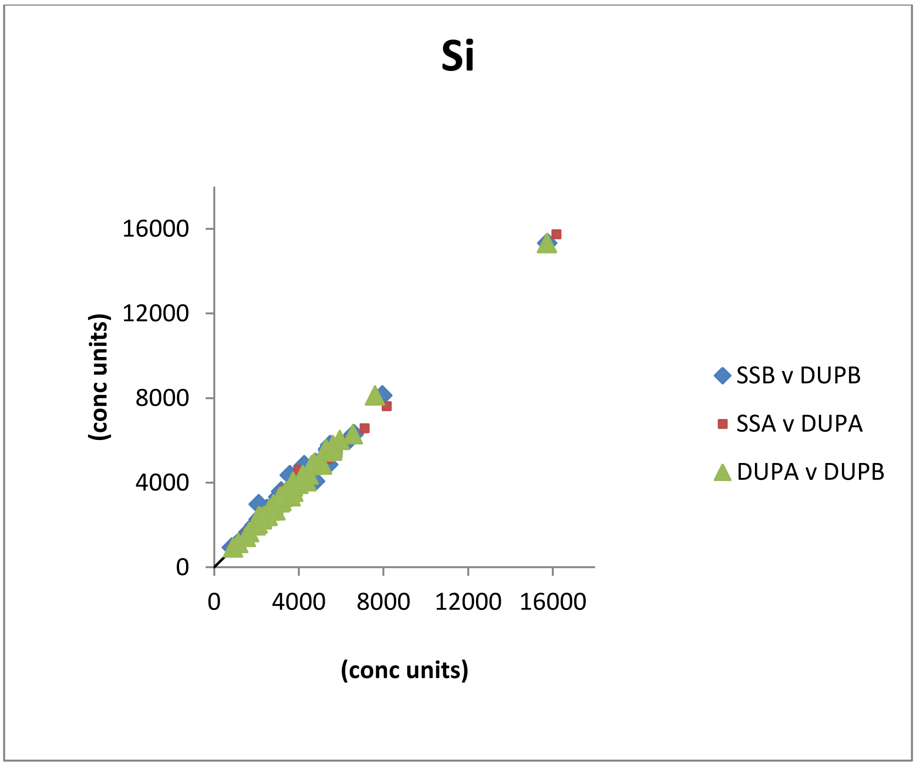


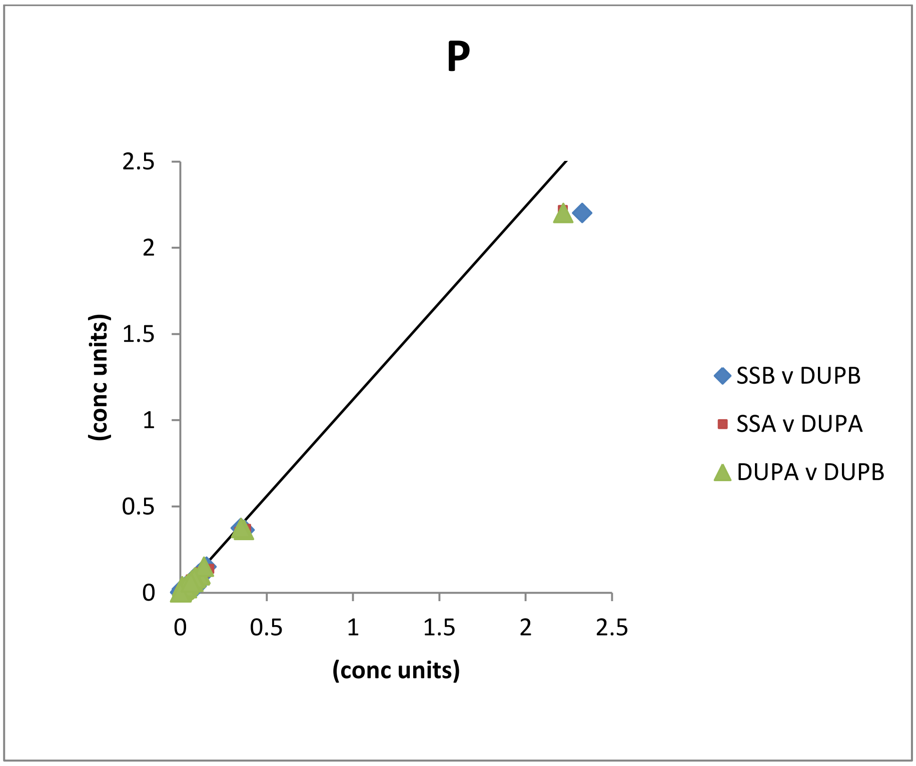

B
95
75
55
35
15
-5
-5
15
35
55
75
95
(conc units)
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB

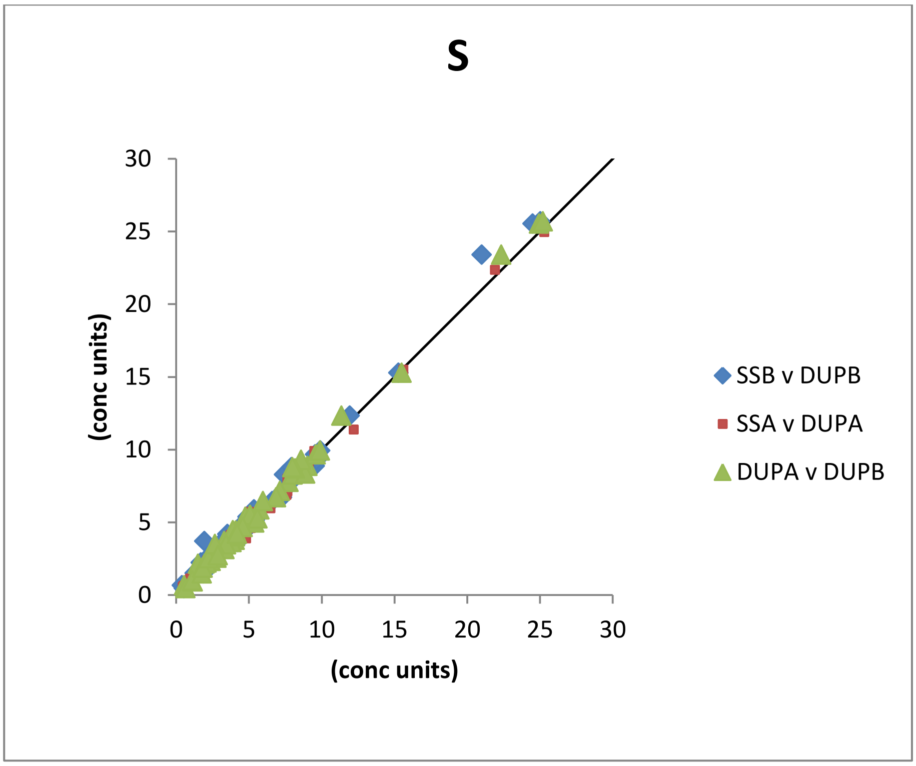

Na
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
(conc units)
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB

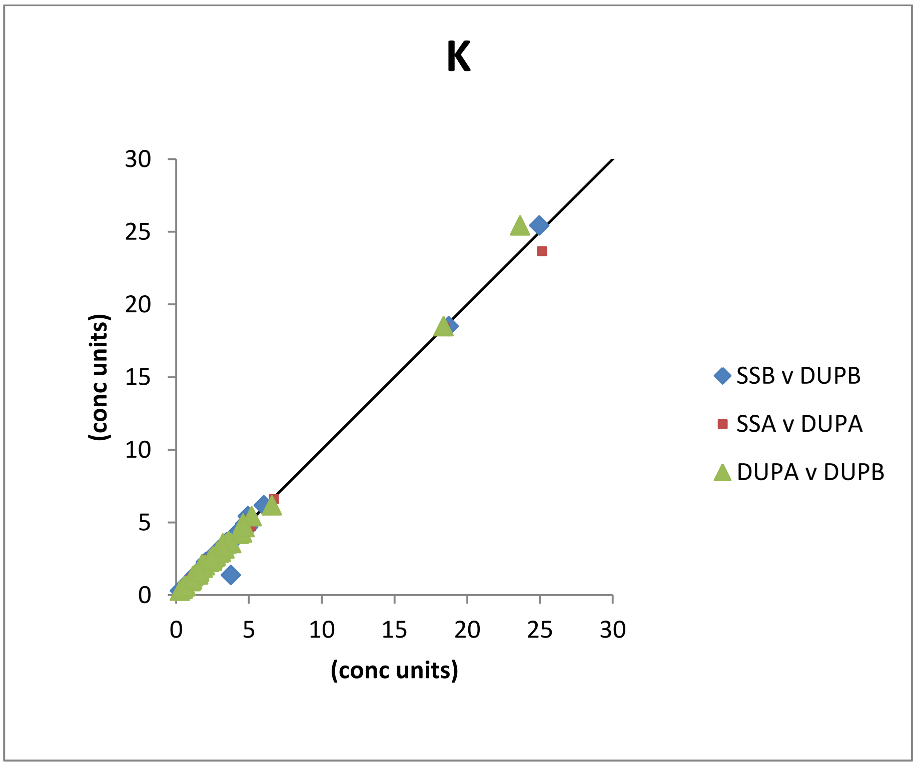

Mg
35
30
25
20
15
10
5
0
(conc units)
0
5
10
15
20
25
30
35
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB

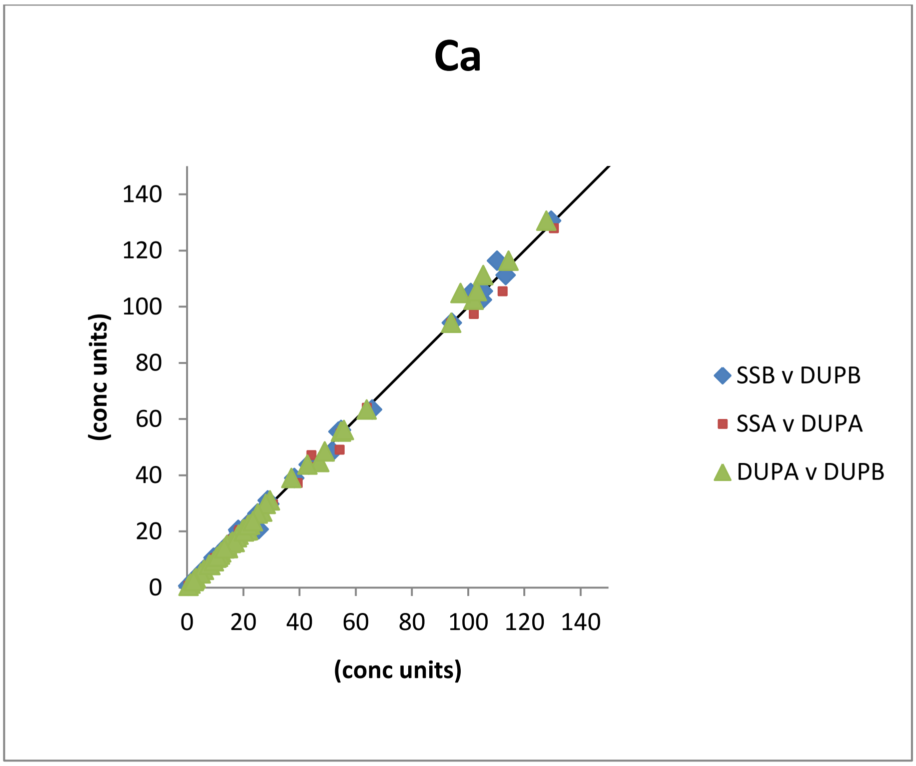

Al
300
250
200
150
100
50
0
(conc units)
0
50
100
150
200
250
300
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB

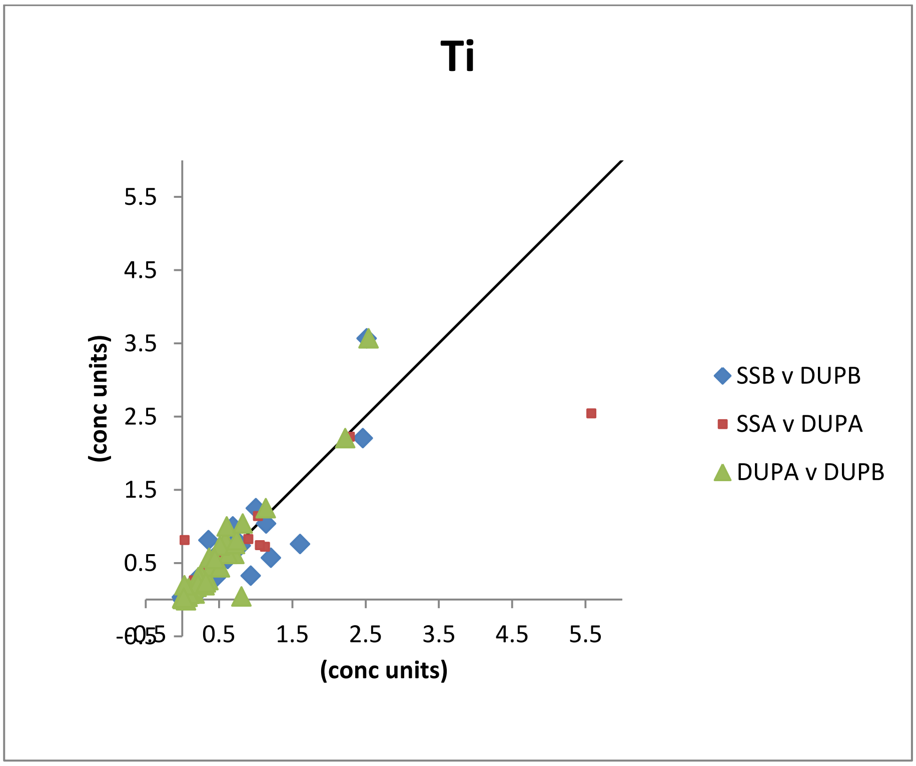

Si
16000
12000
8000
4000
0
0
4000
8000
12000
16000
(conc units)
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB

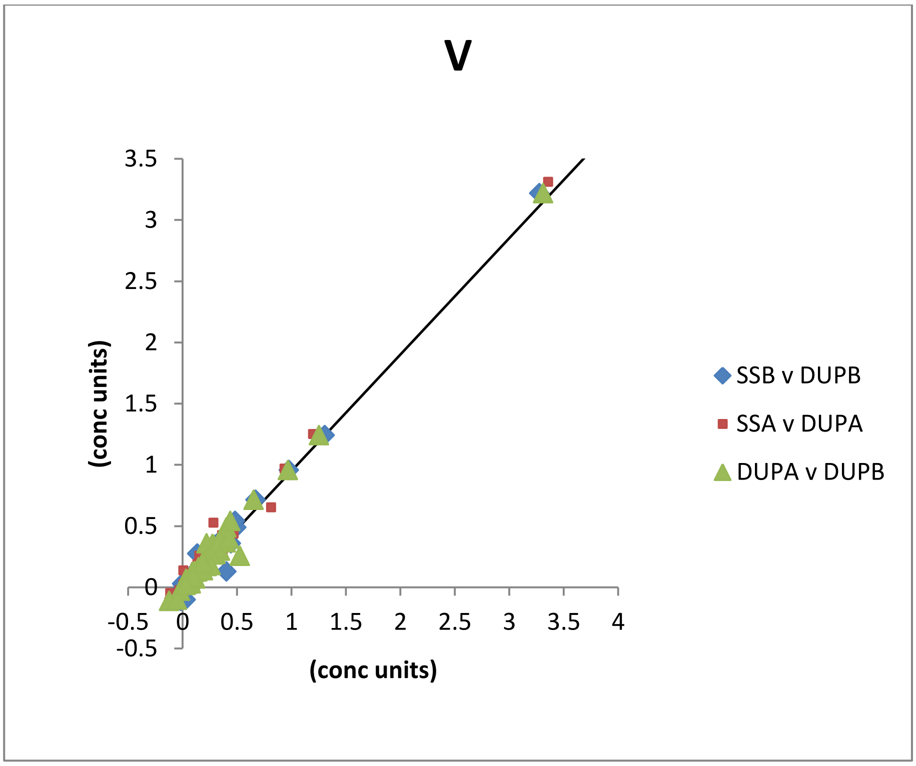

P
2.5
2
1.5
1
0.5
0
0
0.5
1
1.5
2
2.5
(conc units)
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB

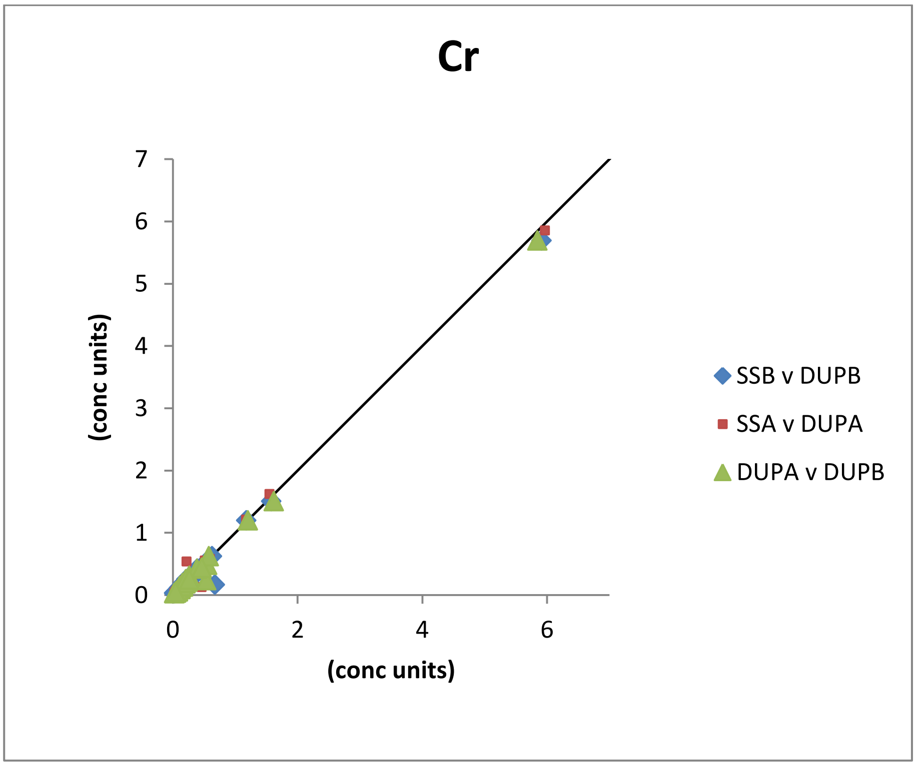

S
(conc units)
(conc units)
0
5
10
15
20
25
30
SSB v DUPB
SSA v DUPA
DUPA v DUPB

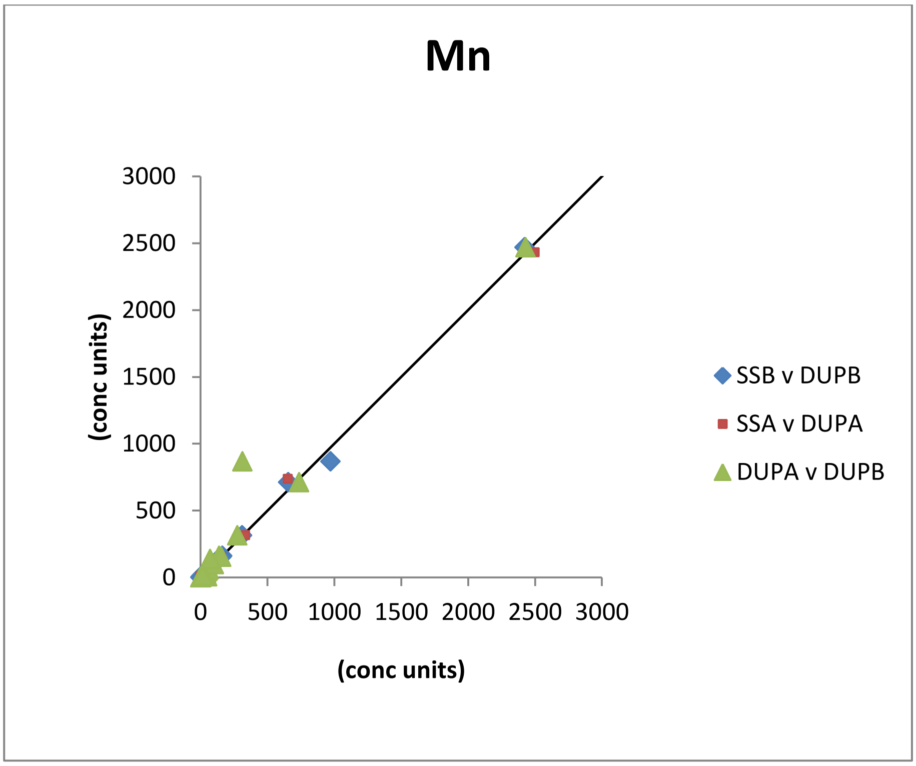

K
(conc units)
(conc units)
0
5
10
15
20
25
30
SSB v DUPB
SSA v DUPA
DUPA v DUPB

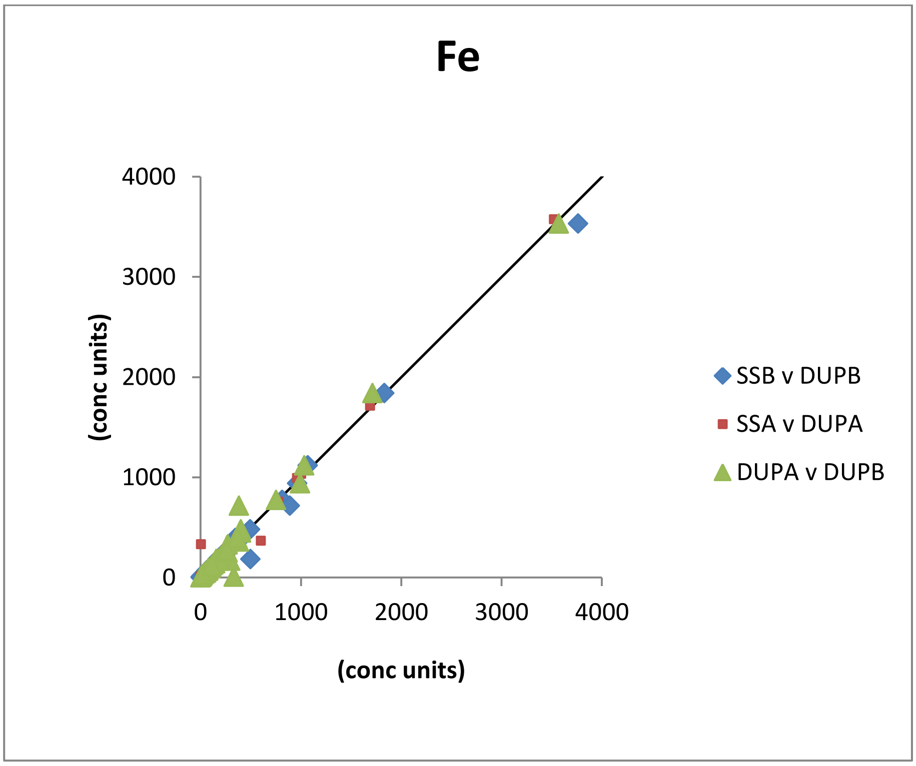

Ca
(conc units)
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB

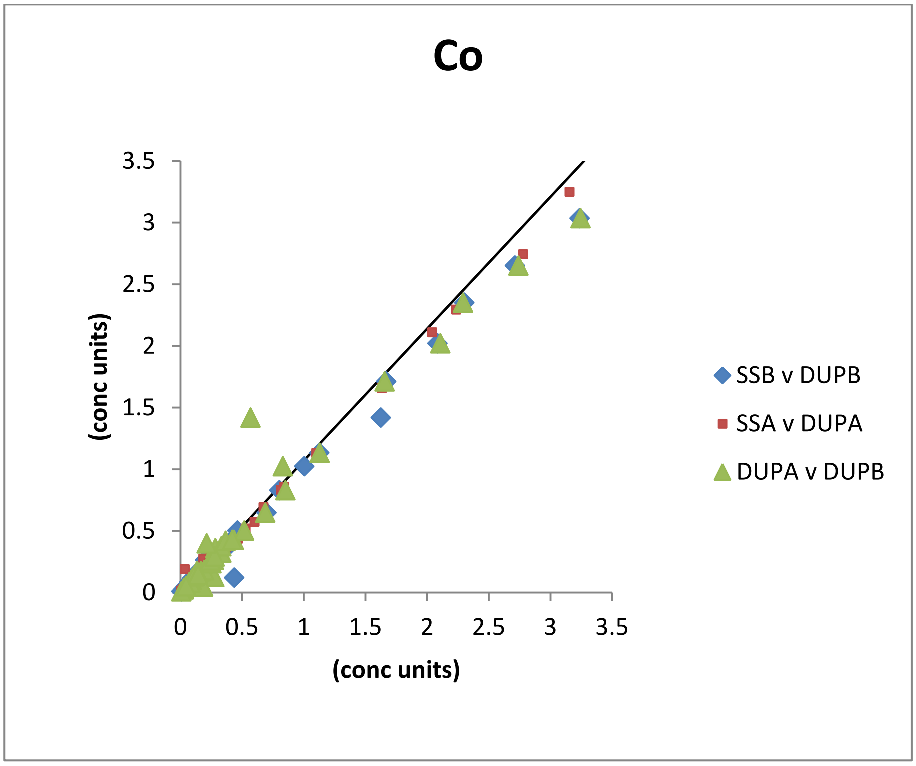

Ti
(conc units)
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB

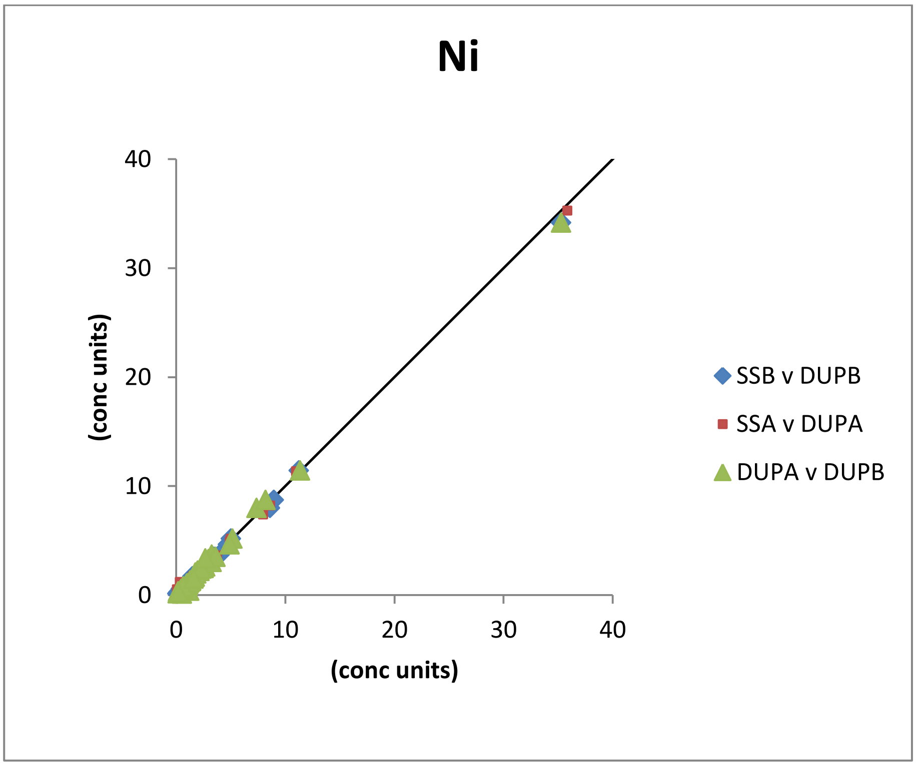

V
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
(conc units)
-0.5
0
0.5
1
1.5
2
2.5
3
3.5
4
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB

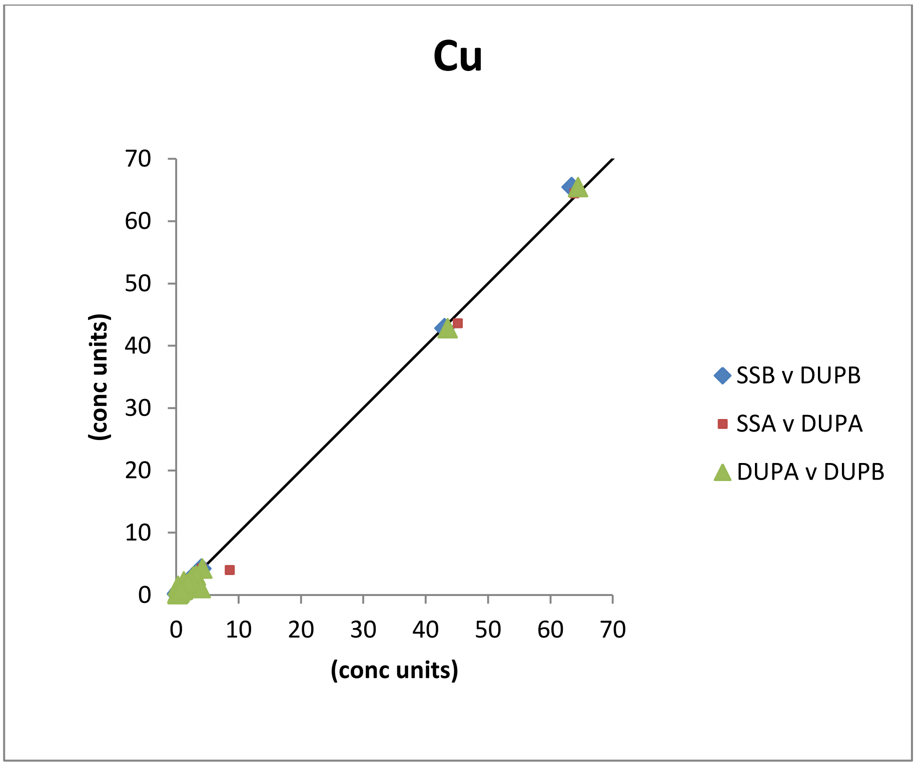

Cr
7
6
5
4
3
2
1
0
(conc units)
0
2
4
6
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB

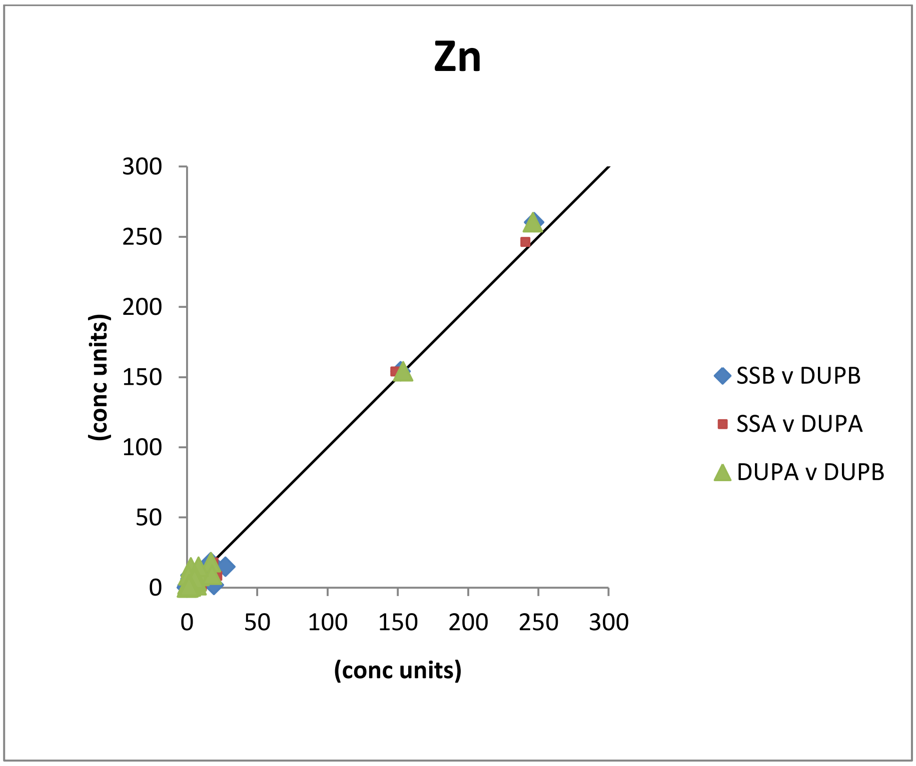

Mn
3000
2500
2000
1500
1000
500
0
(conc units)
0
500
1000
1500
2000
2500
3000
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB

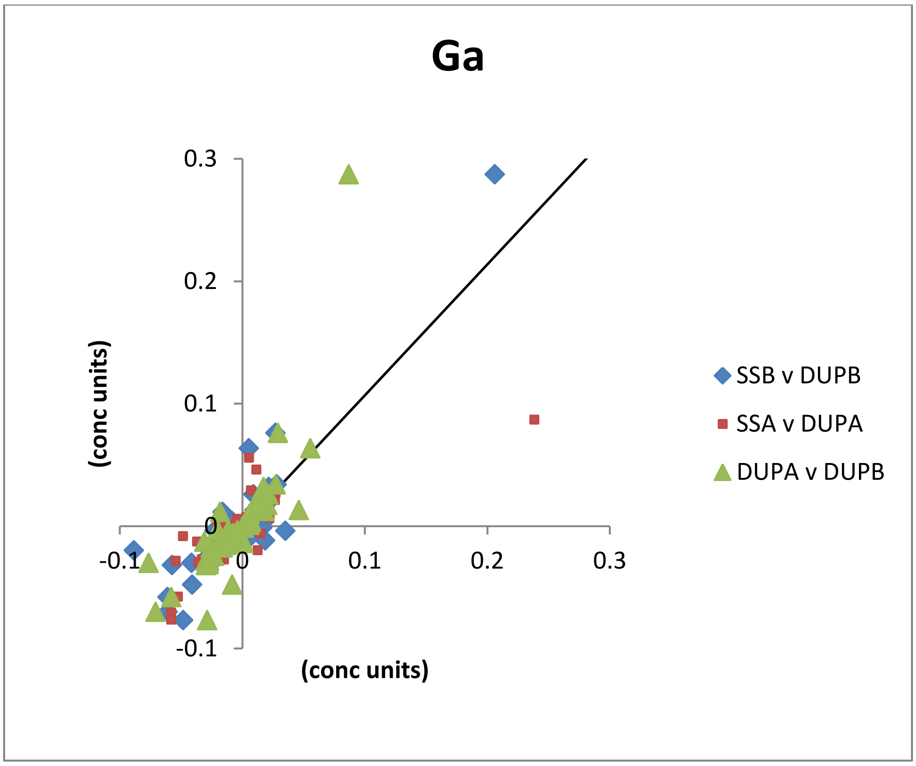

Fe
4000
3000
2000
1000
0
(conc units)
0
1000
2000
3000
4000
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB

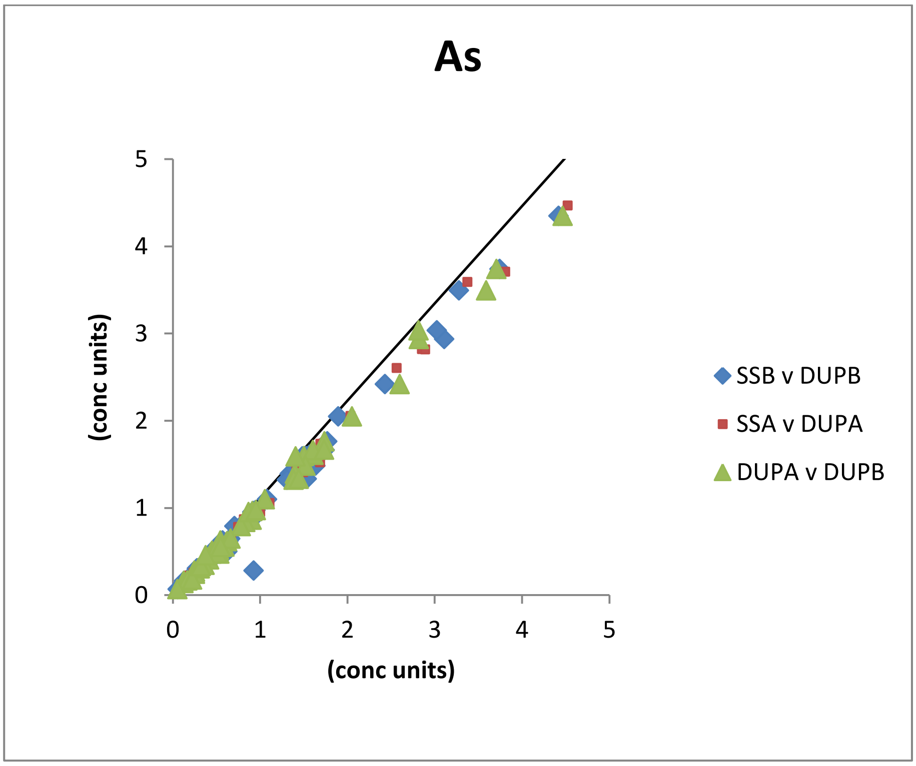

Co
3.5
3
2.5
2
1.5
1
0.5
0
(conc units)
0
0.5
1
1.5
2
2.5
3
3.5
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB

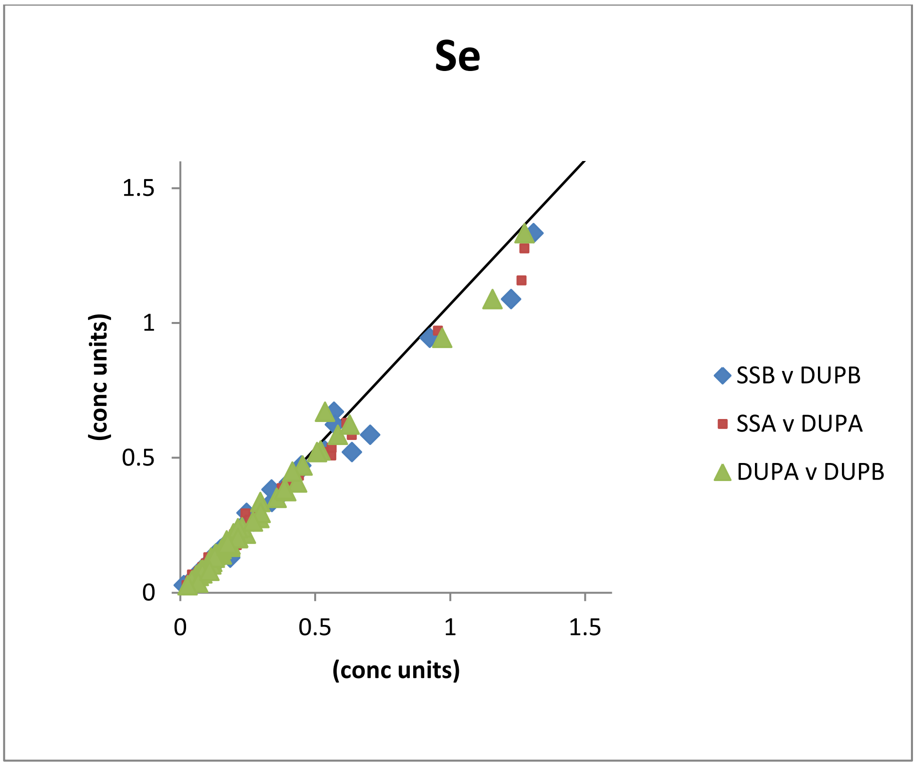

Ni
40
30
20
10
0
(conc units)
0
10
20
30
40
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB

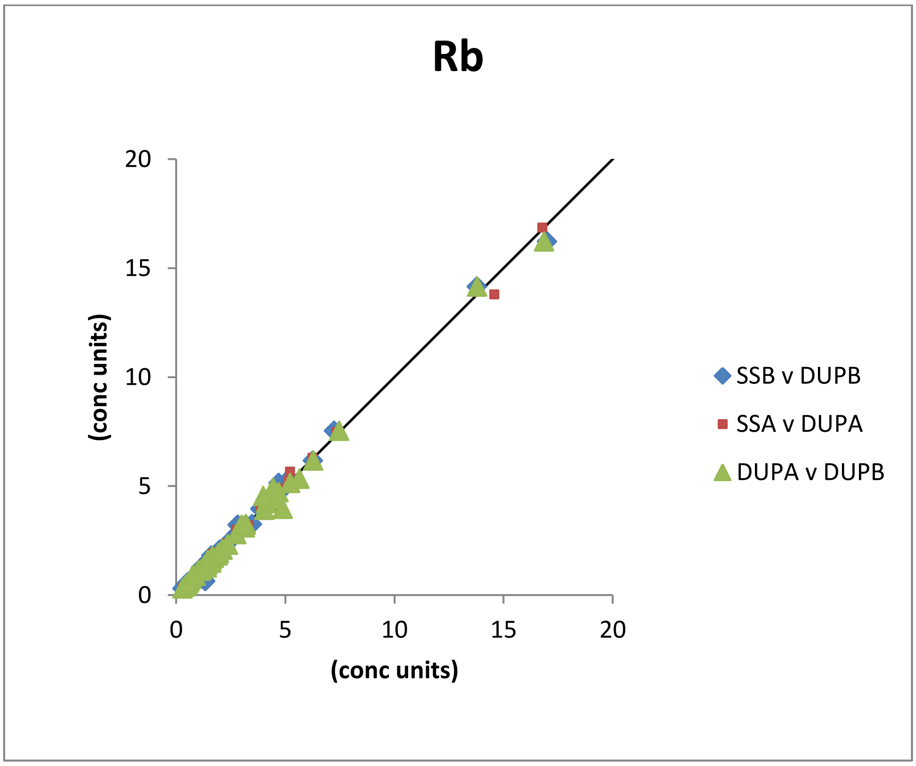

Cu
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
(conc units)
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB

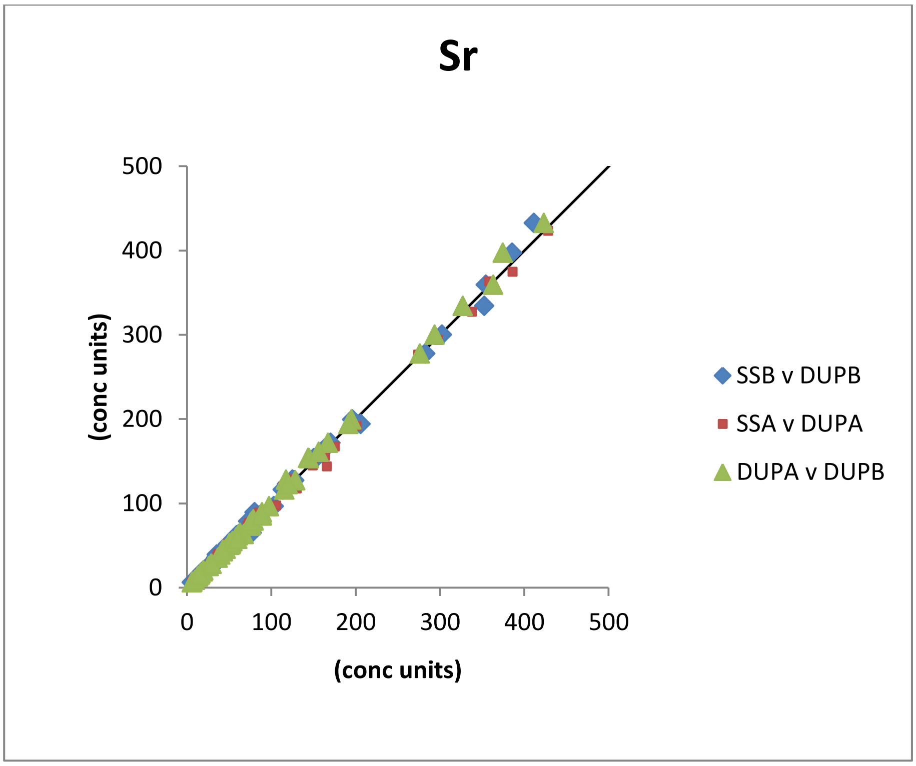

Zn
300
250
200
150
100
50
0
0
50
100
150
200
250
300
(conc units)
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB

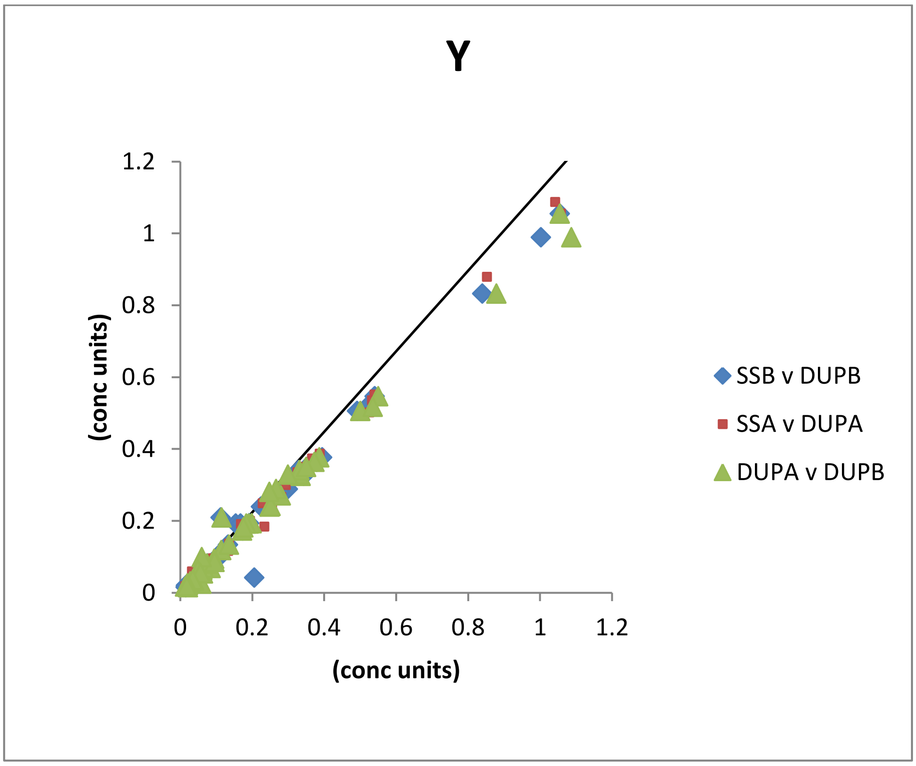

Ga
0.3
0.2
0.1
0
-0.1
-0.1
0
0.1
0.2
0.3
(conc units)
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB

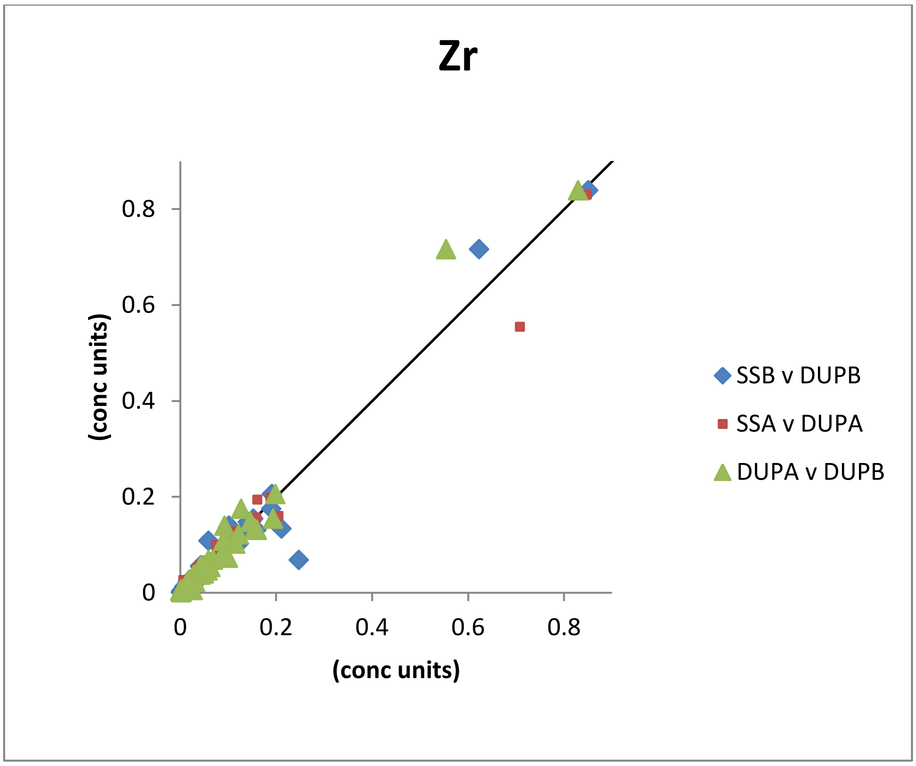

As
5
4
3
2
1
0
0
1
2
3
4
5
(conc units)
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB

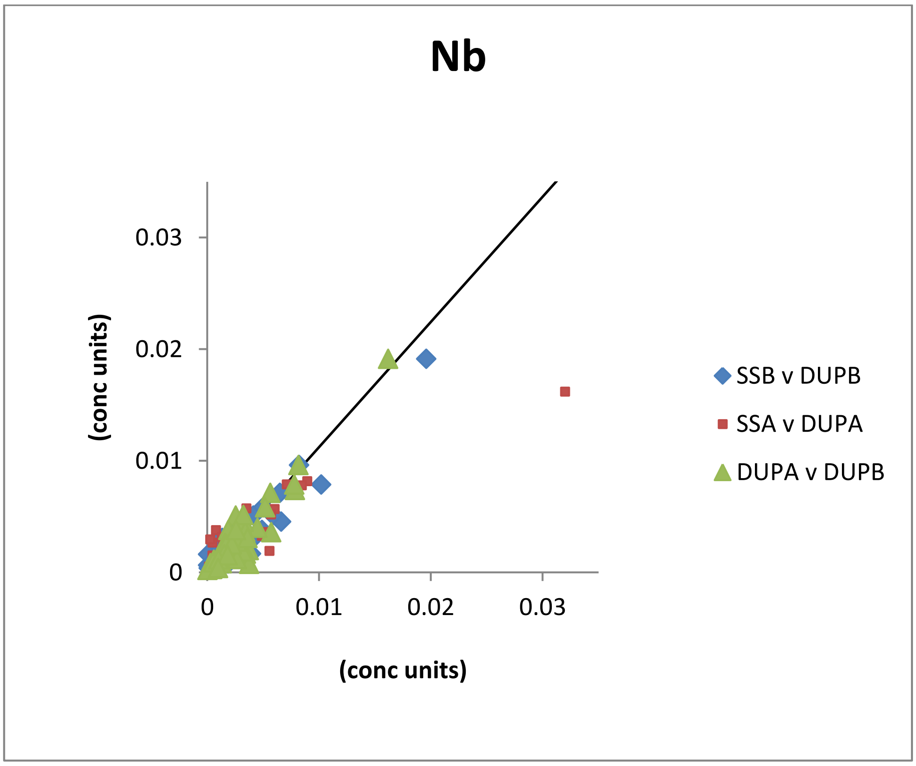

Se
1.5
1
0.5
0
0
0.5
1
1.5
(conc units)
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB

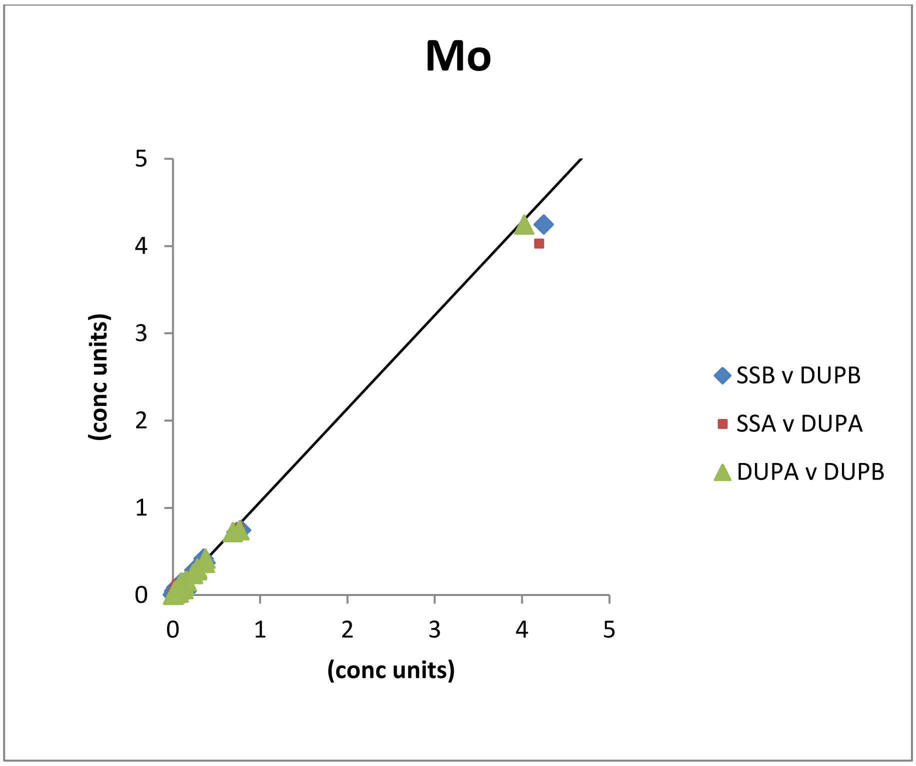

Rb
20
15
10
5
0
0
5
10
15
20
(conc units)
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB

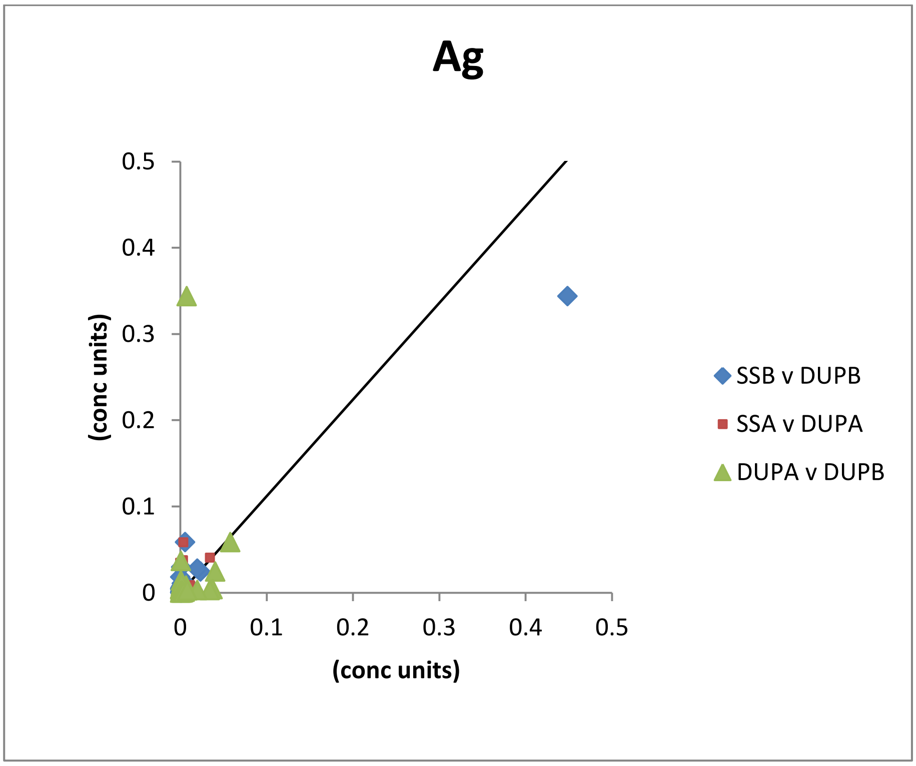

Sr
500
400
300
200
100
0
0
100
200
300
400
500
(conc units)
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB

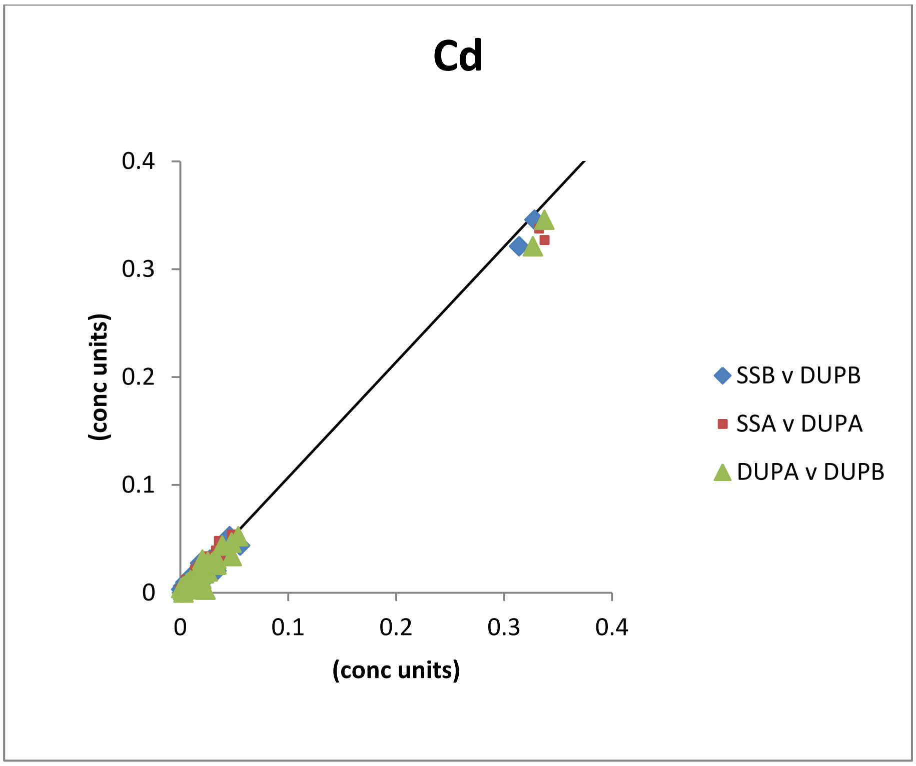

Y
1.2
1
0.8
0.6
0.4
0.2
0
0
0.2
0.4
0.6
0.8
1
1.2
(conc units)
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB

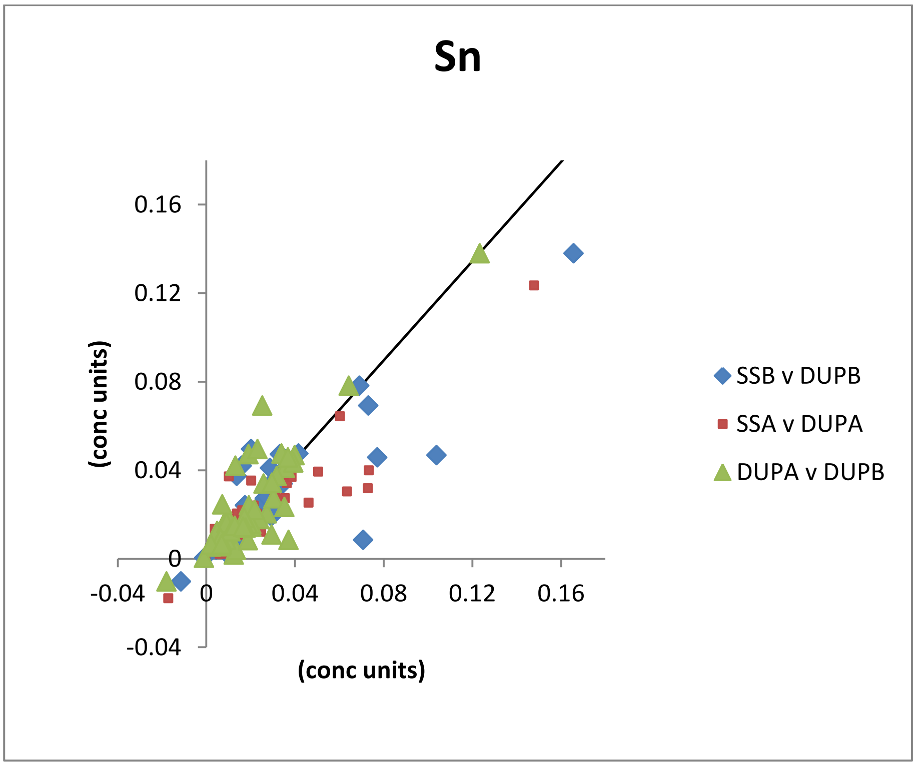

Zr
0.8
0.6
0.4
0.2
0
0
0.2
0.4
0.6
0.8
(conc units)
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB

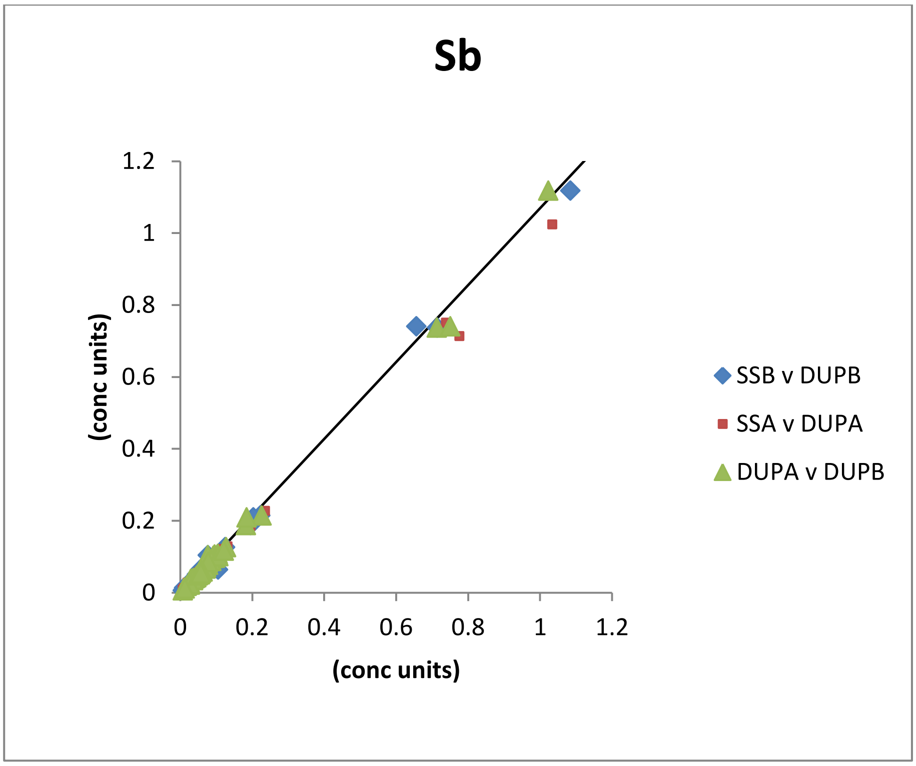

Nb
0.03
0.02
0.01
0
0
0.01
0.02
0.03
(conc units)
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB


Mo
5
4
3
2
1
0
(conc units)
0
1
2
3
4
5
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB

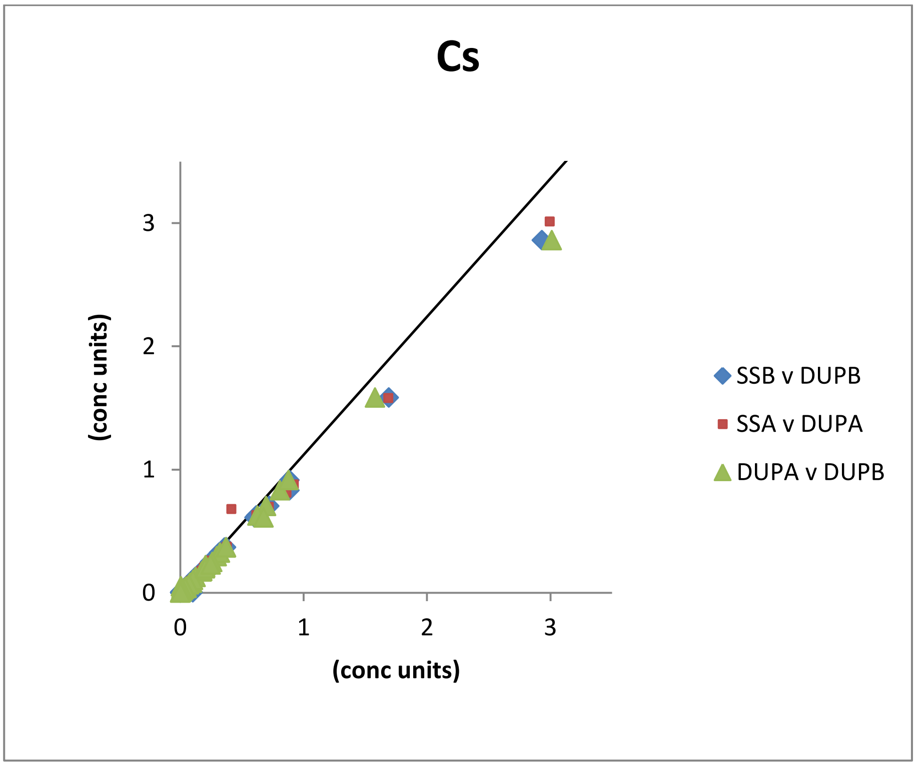

Ag
0.5
0.4
0.3
0.2
0.1
0
(conc units)
0
0.1
0.2
0.3
0.4
0.5
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB


Cd
0.4
0.3
0.2
0.1
0
(conc units)
0
0.1
0.2
0.3
0.4
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB

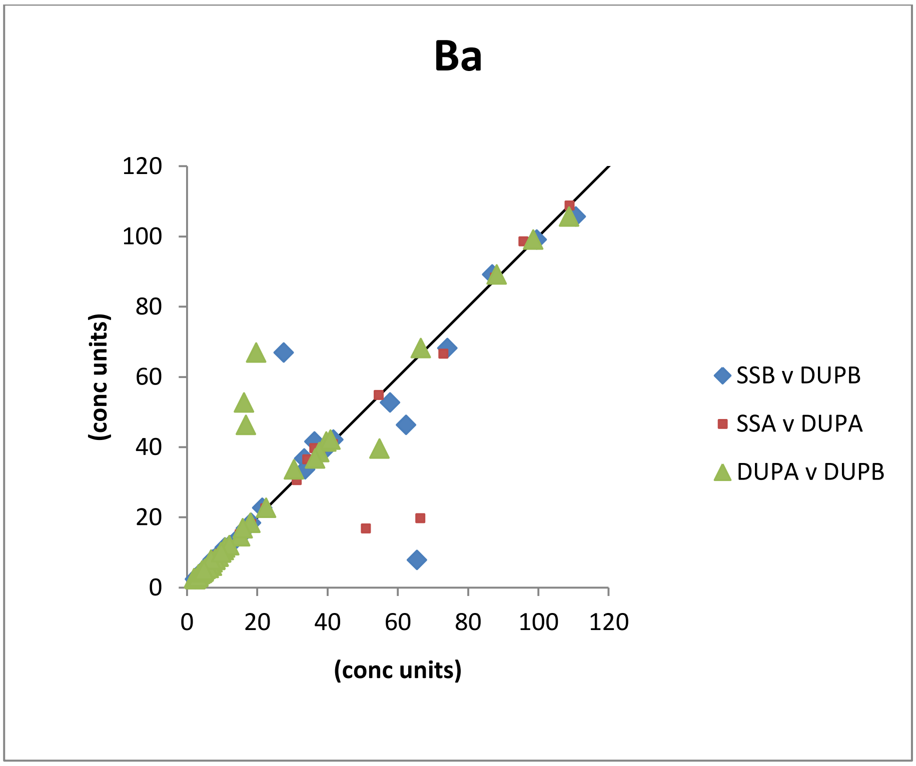

Sn
0.16
0.12
0.08
0.04
0
-0.04
(conc units)
-0.04
0
0.04
0.08
0.12
0.16
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB



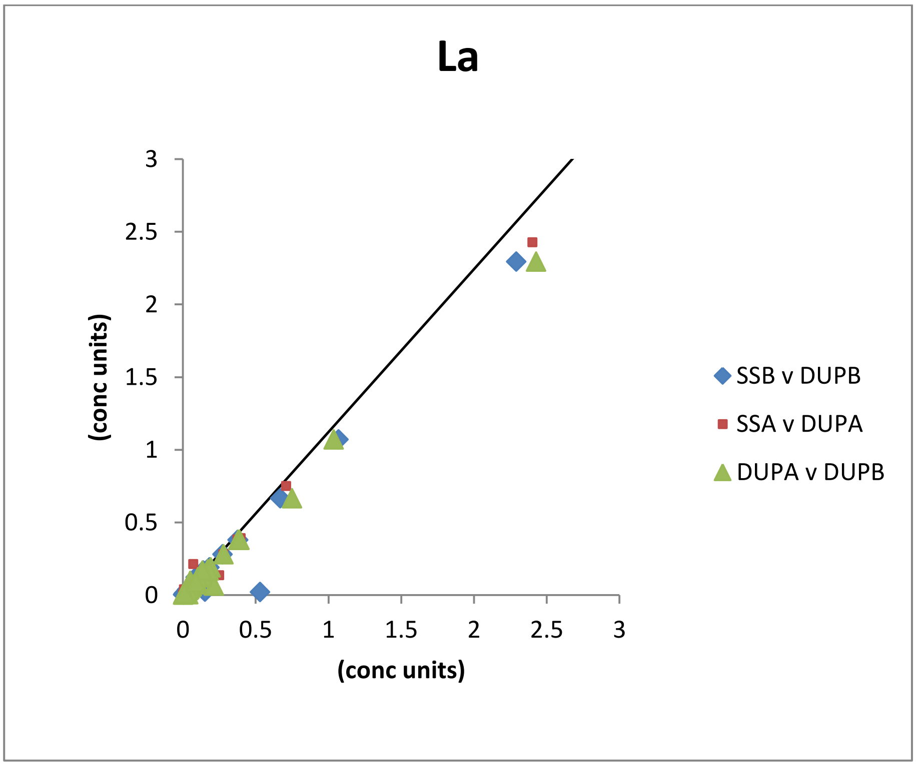
Sb
1.2
1
0.8
0.6
0.4
0.2
0
(conc units)
0
0.2
0.4
0.6
0.8
1
1.2
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB



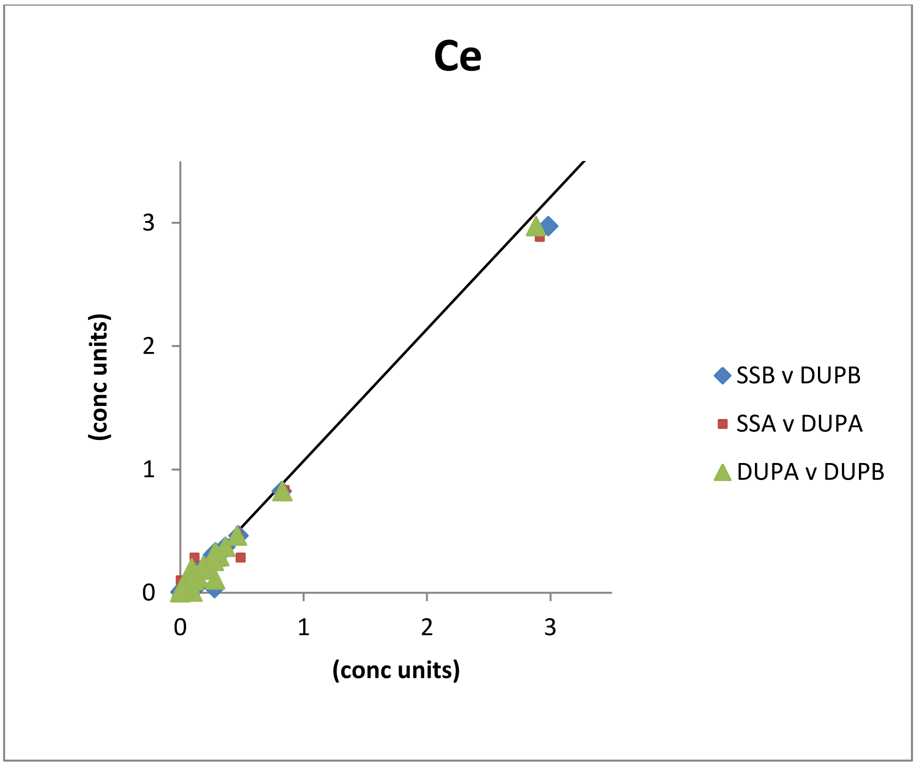
Cs
3
2
1
0
(conc units)
0
1
2
3
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB

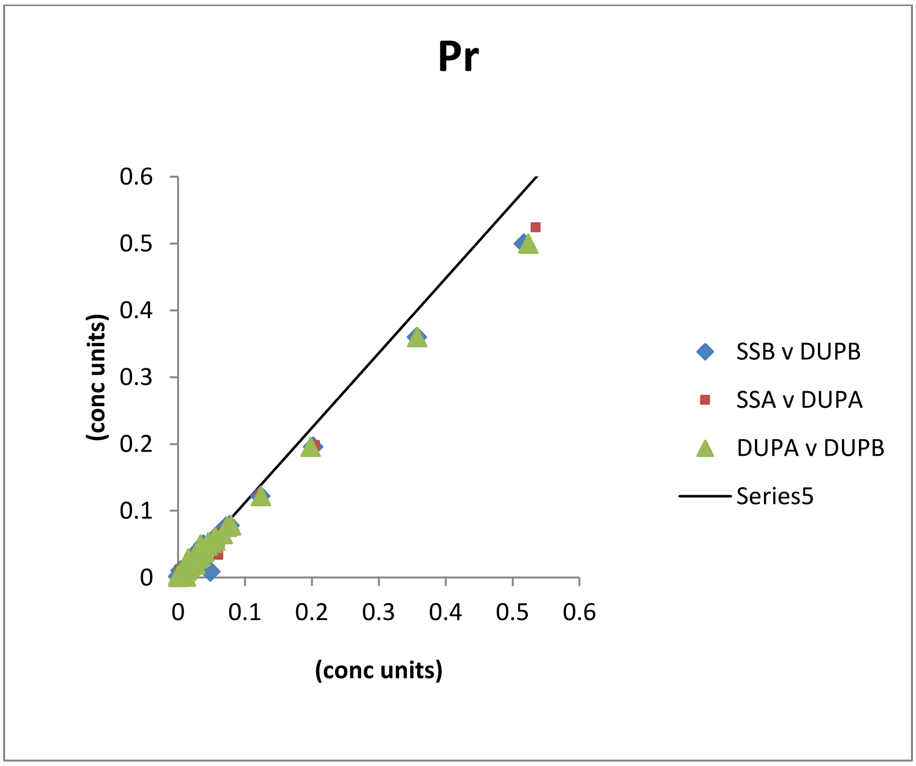


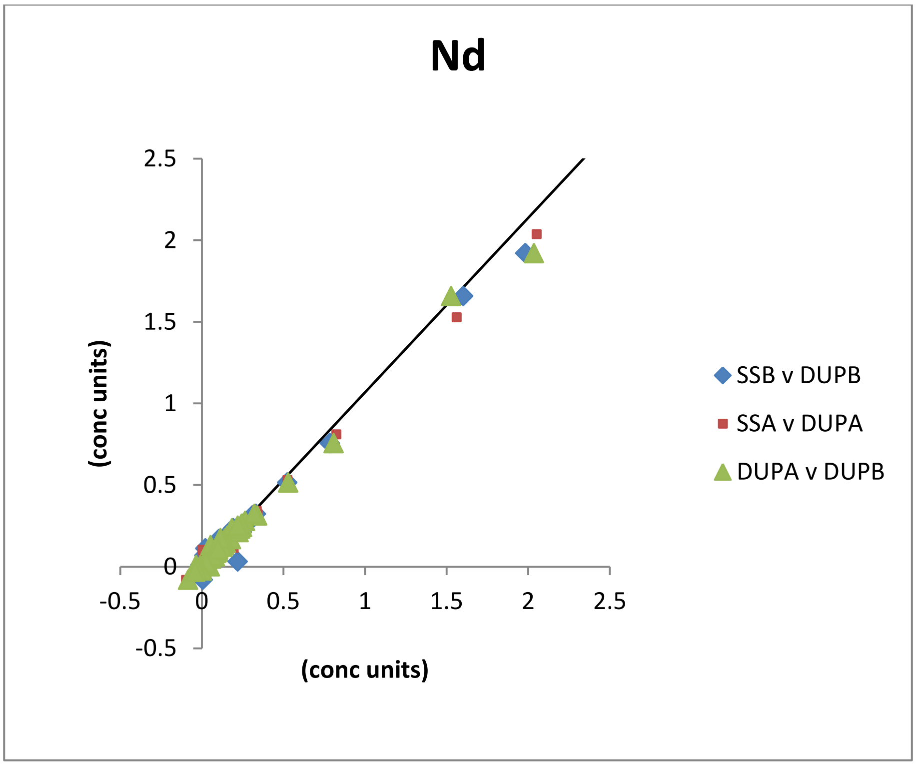
Ba
120
100
80
60
40
20
0
0
20
40
60
80
100
120
(conc units)
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB

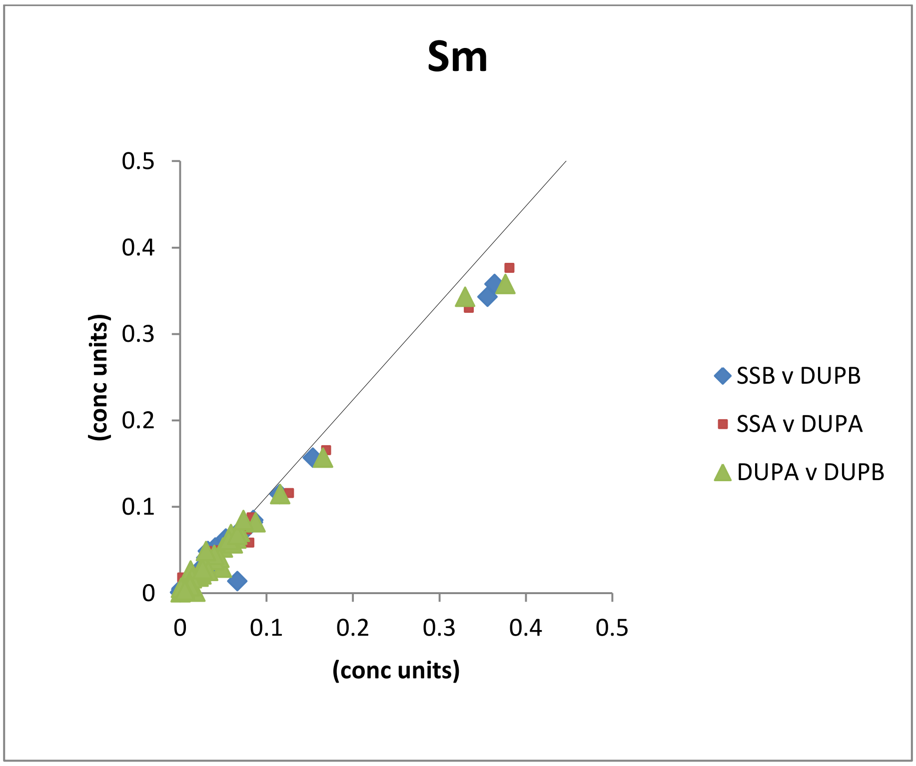


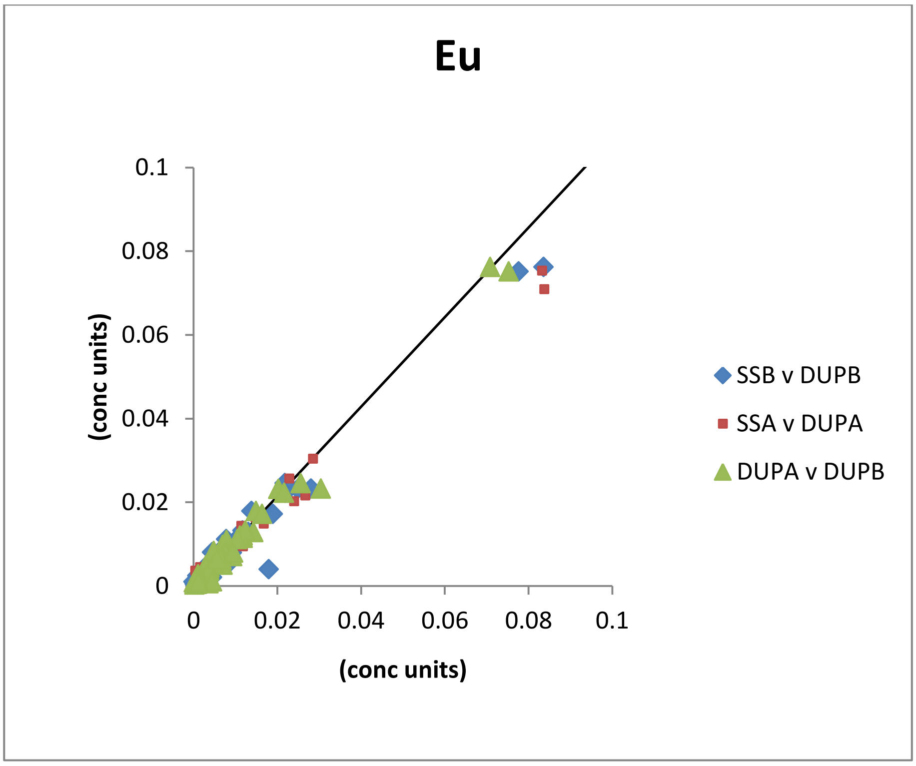
La
3
2.5
2
1.5
1
0.5
0
0
0.5
1
1.5
2
2.5
3
(conc units)
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB


Ce
3
2
1
0
(conc units)
0
1
2
3
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB

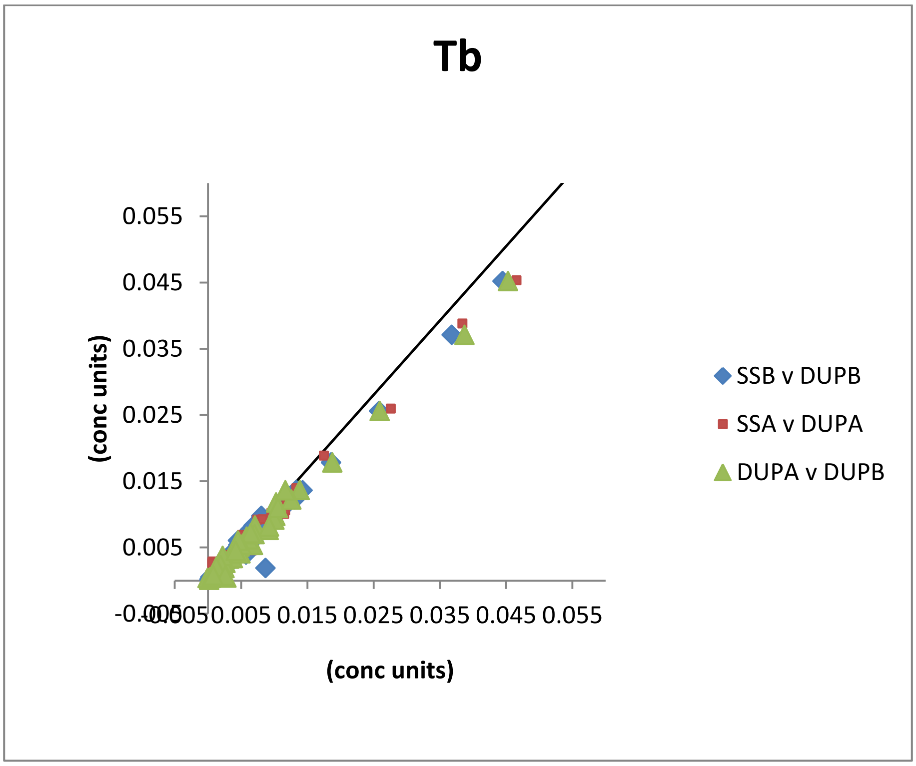

Pr
0.6
0.5
0.4
0.3
0.2
0.1
0
(conc units)
0
0.1
0.2
0.3
0.4
0.5
0.6
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB
Series5


Nd
2.5
2
1.5
1
0.5
0
-0.5
-0.5
0
0.5
1
1.5
2
2.5
(conc units)
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB

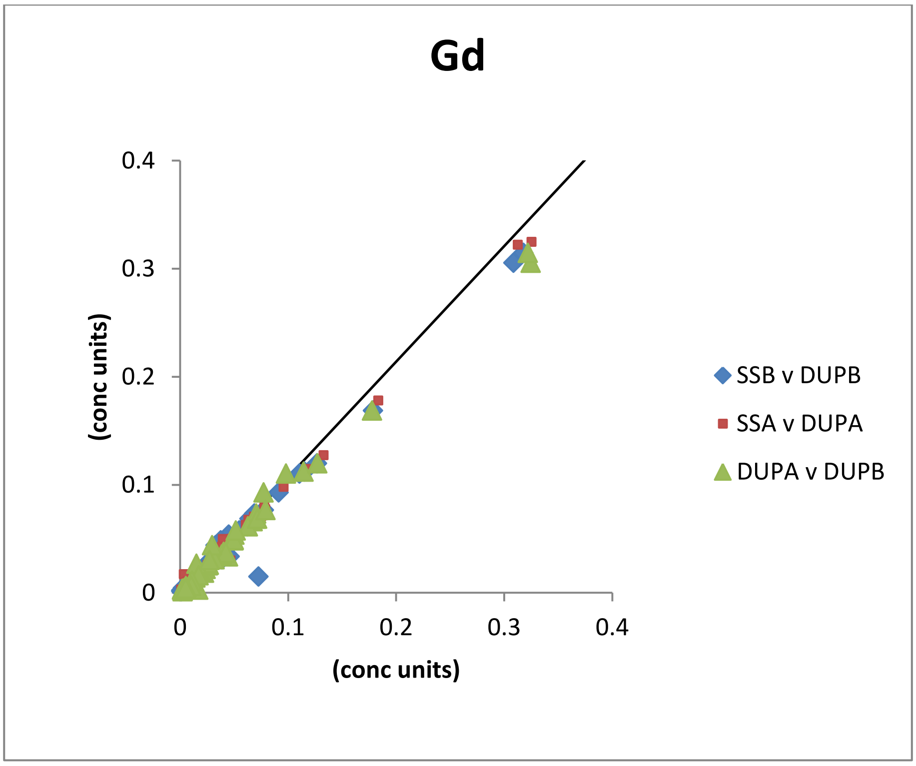

Sm
0.5
0.4
0.3
0.2
0.1
0
0
0.1
0.2
0.3
0.4
0.5
(conc units)
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB

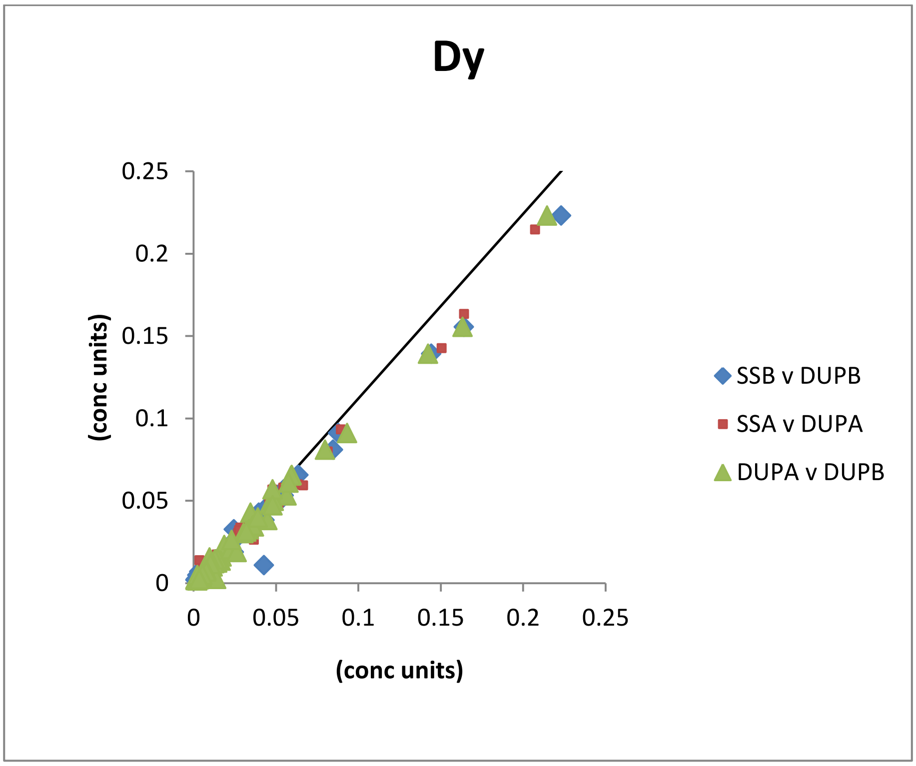


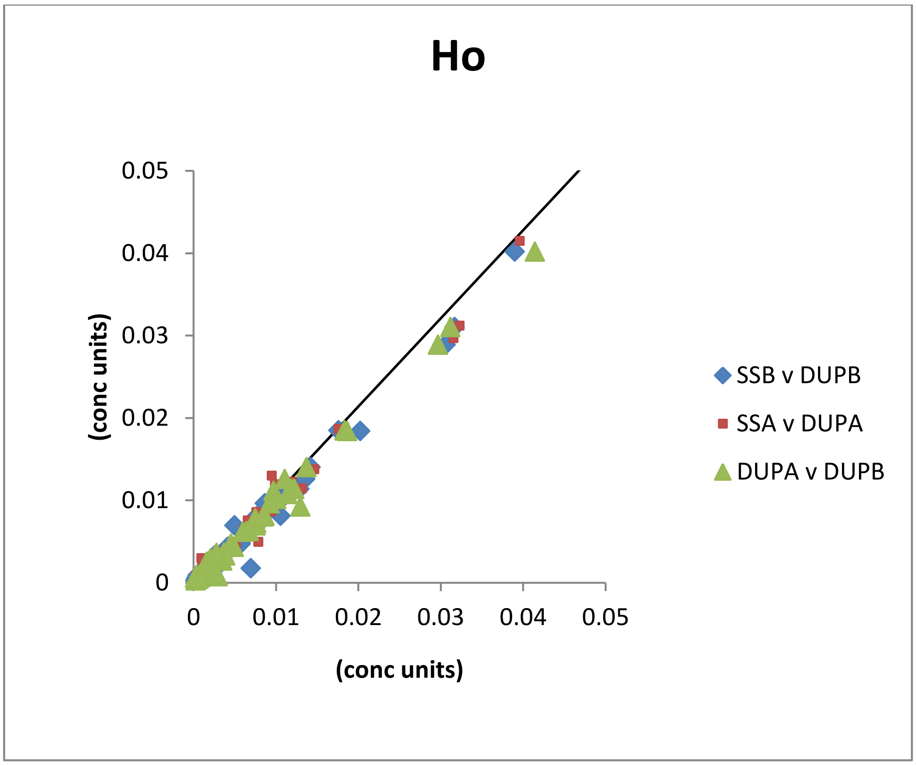
Eu
0.1
0.08
0.06
0.04
0.02
0
(conc units)
0
0.02
0.04
0.06
0.08
0.1
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB

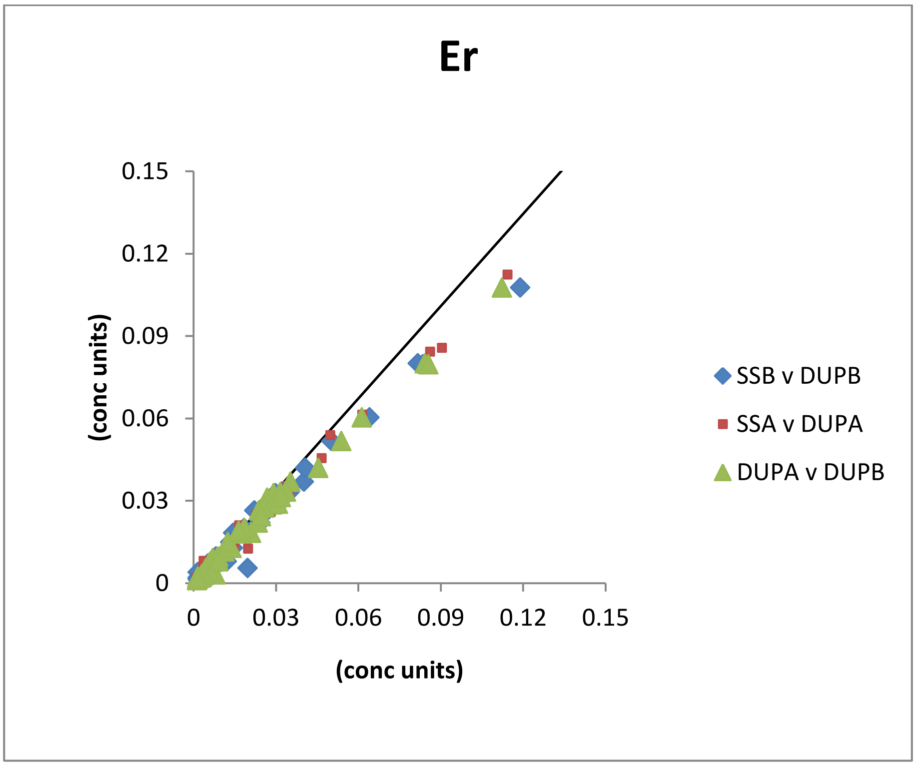


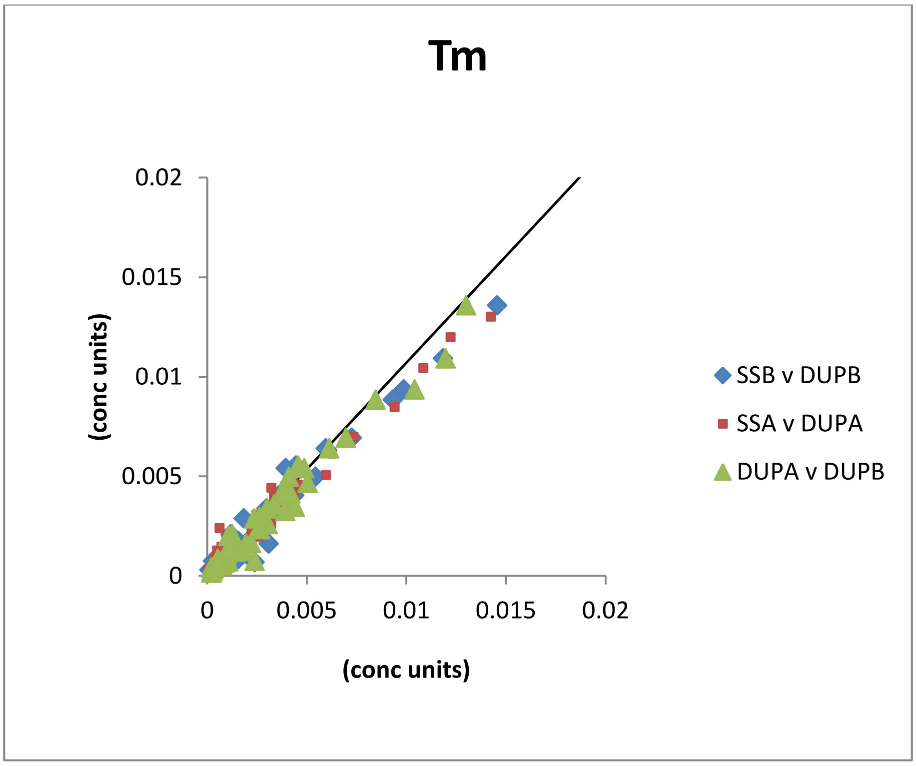
Tb
0.055
0.045
0.035
0.025
0.015
0.005
(conc units)
-0.005
0.005
0.015
0.025
0.035
0.045
0.055
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB

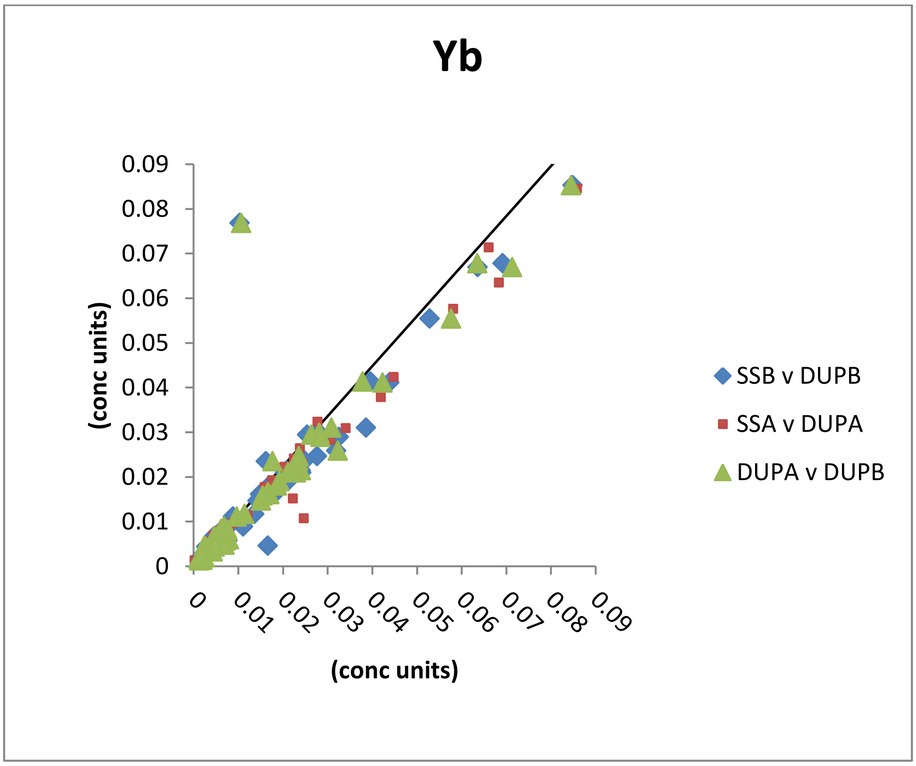

Gd
0.4
0.3
0.2
0.1
0
(conc units)
0
0.1
0.2
0.3
0.4
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB

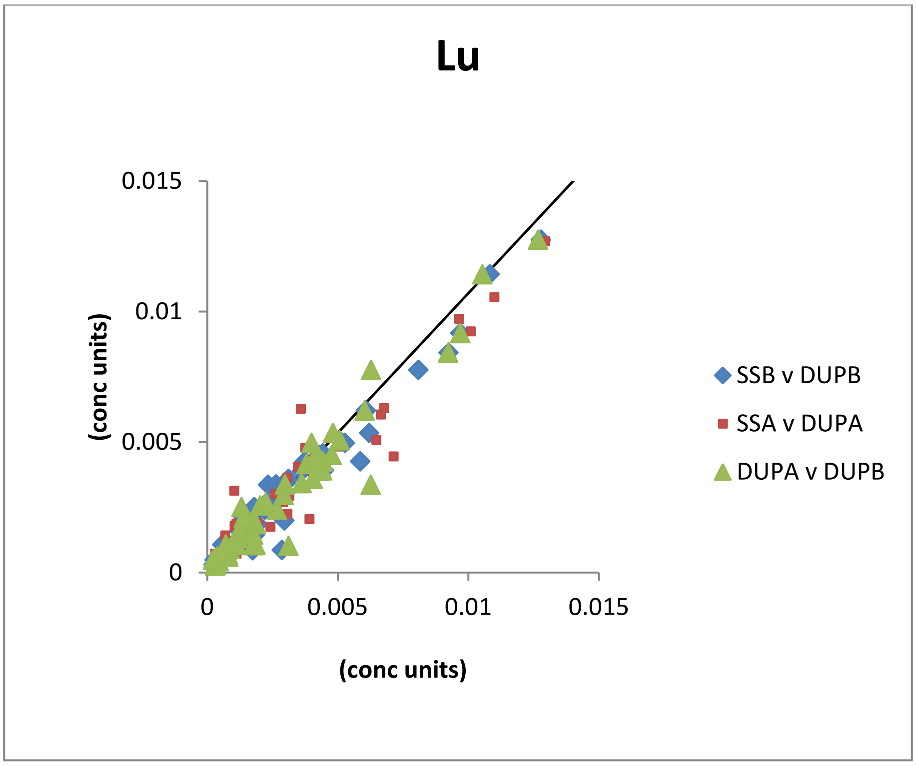

Dy
0.25
0.2
0.15
0.1
0.05
0
(conc units)
0
0.05
0.1
0.15
0.2
0.25
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB


Ho
0.05
0.04
0.03
0.02
0.01
0
(conc units)
0
0.01
0.02
0.03
0.04
0.05
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB

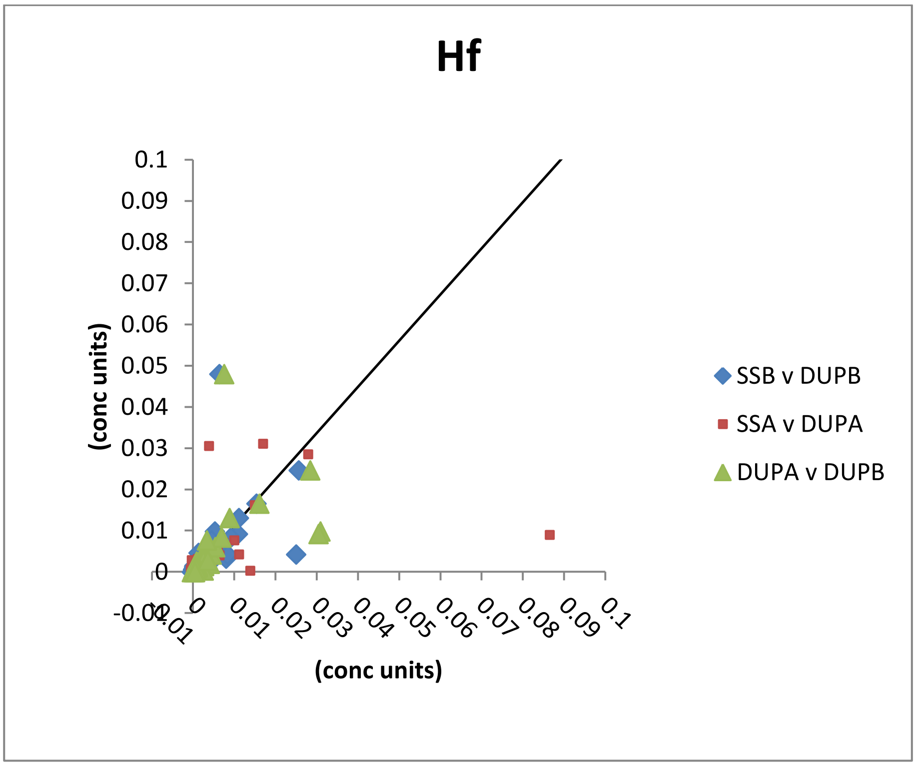

Er
0.15
0.12
0.09
0.06
0.03
0
(conc units)
0
0.03
0.06
0.09
0.12
0.15
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB


Tm
0.02
0.015
0.01
0.005
0
(conc units)
0
0.005
0.01
0.015
0.02
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB

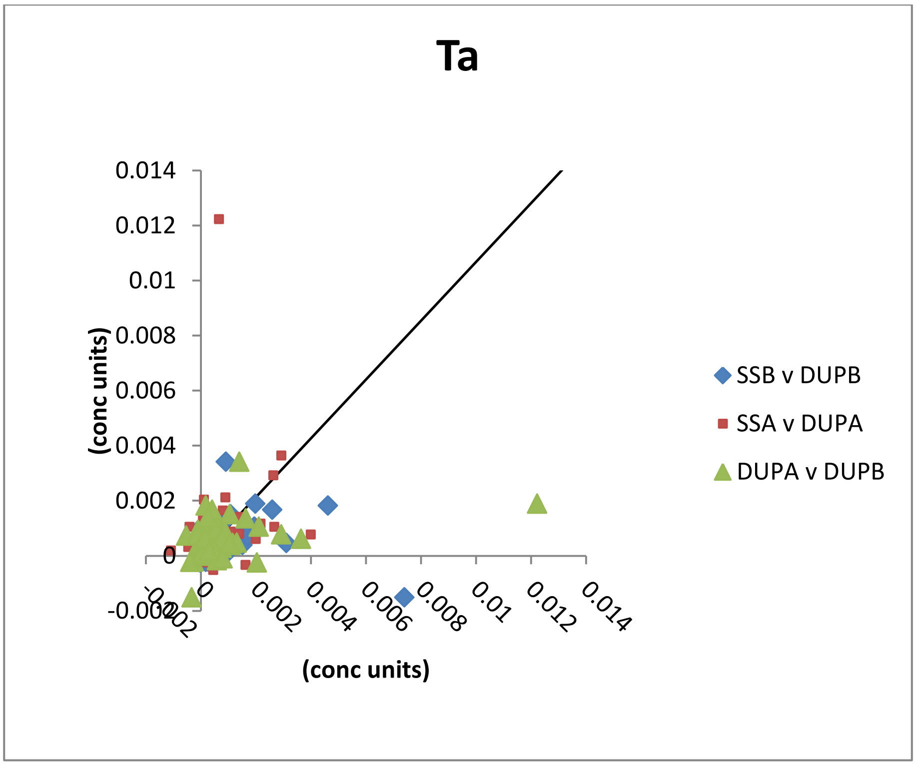

Yb
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
(conc units)
0
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB

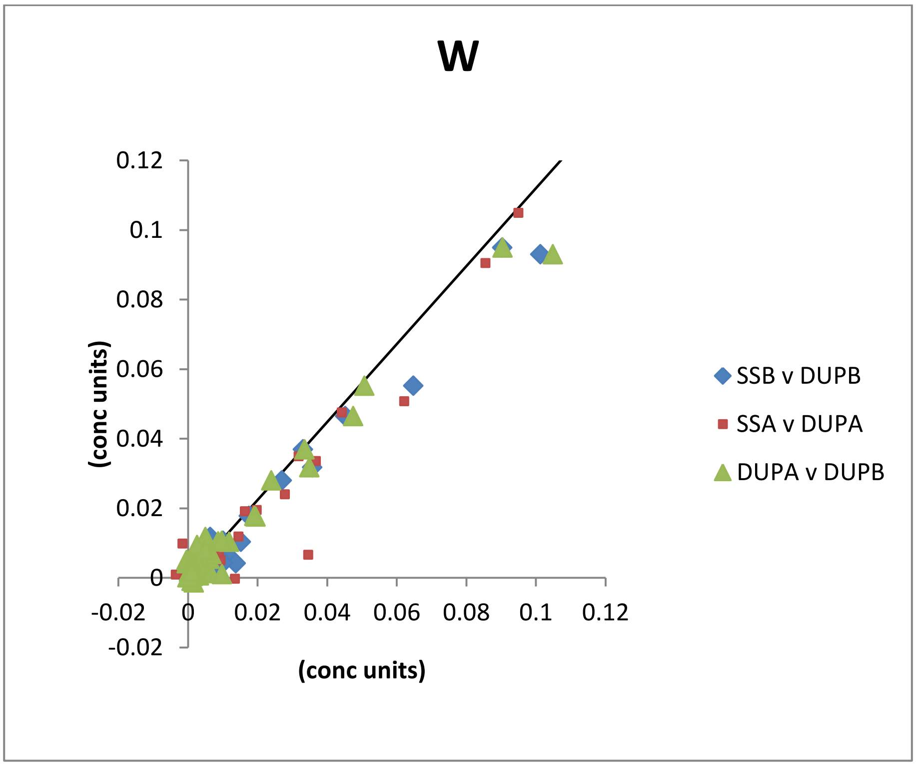


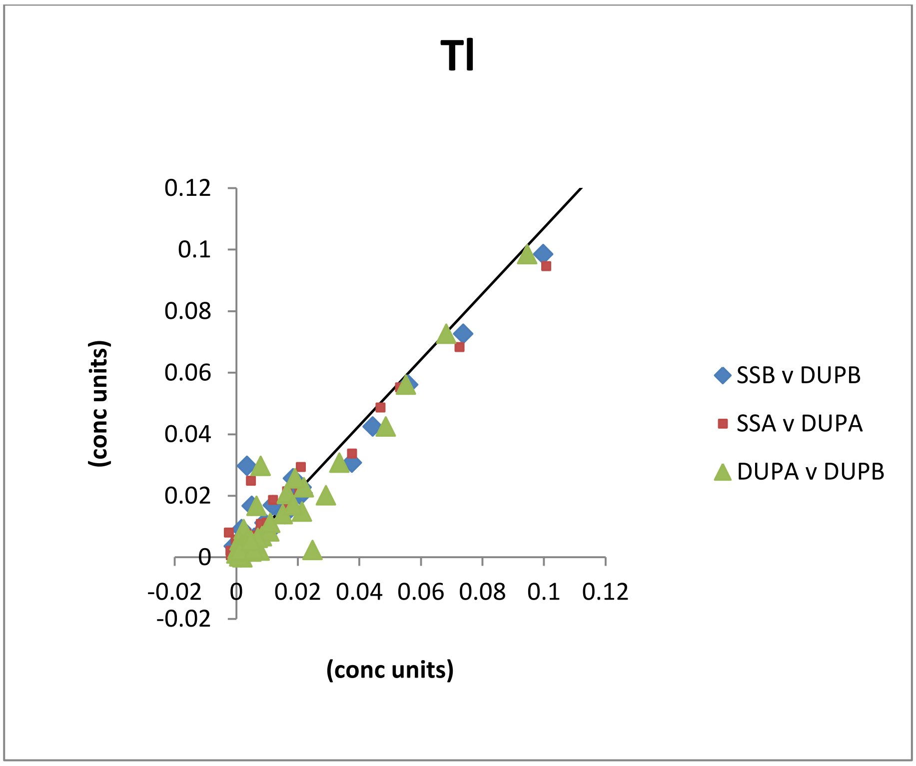
Lu
0.015
0.01
0.005
0
(conc units)
0
0.005
0.01
0.015
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB

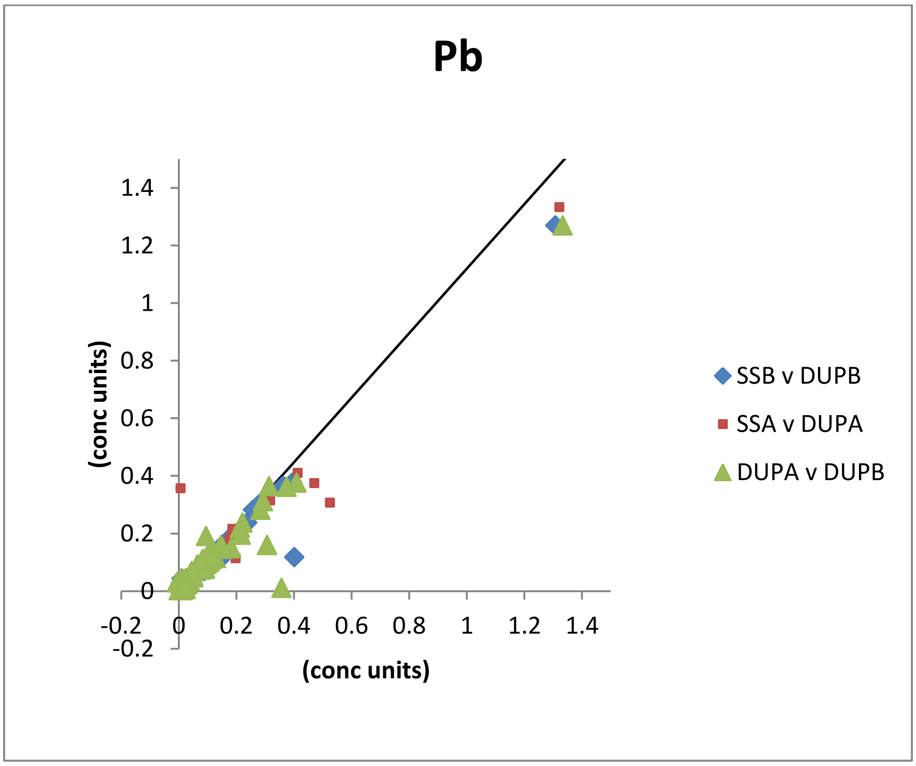


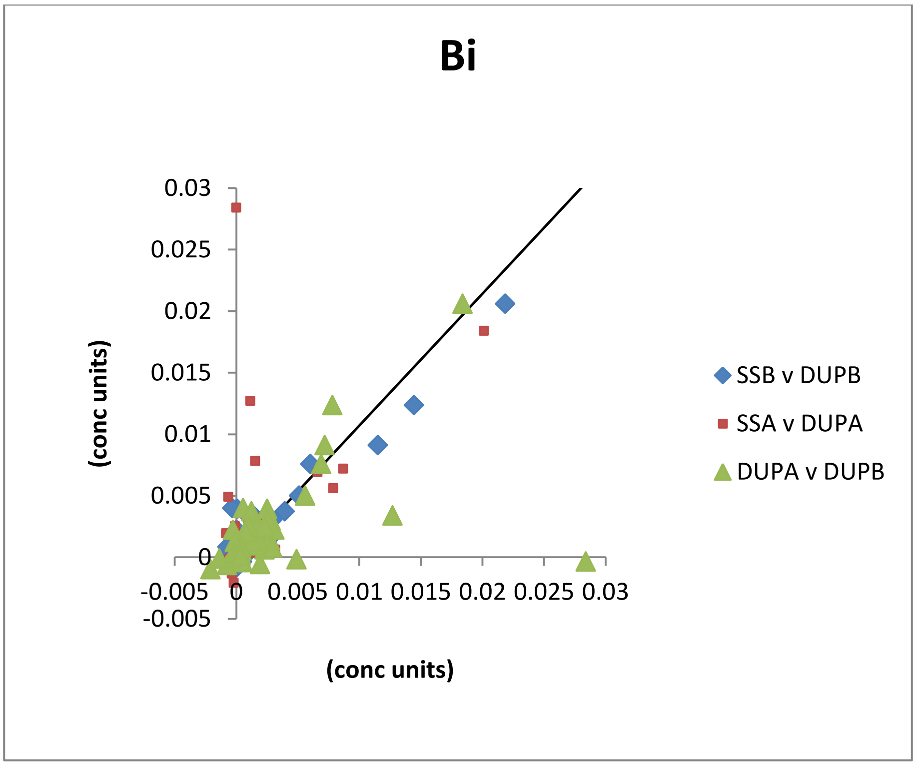
Hf
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
-0.01
(conc units)
-0.01
0
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
0.1
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB

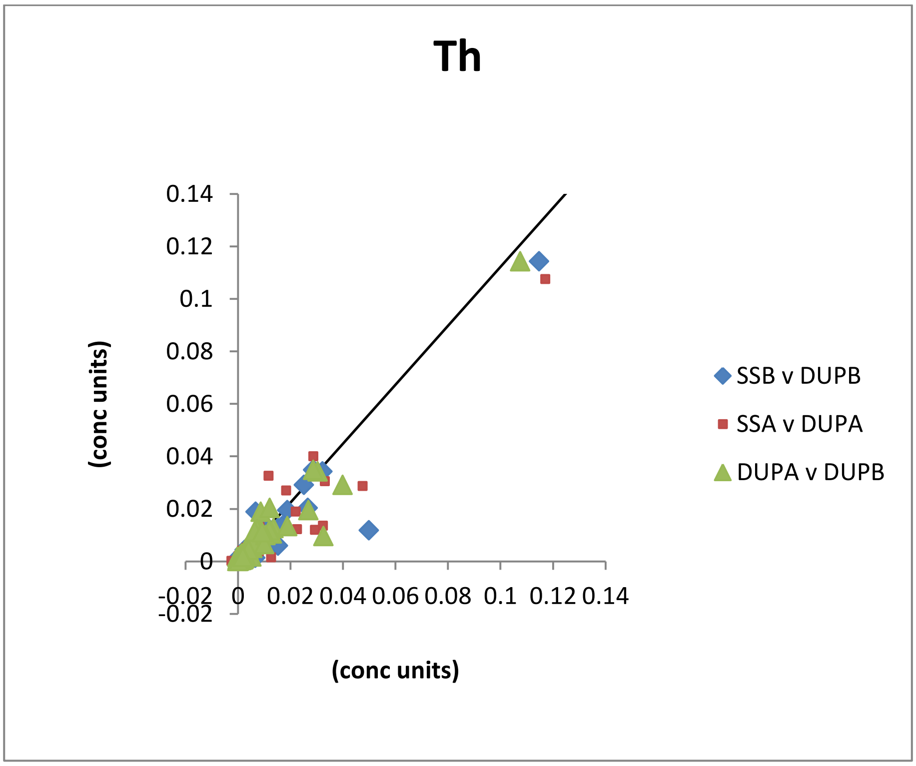

Ta
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
-0.002
(conc units)
-0.002
0
0.002
0.004
0.006
0.008
0.01
0.012
0.014
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB

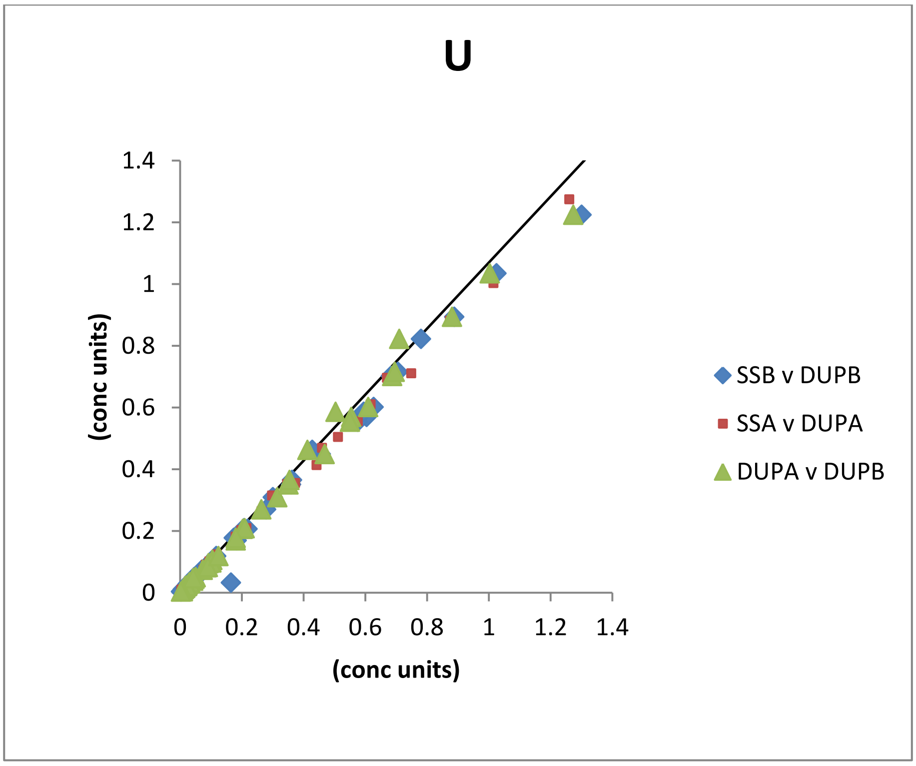

W
0.12
0.1
0.08
0.06
0.04
0.02
0
-0.02
(conc units)
-0.02
0
0.02
0.04
0.06
0.08
0.1
0.12
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB


Tl
0.12
0.1
0.08
0.06
0.04
0.02
0
-0.02
-0.02
0
0.02
0.04
0.06
0.08
0.1
0.12
(conc units)
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB

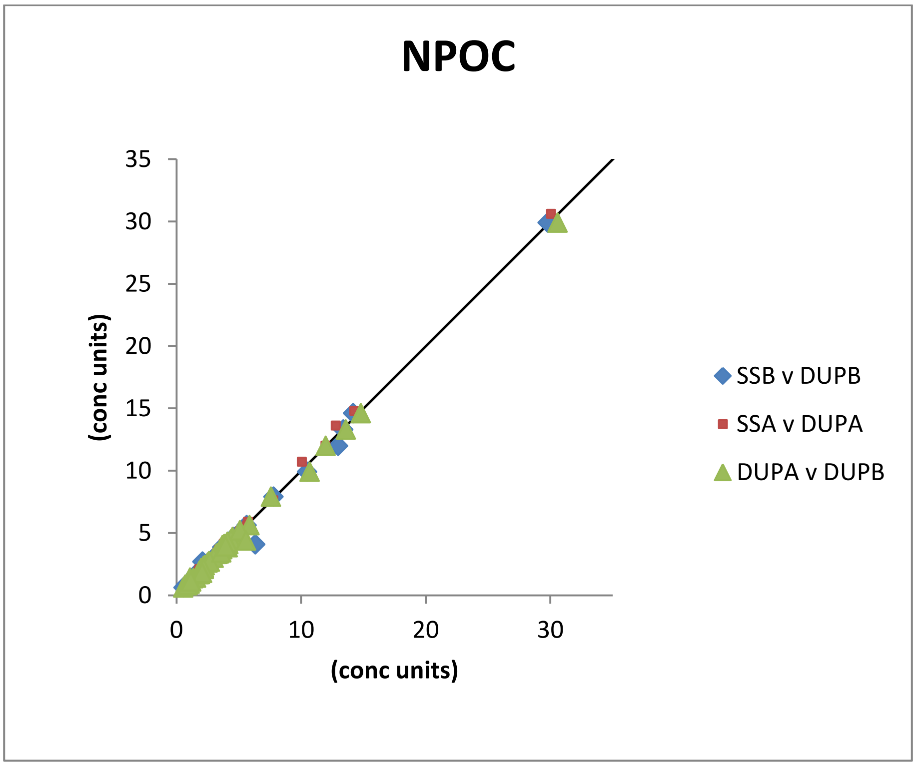

Pb
1.4
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
-0.2
0
0.2
0.4
0.6
0.8
1
1.2
1.4
(conc units)
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB


Bi
0.03
0.025
0.02
0.015
0.01
0.005
0
-0.005
-0.005
0
0.005 0.01 0.015 0.02 0.025 0.03
(conc units)
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB

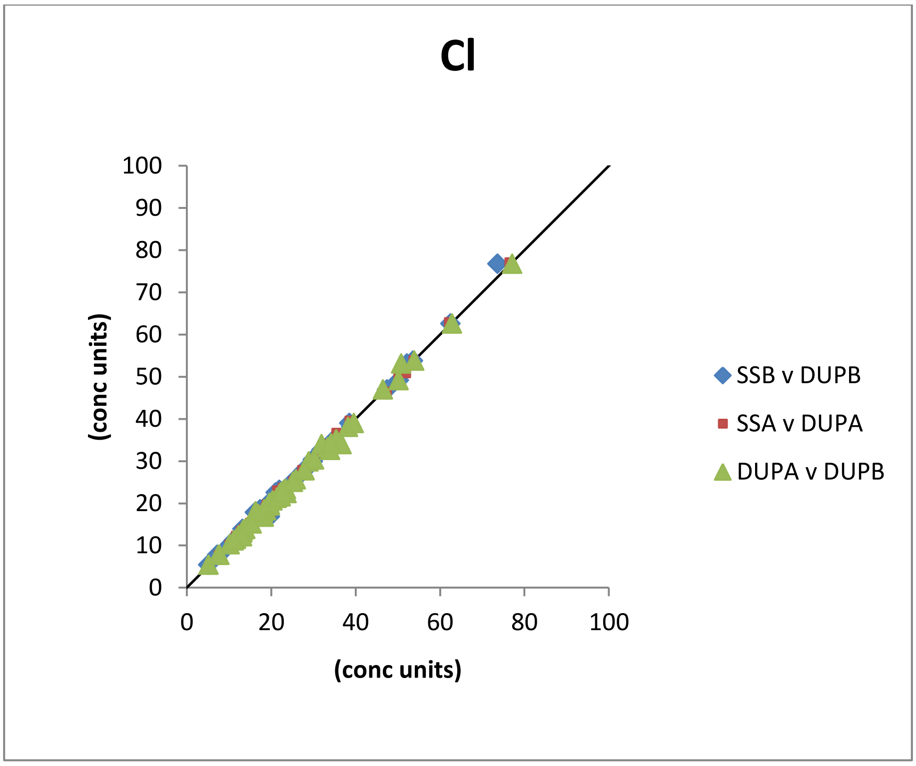

Th
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
-0.02
-0.02
0
0.02 0.04 0.06 0.08 0.1 0.12 0.14
(conc units)
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB

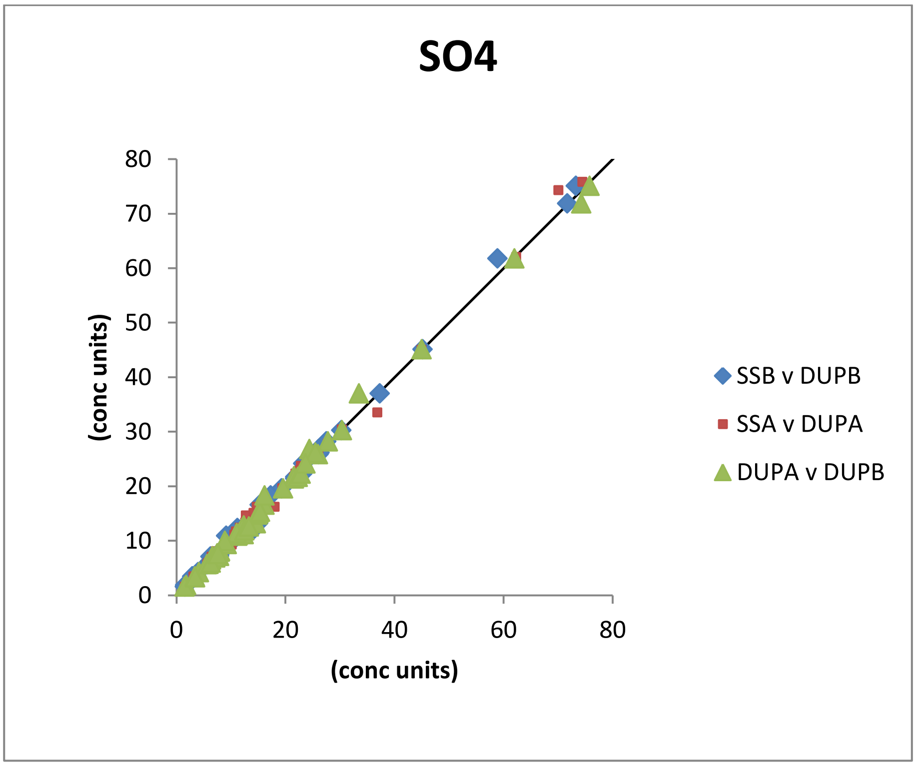


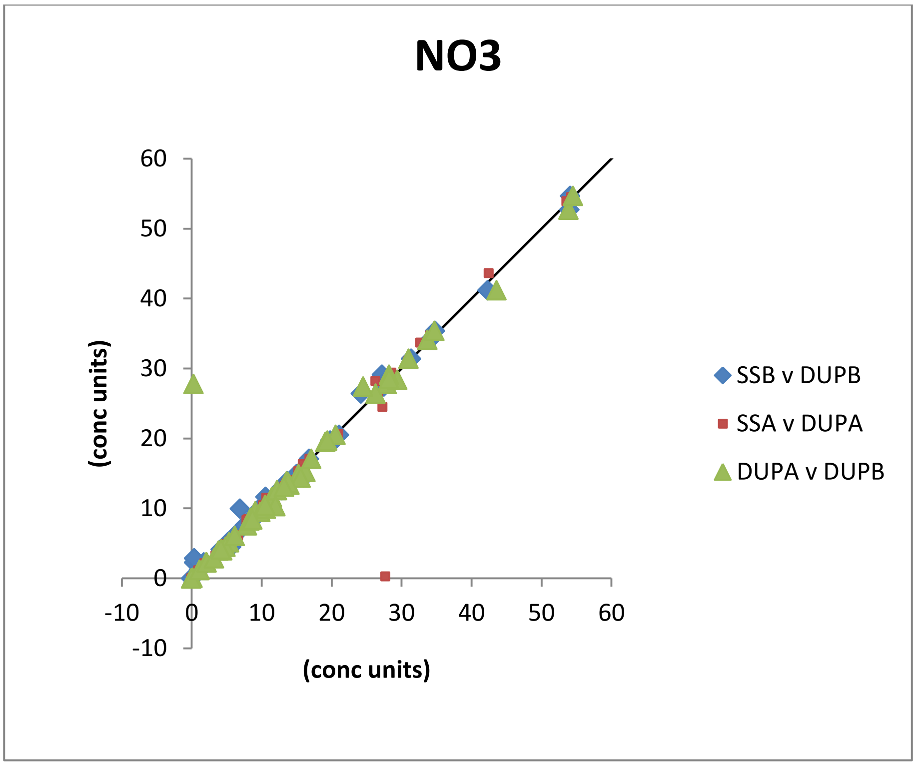
U
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
0.2
0.4
0.6
0.8
1
1.2
1.4
(conc units)
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB

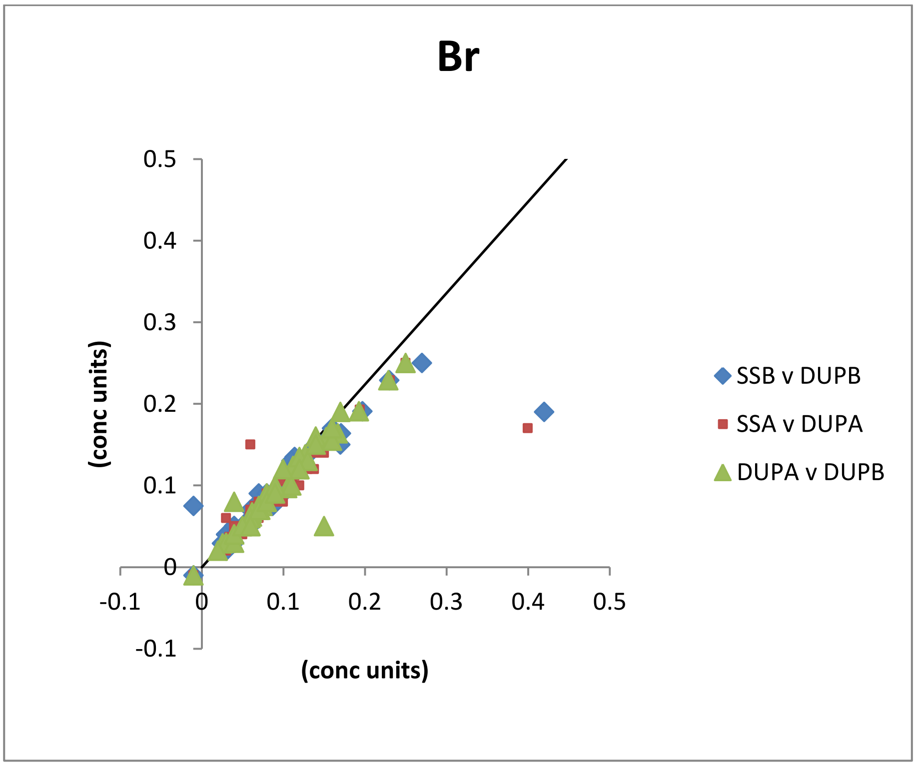


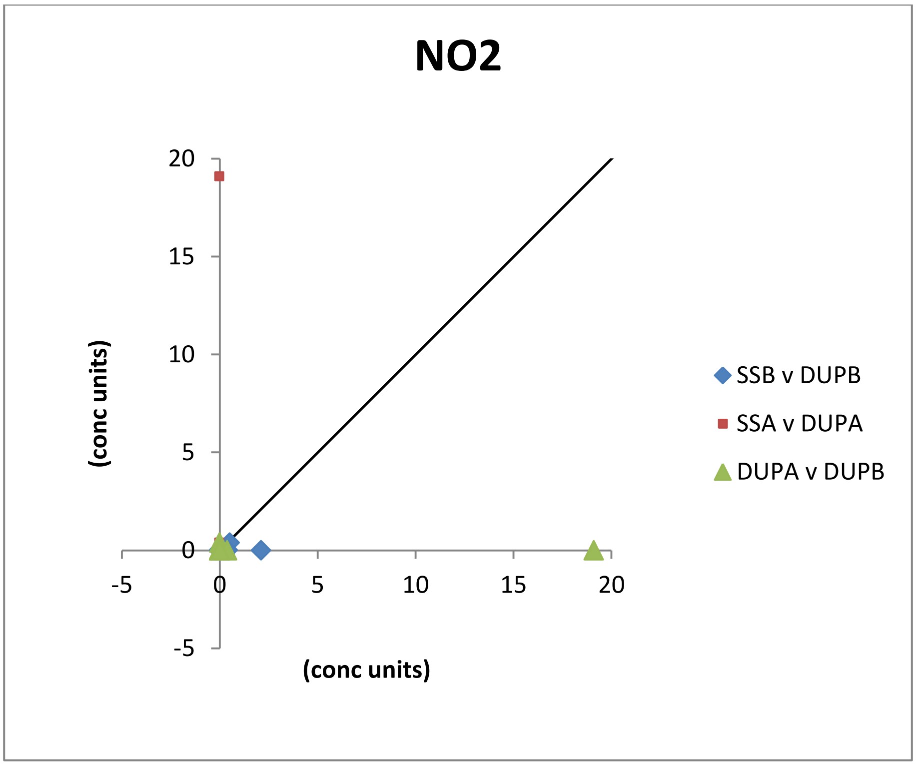
NPOC
35
30
25
20
15
10
5
0
0
10
20
30
(conc units)
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB

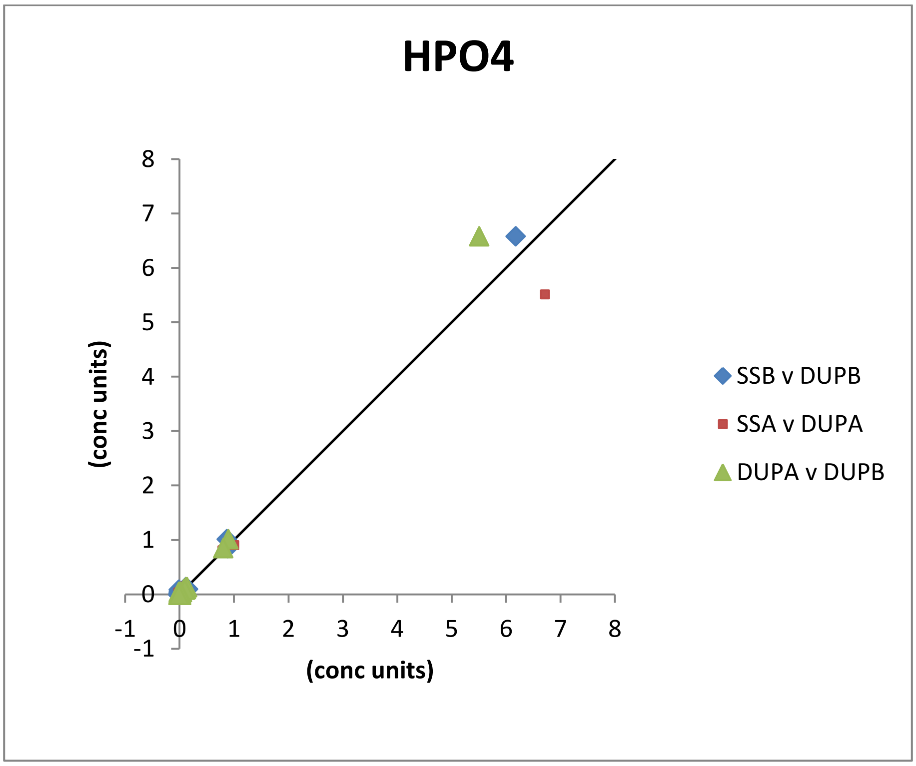

Cl
100
90
80
70
60
50
40
30
20
10
0
0
20
40
60
80
100
(conc units)
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB

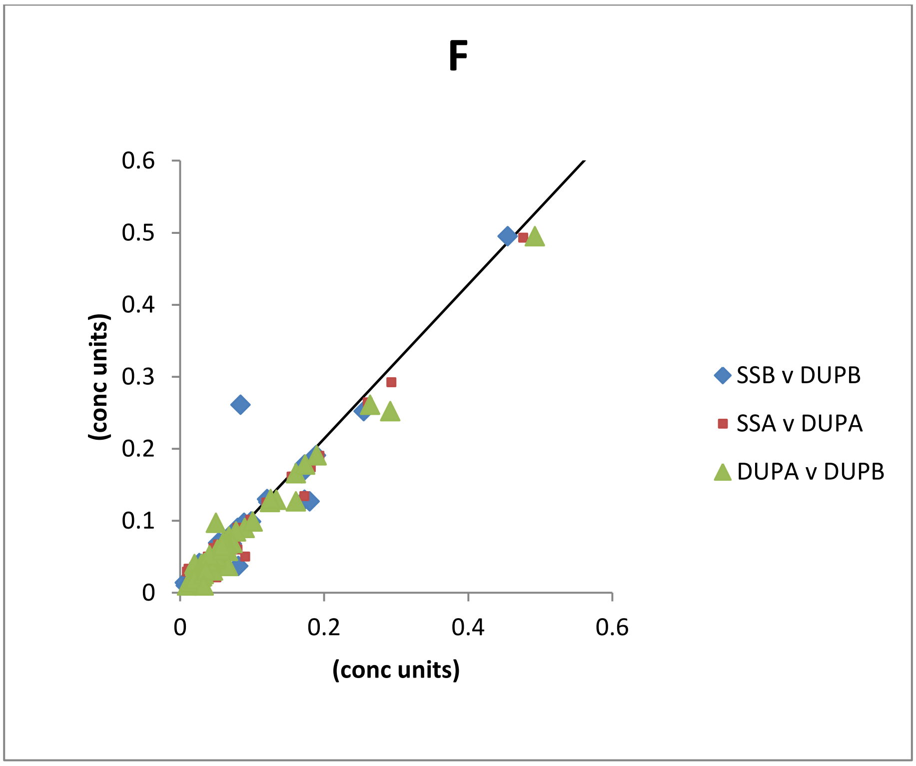

SO4
80
70
60
50
40
30
20
10
0
0
20
40
60
80
(conc units)
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB


NO3
60
50
40
30
20
10
0
-10
-10
0
10
20
30
40
50
60
(conc units)
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB


Br
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.1
0
0.1
0.2
0.3
0.4
0.5
(conc units)
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB


NO2
20
15
10
5
0
-5
-5
0
5
10
15
20
(conc units)
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB

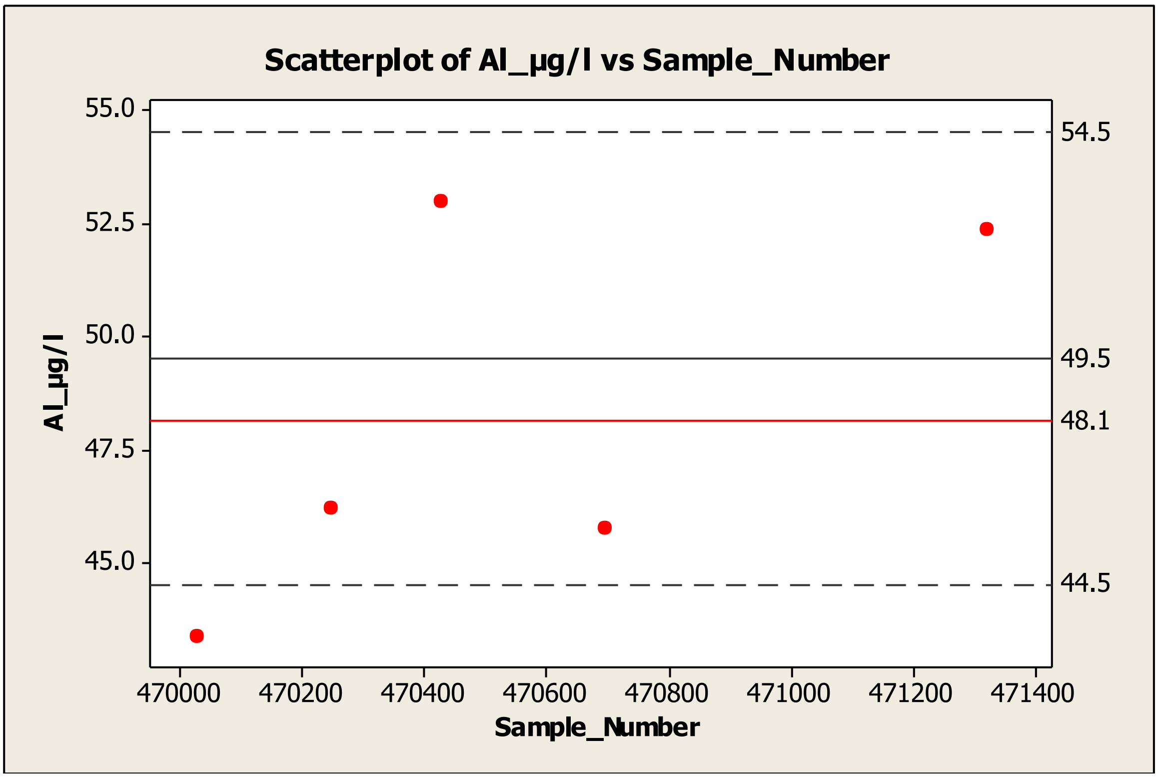

HPO4
8
7
6
5
4
3
2
1
0
-1
-1
0
1
2
3
4
5
6
7
8
(conc units)
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB

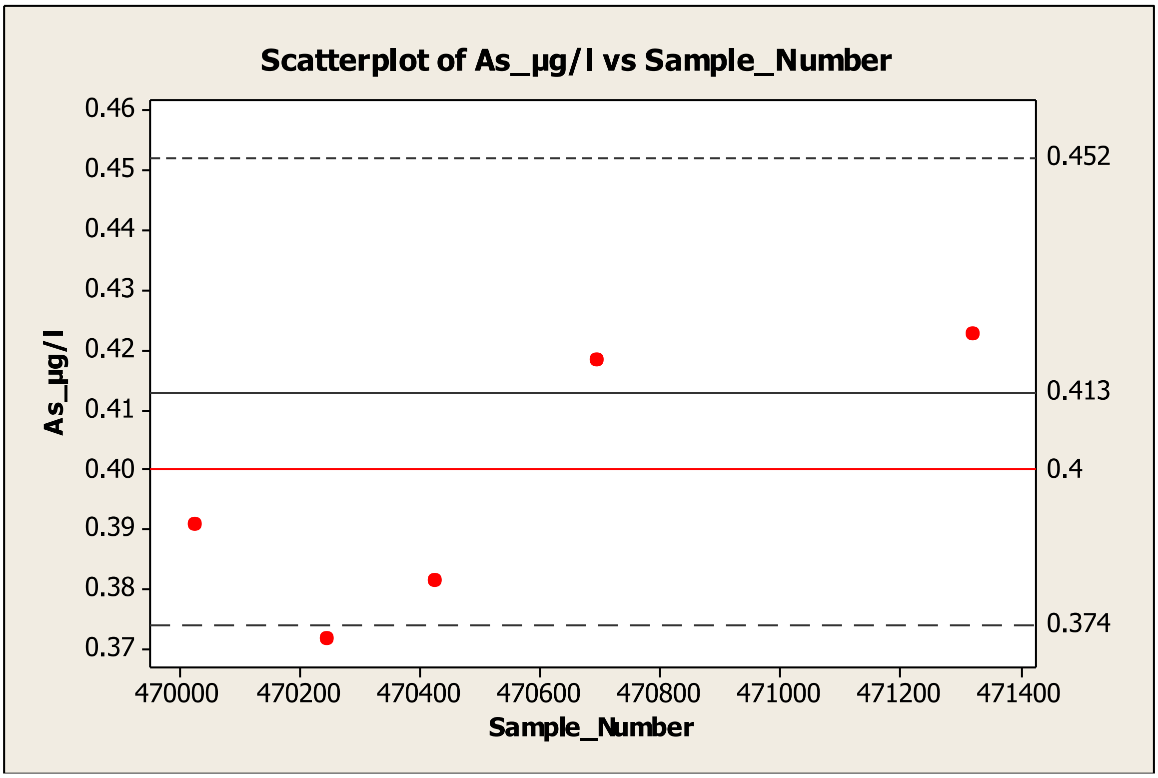

F
0.6
0.5
0.4
0.3
0.2
0.1
0
(conc units)
0
0.2
0.4
0.6
(conc units)
SSB v DUPB
SSA v DUPA
DUPA v DUPB

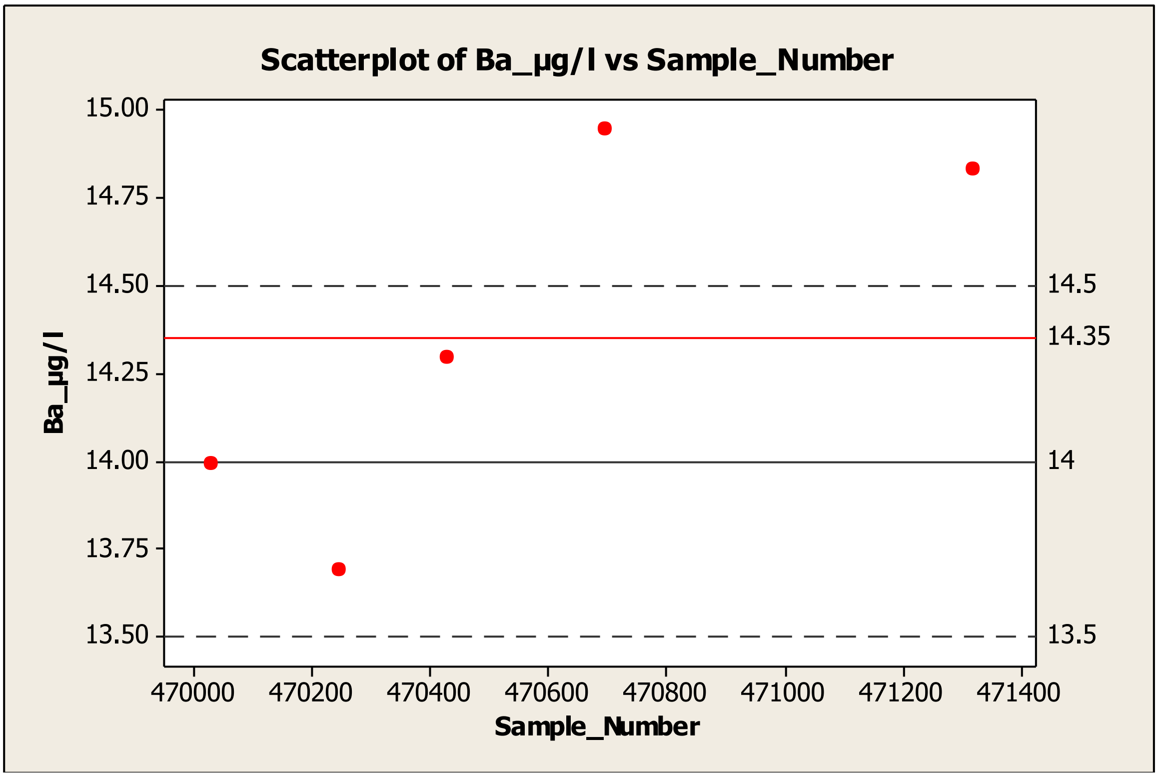
Appendix 5 SRM and CRM data plots

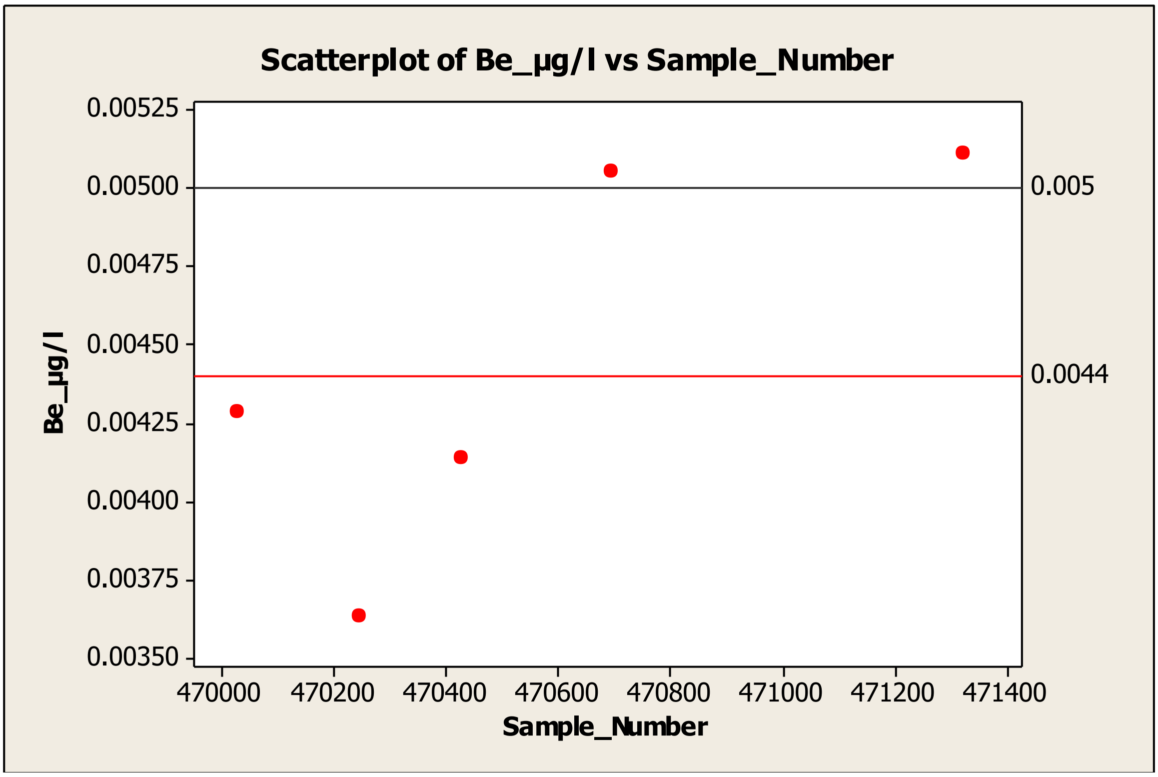
CRMS

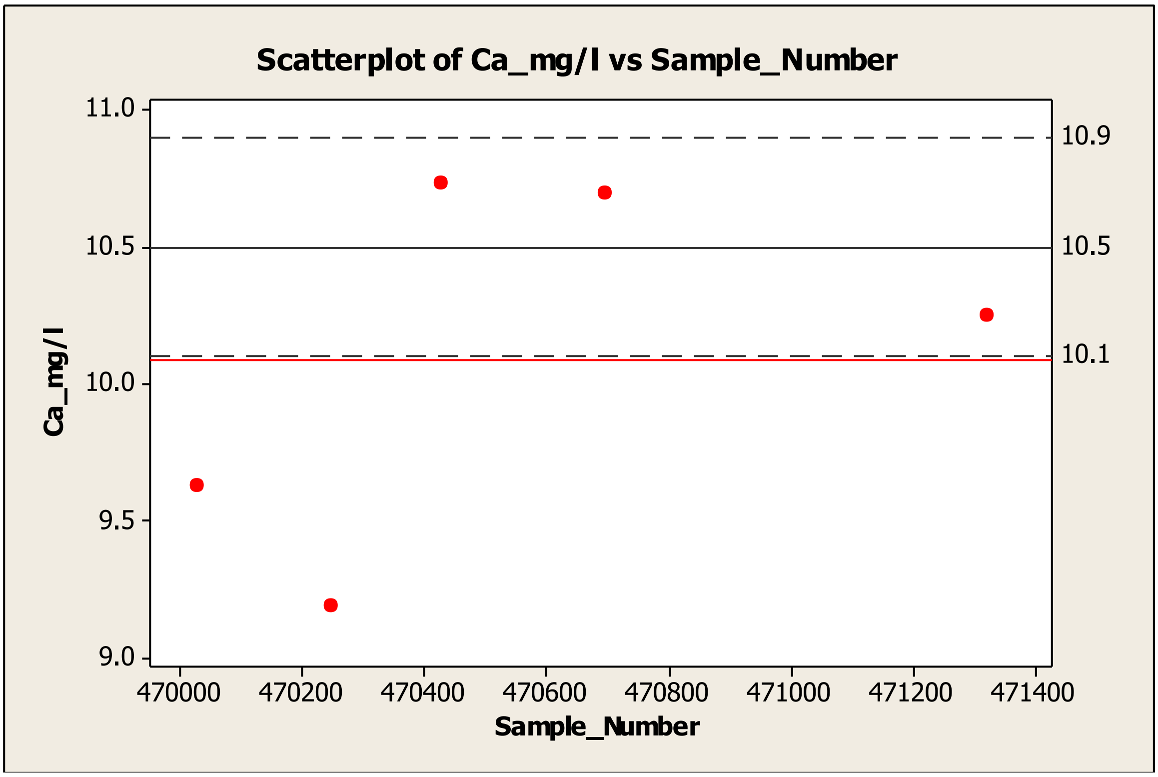
The solid black line represents the certified value, the dashed black lines represents the 95% confidence limits, and the red line represents the average of the measured data.

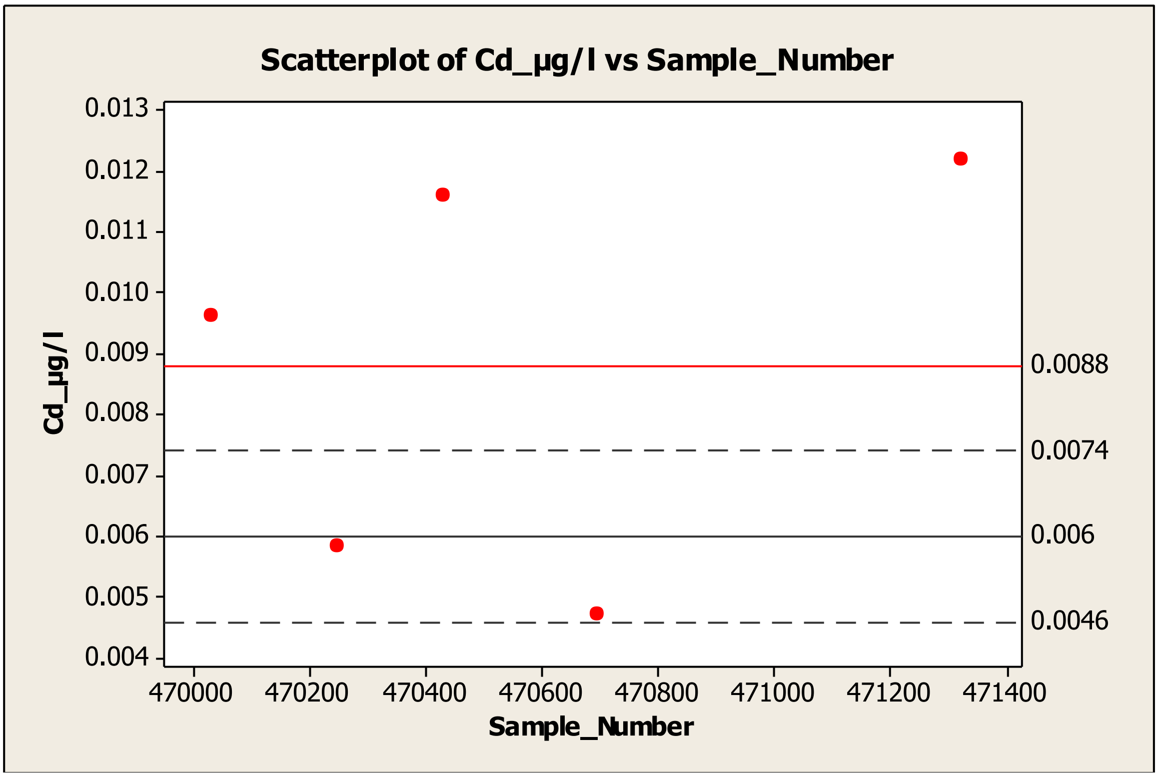


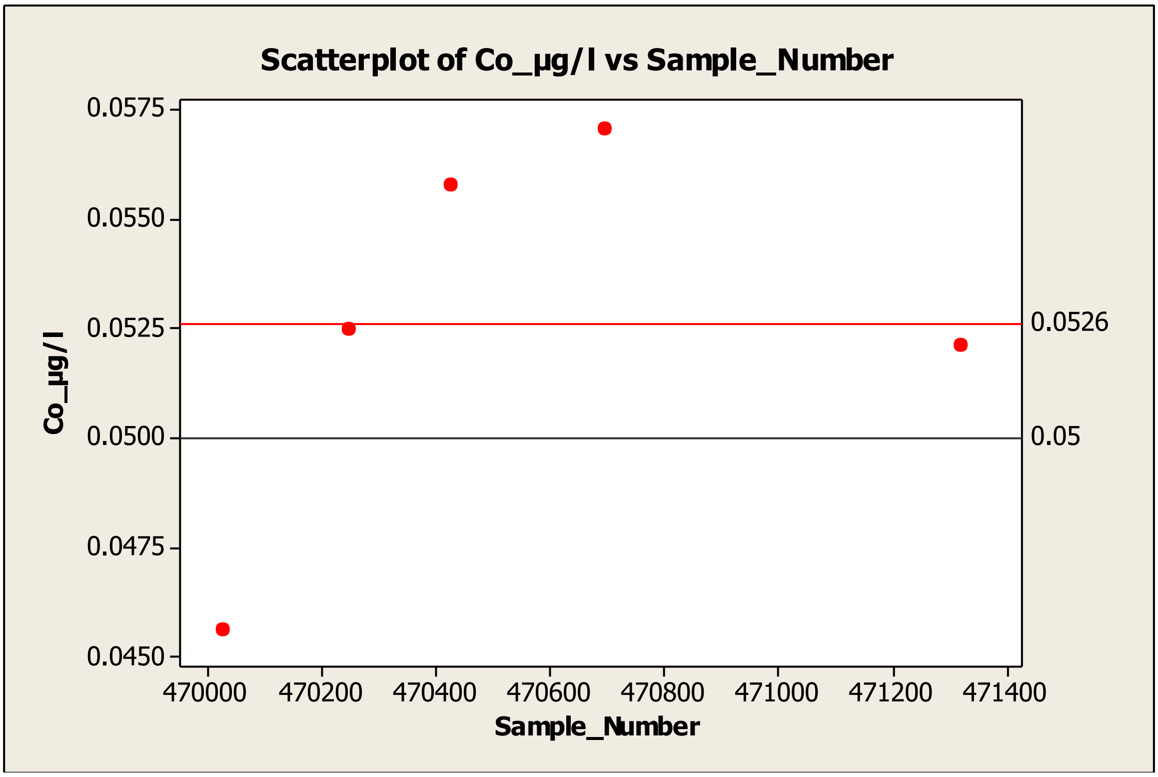



Scatterplot of Ba_µg/l vs Sample_Number
Ba_µg/l
15.00
14.75
14.50
14.25
14.00
13.75
13.50
14.5
14.35
14
13.5
470000
470200
470400
470600
470800
471000
471200
471400
Sample_Number

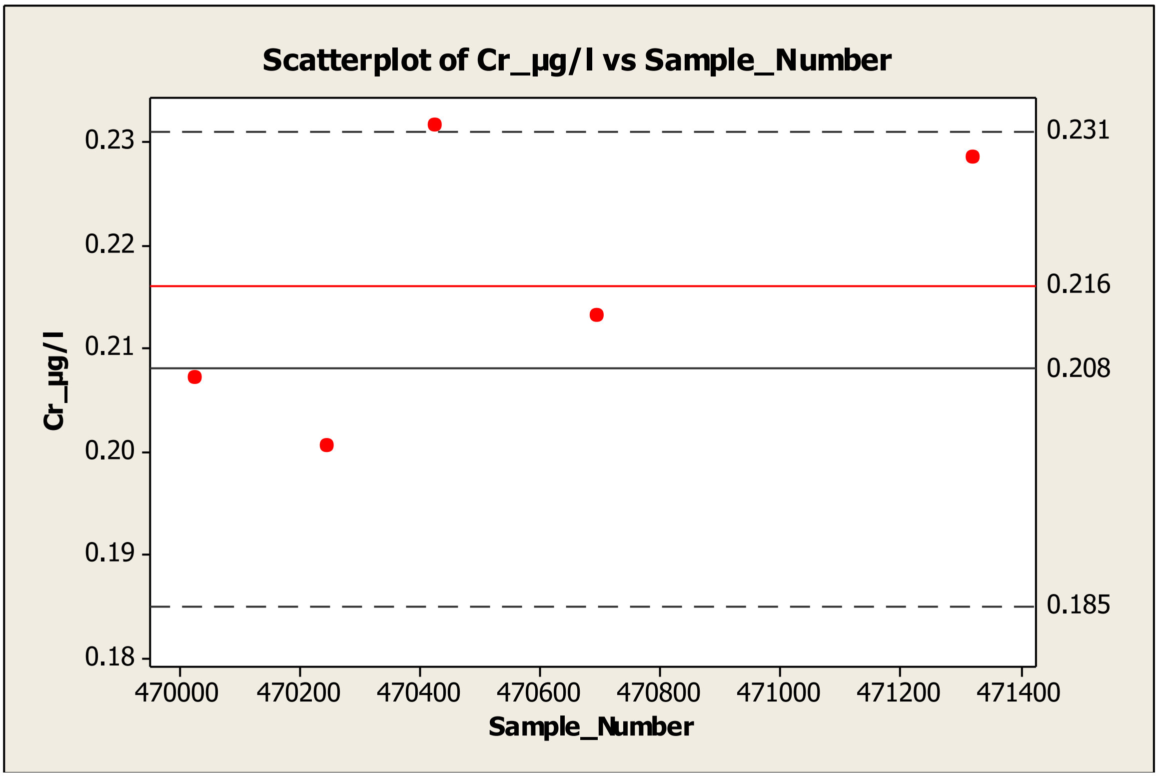

Scatterplot of Be_µg/l vs Sample_Number
Be_µg/l
0.00525
0.00500
0.00475
0.00450
0.00425
0.00400
0.00375
0.00350
0.005
0.0044
470000
470200
470400
470600
470800
471000
471200
471400
Sample_Number


Scatterplot of Ca_mg/l vs Sample_Number
Ca_mg/l
Sample_Number
11.0
10.5
10.0
9.5
9.0
10.9
10.5
10.1
470000
470200
470400
470600
470800
471000
471200
471400

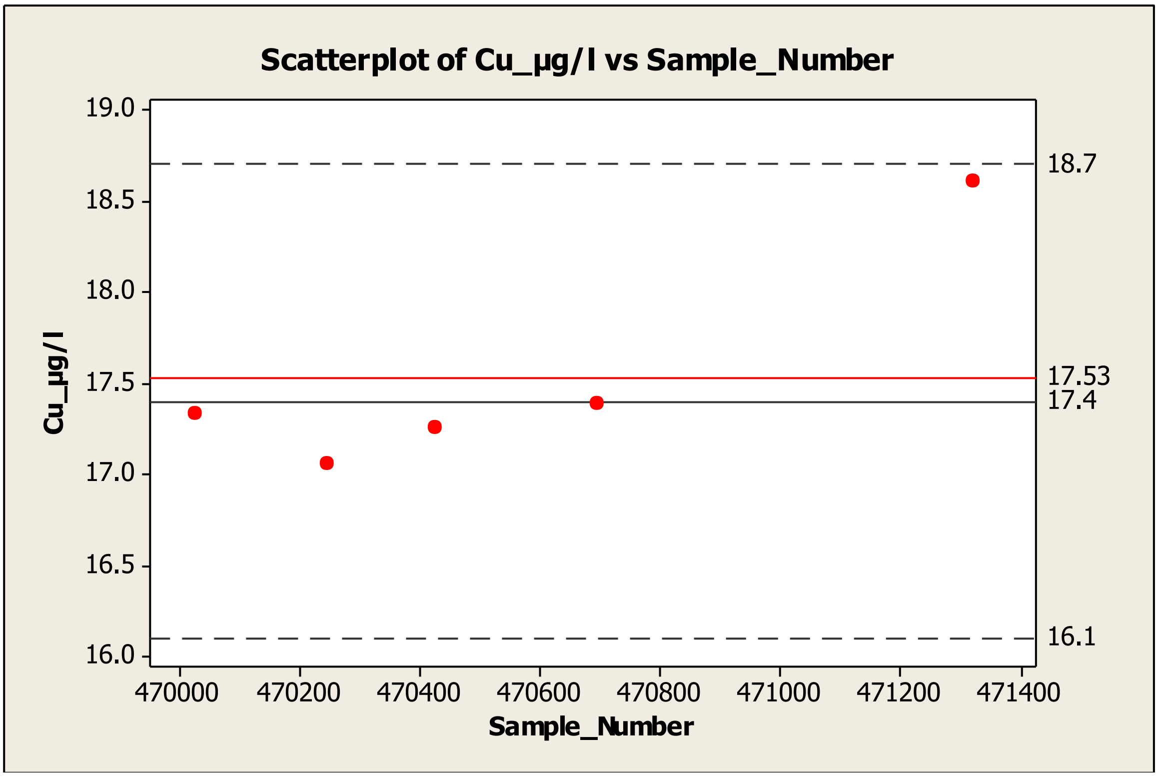

Scatterplot of Cd_µg/l vs Sample_Number
Cd_µg/l
Sample_Number
0.013
0.012
0.011
0.010
0.009
0.008
0.007
0.006
0.005
0.004
0.0088
0.0074
0.006
0.0046
470000
470200
470400
470600
470800
471000
471200
471400

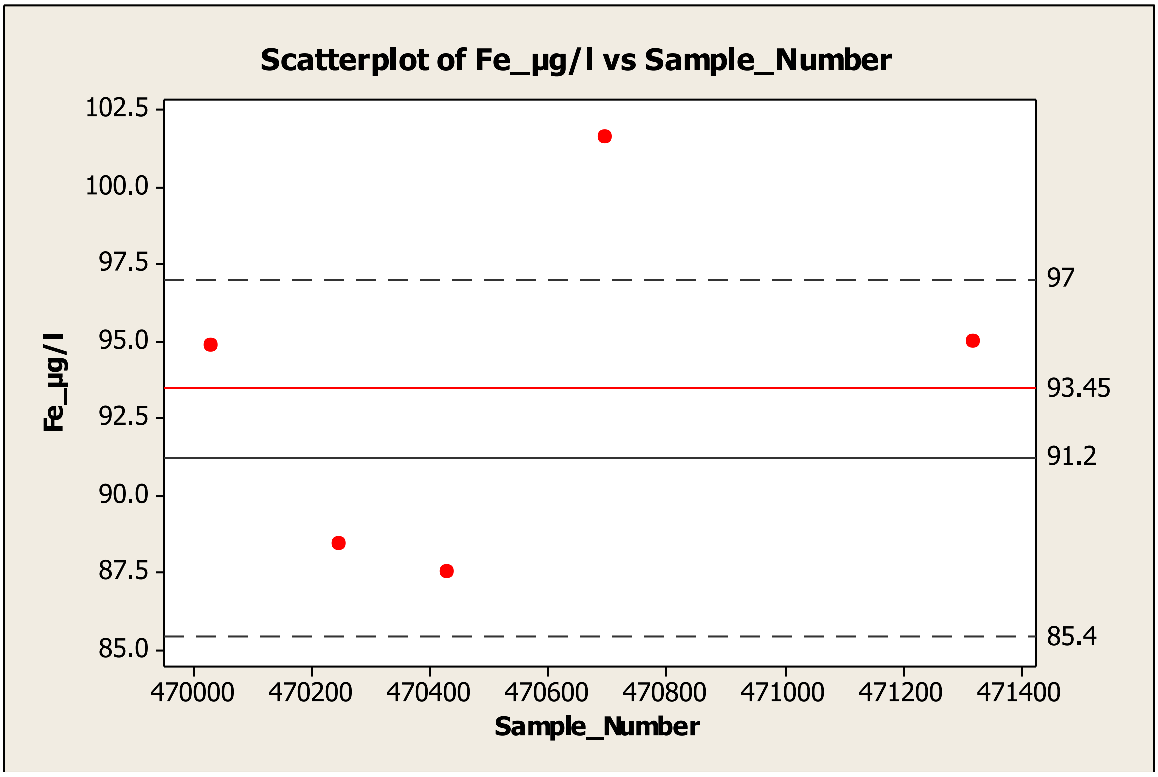


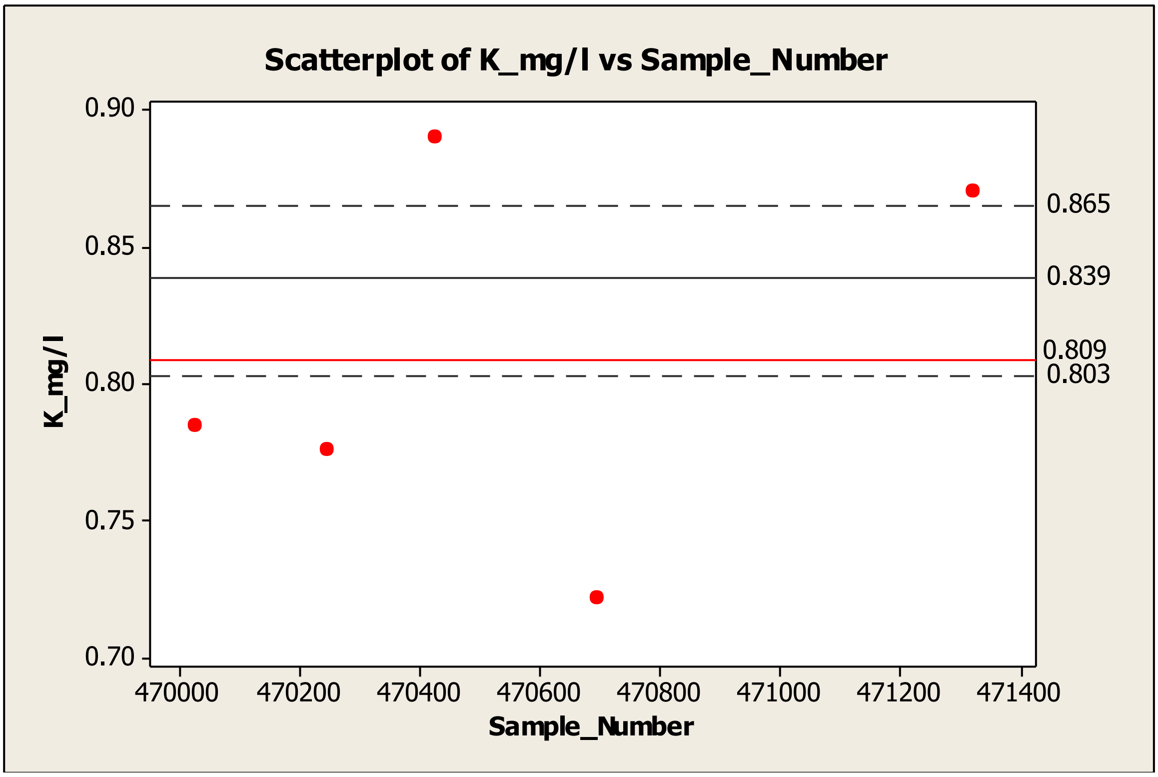
Scatterplot of Co_µg/l vs Sample_Number
Co_µg/l
0.0575
0.0550
0.0525
0.0500
0.0475
0.0450
0.0526
0.05
470000
470200
470400
470600
470800
471000
471200
471400
Sample_Number

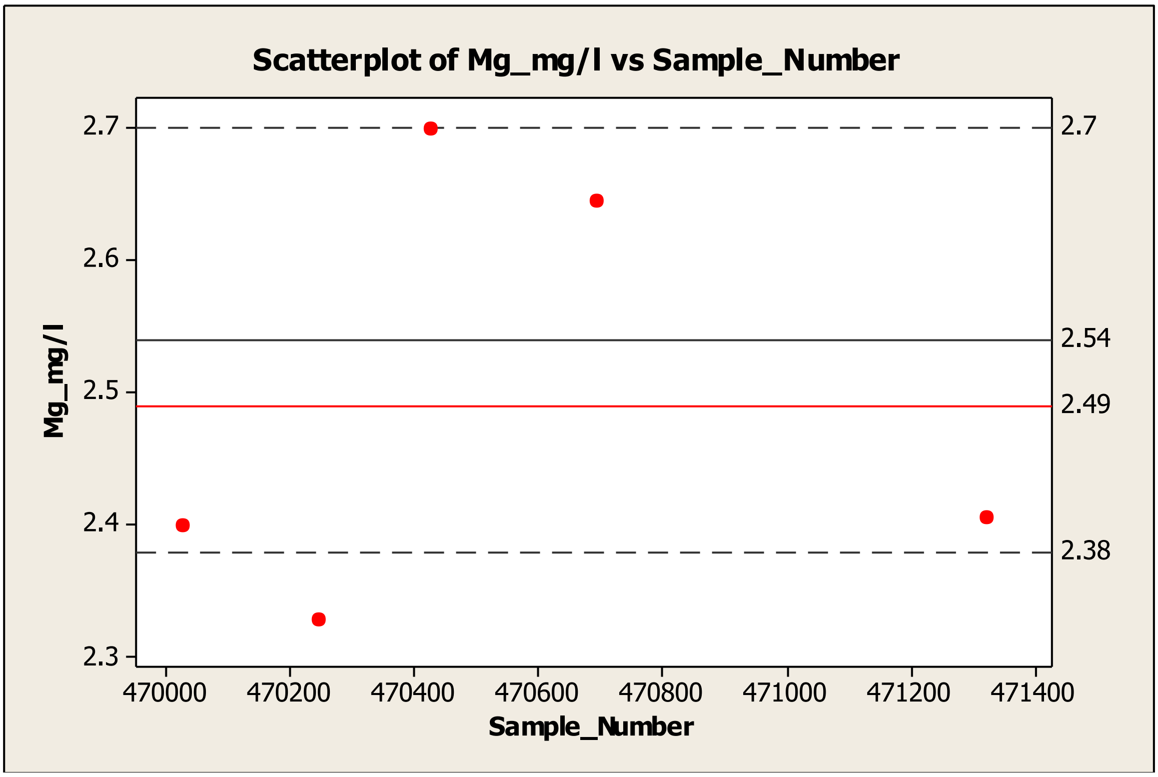


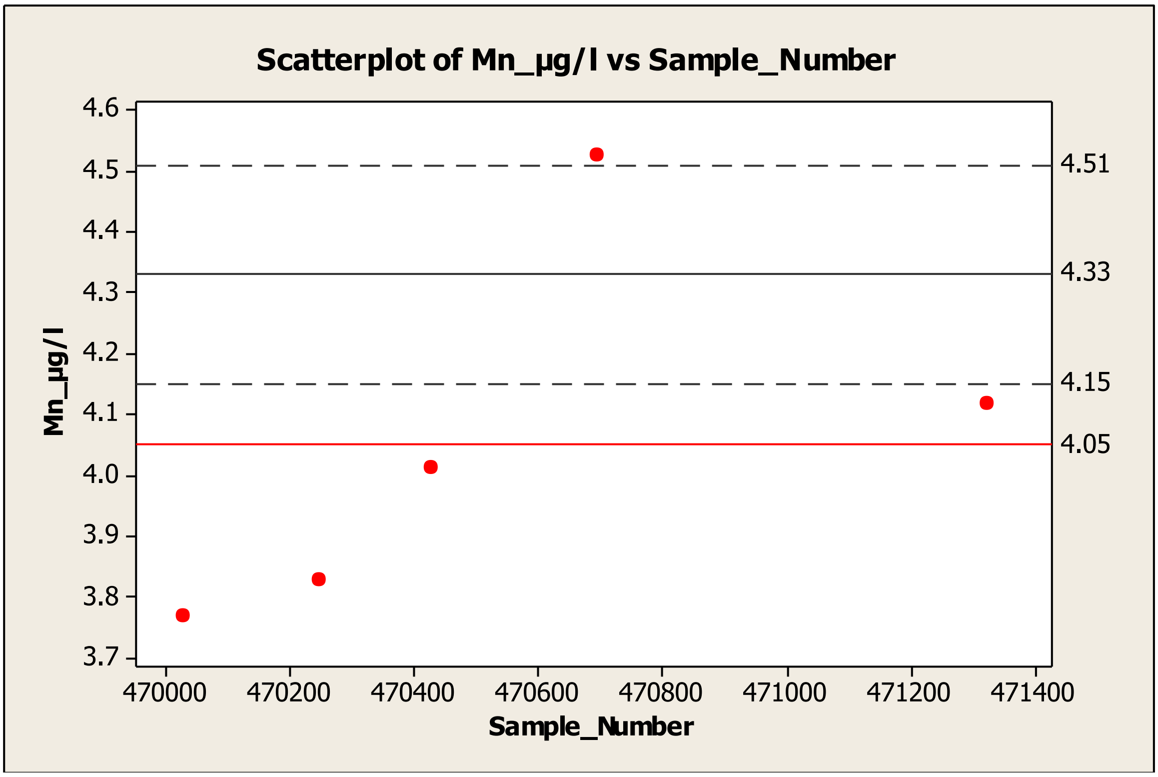
Scatterplot of Cr_µg/l vs Sample_Number
Cr_µg/l
0.23
0.22
0.21
0.20
0.19
0.18
0.231
0.216
0.208
0.185
470000
470200
470400
470600
470800
471000
471200
471400
Sample_Number

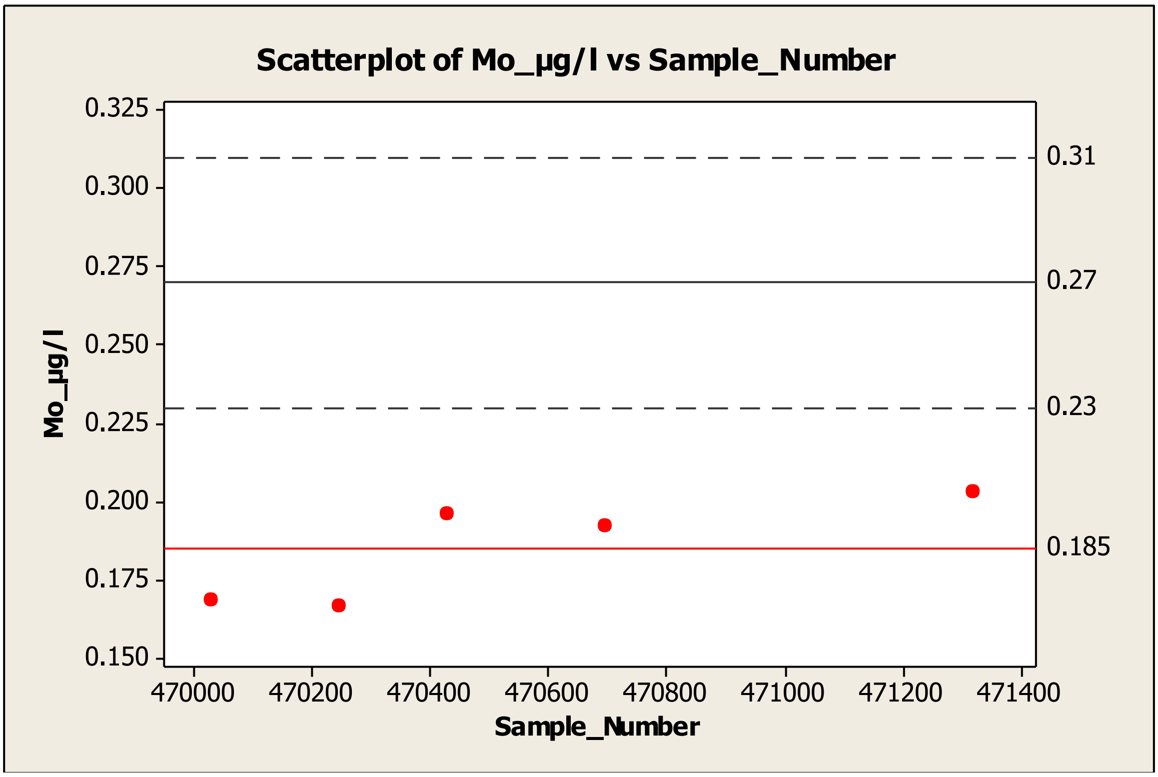

Scatterplot of Cu_µg/l vs Sample_Number
Cu_µg/l
19.0
18.5
18.0
17.5
17.0
16.5
16.0
18.7
17.53
17.4
16.1
470000
470200
470400
470600
470800
471000
471200
471400
Sample_Number

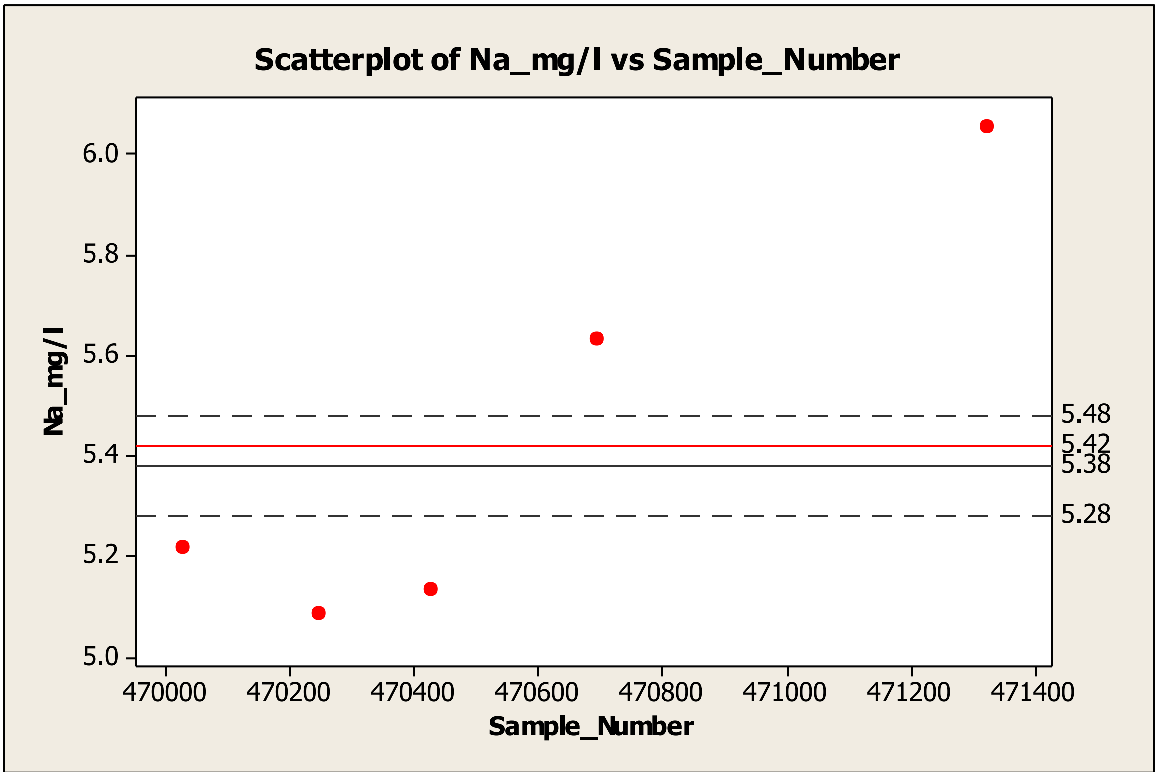

Scatterplot of Fe_µg/l vs Sample_Number
Fe_µg/l
102.5
100.0
97.5
95.0
92.5
90.0
87.5
85.0
97
93.45
91.2
85.4
470000
470200
470400
470600
470800
471000
471200
471400
Sample_Number

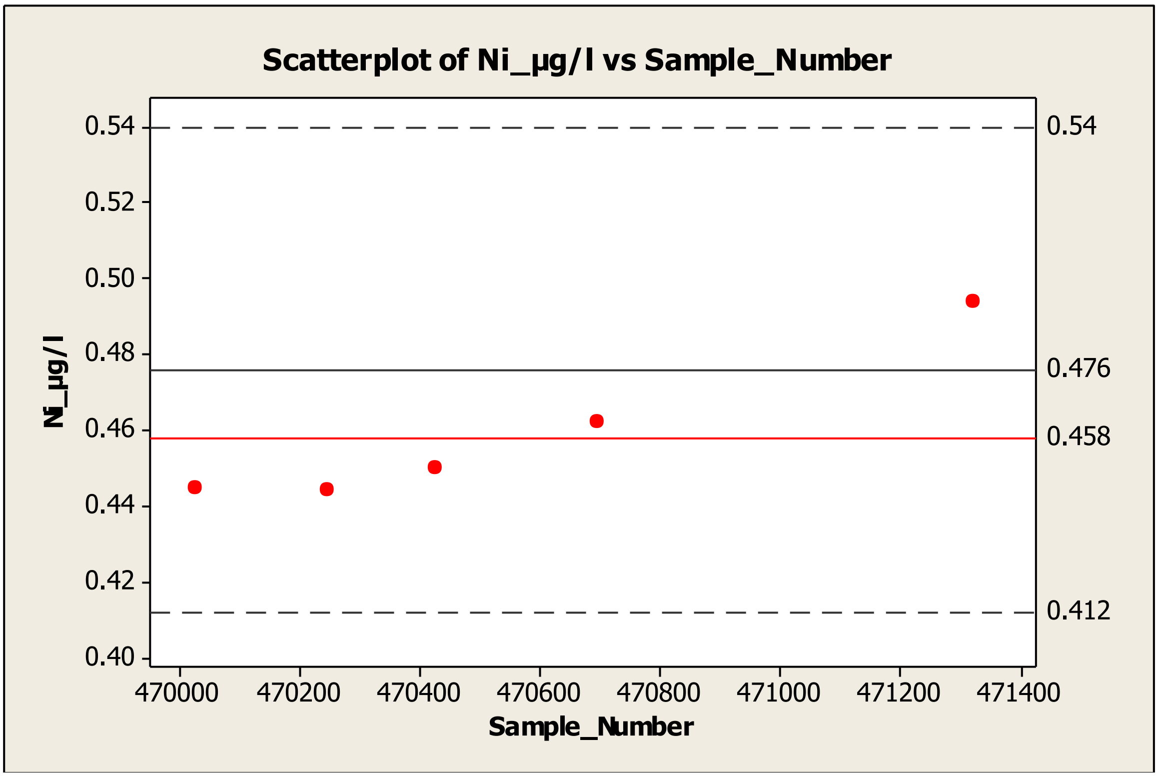

Scatterplot of K_mg/l vs Sample_Number
K_mg/l
0.90
0.85
0.80
0.75
0.70
0.865
0.839
0.809
0.803
470000
470200
470400
470600
470800
471000
471200
471400
Sample_Number

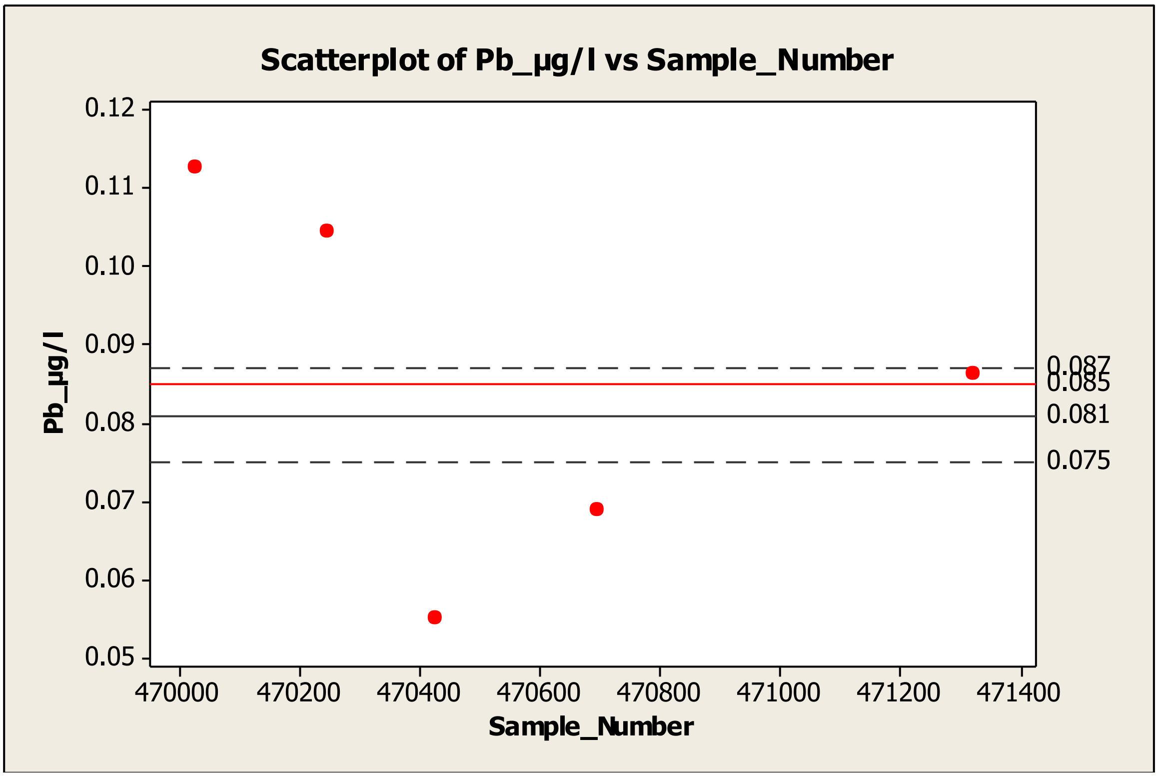

Scatterplot of Mg_mg/l vs Sample_Number
Mg_mg/l
2.7
2.6
2.5
2.4
2.3
2.7
2.54
2.49
2.38
470000
470200
470400
470600
470800
471000
471200
471400
Sample_Number


Scatterplot of Mn_µg/l vs Sample_Number
Mn_µg/l
4.6
4.5
4.4
4.3
4.2
4.1
4.0
3.9
3.8
3.7
4.51
4.33
4.15
4.05
470000
470200
470400
470600
470800
471000
471200
471400
Sample_Number

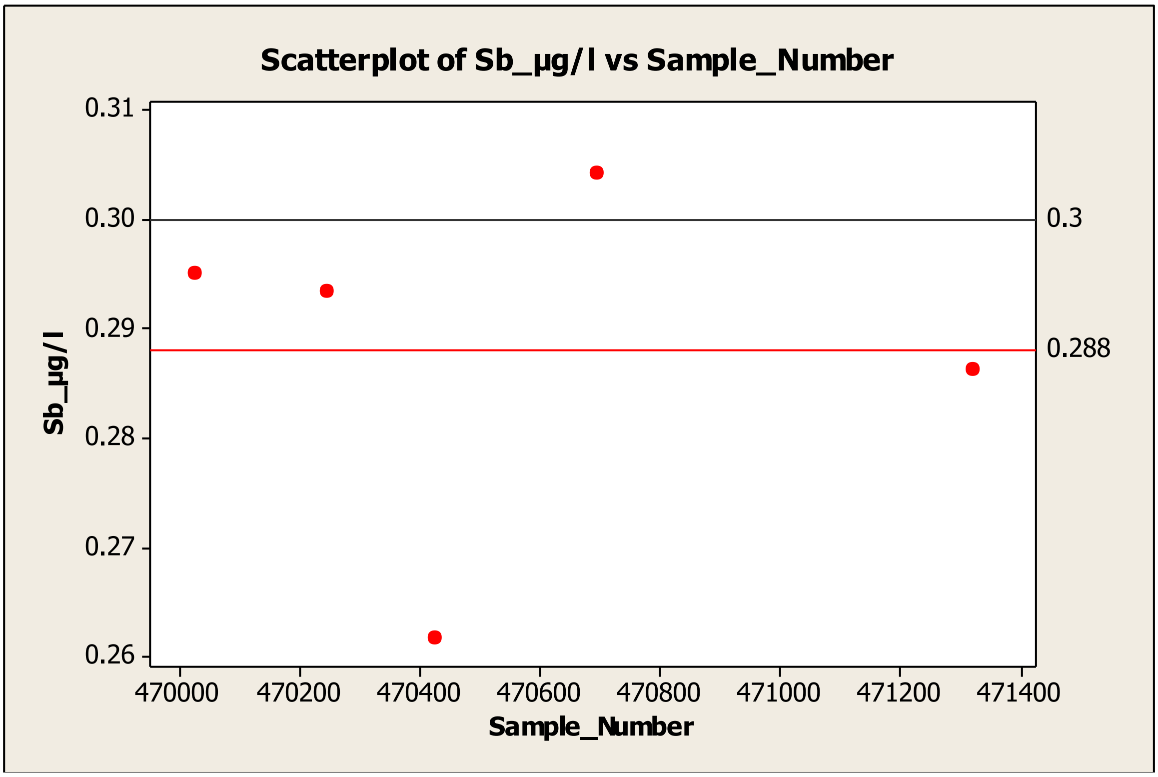

Scatterplot of Mo_µg/l vs Sample_Number
Mo_µg/l
0.325
0.300
0.275
0.250
0.225
0.200
0.175
0.150
0.31
0.27
0.23
0.185
470000
470200
470400
470600
470800
471000
471200
471400
Sample_Number


Scatterplot of Na_mg/l vs Sample_Number
Na_mg/l
6.0
5.8
5.6
5.4
5.2
5.0
5.48
5.42
5.38
5.28
470000
470200
470400
470600
470800
471000
471200
471400
Sample_Number

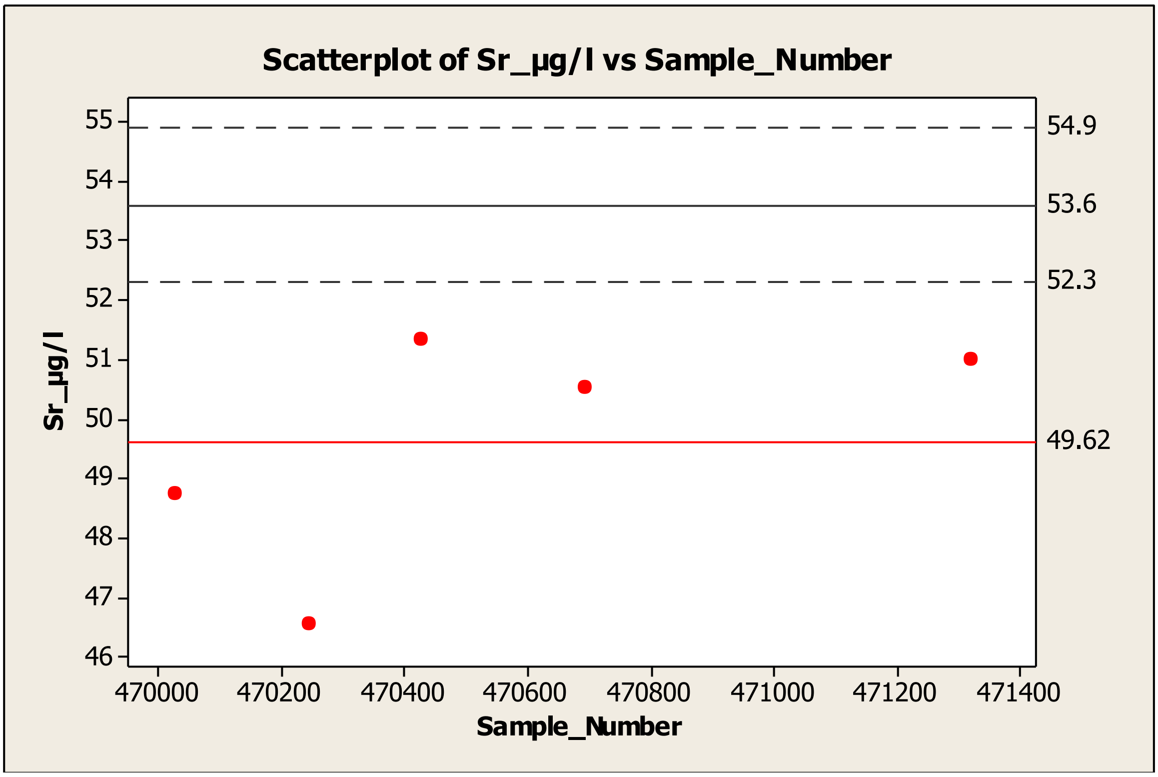

Scatterplot of Ni_µg/l vs Sample_Number
Ni_µg/l
0.54
0.52
0.50
0.48
0.46
0.44
0.42
0.40
0.54
0.476
0.458
0.412
470000
470200
470400
470600
470800
471000
471200
471400
Sample_Number

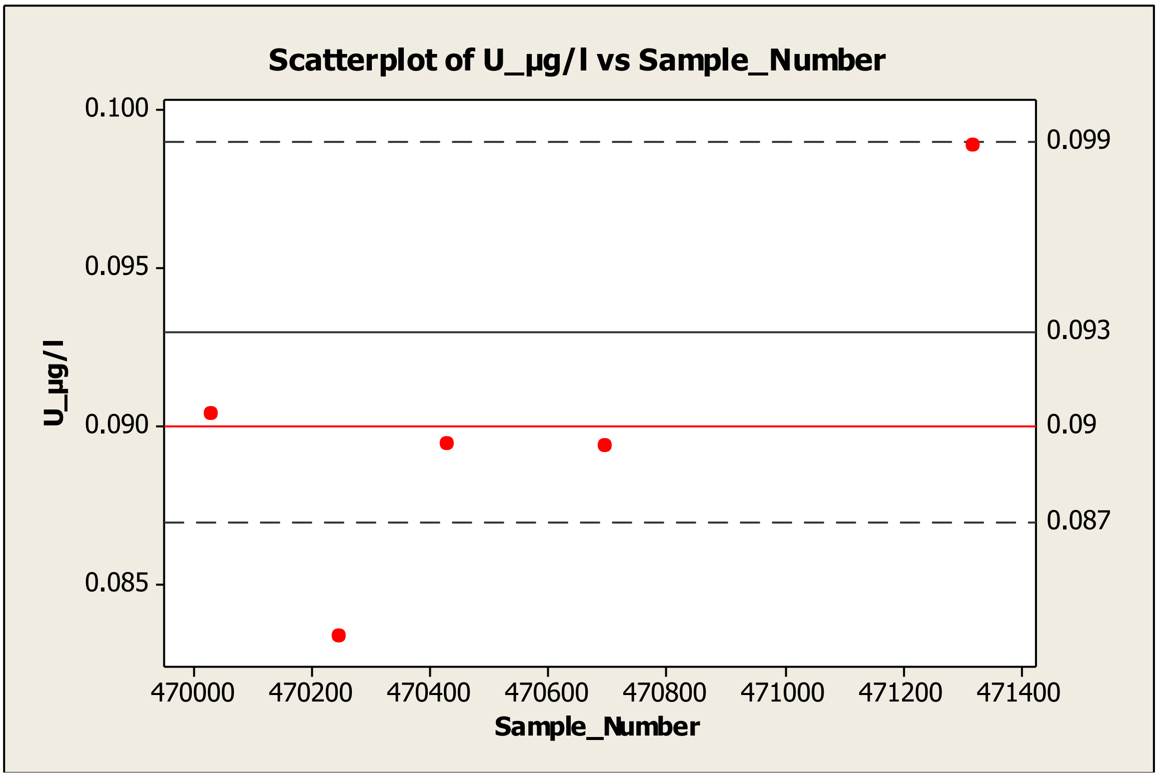


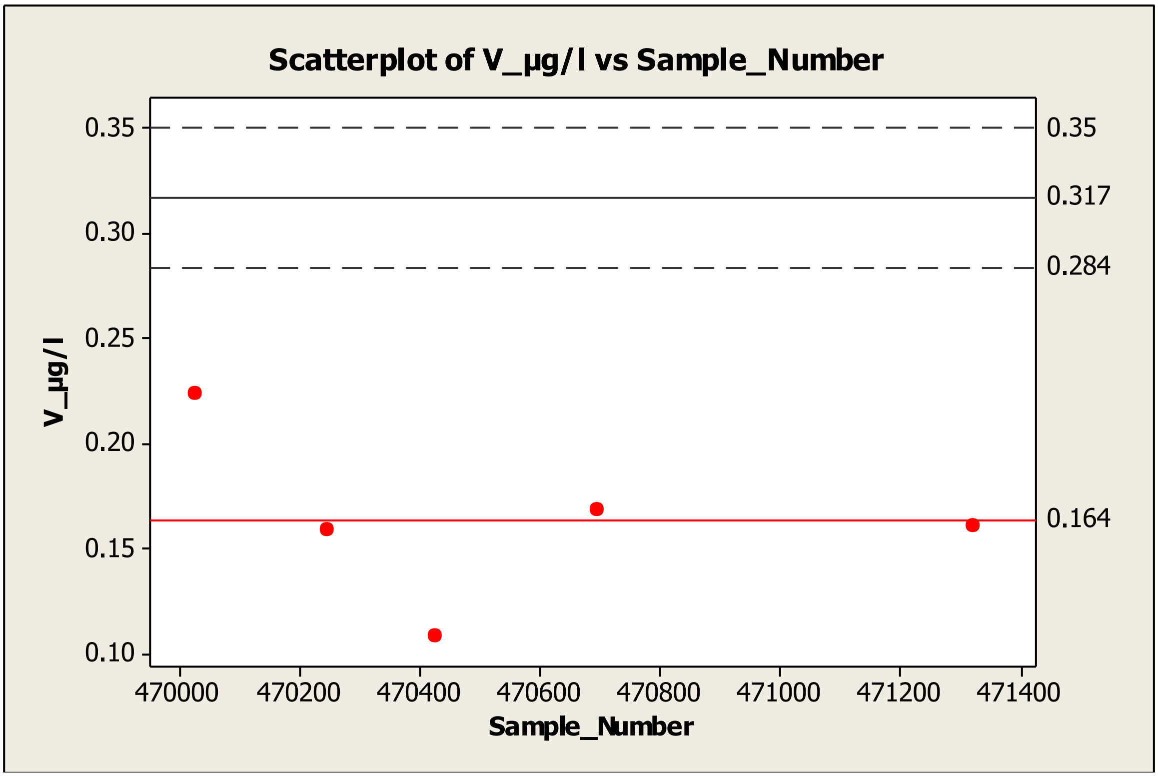
Scatterplot of Pb_µg/l vs Sample_Number
Pb_µg/l
0.12
0.11
0.10
0.09
0.08
0.07
0.06
0.05
0.087
0.085
0.081
0.075
470000
470200
470400
470600
470800
471000
471200
471400
Sample_Number

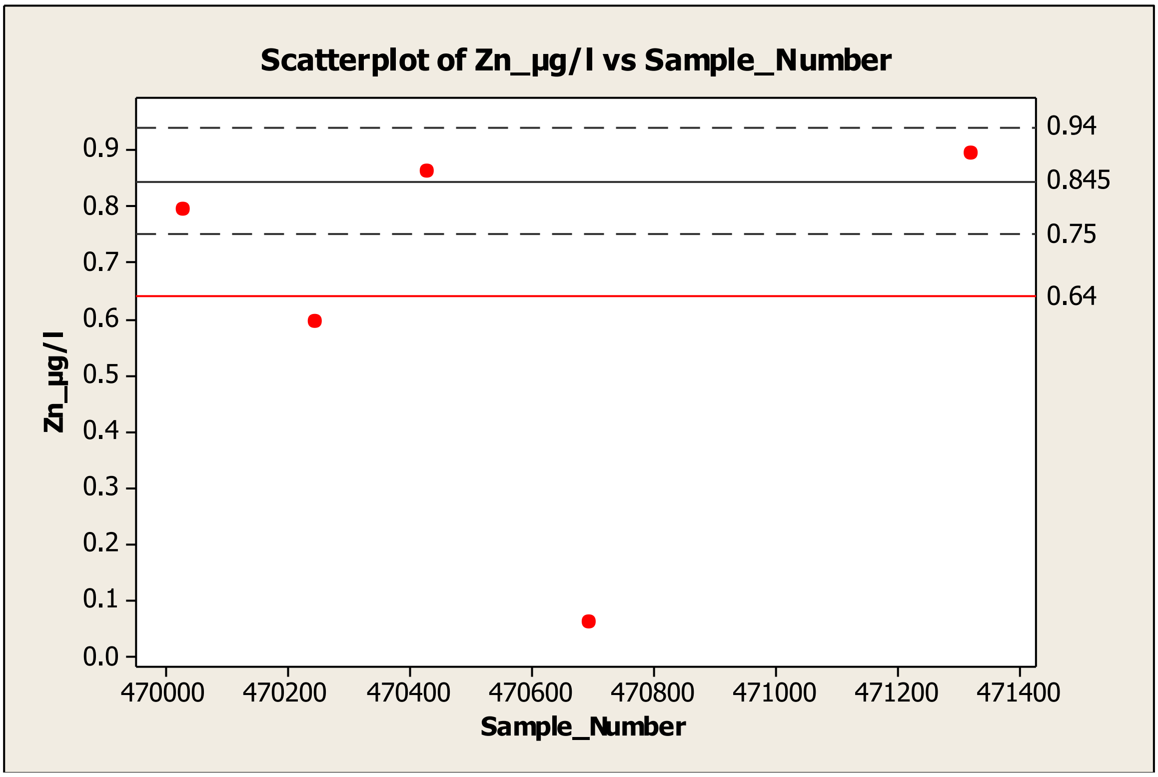


Scatterplot of Sb_µg/l vs Sample_Number
Sb_µg/l
0.31
0.30
0.29
0.28
0.27
0.26
0.3
0.288
470000
470200
470400
470600
470800
471000
471200
471400
Sample_Number


Scatterplot of Sr_µg/l vs Sample_Number
Sr_µg/l
55
54
53
52
51
50
49
48
47
46
54.9
53.6
52.3
49.62
470000
470200
470400
470600
470800
471000
471200
471400
Sample_Number

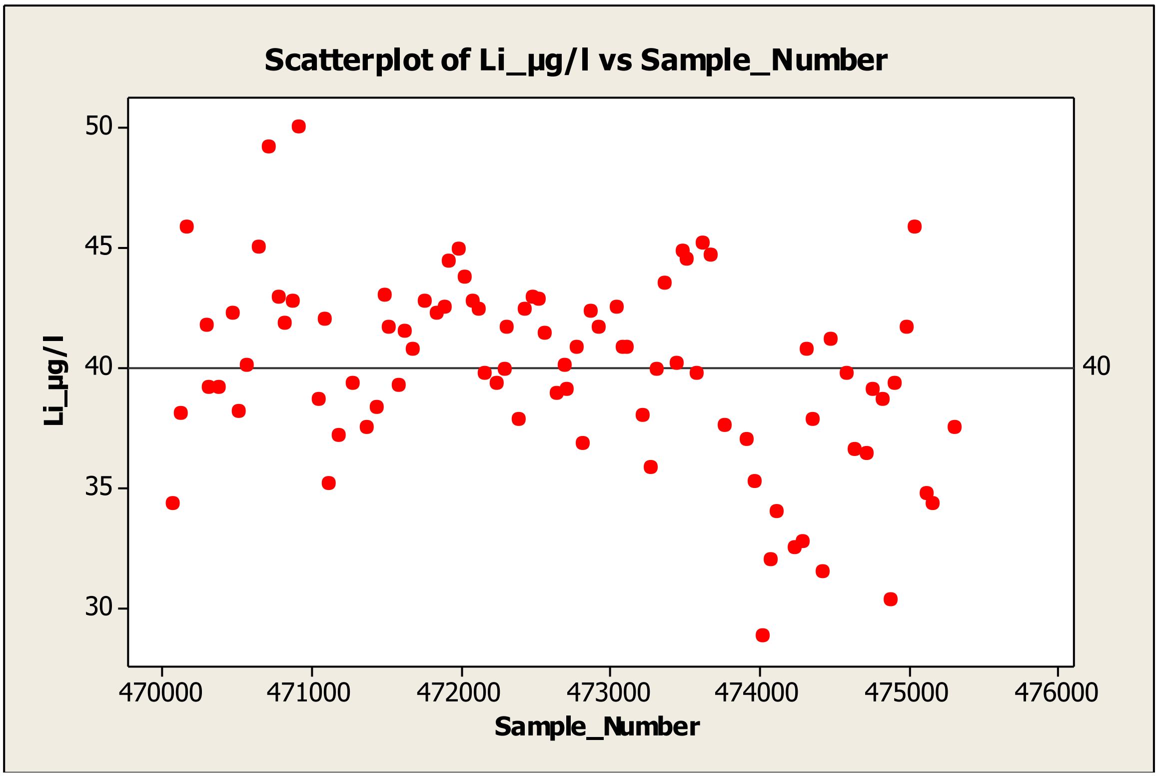

Scatterplot of U_µg/l vs Sample_Number
U_µg/l
0.100
0.095
0.090
0.085
0.099
0.093
0.09
0.087
470000
470200
470400
470600
470800
471000
471200
471400
Sample_Number

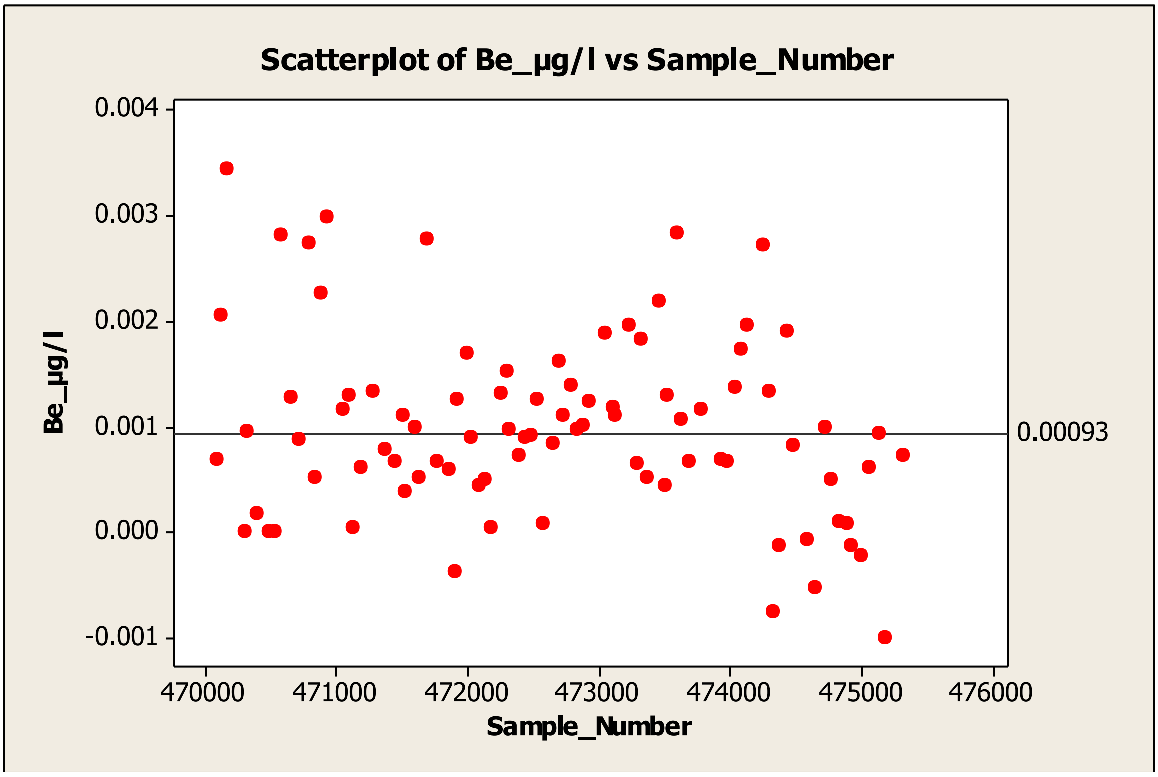


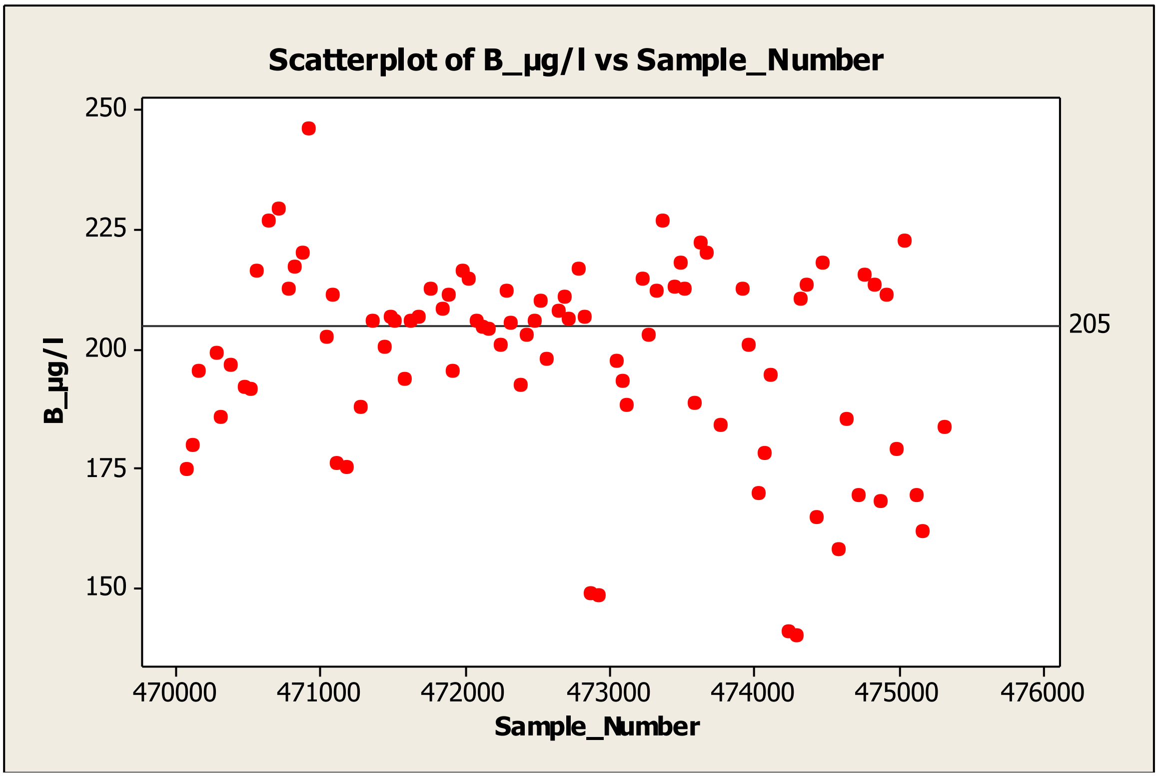


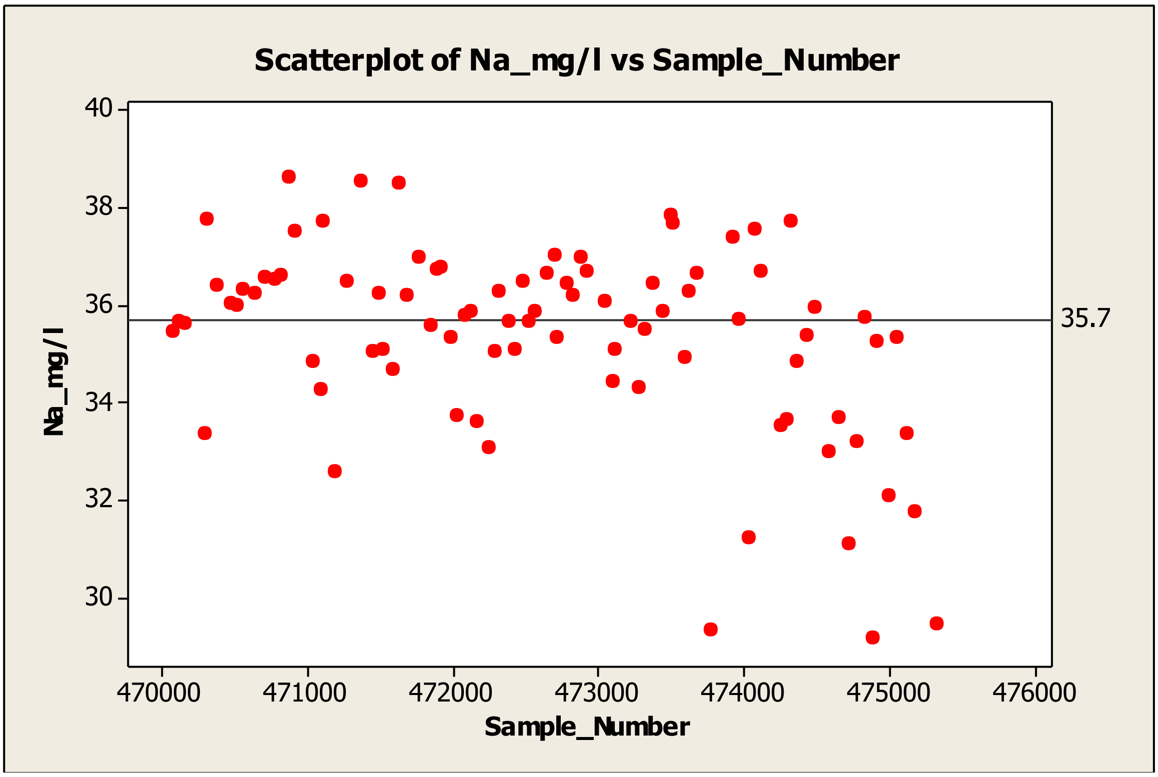
SRMs

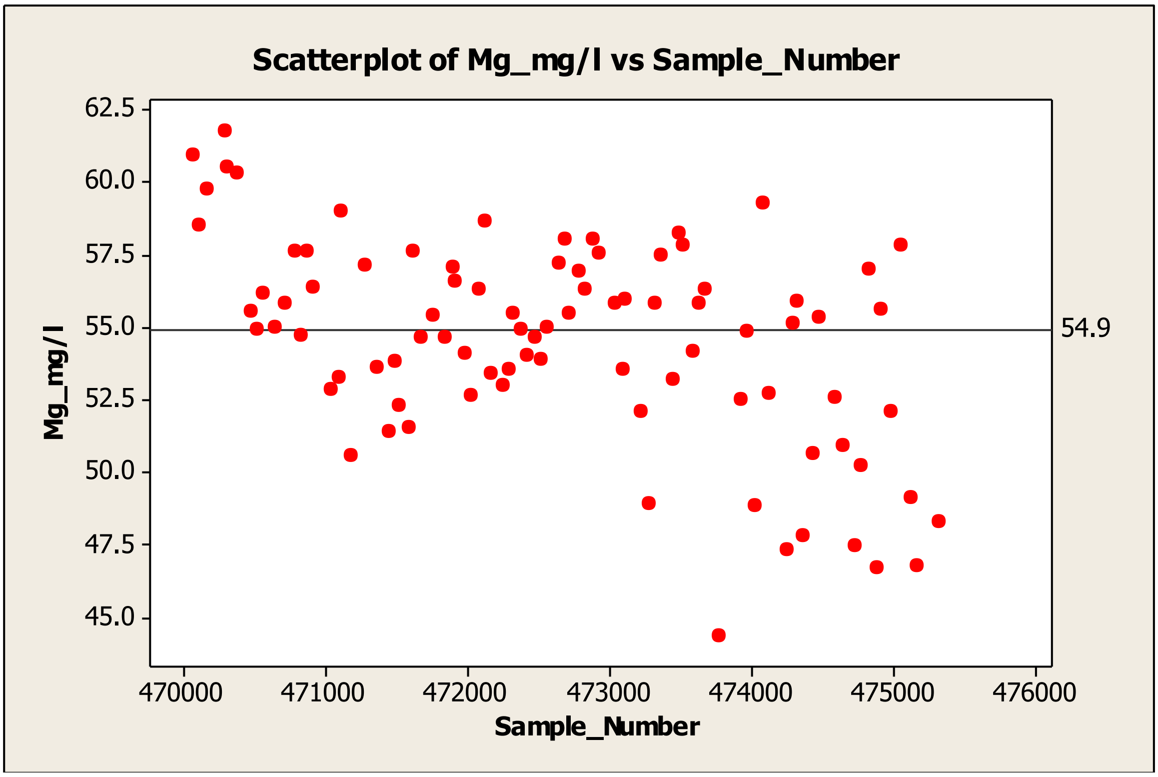
The black line represents the median value of the SRM data

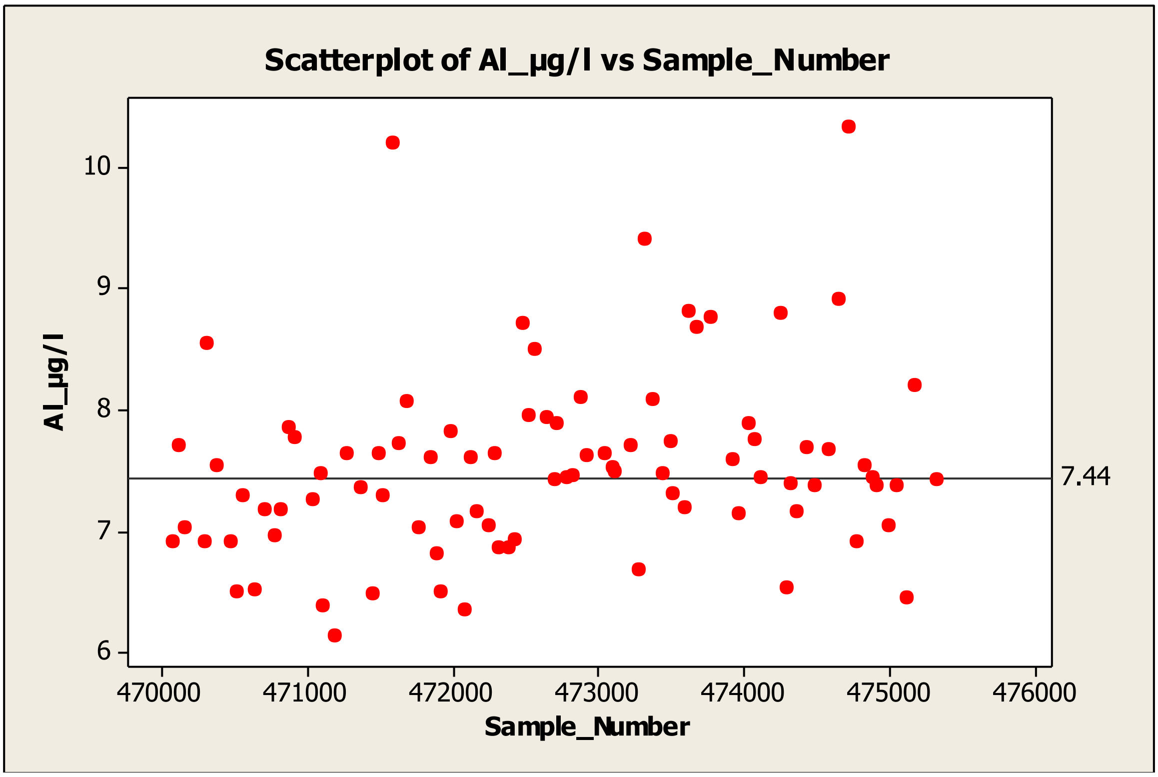

Scatterplot of Li_µg/l vs Sample_Number
Li_µg/l
50
45
40
35
30
40
470000
471000
472000
473000
474000
475000
476000
Sample_Number

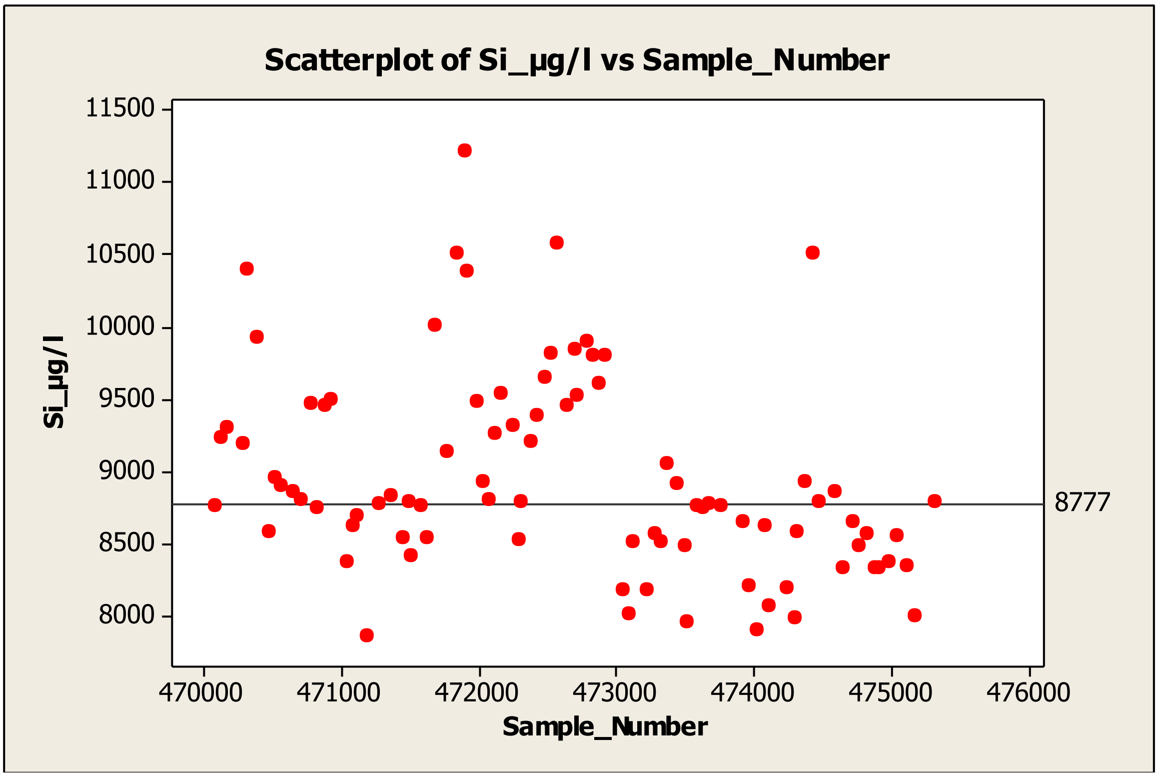

Scatterplot of Be_µg/l vs Sample_Number
Be_µg/l
0.004
0.003
0.002
0.001
0.000
-0.001
0.00093
470000
471000
472000
473000
474000
475000
476000
Sample_Number

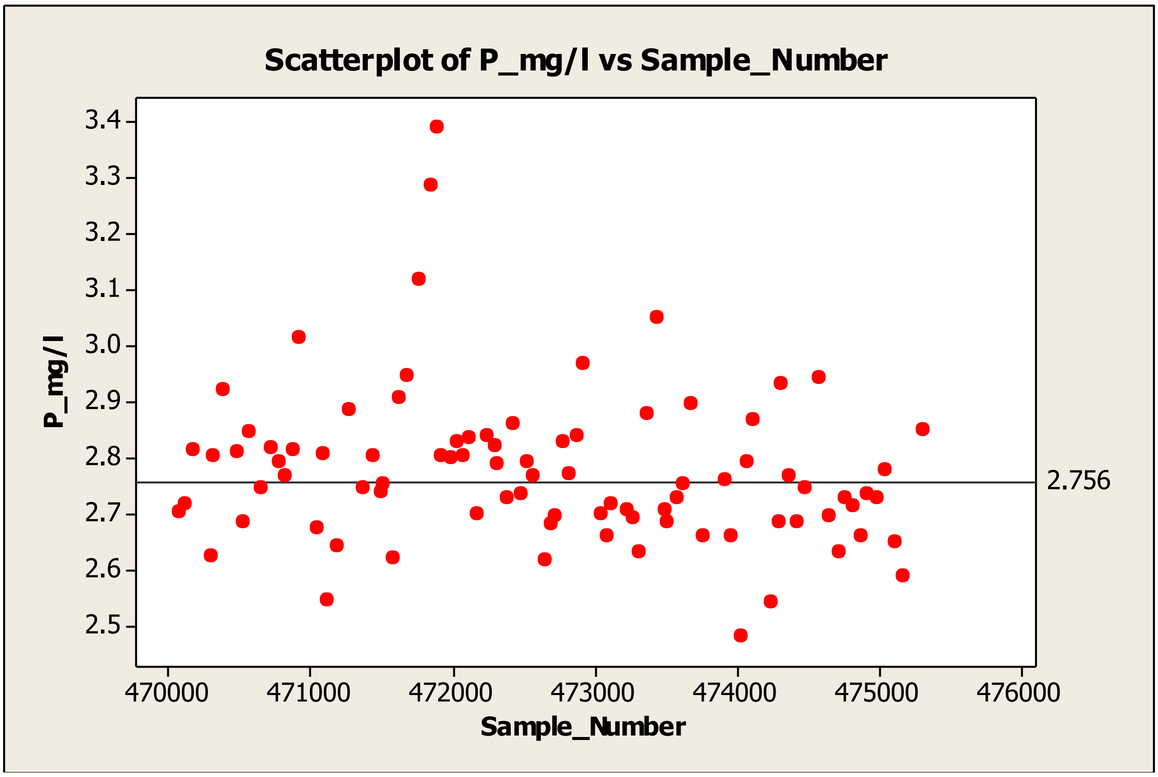

Scatterplot of B_µg/l vs Sample_Number
B_µg/l
250
225
200
175
150
205
470000
471000
472000
473000
474000
475000
476000
Sample_Number

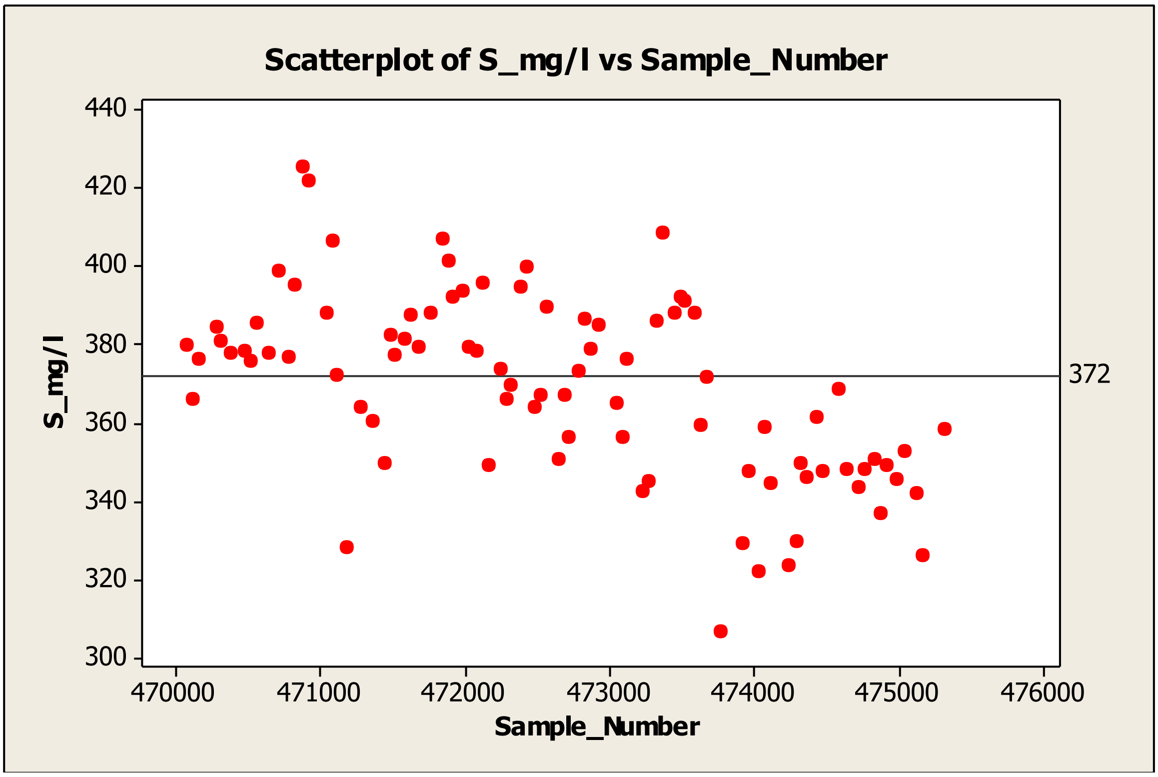

Scatterplot of Na_mg/l vs Sample_Number
Na_mg/l
40
38
36
34
32
30
35.7
470000
471000
472000
473000
474000
475000
476000
Sample_Number

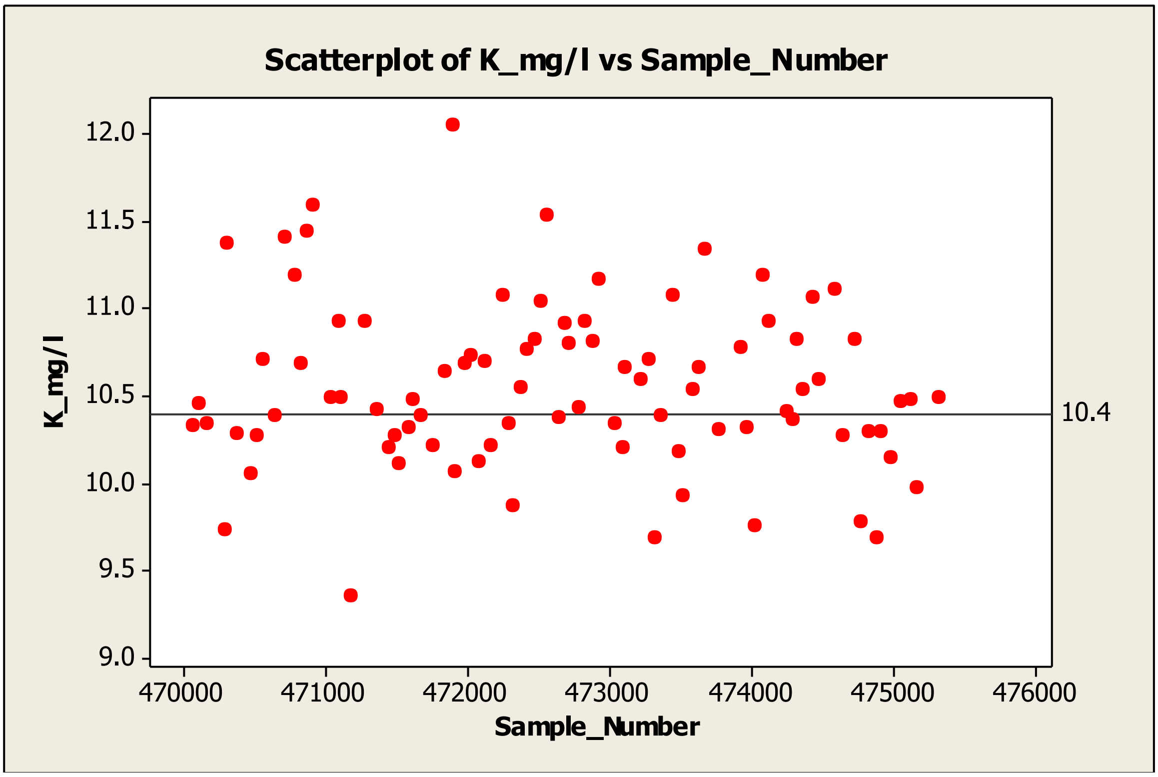

Scatterplot of Mg_mg/l vs Sample_Number
Mg_mg/l
62.5
60.0
57.5
55.0
52.5
50.0
47.5
45.0
54.9
470000
471000
472000
473000
474000
475000
476000
Sample_Number

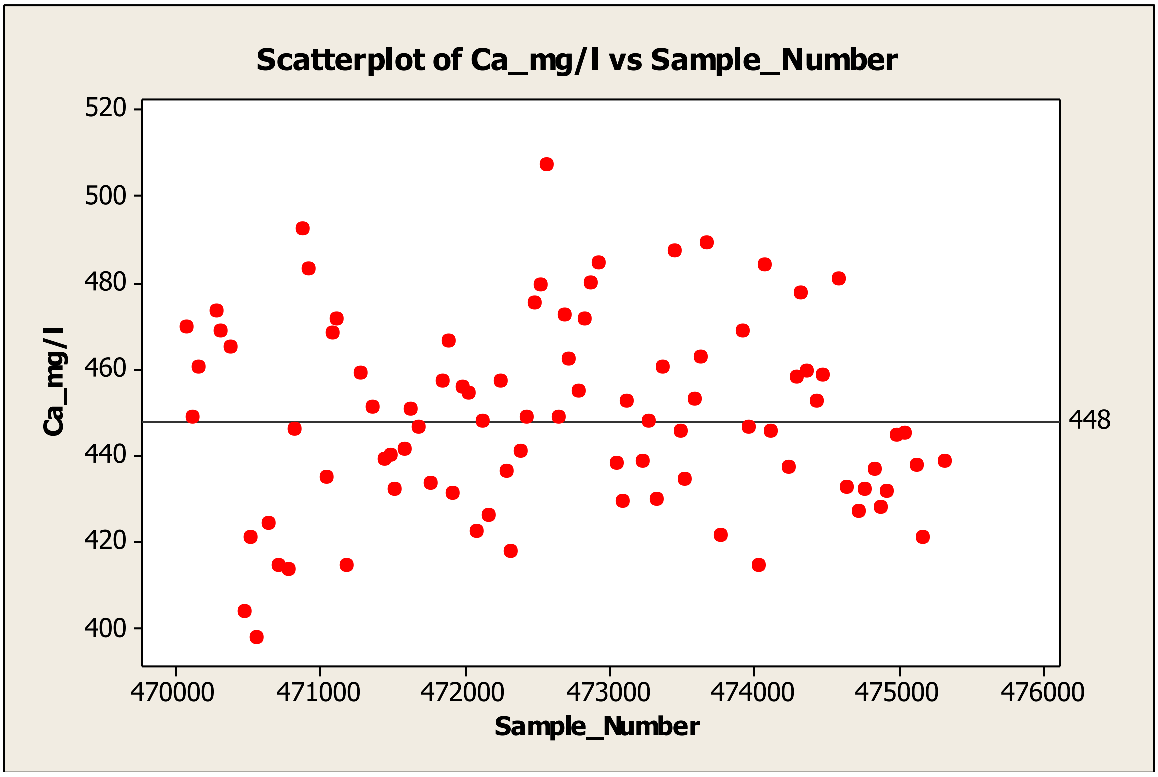

Scatterplot of Al_µg/l vs Sample_Number
Al_µg/l
10
9
8
7
6
7.44
470000
471000
472000
473000
474000
475000
476000
Sample_Number

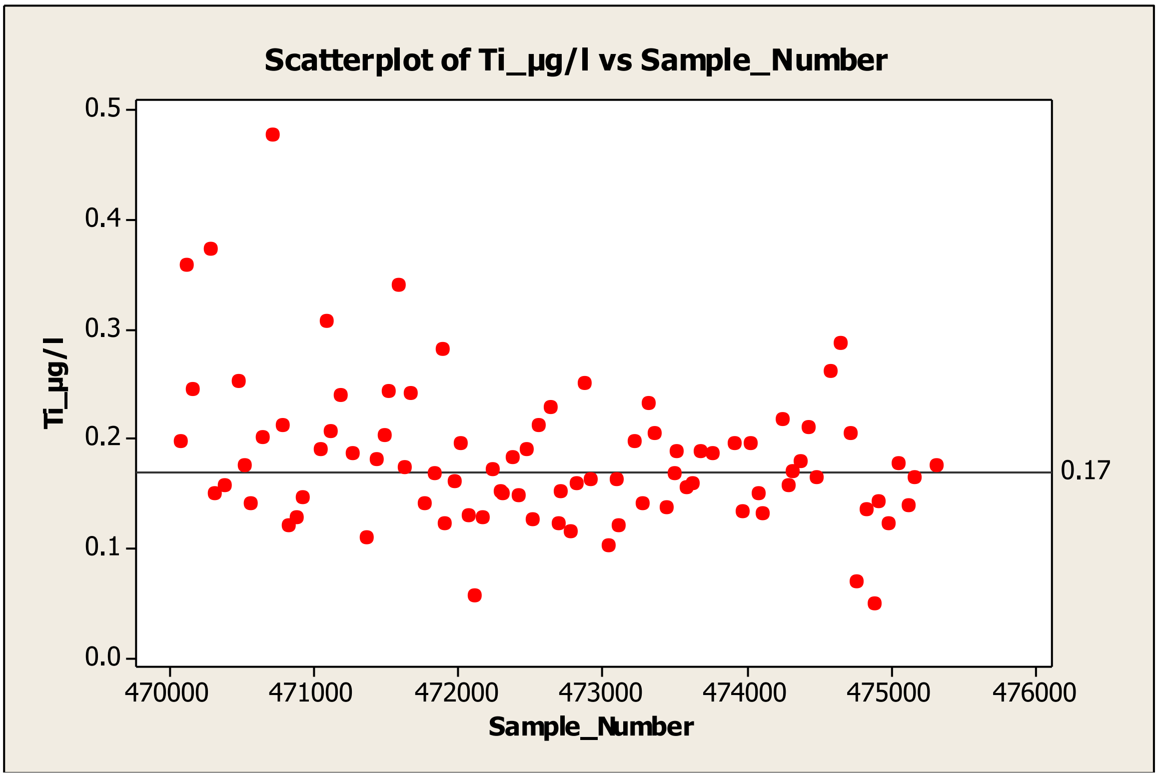

Scatterplot of Si_µg/l vs Sample_Number
Si_µg/l
11500
11000
10500
10000
9500
9000
8500
8000
8777
470000
471000
472000
473000
474000
475000
476000
Sample_Number

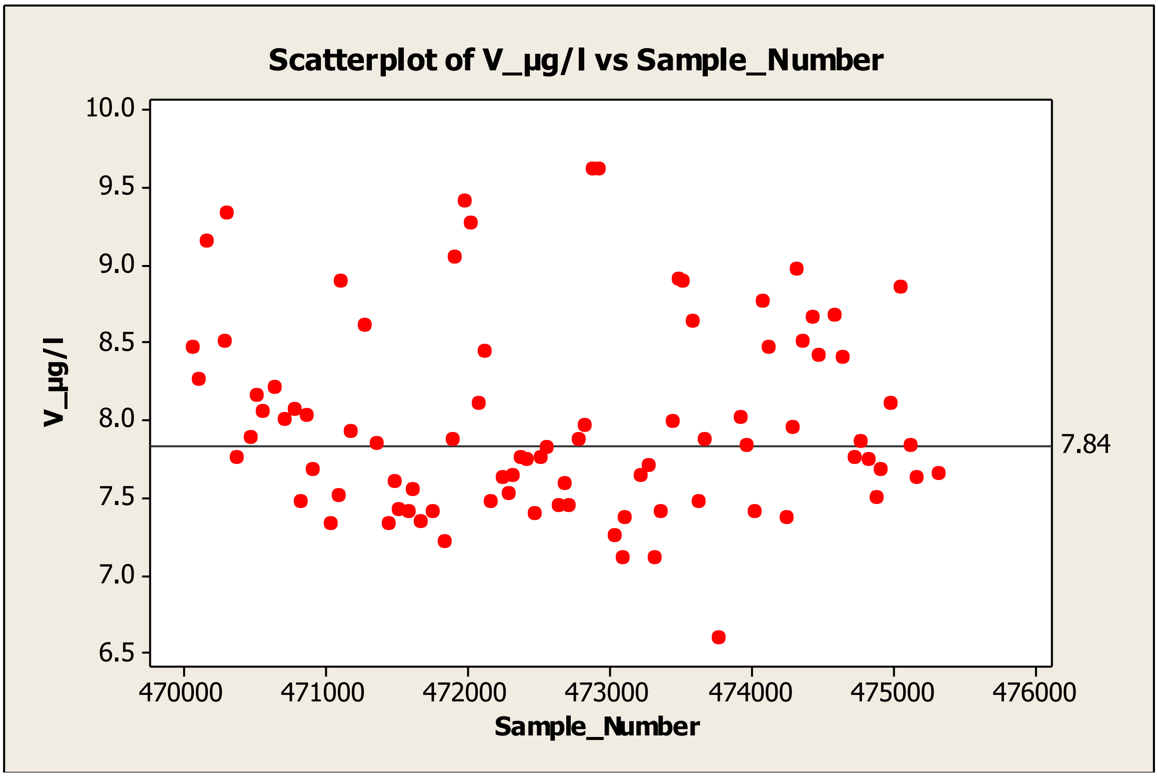

Scatterplot of P_mg/l vs Sample_Number
P_mg/l
3.4
3.3
3.2
3.1
3.0
2.9
2.8
2.7
2.6
2.5
2.756
470000
471000
472000
473000
474000
475000
476000
Sample_Number

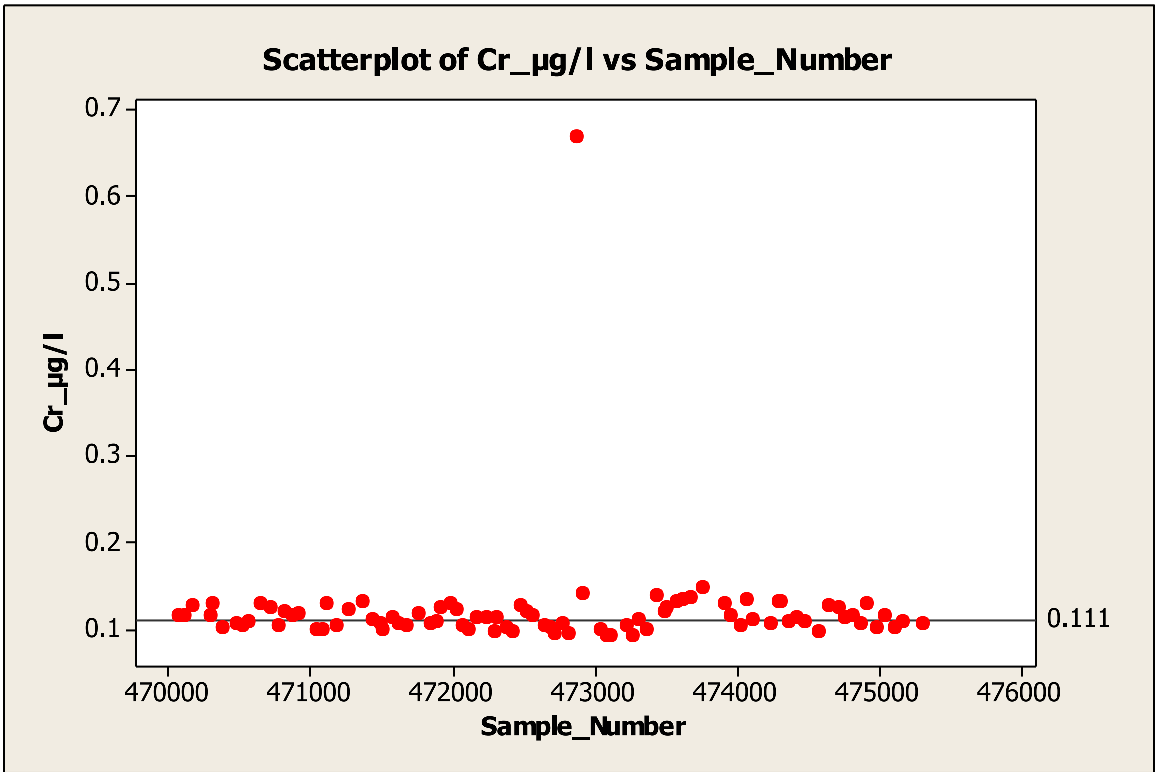

Scatterplot of S_mg/l vs Sample_Number
S_mg/l
440
420
400
380
360
340
320
300
372
470000
471000
472000
473000
474000
475000
476000
Sample_Number

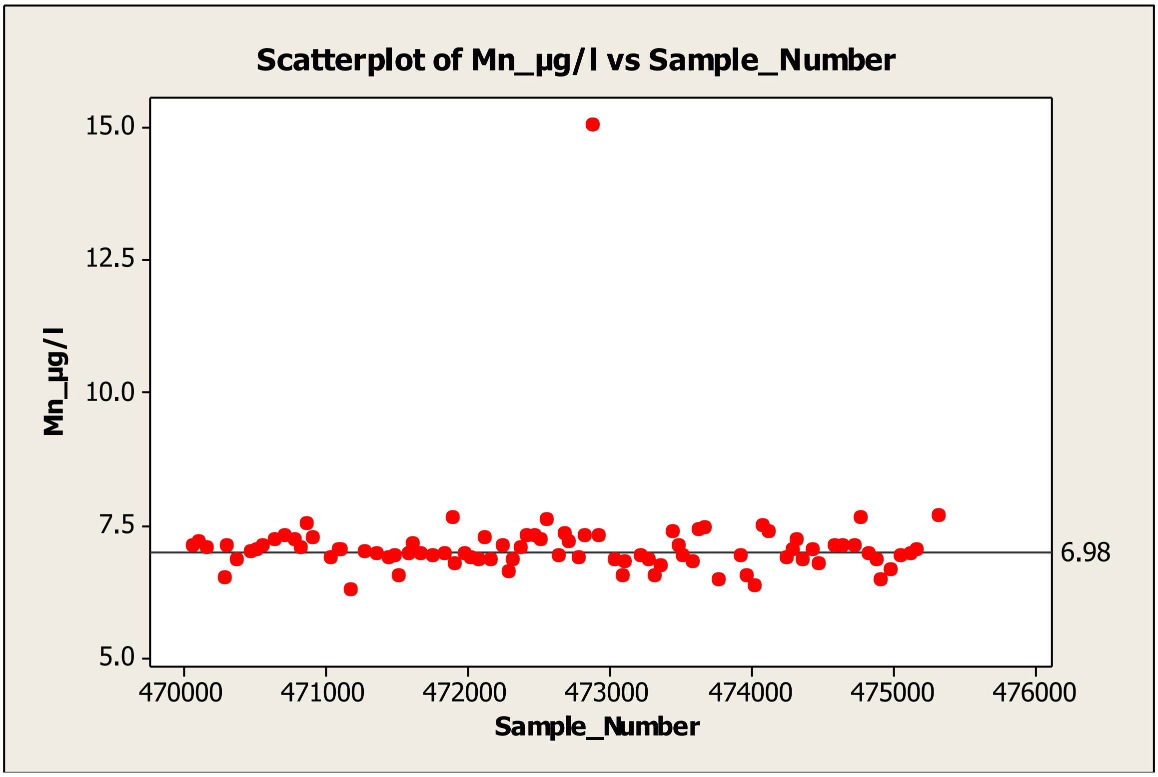

Scatterplot of K_mg/l vs Sample_Number
K_mg/l
12.0
11.5
11.0
10.5
10.0
9.5
9.0
10.4
470000
471000
472000
473000
474000
475000
476000
Sample_Number

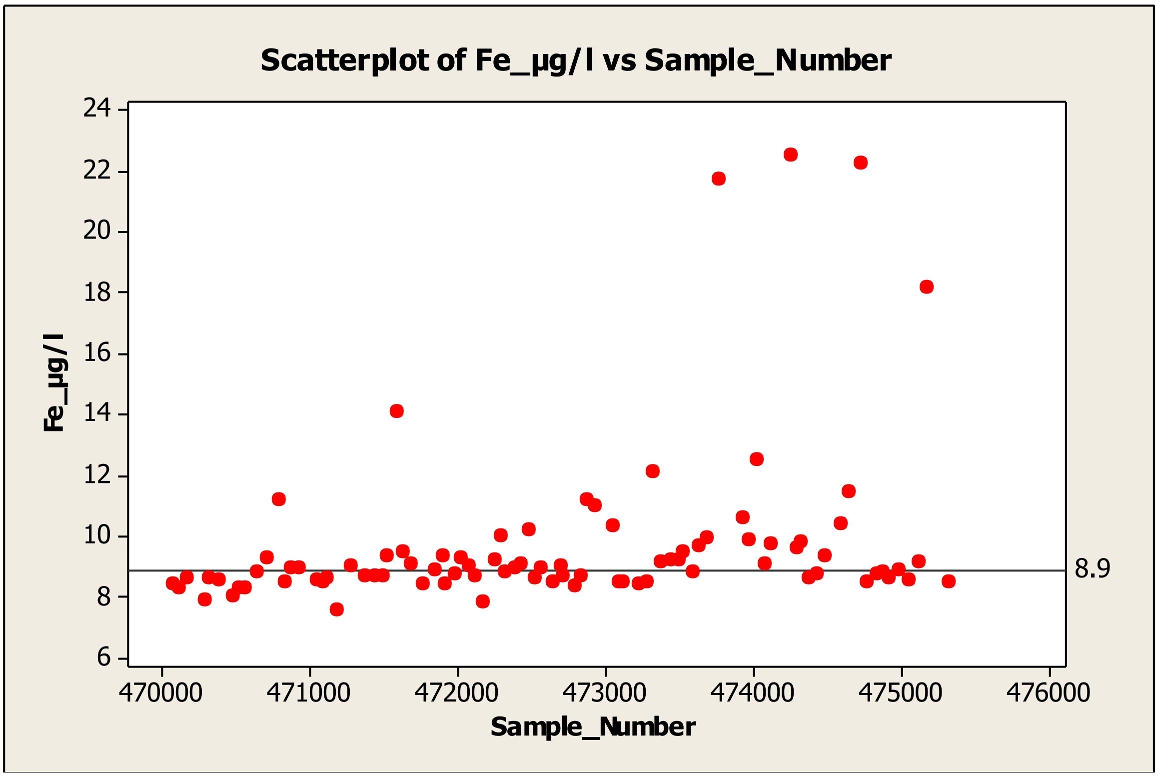

Scatterplot of Ca_mg/l vs Sample_Number
Ca_mg/l
520
500
480
460
440
420
400
448
470000
471000
472000
473000
474000
475000
476000
Sample_Number

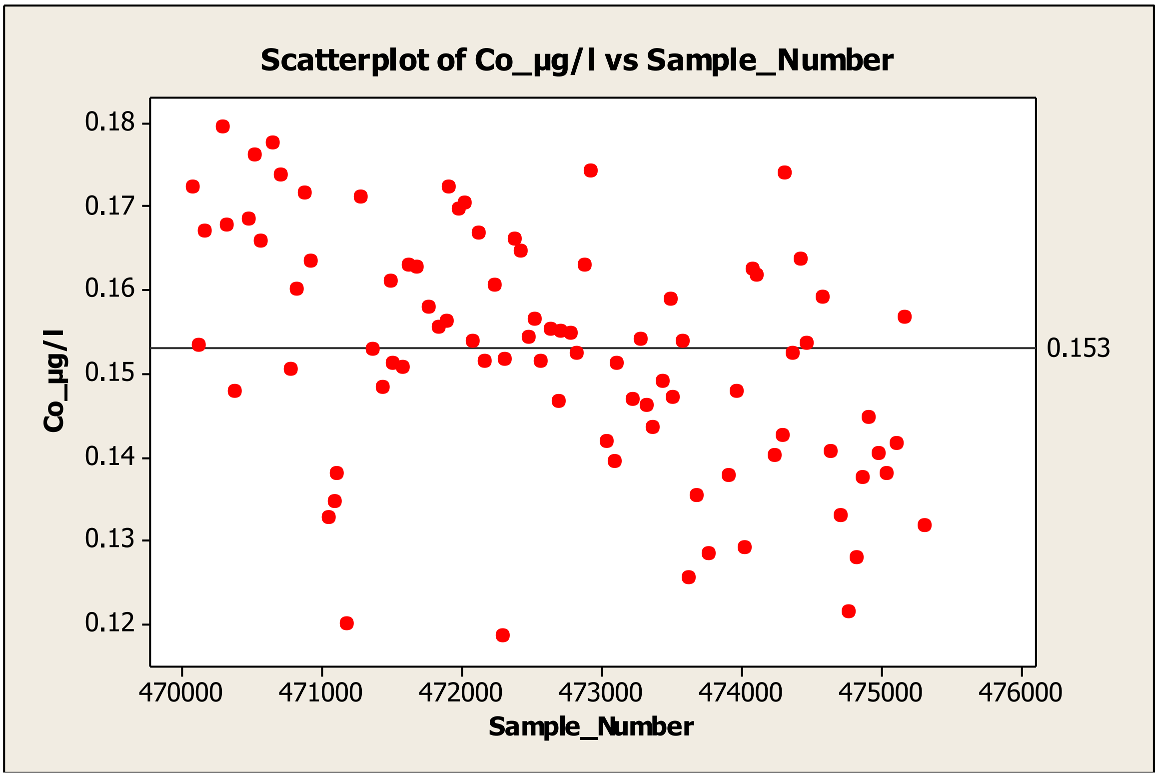

Scatterplot of Ti_µg/l vs Sample_Number
Ti_µg/l
0.5
0.4
0.3
0.2
0.1
0.0
0.17
470000
471000
472000
473000
474000
475000
476000
Sample_Number


Scatterplot of V_µg/l vs Sample_Number
V_µg/l
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
7.84
470000
471000
472000
473000
474000
475000
476000
Sample_Number

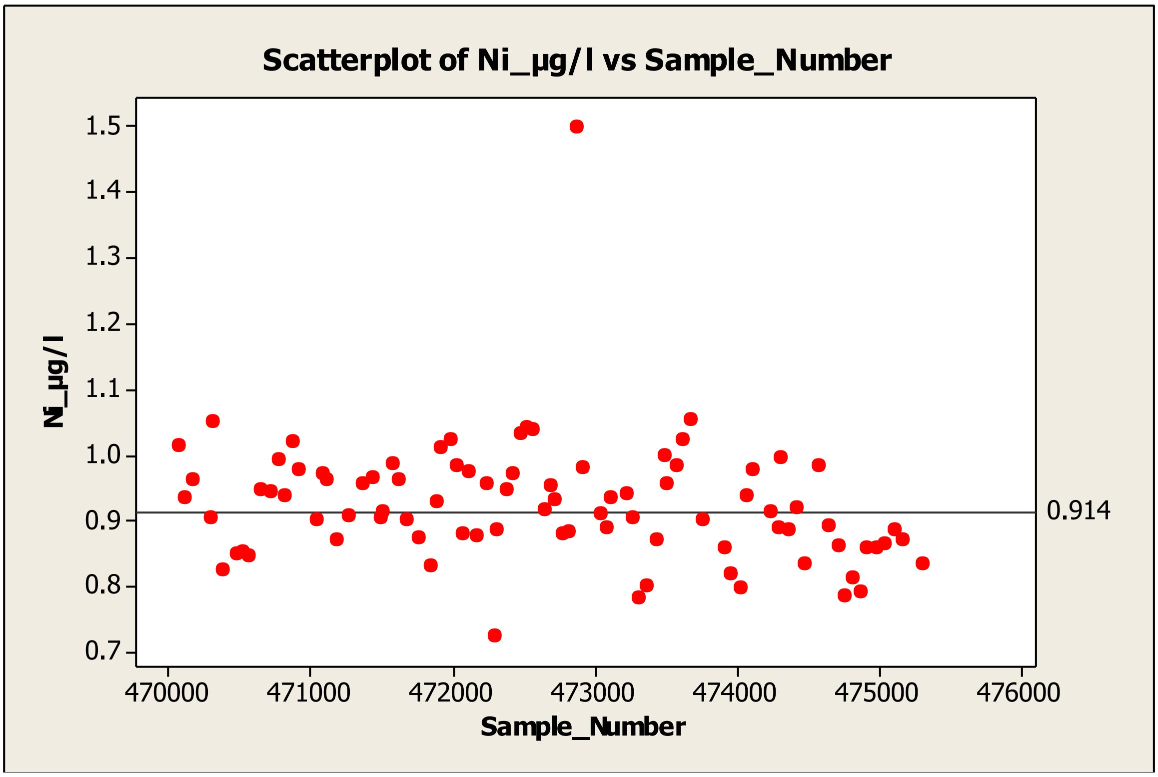

Scatterplot of Cr_µg/l vs Sample_Number
Cr_µg/l
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.111
470000
471000
472000
473000
474000
475000
476000
Sample_Number


Scatterplot of Mn_µg/l vs Sample_Number
Mn_µg/l
15.0
12.5
10.0
7.5
5.0
6.98
470000
471000
472000
473000
474000
475000
476000
Sample_Number

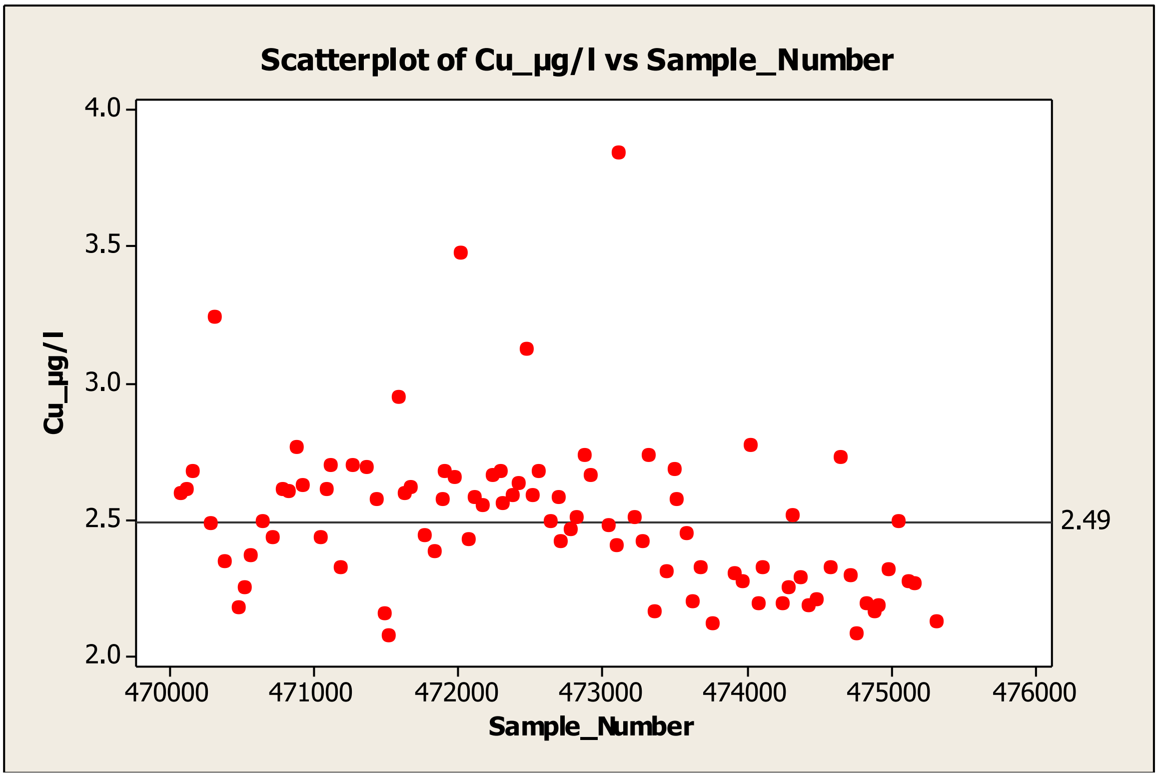

Scatterplot of Fe_µg/l vs Sample_Number
Fe_µg/l
24
22
20
18
16
14
12
10
8
6
8.9
470000
471000
472000
473000
474000
475000
476000
Sample_Number

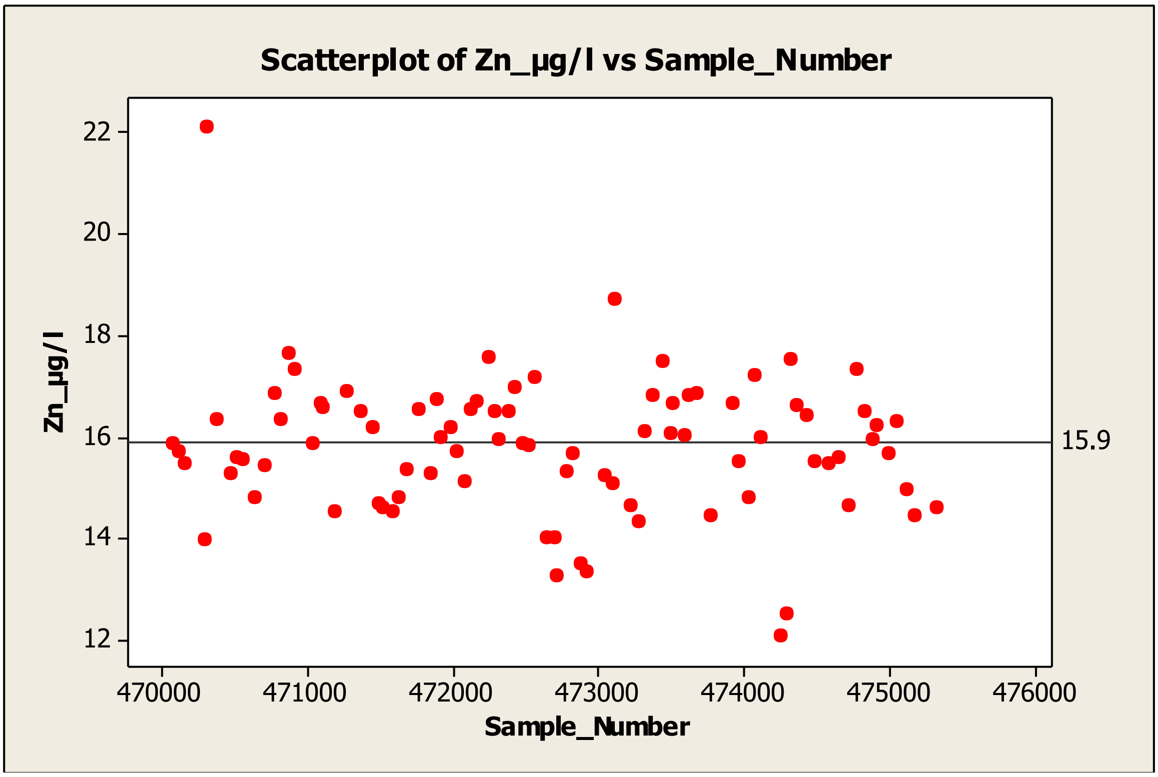


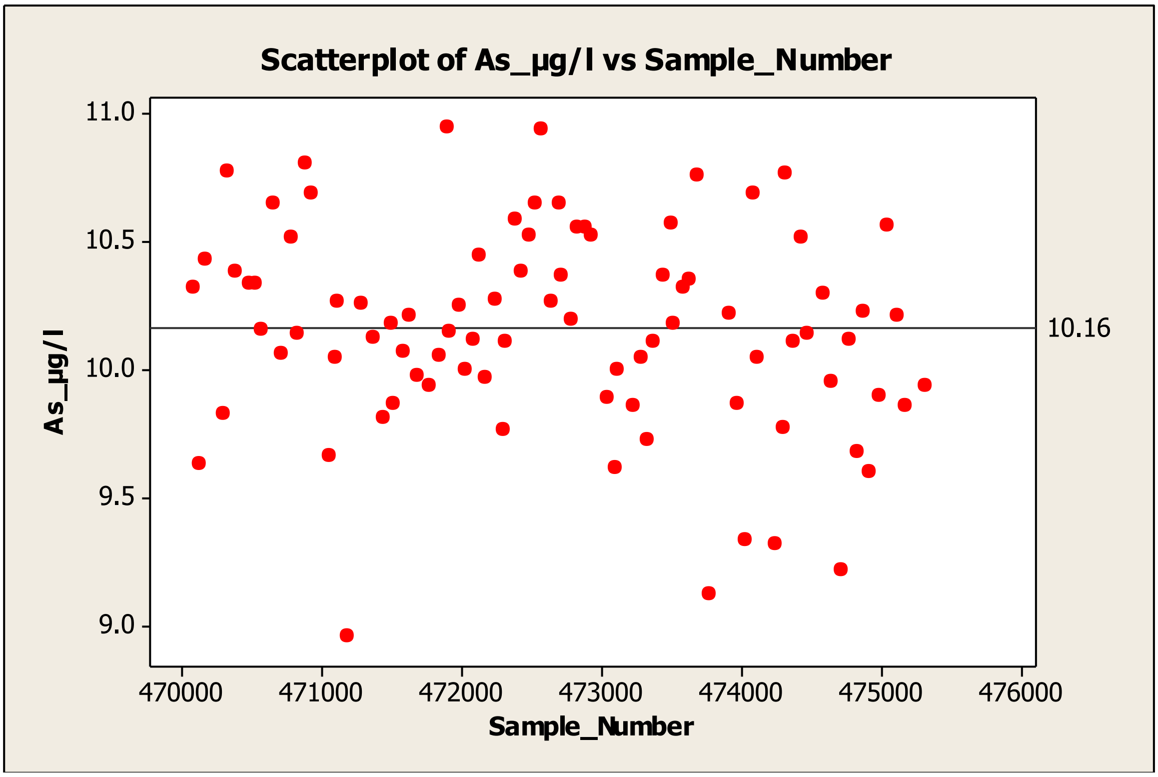
Scatterplot of Co_µg/l vs Sample_Number
Co_µg/l
0.18
0.17
0.16
0.15
0.14
0.13
0.12
0.153
470000
471000
472000
473000
474000
475000
476000
Sample_Number



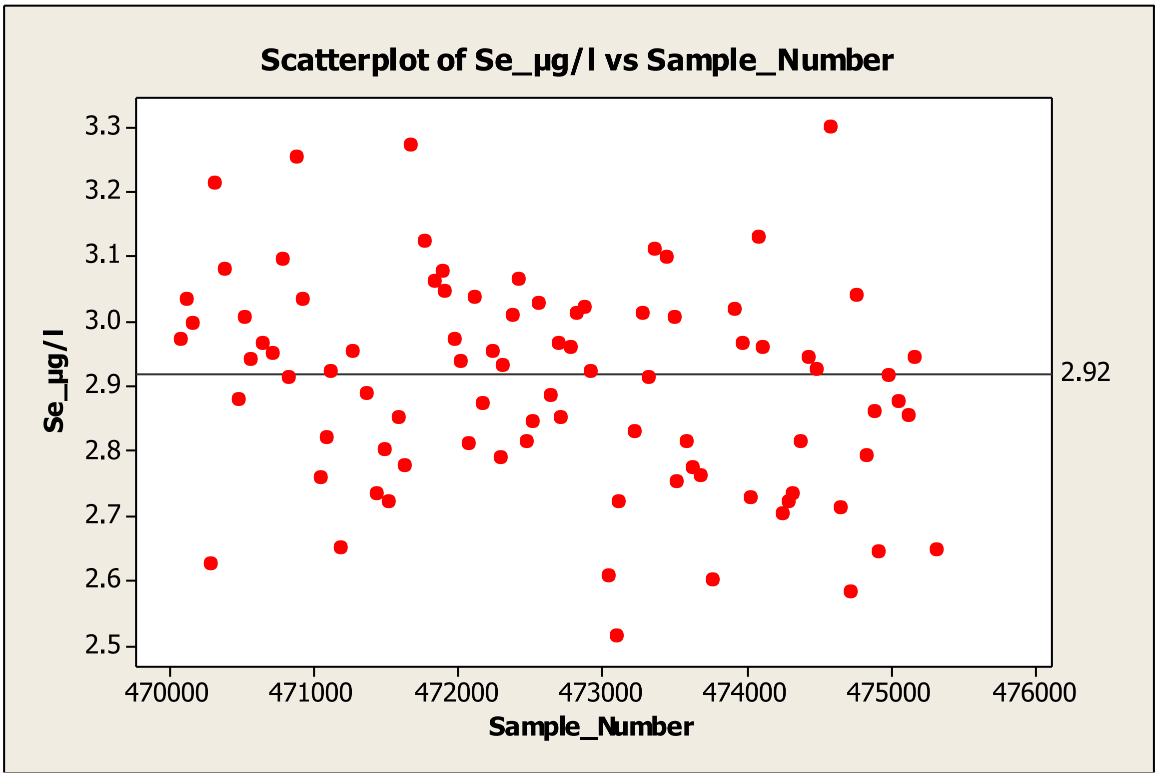
Scatterplot of Ni_µg/l vs Sample_Number
Ni_µg/l
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.914
470000
471000
472000
473000
474000
475000
476000
Sample_Number


Scatterplot of Cu_µg/l vs Sample_Number
Cu_µg/l
4.0
3.5
3.0
2.5
2.0
2.49
470000
471000
472000
473000
474000
475000
476000
Sample_Number

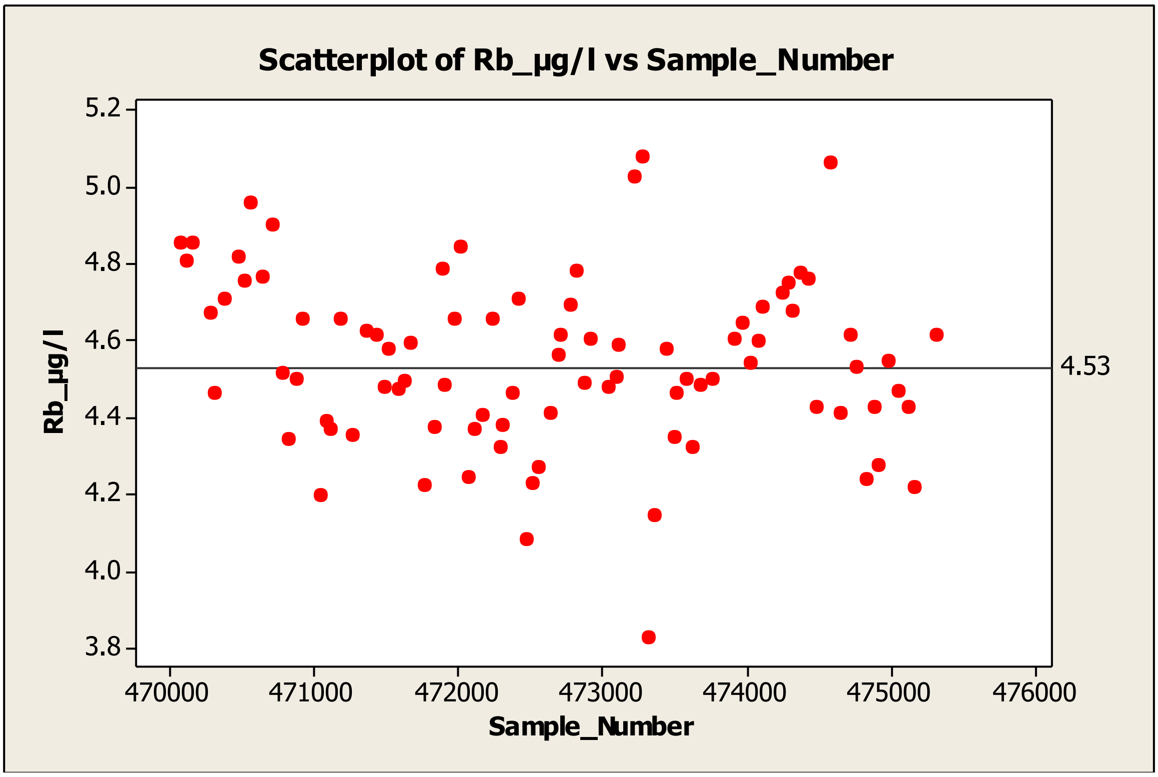

Scatterplot of Zn_µg/l vs Sample_Number
Zn_µg/l
22
20
18
16
14
12
15.9
470000
471000
472000
473000
474000
475000
476000
Sample_Number

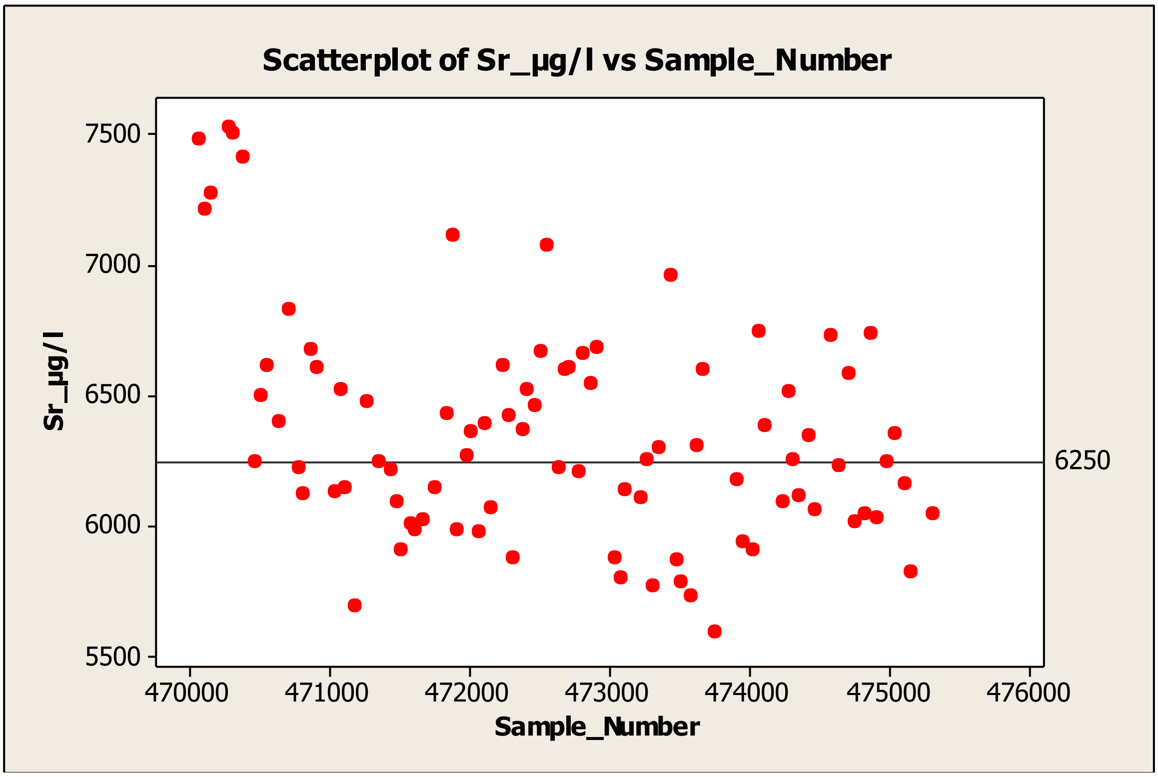


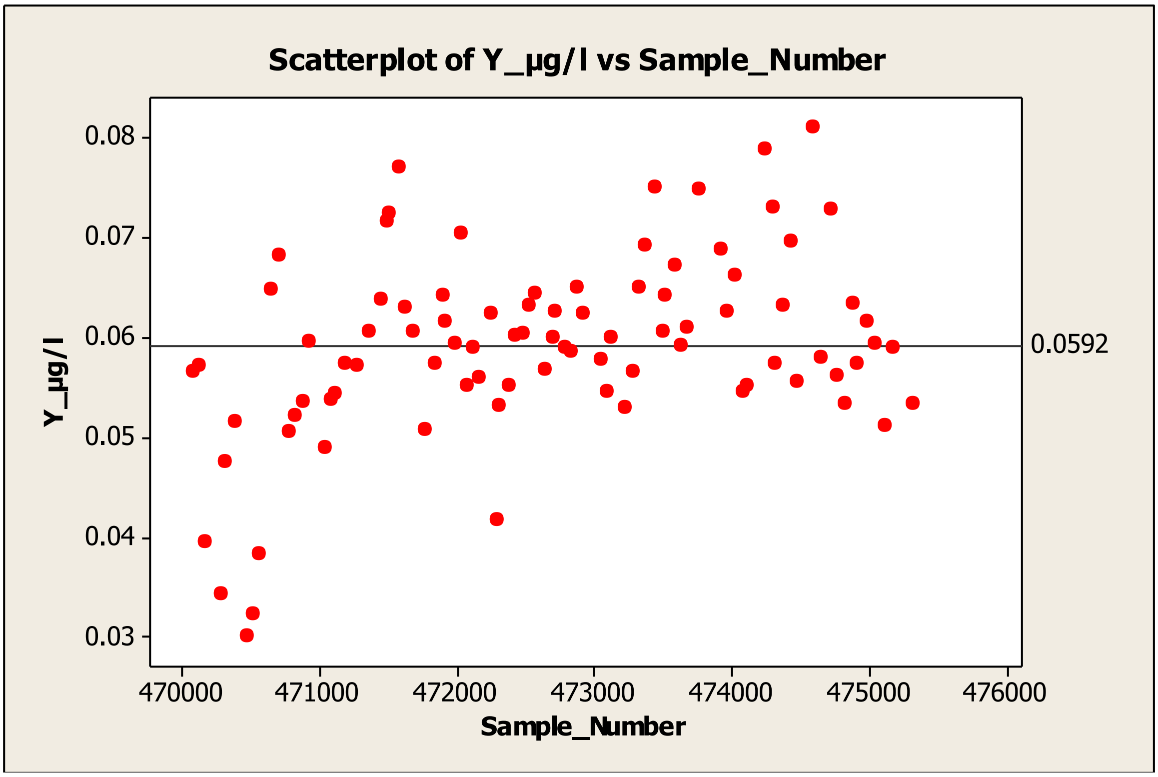
Scatterplot of As_µg/l vs Sample_Number
As_µg/l
11.0
10.5
10.0
9.5
9.0
10.16
470000
471000
472000
473000
474000
475000
476000
Sample_Number

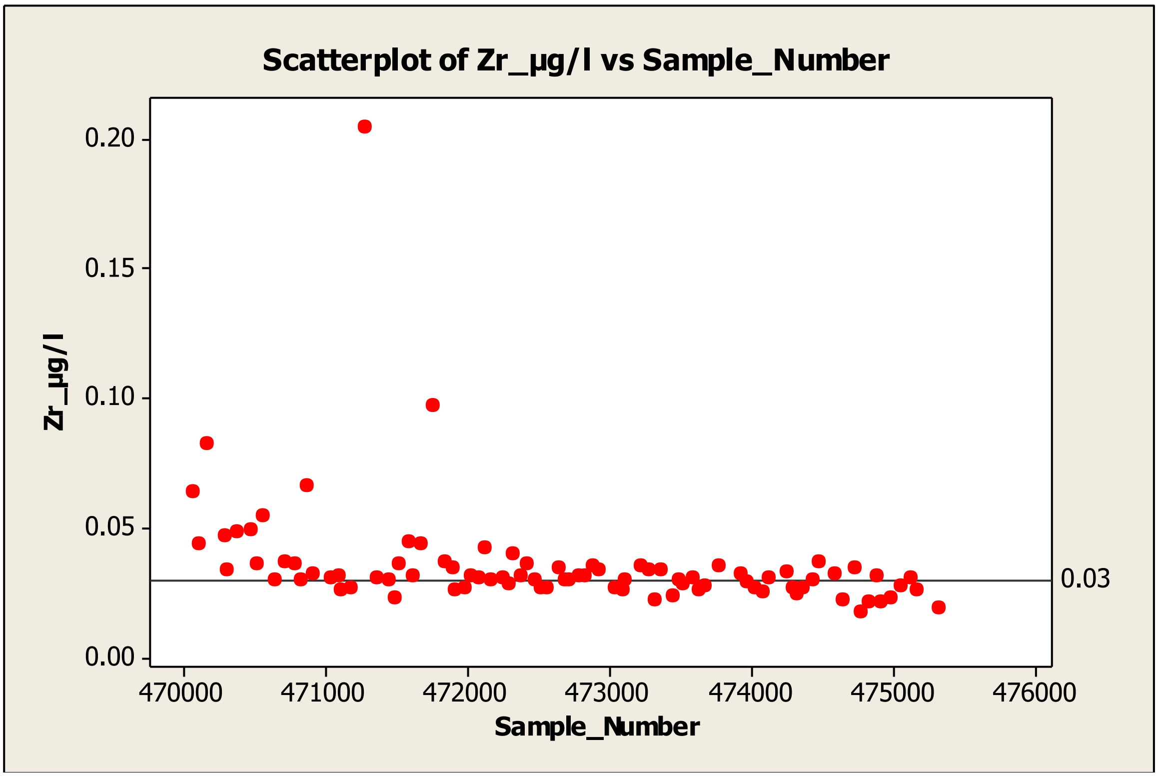


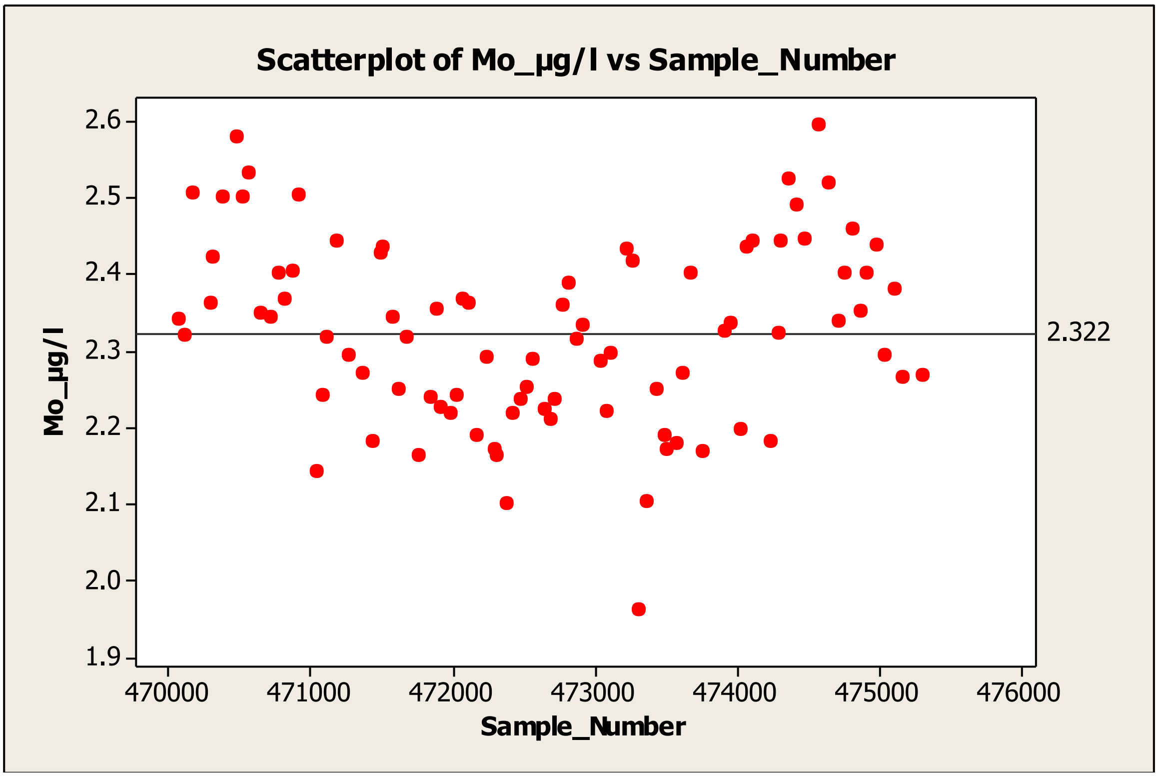
Scatterplot of Se_µg/l vs Sample_Number
Se_µg/l
3.3
3.2
3.1
3.0
2.9
2.8
2.7
2.6
2.5
2.92
470000
471000
472000
473000
474000
475000
476000
Sample_Number

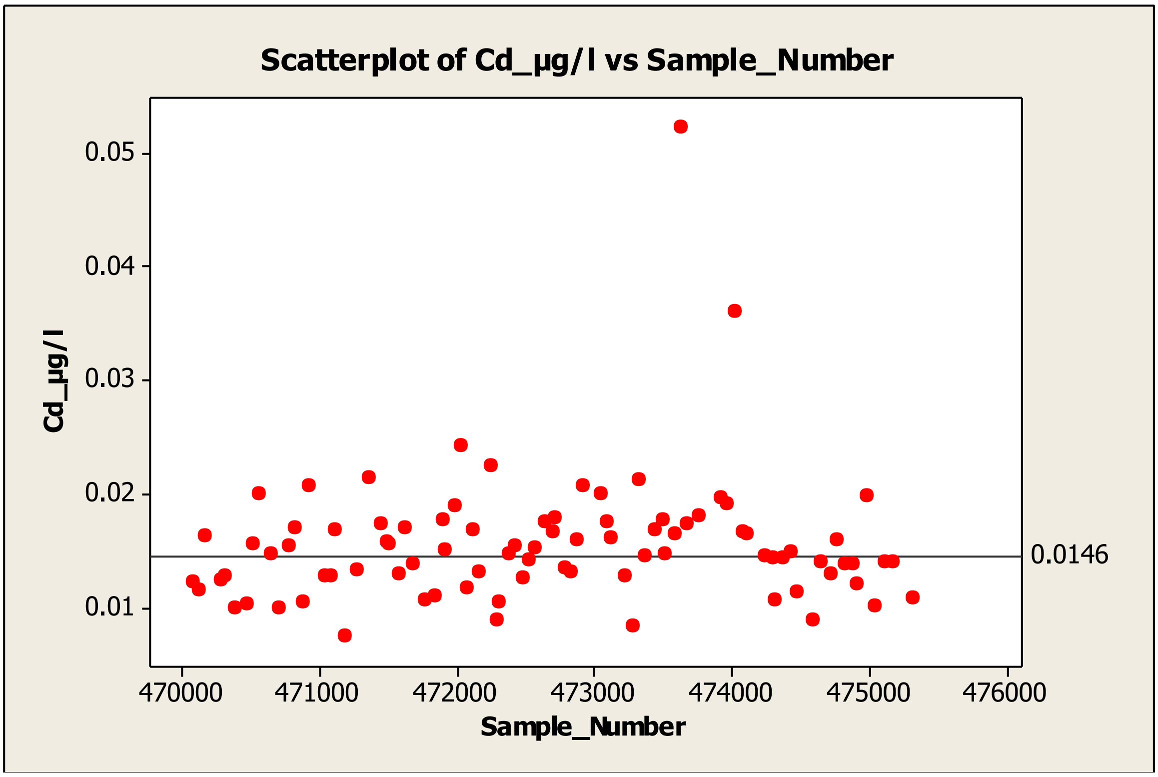

Scatterplot of Rb_µg/l vs Sample_Number
5.2
5.0
4.8
4.6
4.4
4.2
4.0
3.8
Rb_µg/l
4.53
470000
471000
472000
473000
474000
475000
476000
Sample_Number

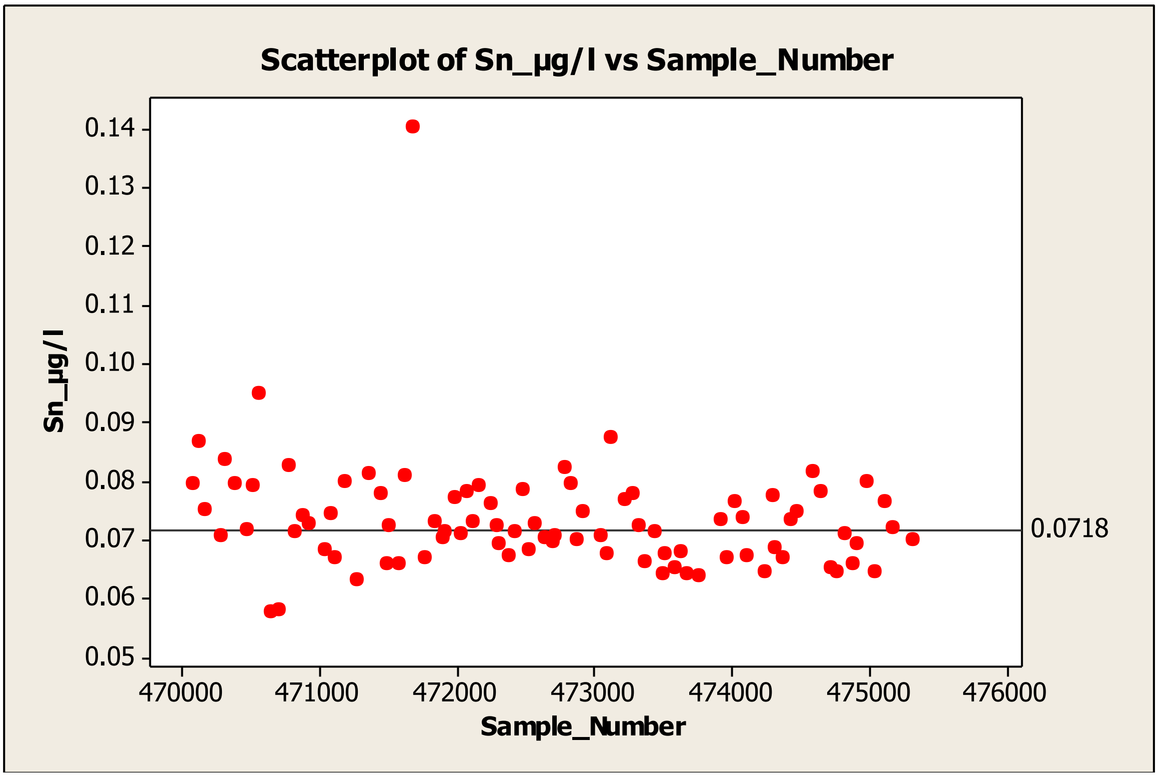

Scatterplot of Sr_µg/l vs Sample_Number
7500
7000
6500
6000
5500
Sr_µg/l
6250
470000
471000
472000
473000
474000
475000
476000
Sample_Number

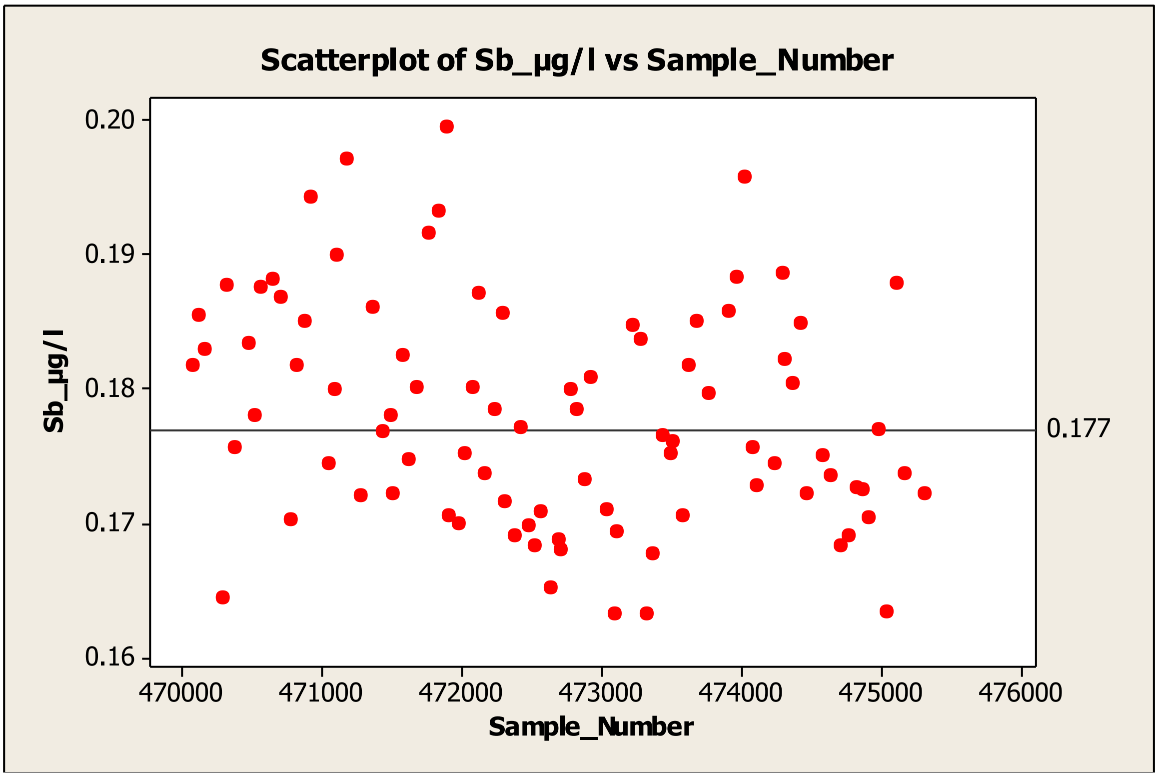

Scatterplot of Y_µg/l vs Sample_Number
0.08
0.07
0.06
0.05
0.04
0.03
Y_µg/l
0.0592
470000
471000
472000
473000
474000
475000
476000
Sample_Number

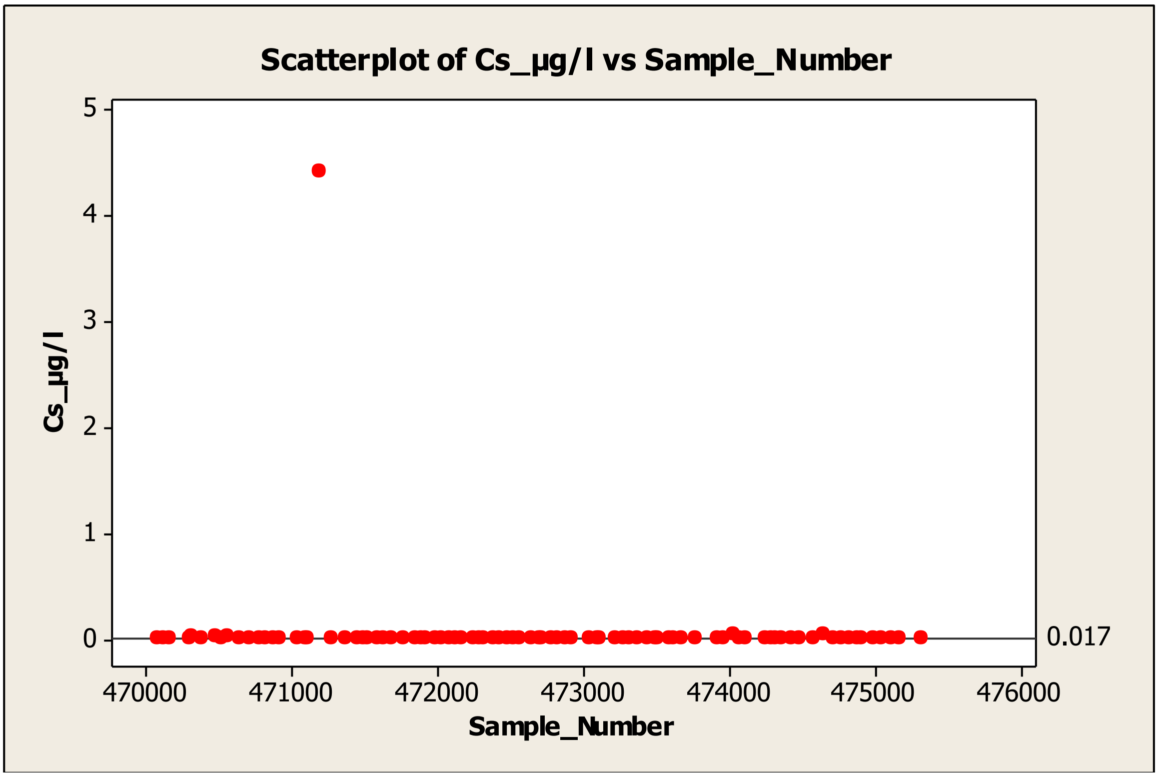

Scatterplot of Zr_µg/l vs Sample_Number
0.20
0.15
0.10
0.05
0.00
Zr_µg/l
0.03
470000
471000
472000
473000
474000
475000
476000
Sample_Number


Scatterplot of Mo_µg/l vs Sample_Number
Mo_µg/l
Sample_Number
2.322
2.6
2.5
2.4
2.3
2.2
2.1
2.0
1.9
470000
471000
472000
473000
474000
475000
476000

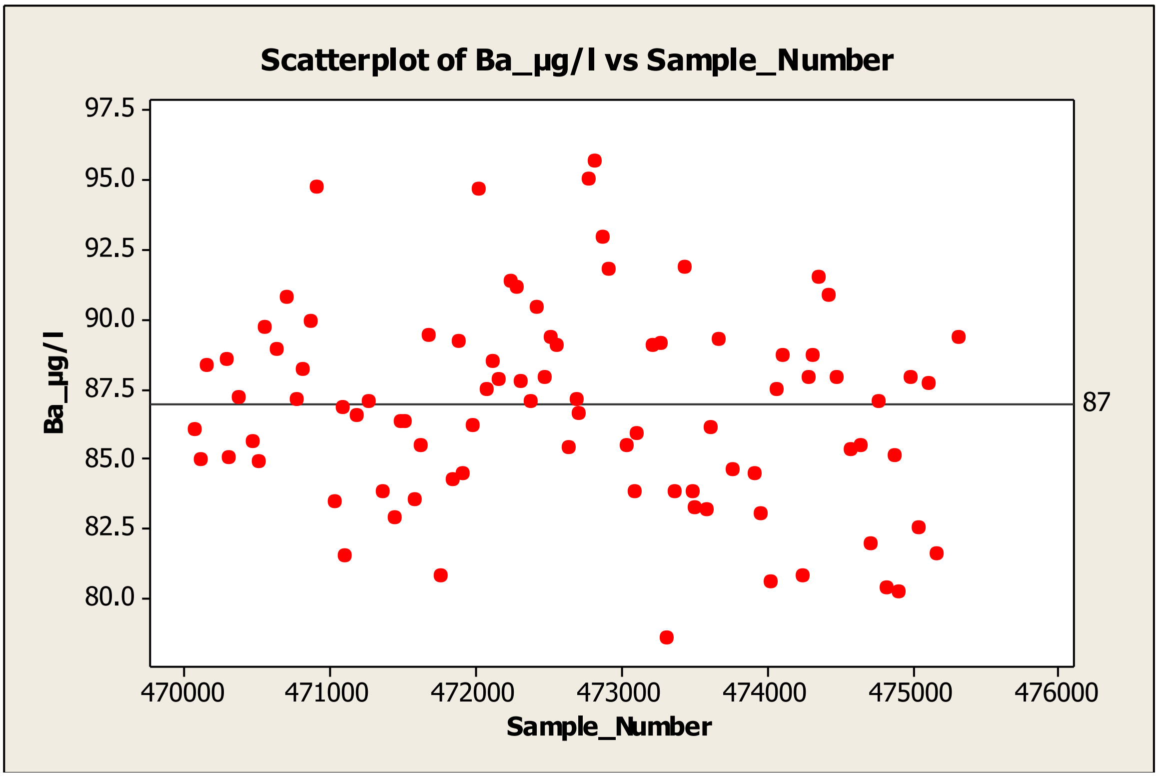

Scatterplot of Cd_µg/l vs Sample_Number
Cd_µg/l
Sample_Number
0.0146
0.05
0.04
0.03
0.02
0.01
470000
471000
472000
473000
474000
475000
476000


Scatterplot of Sn_µg/l vs Sample_Number
Sn_µg/l
0.14
0.13
0.12
0.11
0.10
0.09
0.08
0.07
0.06
0.05
0.0718
470000
471000
472000
473000
474000
475000
476000
Sample_Number

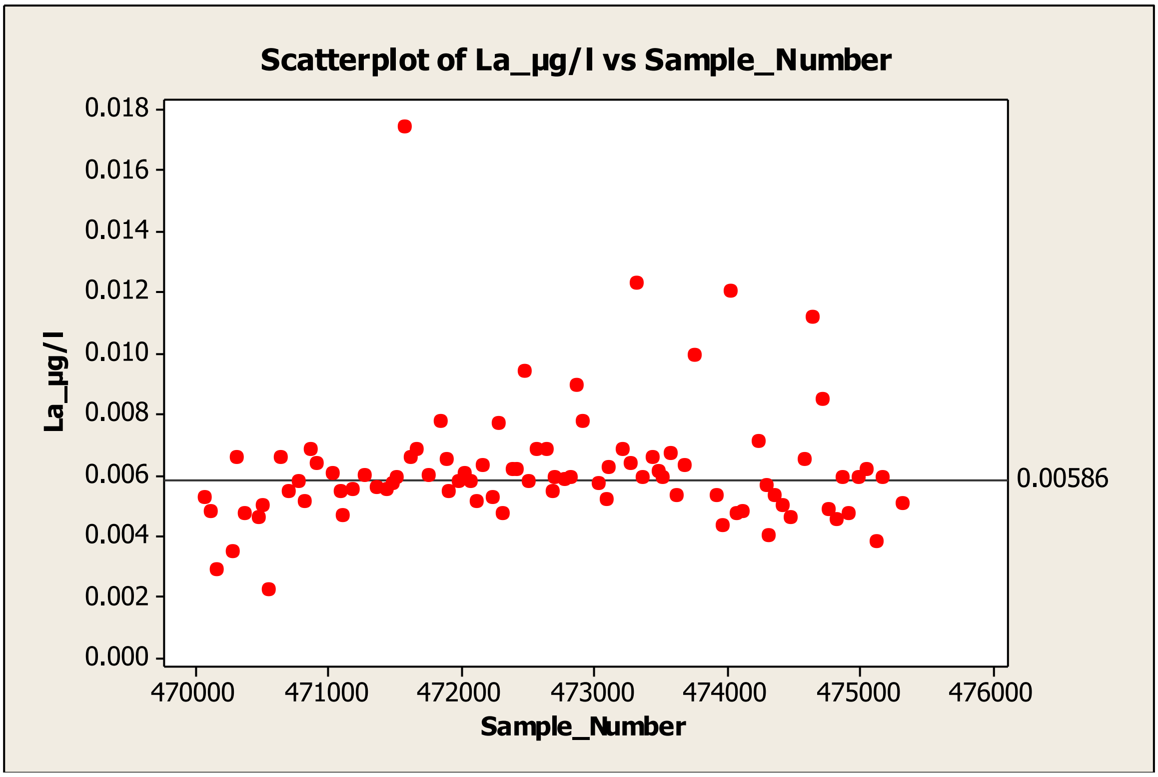

Scatterplot of Sb_µg/l vs Sample_Number
Sb_µg/l
0.20
0.19
0.18
0.17
0.16
0.177
470000
471000
472000
473000
474000
475000
476000
Sample_Number

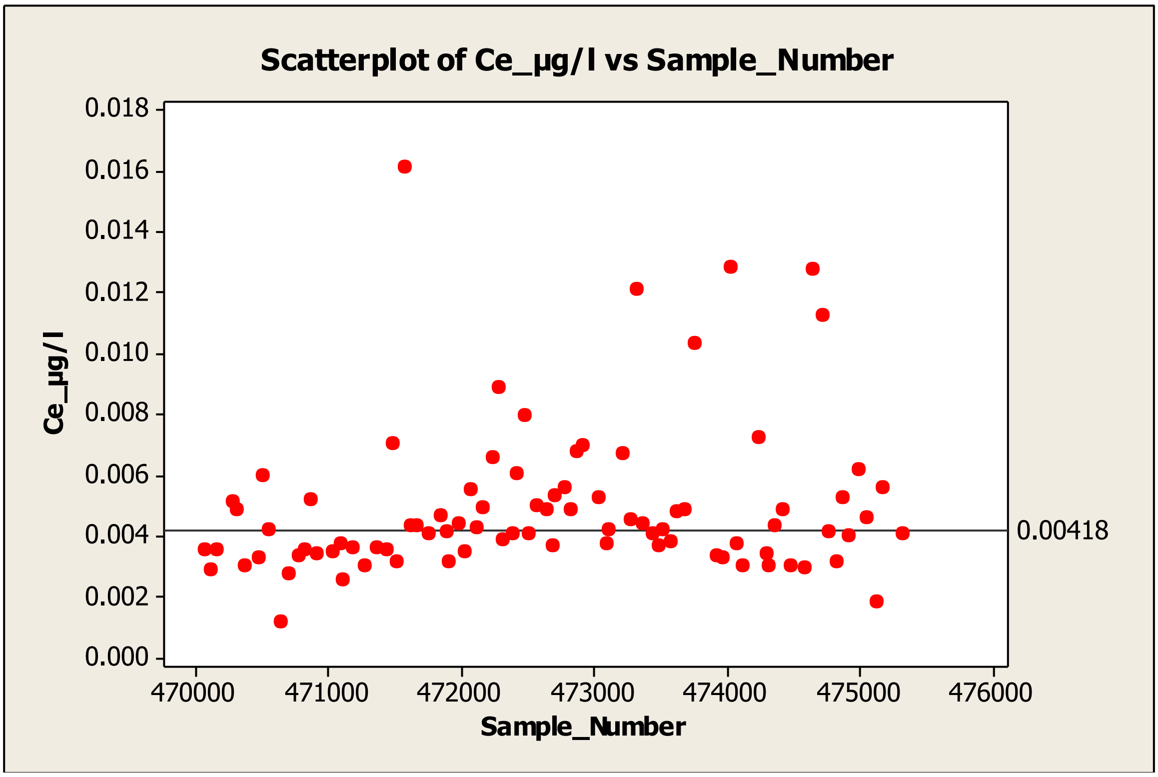


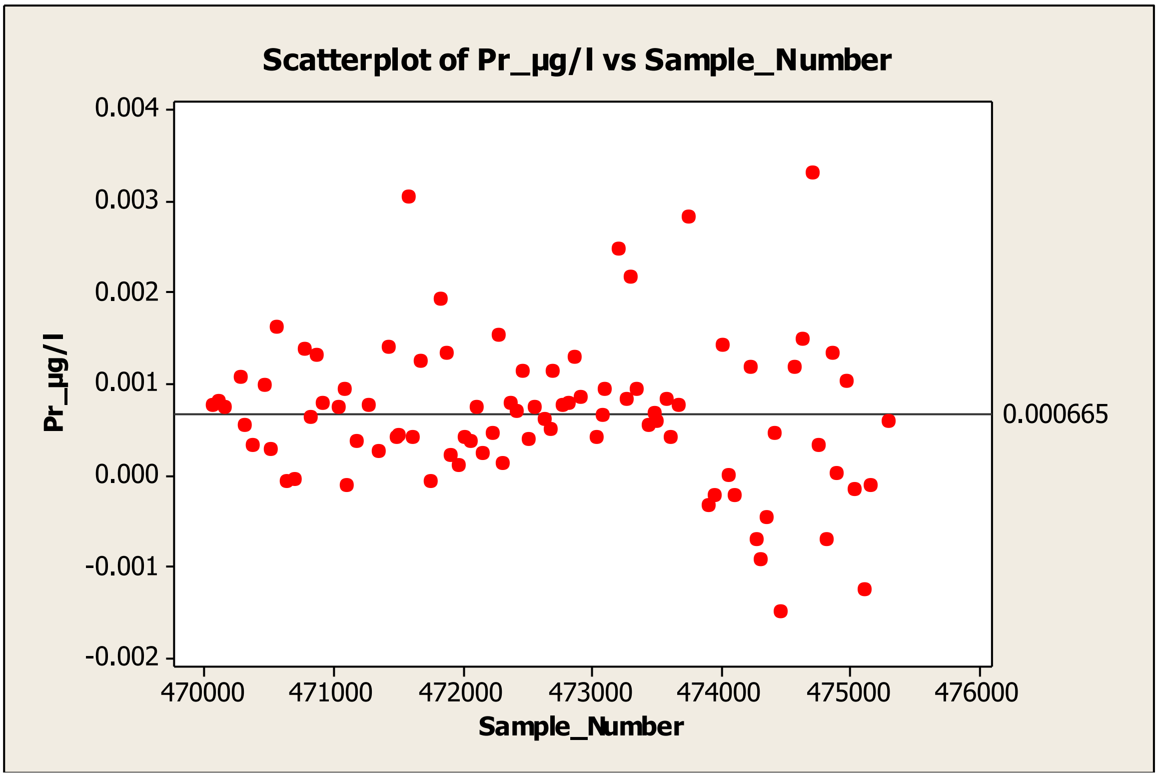
Scatterplot of Cs_µg/l vs Sample_Number
Cs_µg/l
5
4
3
2
1
0
0.017
470000
471000
472000
473000
474000
475000
476000
Sample_Number

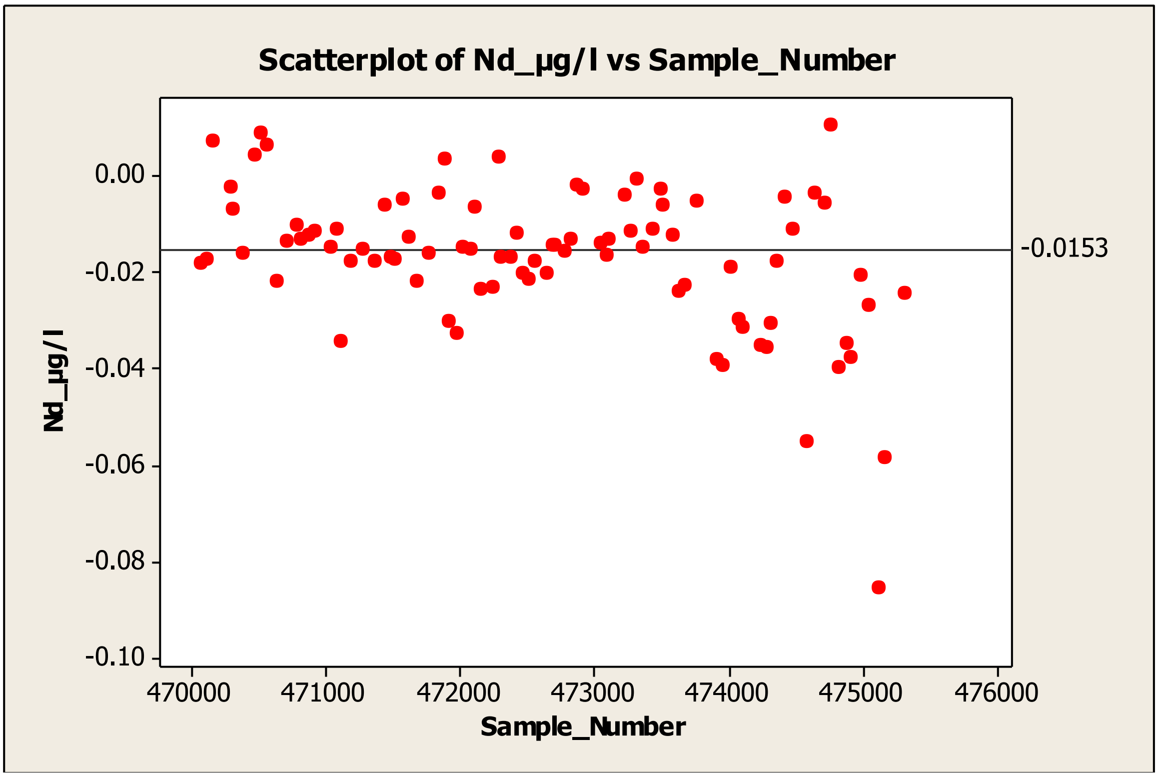


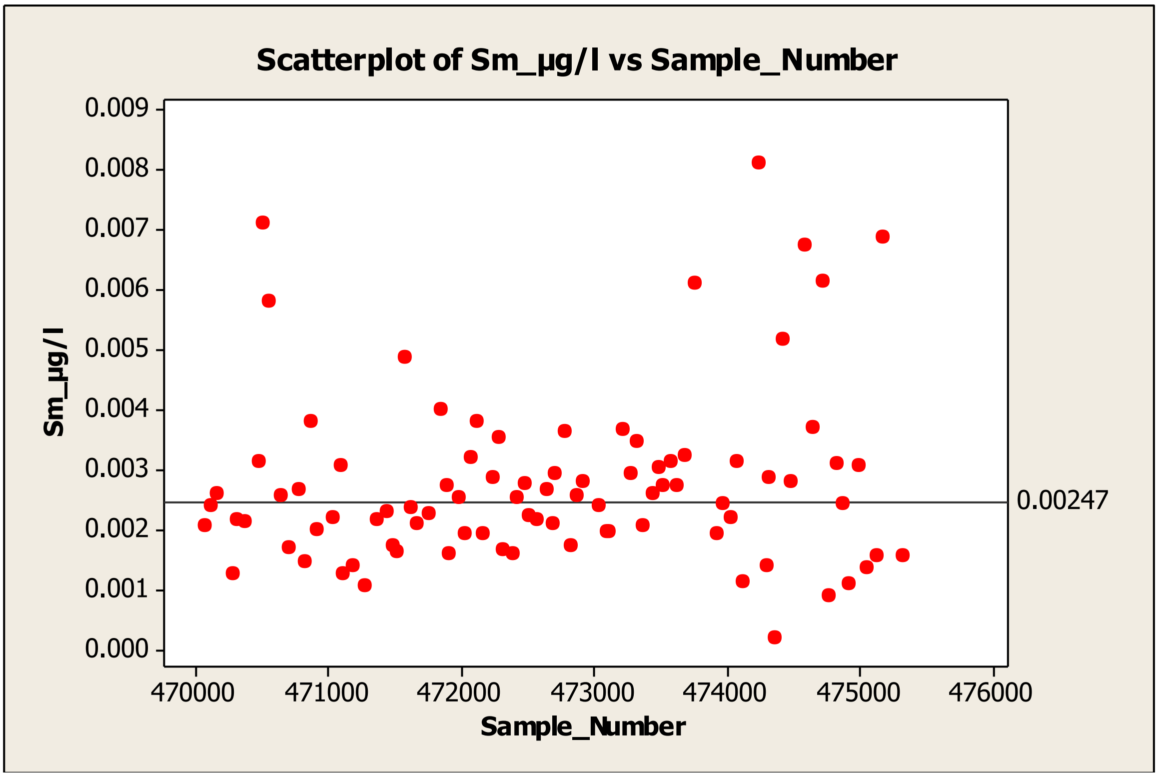
Scatterplot of Ba_µg/l vs Sample_Number
Ba_µg/l
97.5
95.0
92.5
90.0
87.5
85.0
82.5
80.0
87
470000
471000
472000
473000
474000
475000
476000
Sample_Number

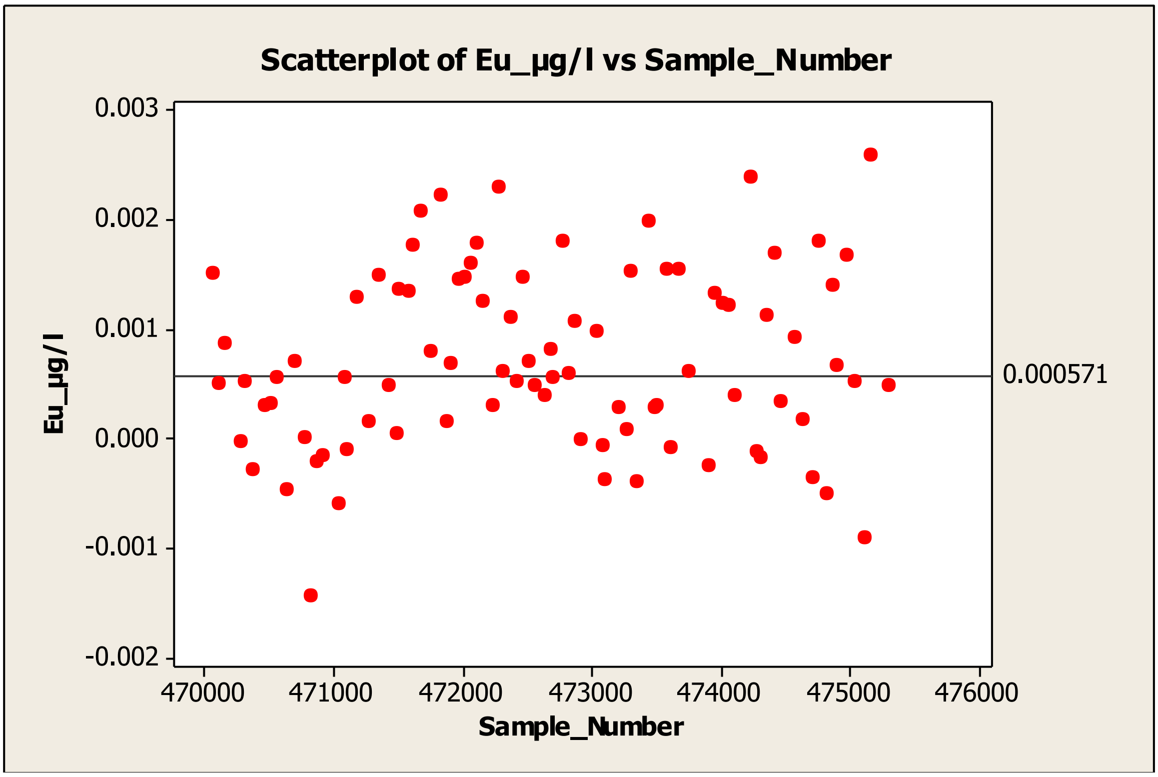

Scatterplot of La_µg/l vs Sample_Number
La_µg/l
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
0.016
0.018
0.00586
470000
471000
472000
473000
474000
475000
476000
Sample_Number

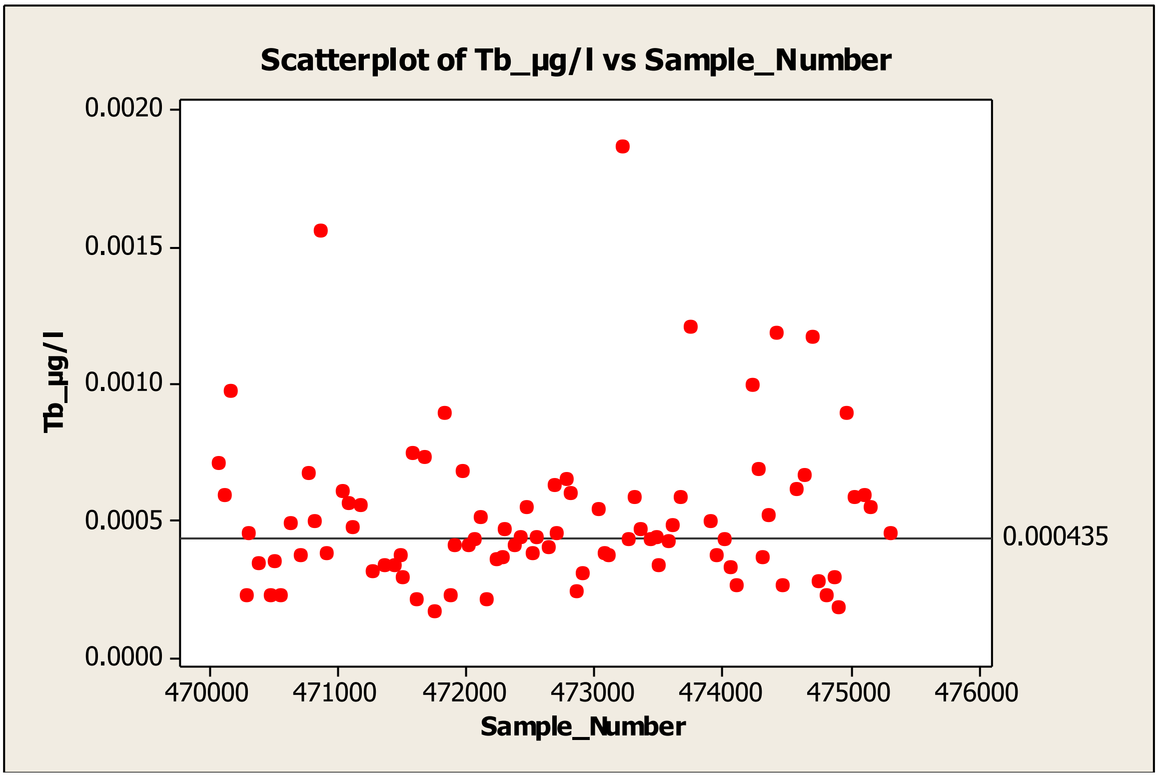

Scatterplot of Ce_µg/l vs Sample_Number
Ce_µg/l
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
0.016
0.018
0.00418
470000
471000
472000
473000
474000
475000
476000
Sample_Number

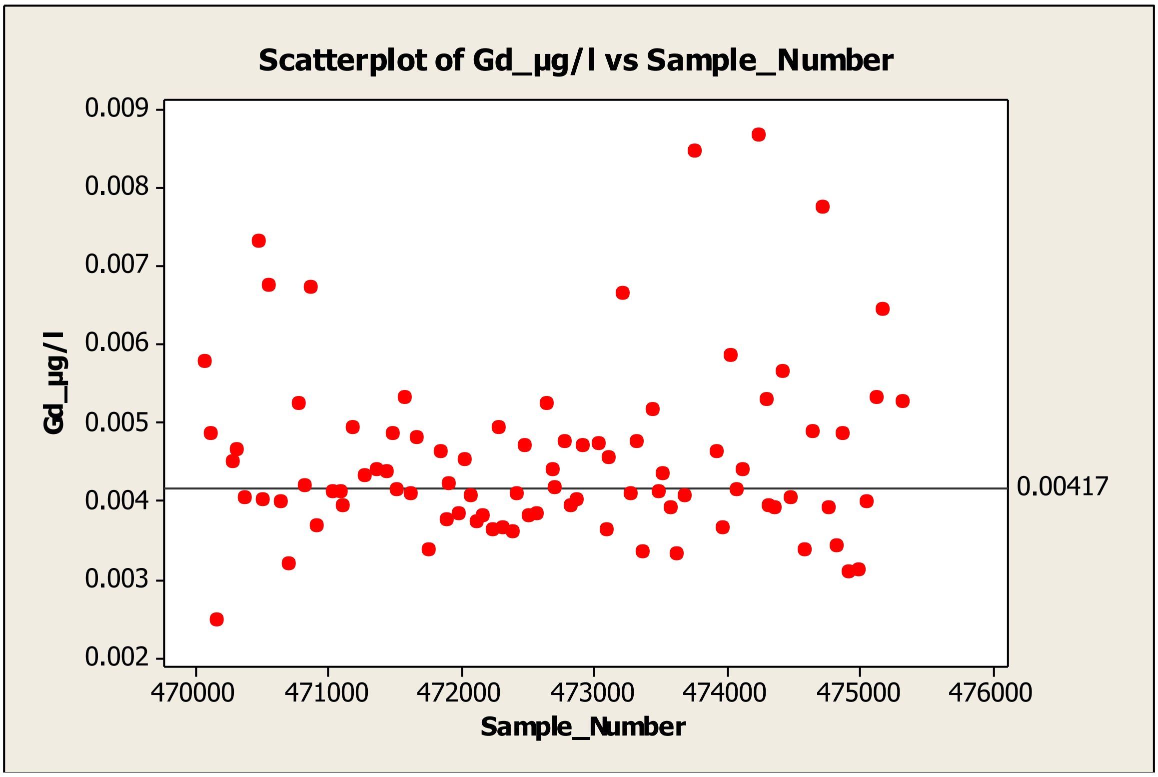

Scatterplot of Pr_µg/l vs Sample_Number
Pr_µg/l
0.004
0.003
0.002
0.001
0.000
-0.001
-0.002
0.000665
470000
471000
472000
473000
474000
475000
476000
Sample_Number

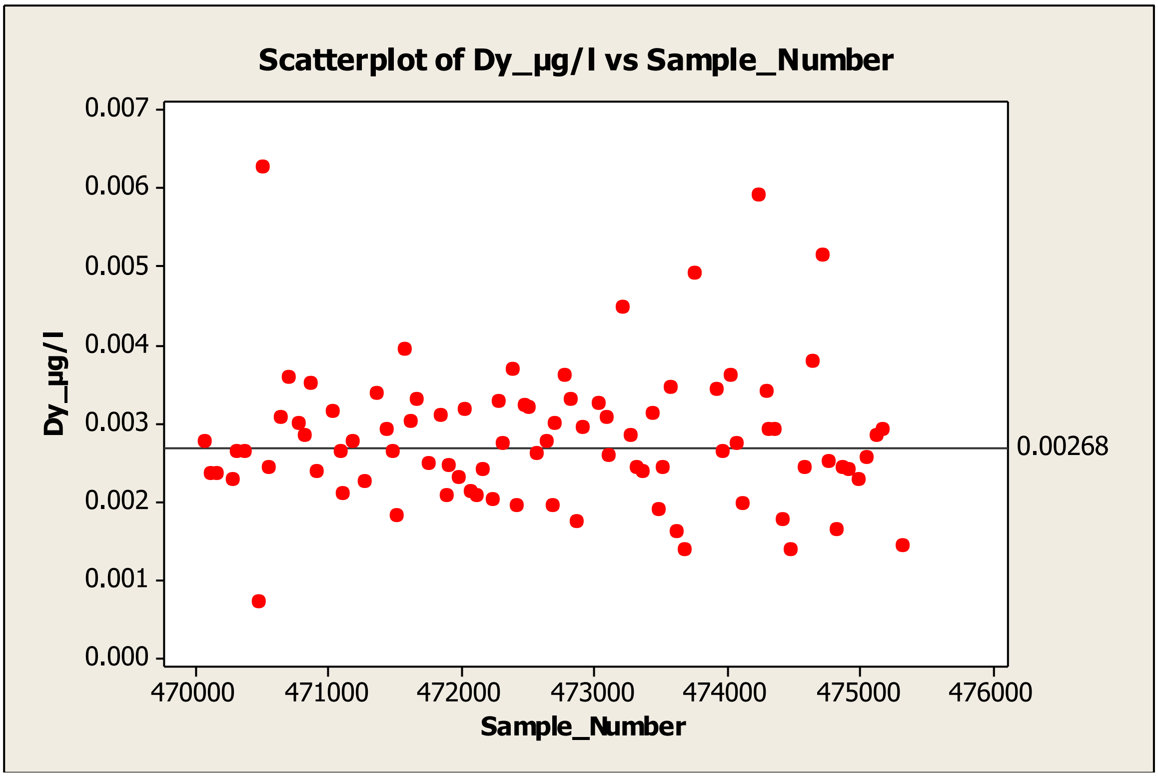

Scatterplot of Nd_µg/l vs Sample_Number
Nd_µg/l
0.00
-0.02
-0.04
-0.06
-0.08
-0.10
-0.0153
470000
471000
472000
473000
474000
475000
476000
Sample_Number

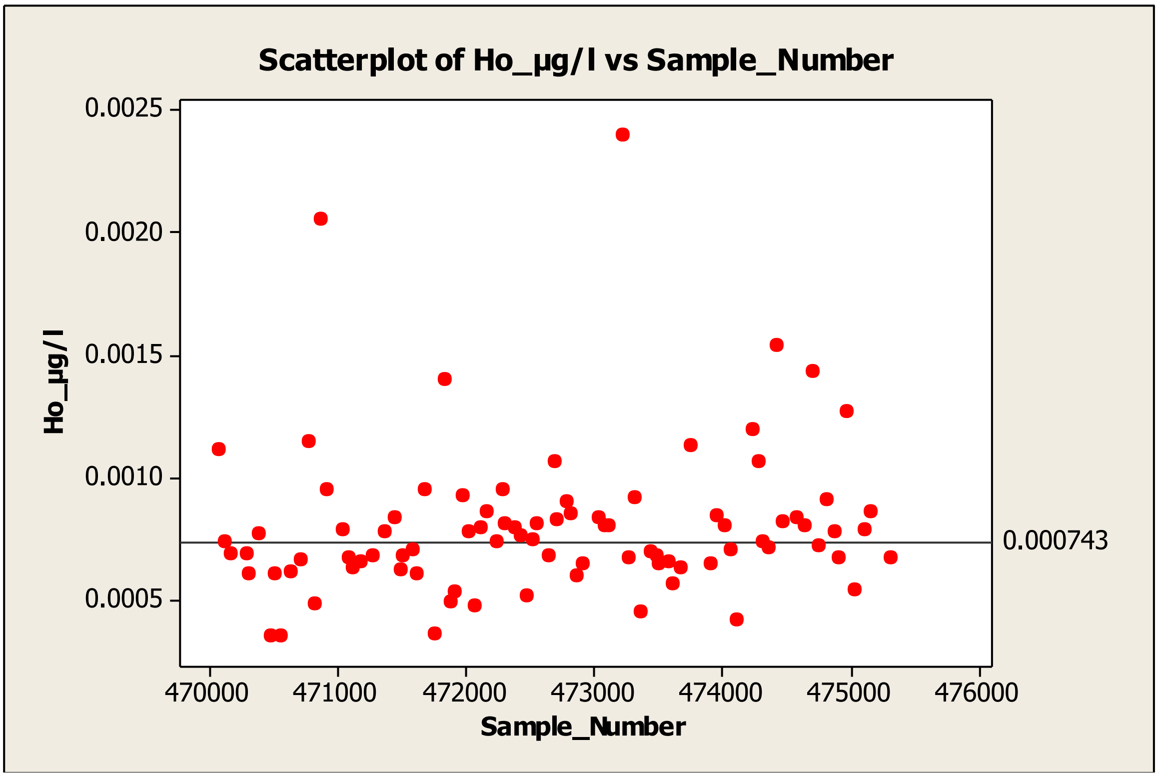

Scatterplot of Sm_µg/l vs Sample_Number
Sm_µg/l
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0.000
0.00247
470000
471000
472000
473000
474000
475000
476000
Sample_Number

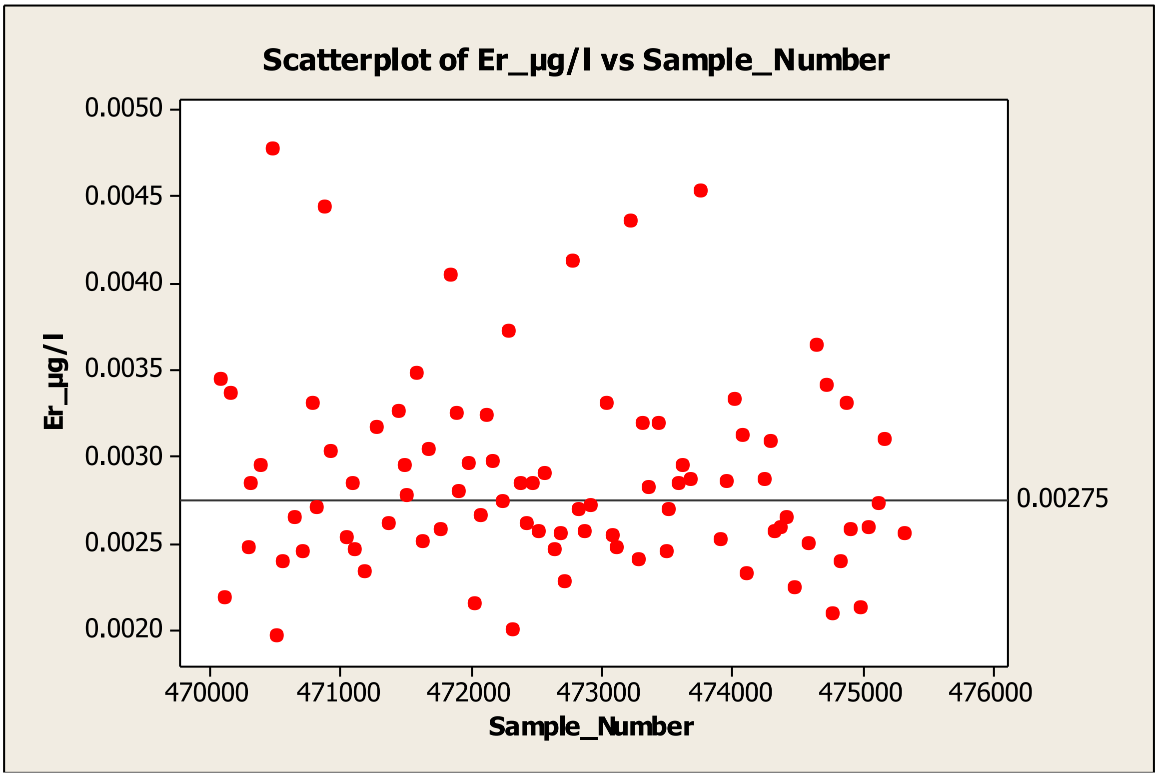

Scatterplot of Eu_µg/l vs Sample_Number
Eu_µg/l
0.003
0.002
0.001
0.000
-0.001
-0.002
0.000571
470000
471000
472000
473000
474000
475000
476000
Sample_Number

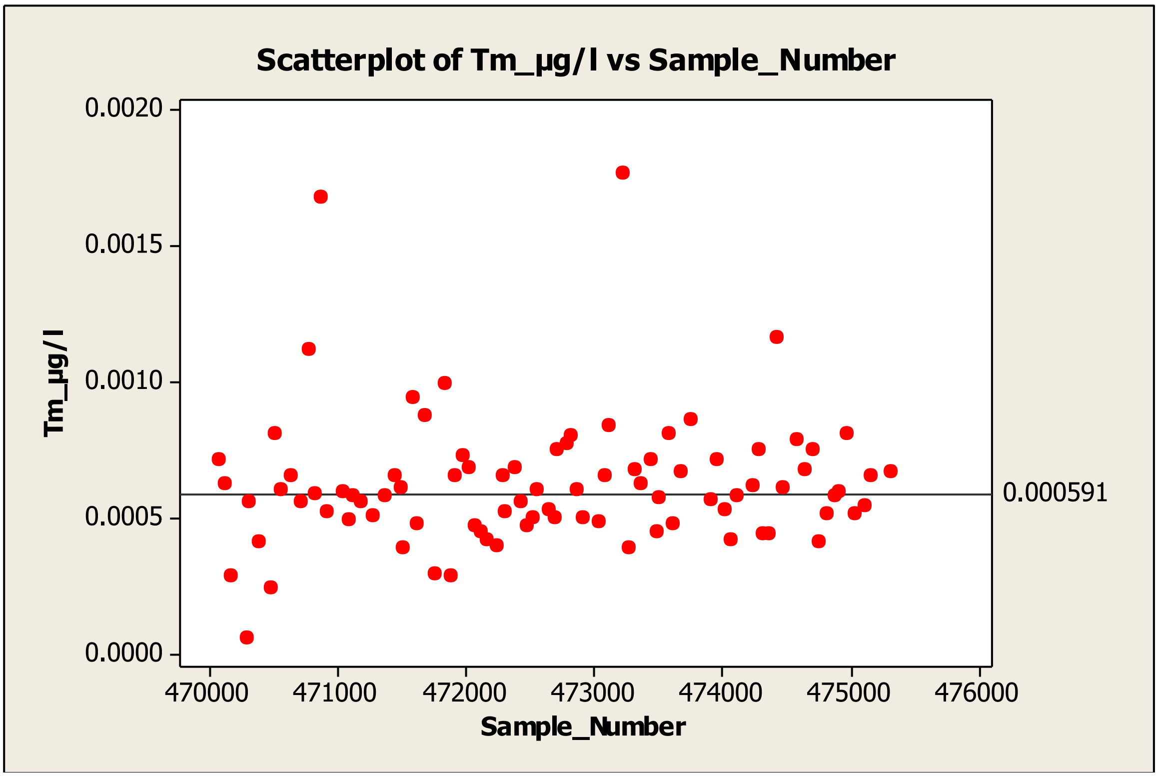

Scatterplot of Tb_µg/l vs Sample_Number
0.0020
0.0015
0.0010
0.0005
0.0000
Tb_µg/l
0.000435
470000
471000
472000
473000
474000
475000
476000
Sample_Number

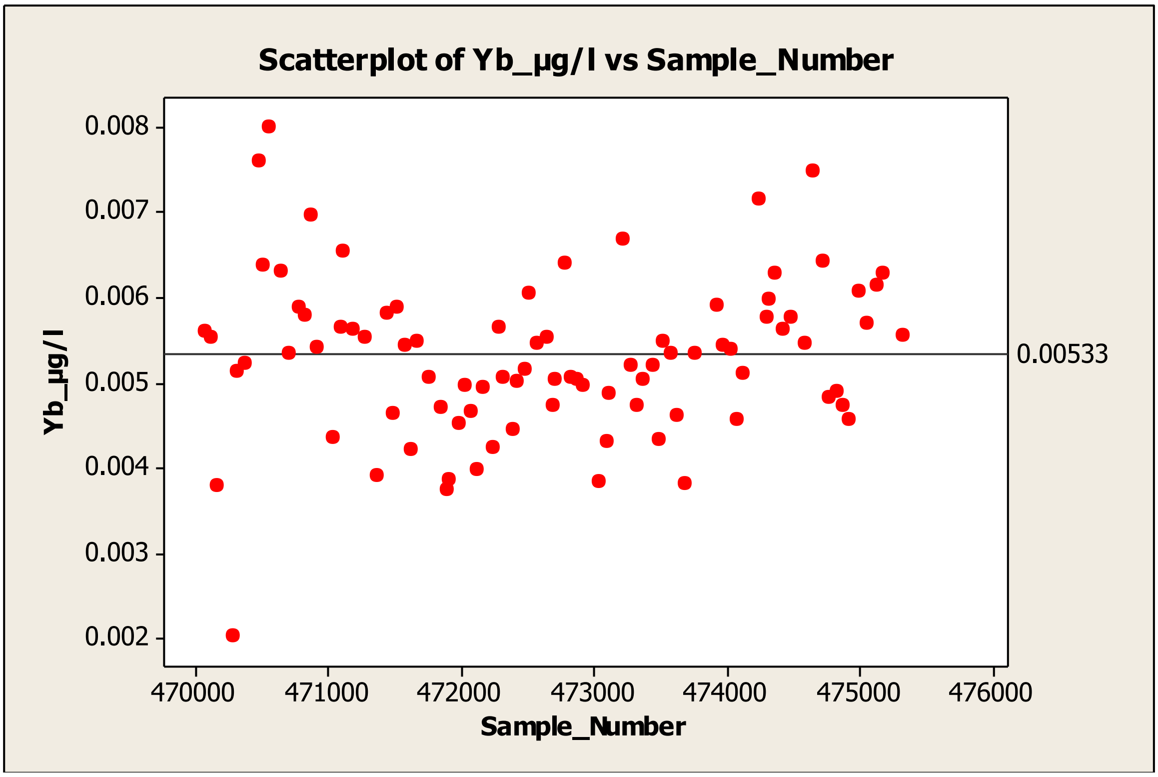

Scatterplot of Gd_µg/l vs Sample_Number
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
Gd_µg/l
0.00417
470000
471000
472000
473000
474000
475000
476000
Sample_Number


Scatterplot of Dy_µg/l vs Sample_Number
Dy_µg/l
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0.000
0.00268
470000
471000
472000
473000
474000
475000
476000
Sample_Number

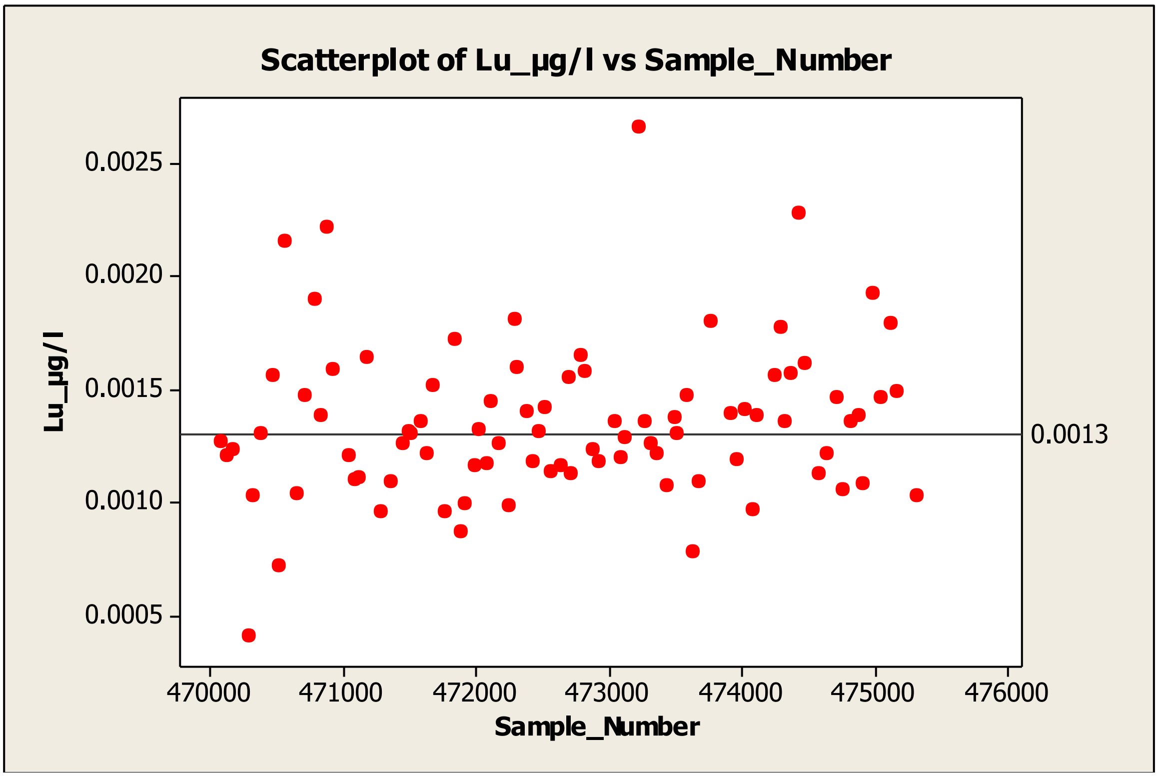

Scatterplot of Ho_µg/l vs Sample_Number
Ho_µg/l
0.0025
0.0020
0.0015
0.0010
0.0005
0.000743
470000
471000
472000
473000
474000
475000
476000
Sample_Number


Scatterplot of Er_µg/l vs Sample_Number
Er_µg/l
0.0050
0.0045
0.0040
0.0035
0.0030
0.0025
0.0020
0.00275
470000
471000
472000
473000
474000
475000
476000
Sample_Number

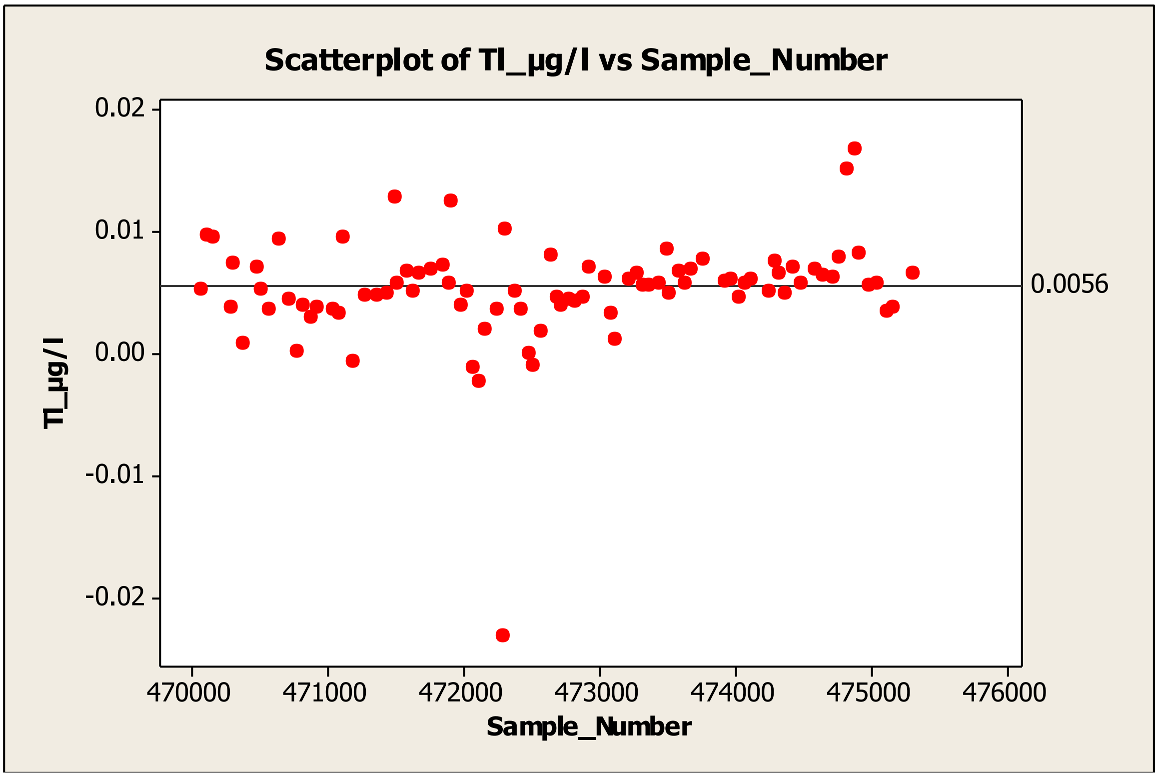

Scatterplot of Tm_µg/l vs Sample_Number
Tm_µg/l
0.0020
0.0015
0.0010
0.0005
0.0000
0.000591
470000
471000
472000
473000
474000
475000
476000
Sample_Number

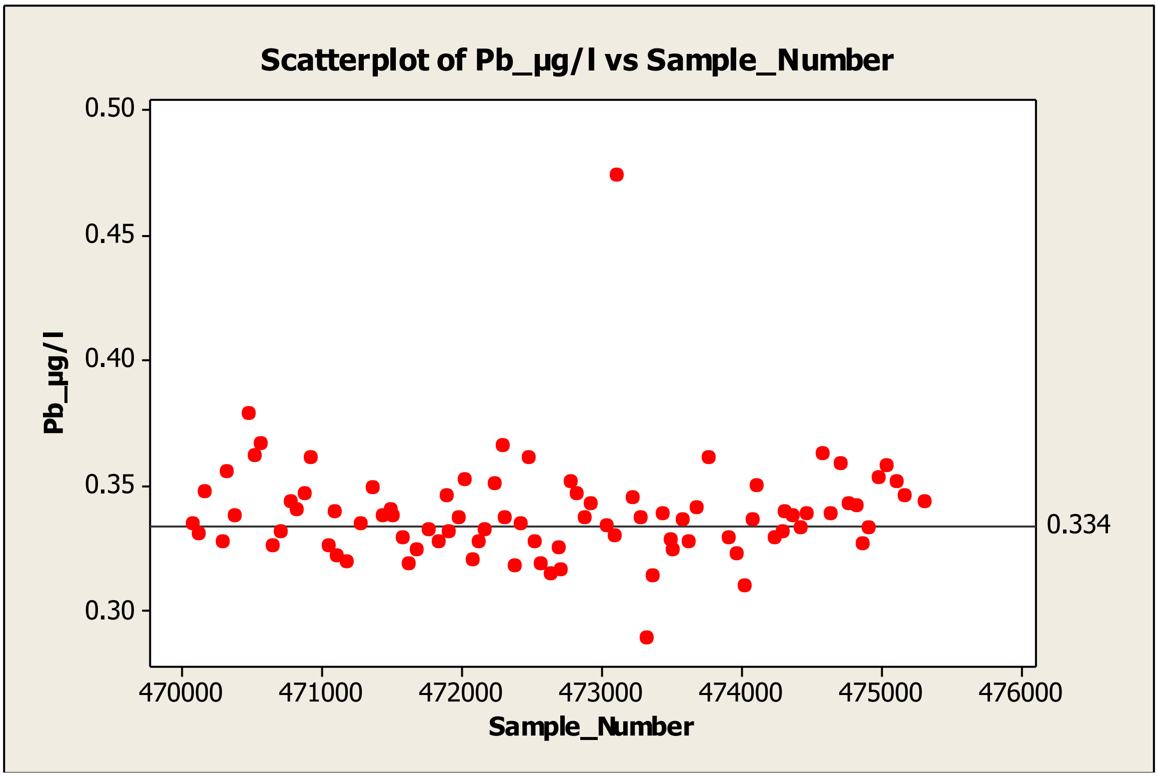


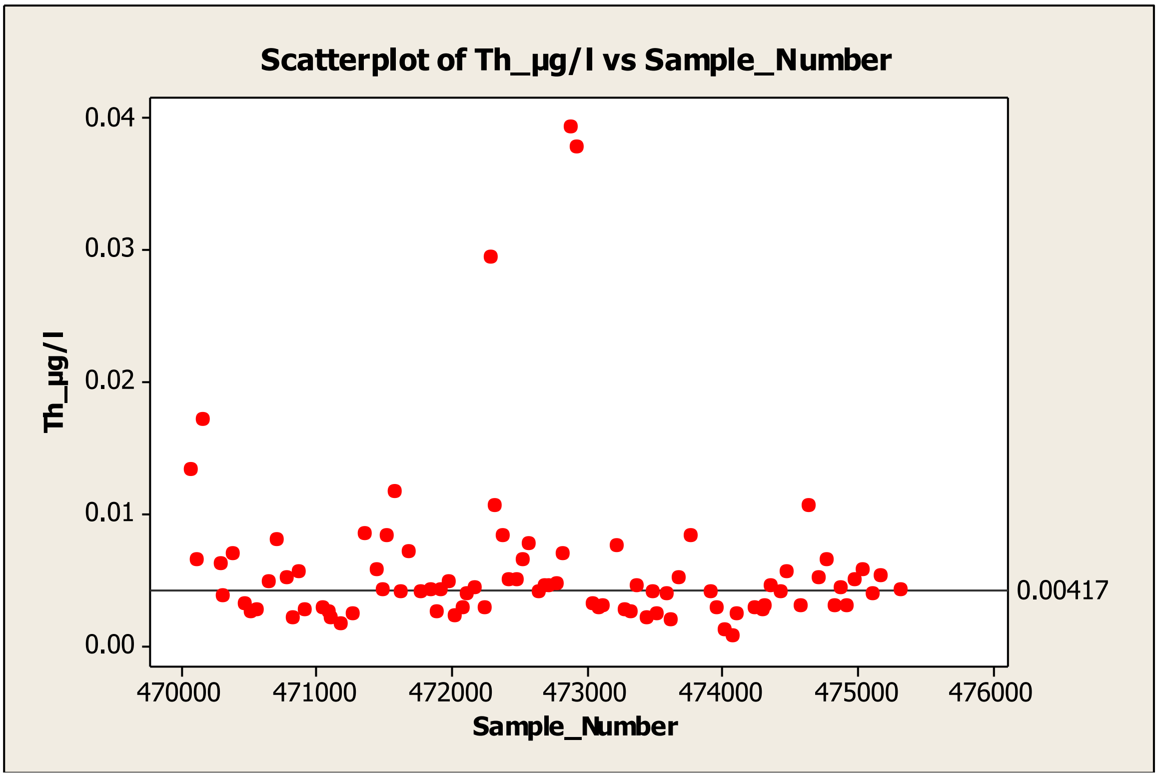
Scatterplot of Yb_µg/l vs Sample_Number
Yb_µg/l
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.00533
470000
471000
472000
473000
474000
475000
476000
Sample_Number

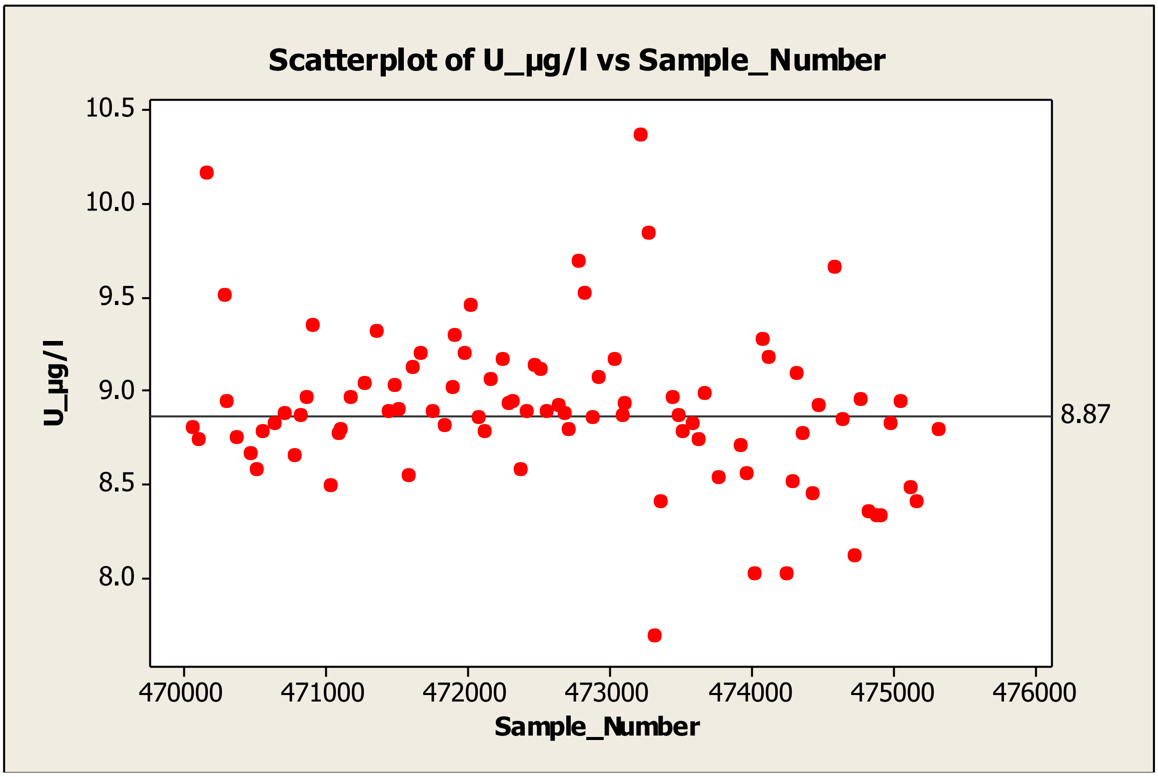


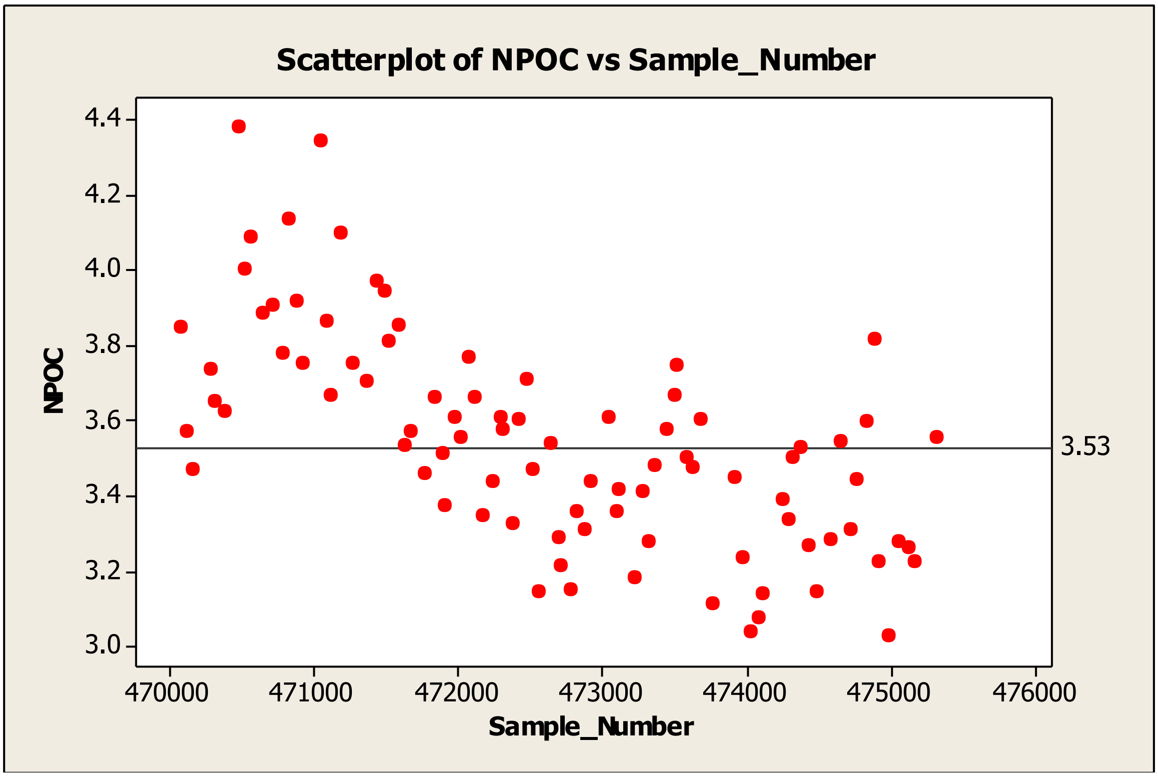
Scatterplot of Lu_µg/l vs Sample_Number
Lu_µg/l
0.0025
0.0020
0.0015
0.0010
0.0005
0.0013
470000
471000
472000
473000
474000
475000
476000
Sample_Number

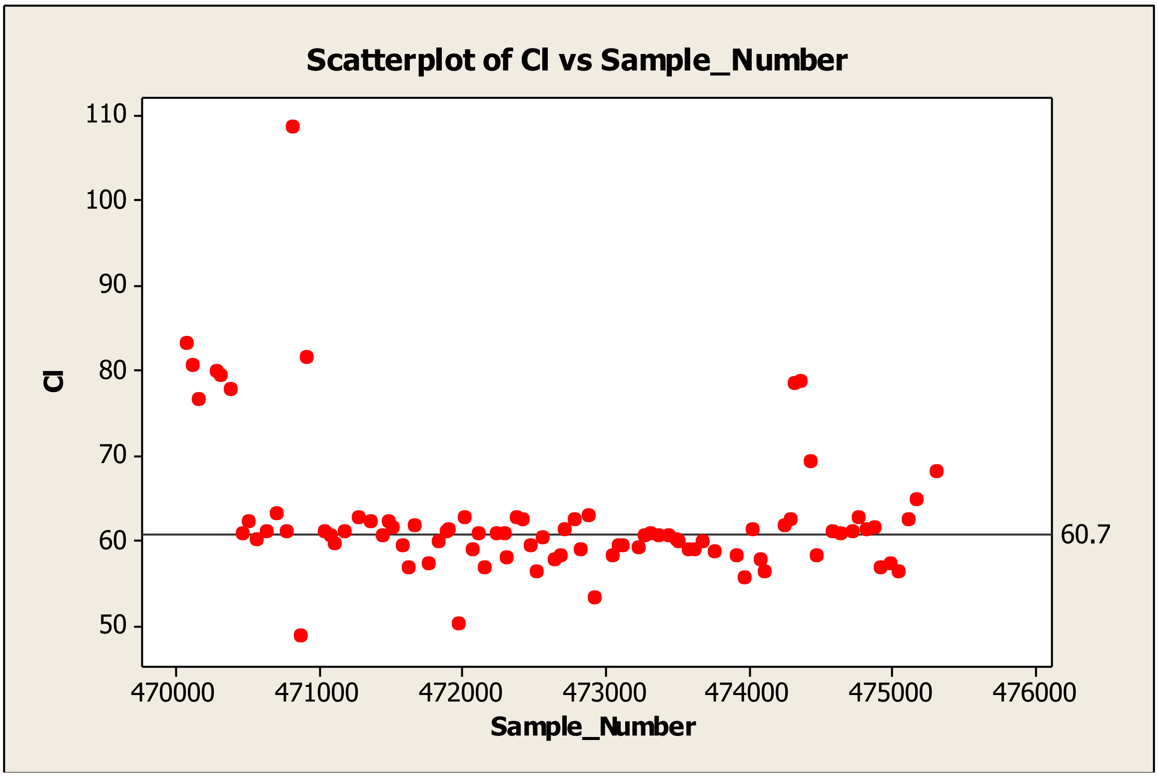

Scatterplot of Tl_µg/l vs Sample_Number
0.02
0.01
0.00
-0.01
-0.02
Tl_µg/l
0.0056
470000
471000
472000
473000
474000
475000
476000
Sample_Number

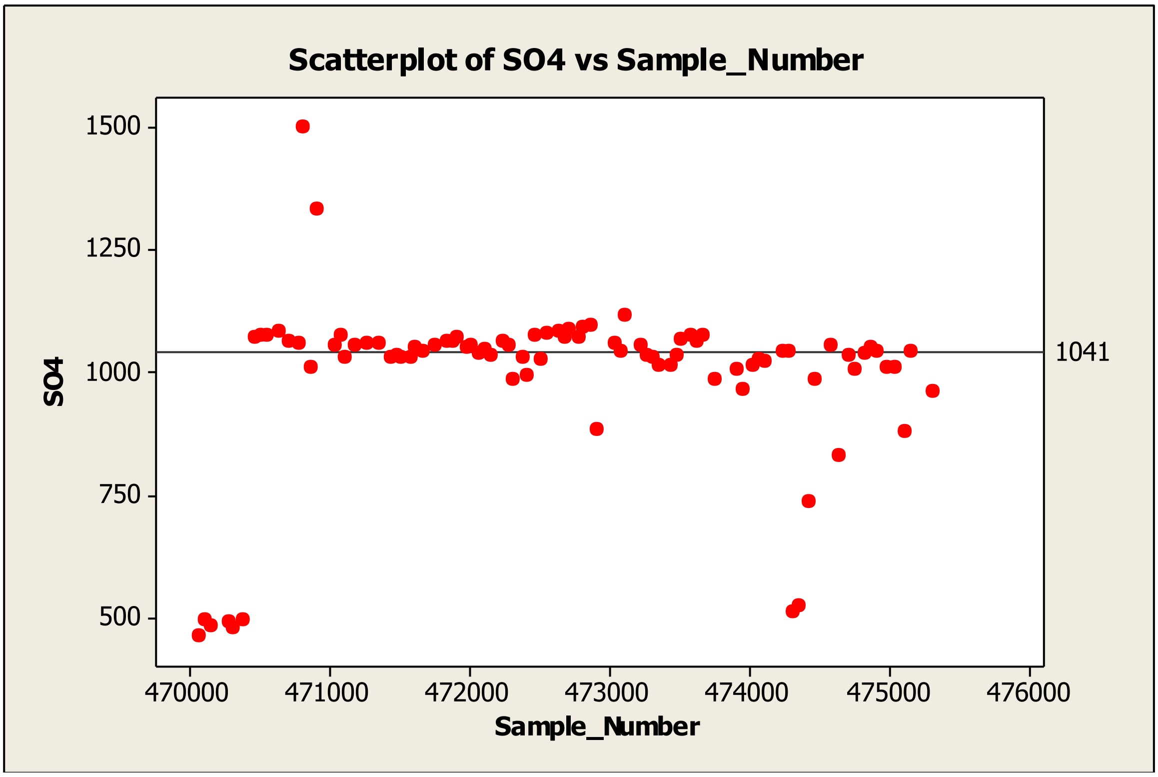

Scatterplot of Pb_µg/l vs Sample_Number
0.50
0.45
0.40
0.35
0.30
Pb_µg/l
0.334
470000
471000
472000
473000
474000
475000
476000
Sample_Number

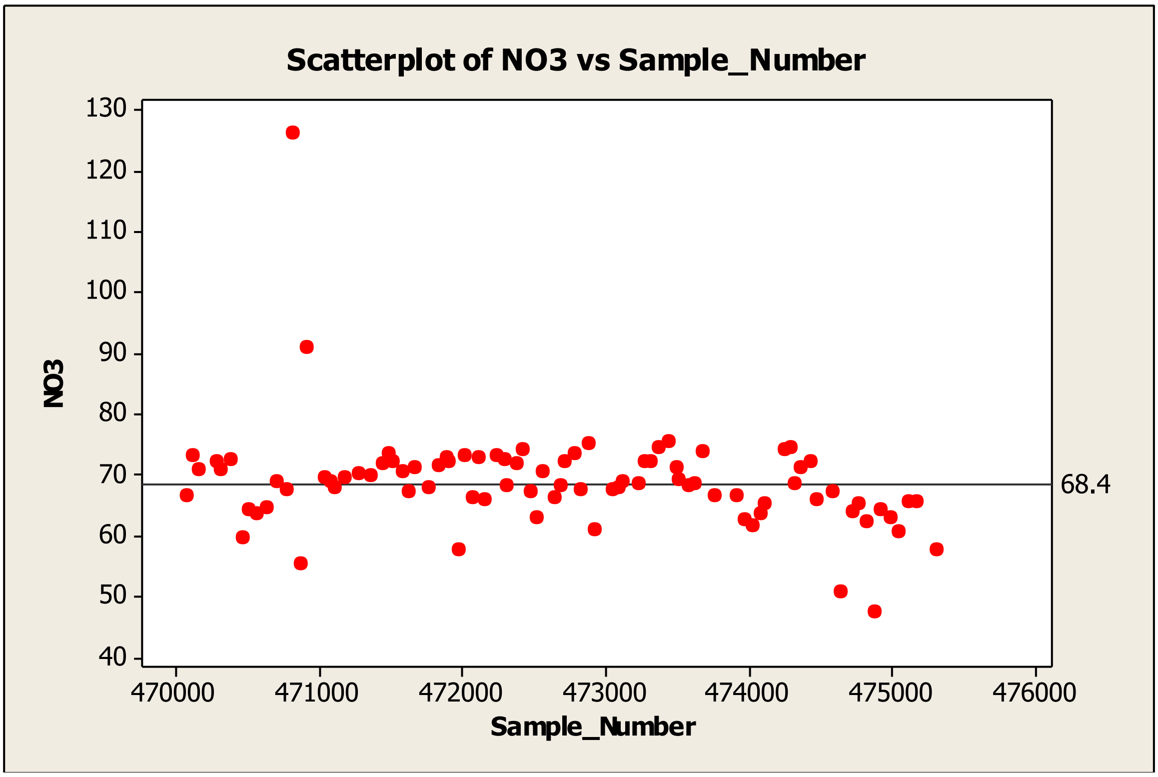

Scatterplot of Th_µg/l vs Sample_Number
Th_µg/l
0.04
0.03
0.02
0.01
0.00
0.00417
470000
471000
472000
473000
474000
475000
476000
Sample_Number

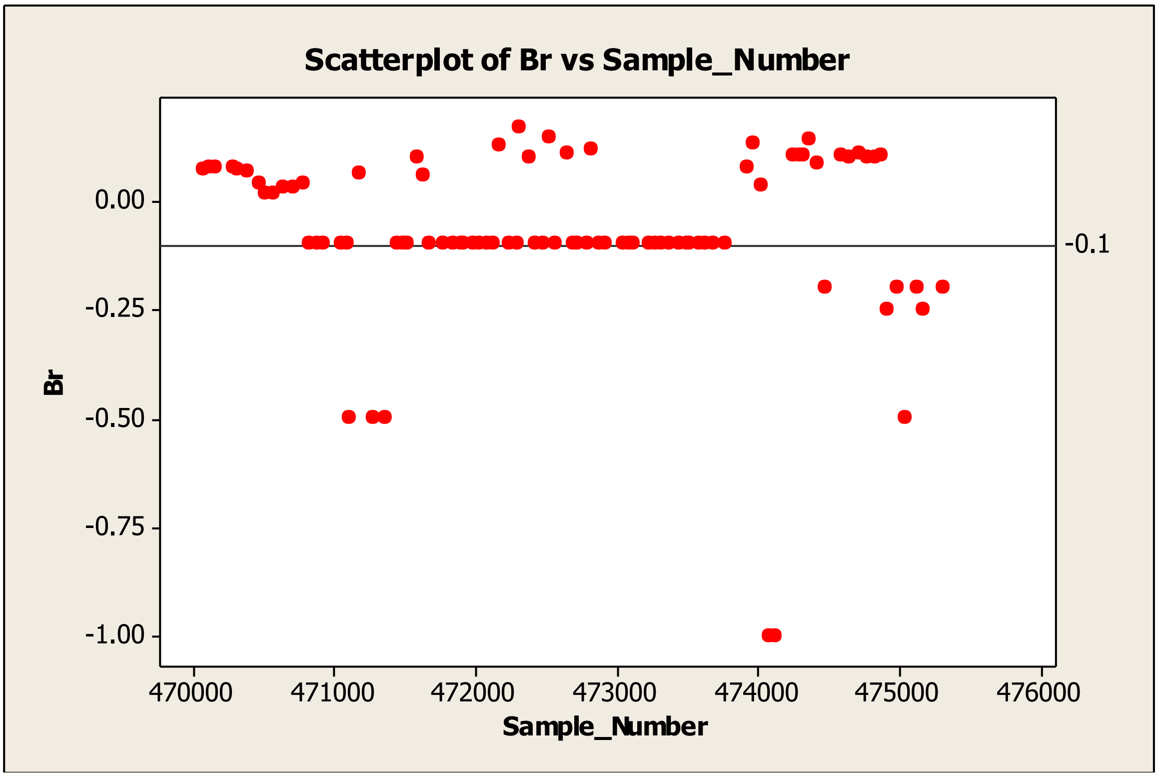

Scatterplot of U_µg/l vs Sample_Number
U_µg/l
10.5
10.0
9.5
9.0
8.5
8.0
8.87
470000
471000
472000
473000
474000
475000
476000
Sample_Number

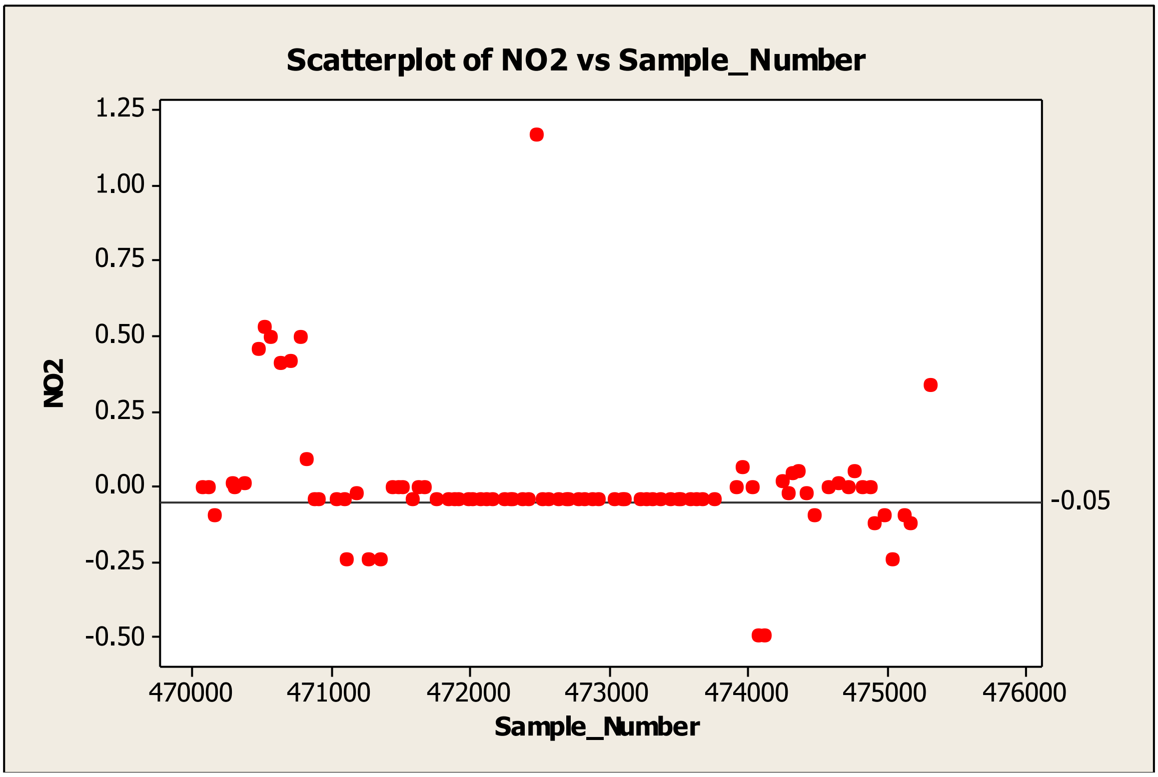

Scatterplot of NPOC vs Sample_Number
NPOC
4.4
4.2
4.0
3.8
3.6
3.4
3.2
3.0
3.53
470000
471000
472000
473000
474000
475000
476000
Sample_Number

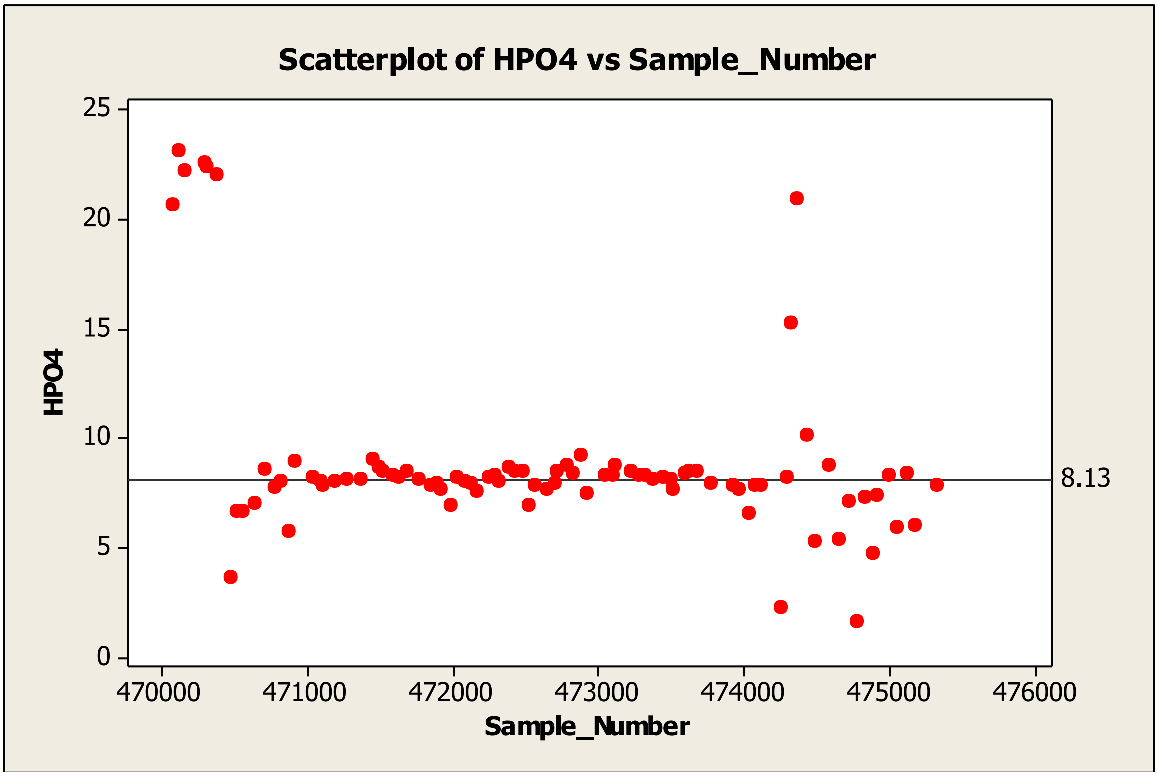

Scatterplot of Cl vs Sample_Number
Cl
110
100
90
80
70
60
50
60.7
470000
471000
472000
473000
474000
475000
476000
Sample_Number

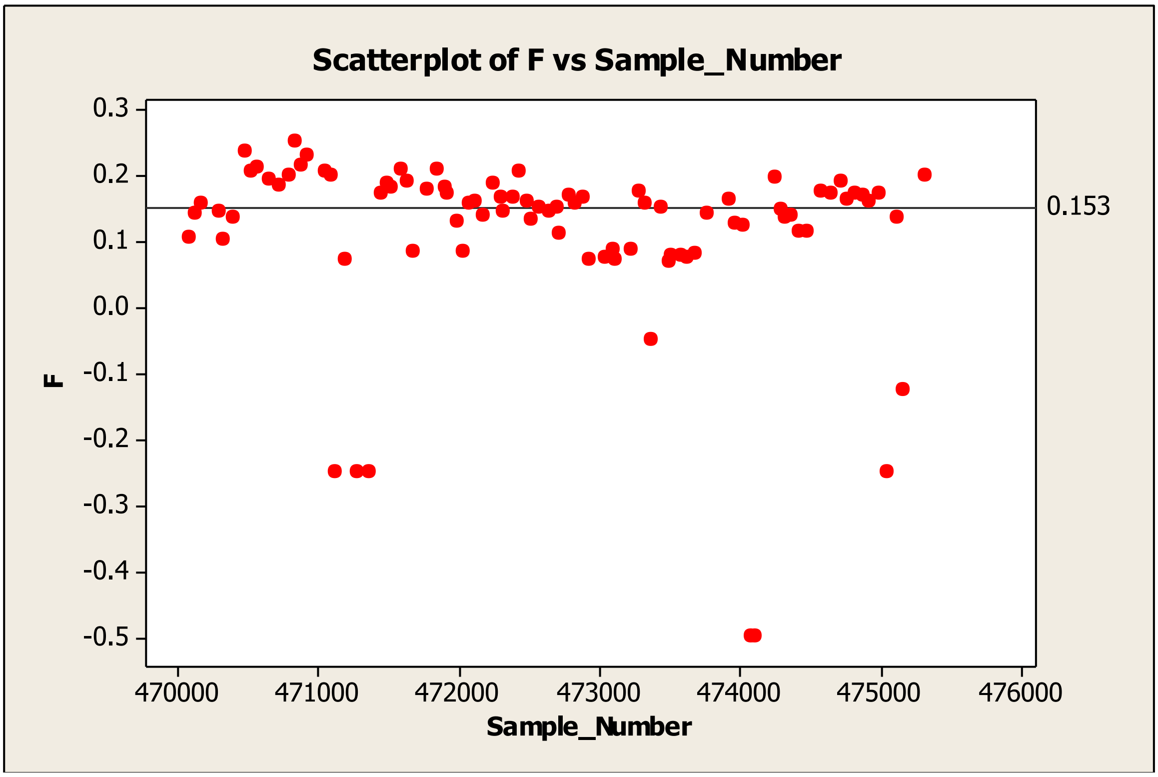

Scatterplot of SO4 vs Sample_Number
1500
1250
1000
750
500
SO4
1041
470000
471000
472000
473000
474000
475000
476000
Sample_Number


Scatterplot of NO3 vs Sample_Number
130
120
110
100
90
80
70
60
50
40
NO3
68.4
470000
471000
472000
473000
474000
475000
476000
Sample_Number


Scatterplot of Br vs Sample_Number
Br
0.00
-0.25
-0.50
-0.75
-1.00
-0.1
470000
471000
472000
473000
474000
475000
476000
Sample_Number

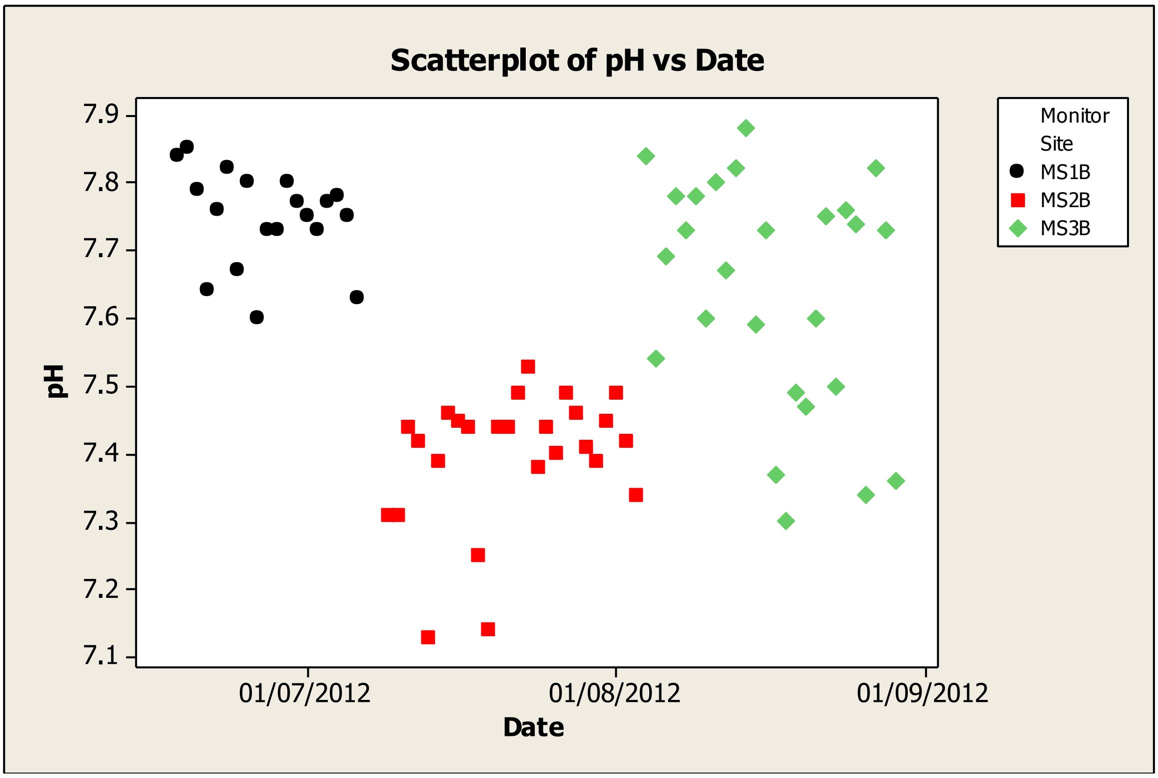

Scatterplot of NO2 vs Sample_Number
NO2
1.25
1.00
0.75
0.50
0.25
0.00
-0.25
-0.50
-0.05
470000
471000
472000
473000
474000
475000
476000
Sample_Number

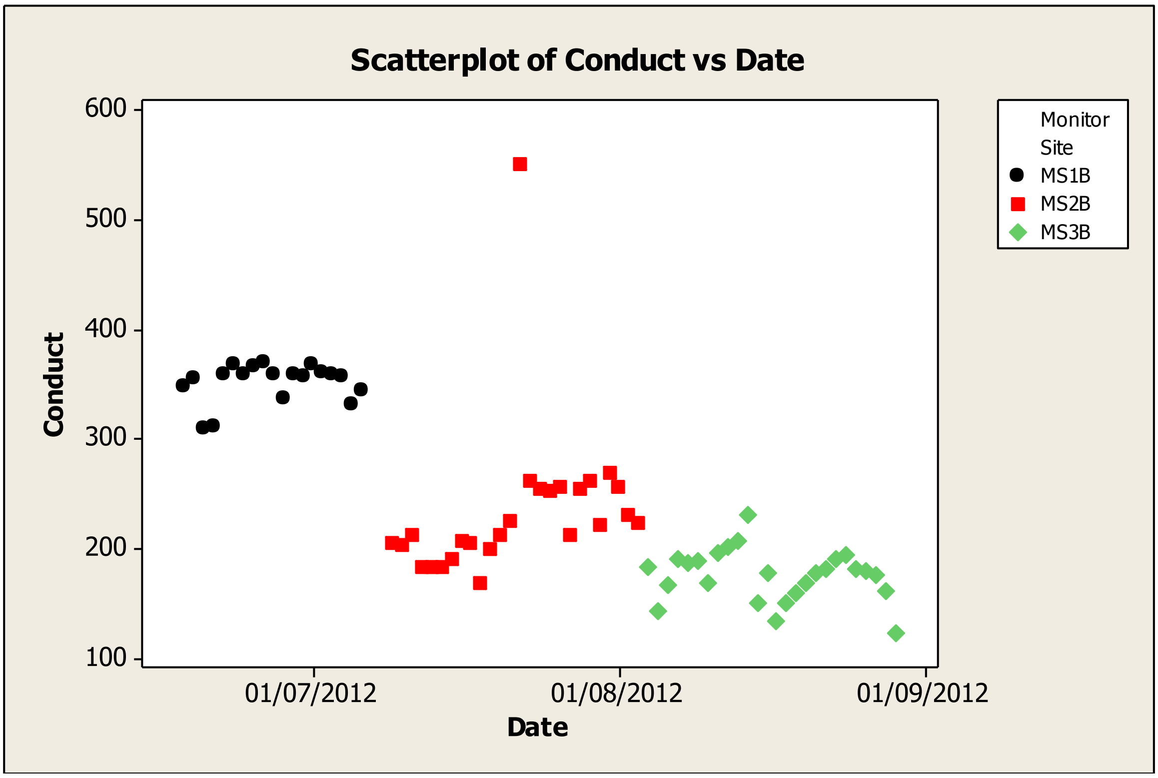

Scatterplot of HPO4 vs Sample_Number
HPO4
25
20
15
10
5
0
470000
471000
472000
473000
474000
475000
476000
Sample_Number
8.13

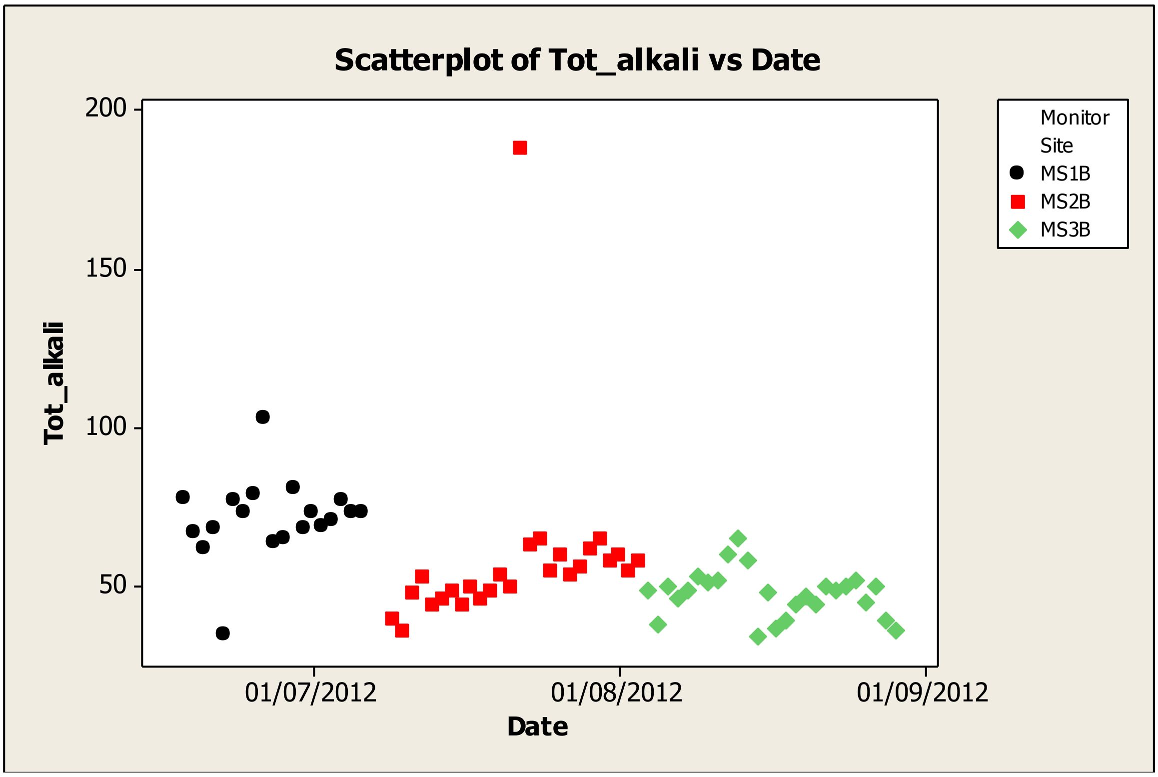

Scatterplot of F vs Sample_Number
F
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
470000
471000
472000
473000
474000
475000
476000
Sample_Number
0.153

Appendix 6 Monitor Site data graphs

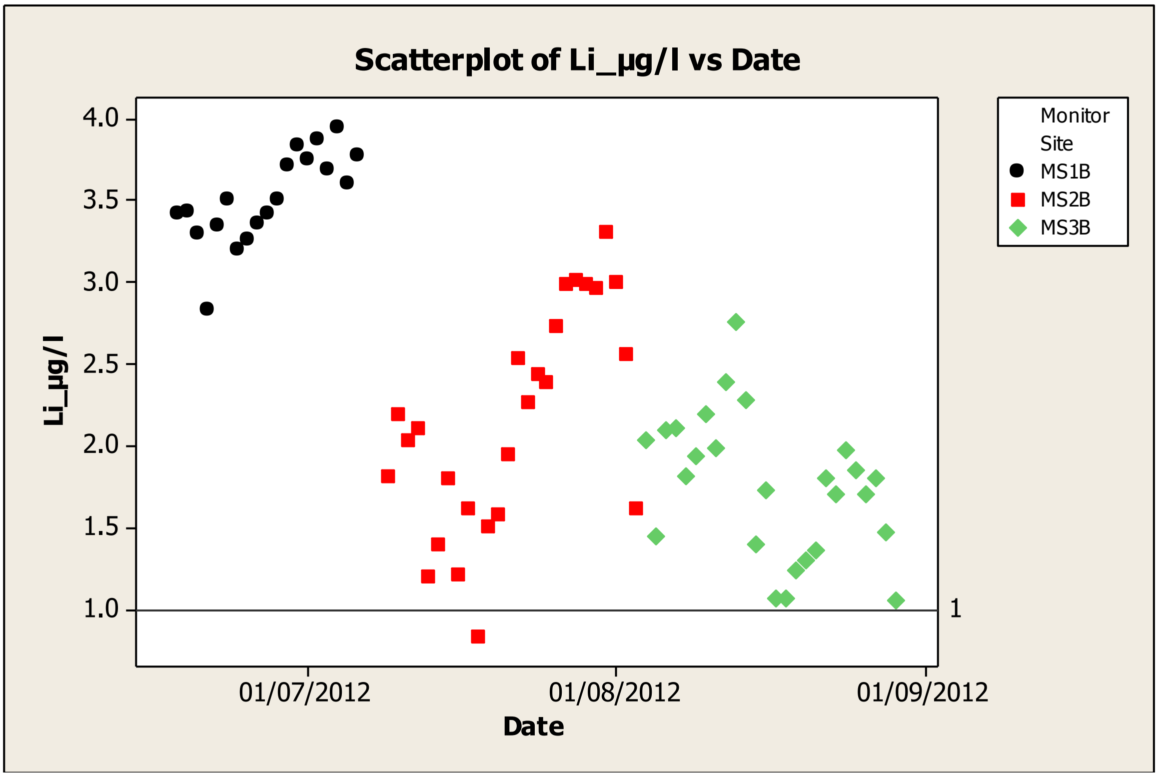
Where applicable detection limits are marked as horizontal lines on each graph.



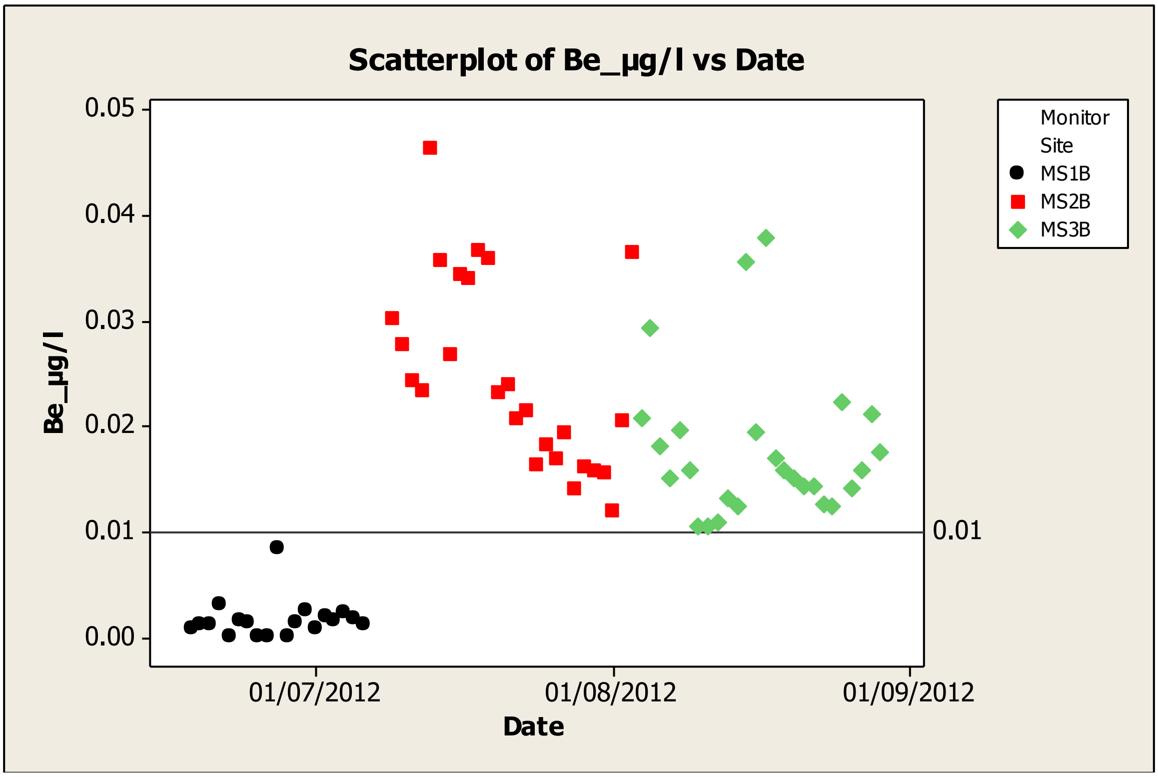


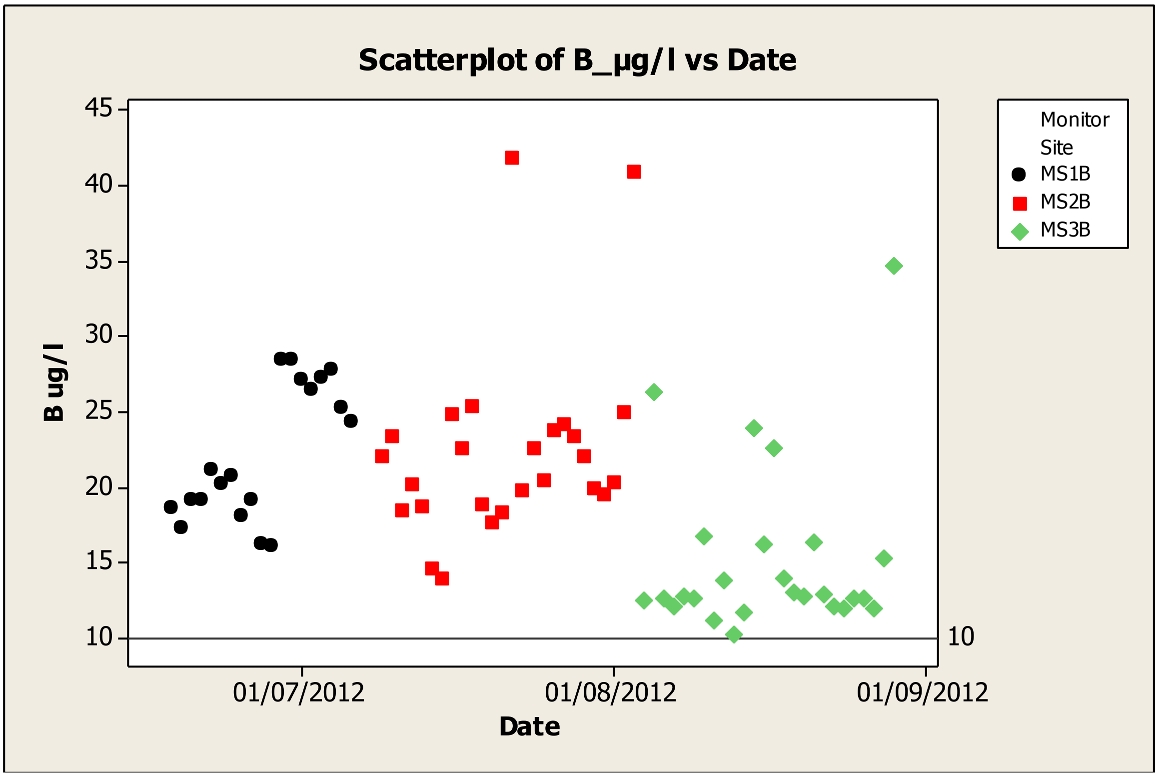


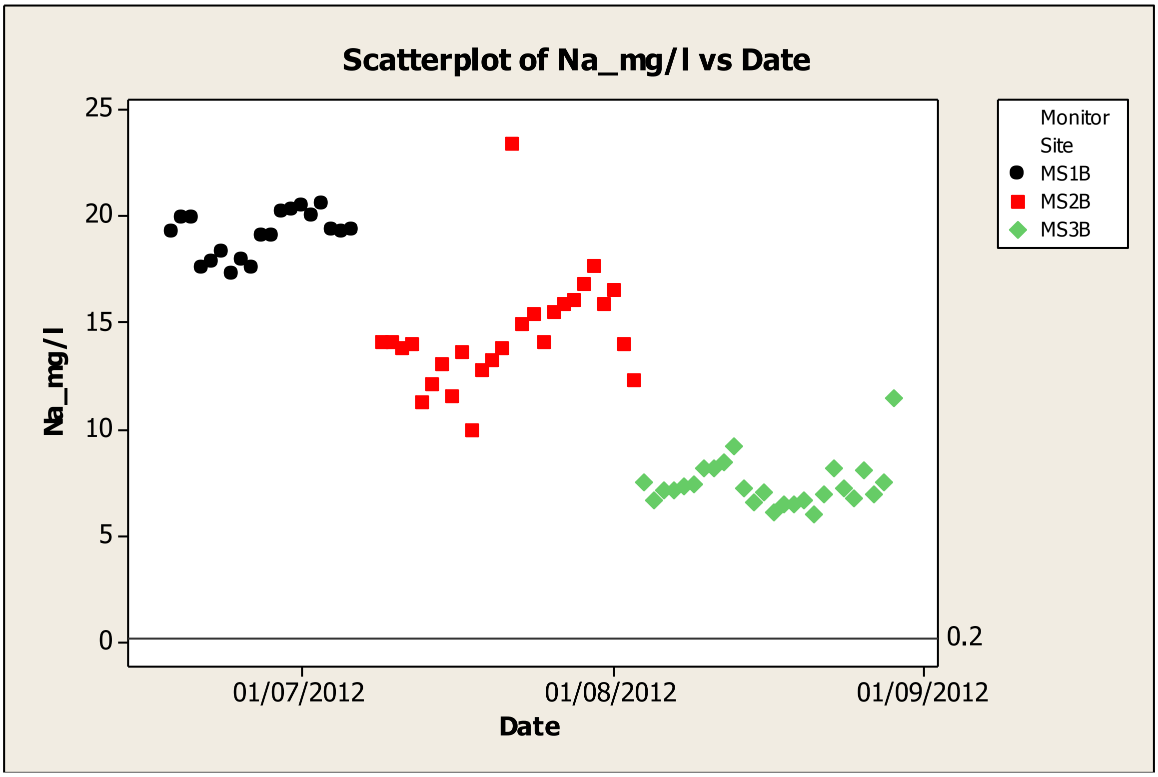
Scatterplot of Tot_alkali vs Date
Tot_alkali
200
150
100
50
01/07/2012
01/08/2012
01/09/2012
Date
Monitor
Site
MS1B
MS2B
MS3B

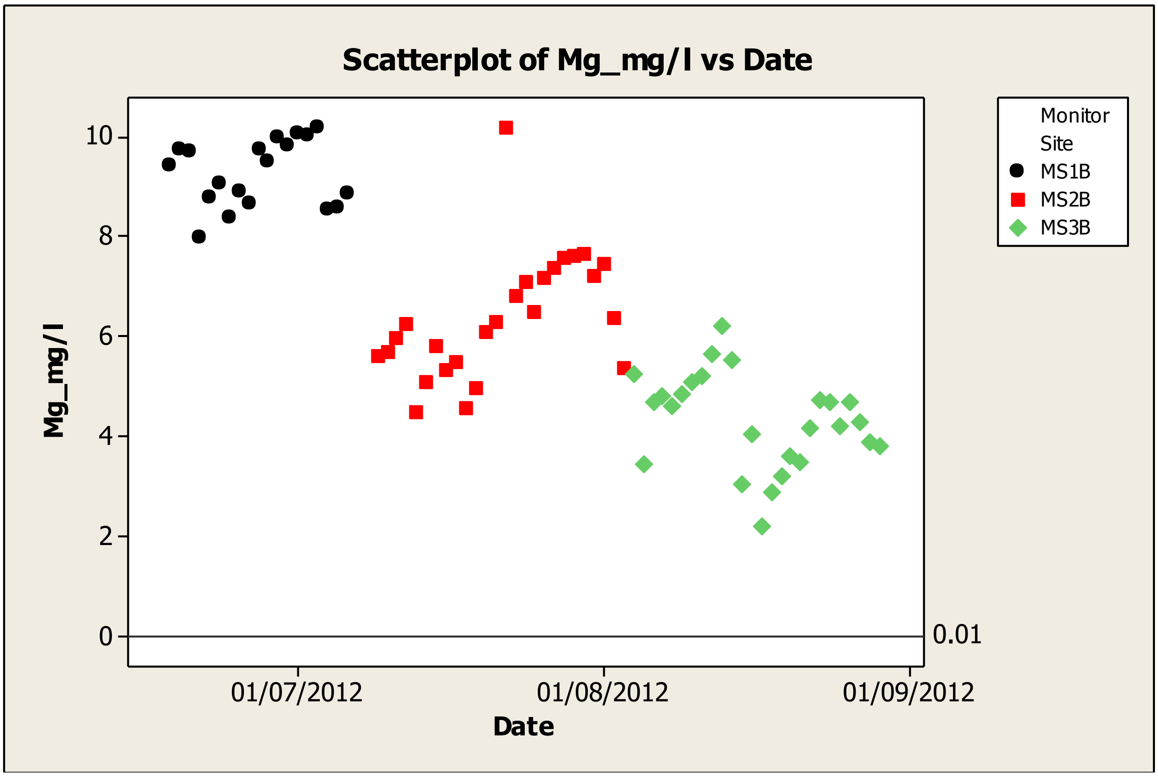


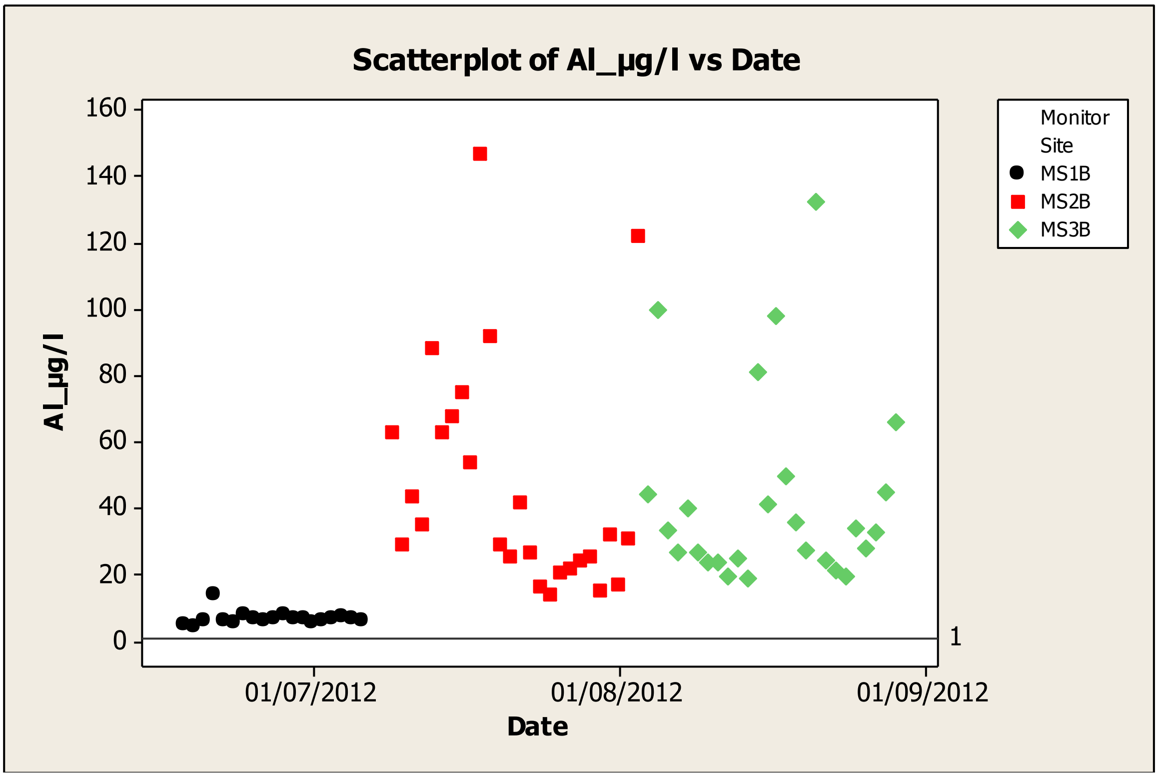
Scatterplot of Li_µg/l vs Date
Li_µg/l
4.0
3.5
3.0
2.5
2.0
1.5
1.0
1
01/07/2012
01/08/2012
01/09/2012
Date
Monitor
Site
MS1B
MS2B
MS3B

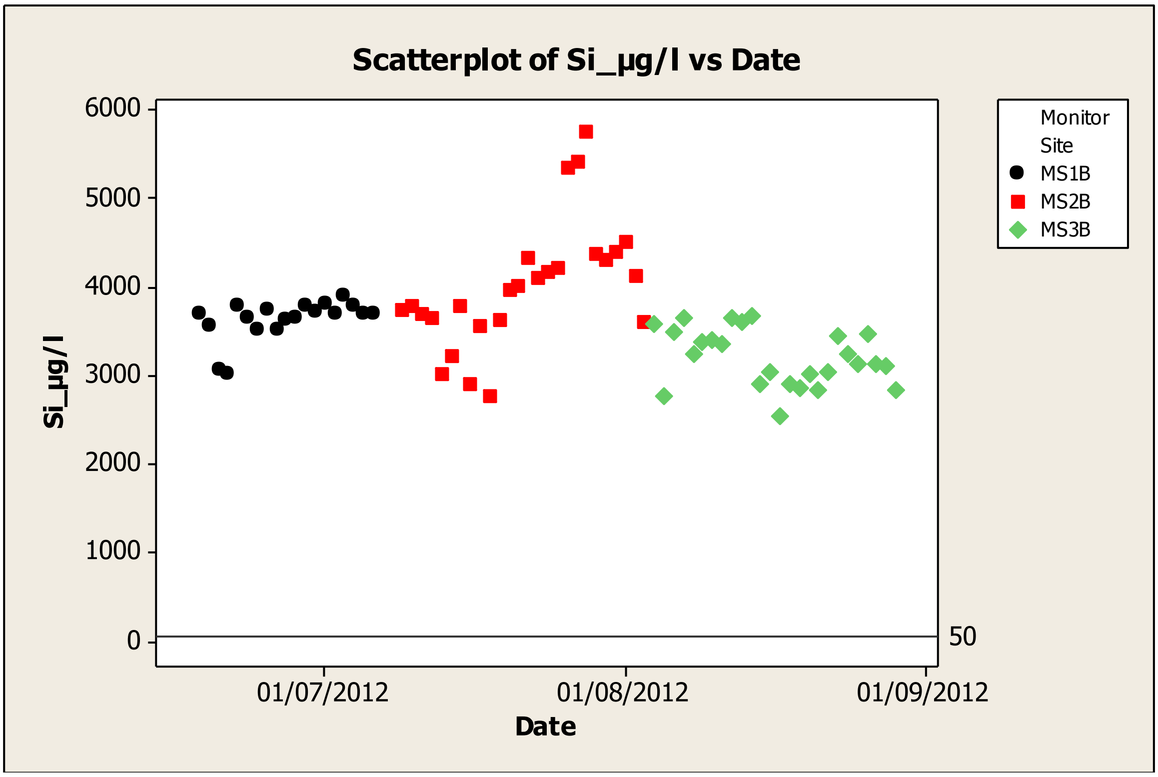

Scatterplot of Be_µg/l vs Date
Be_µg/l
0.05
0.04
0.03
0.02
0.01
0.00
0.01
01/07/2012
01/08/2012
01/09/2012
Date
Monitor Site
MS1B
MS2B
MS3B

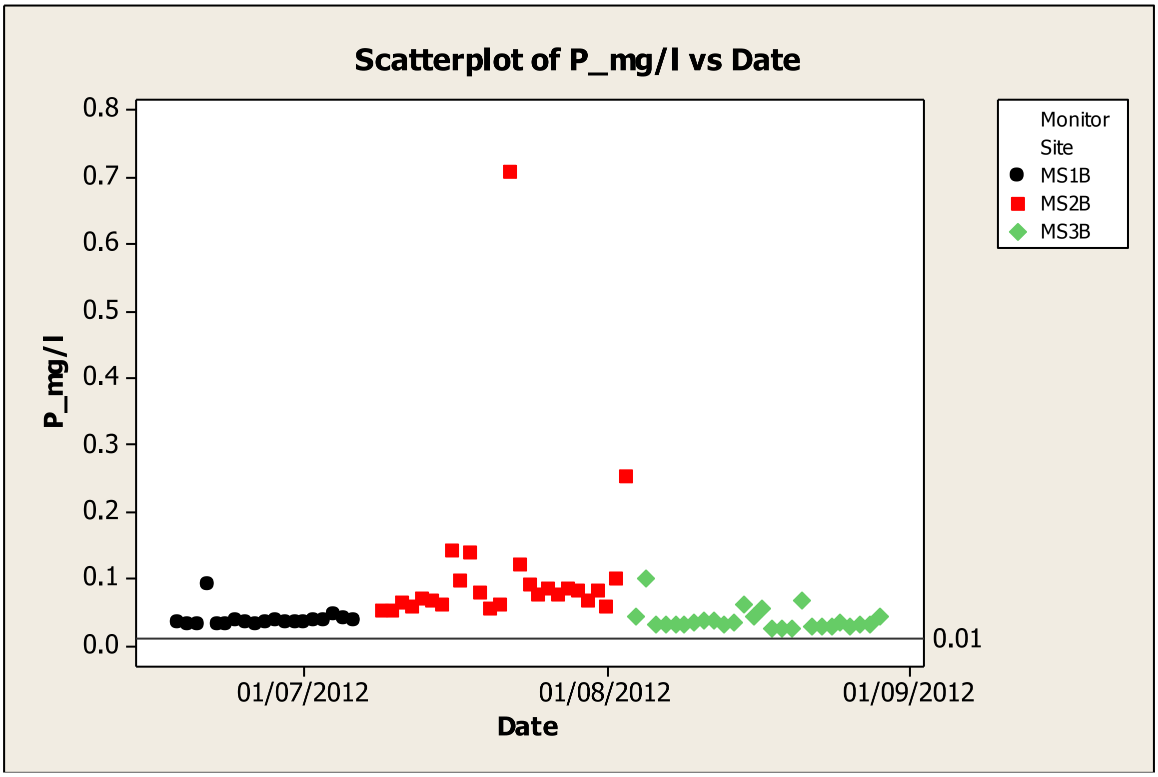

Scatterplot of B_µg/l vs Date
B ug/l
45
40
35
30
25
20
15
10
10
01/07/2012
01/08/2012
01/09/2012
Date
Monitor Site
MS1B
MS2B
MS3B


Scatterplot of Na_mg/l vs Date
Na_mg/l
25
20
15
10
5
0
0.2
01/07/2012
01/08/2012
01/09/2012
Date
Monitor Site
MS1B
MS2B
MS3B

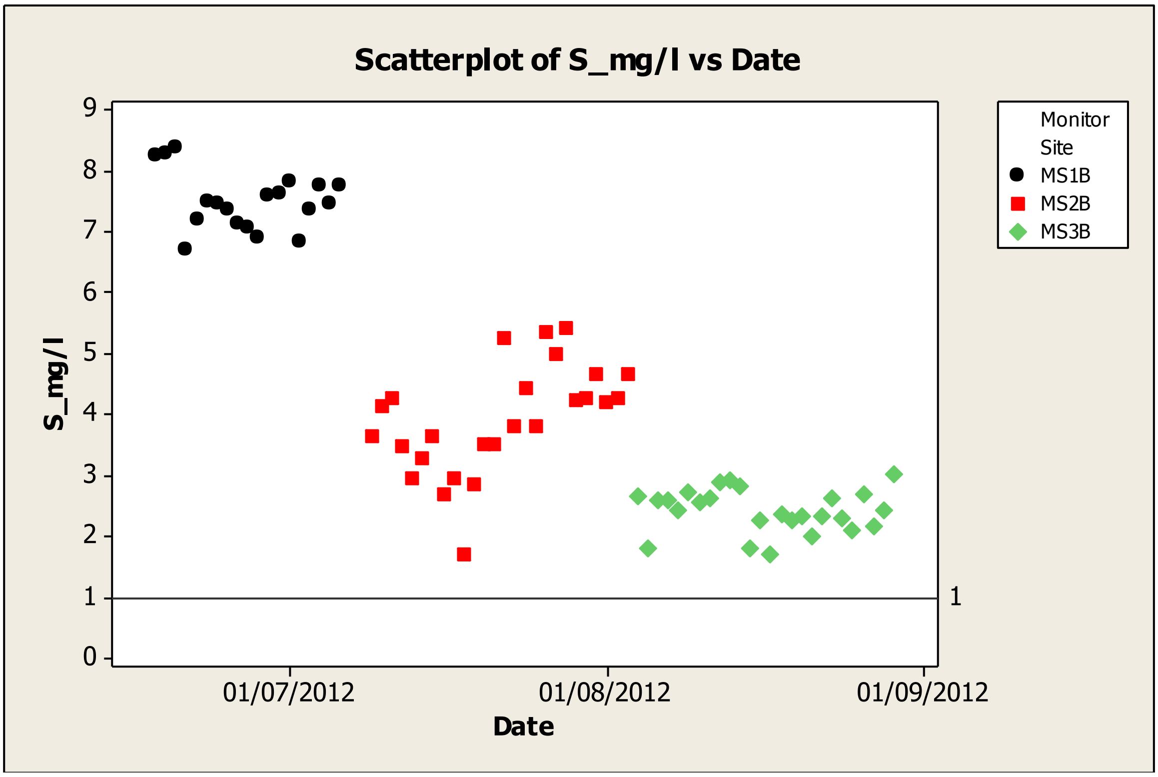

Scatterplot of Mg_mg/l vs Date
Mg_mg/l
10
8
6
4
2
0
0.01
01/07/2012
01/08/2012
01/09/2012
Date
Monitor Site
MS1B
MS2B
MS3B


Scatterplot of Al_µg/l vs Date
Al_µg/l
160
140
120
100
80
60
40
20
0
1
01/07/2012
01/08/2012
01/09/2012
Date
Monitor
Site
MS1B
MS2B
MS3B

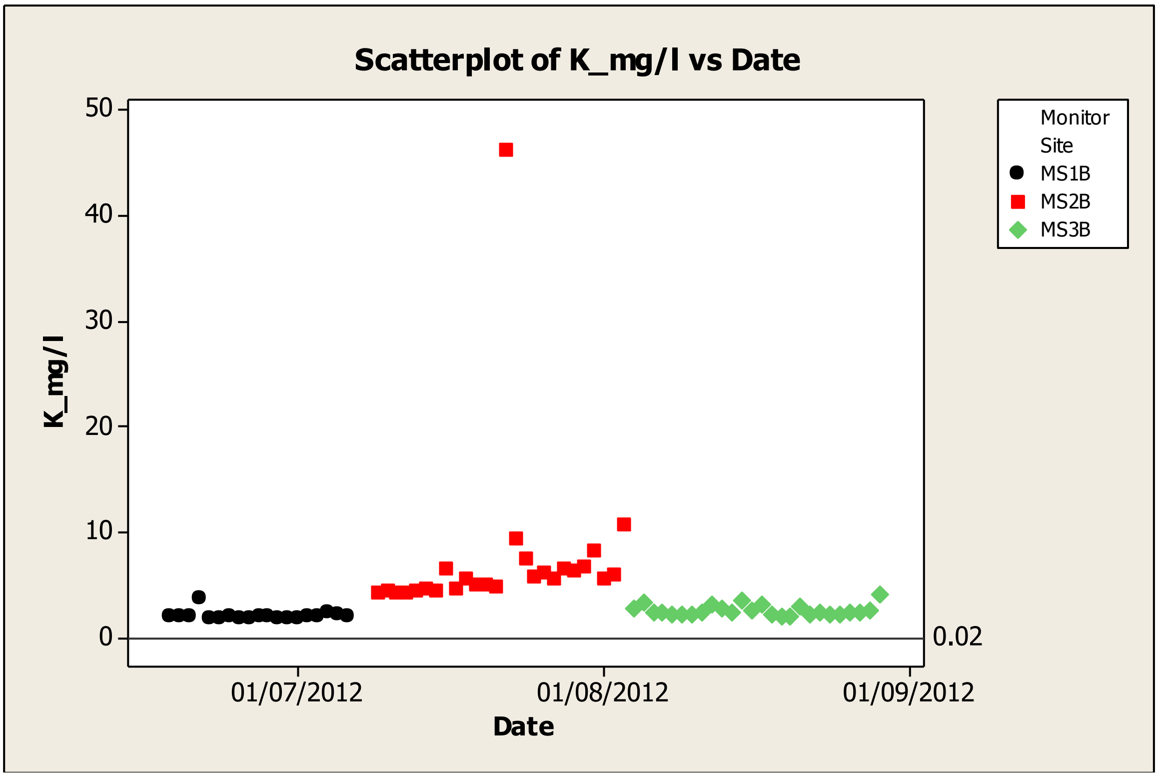

Scatterplot of Si_µg/l vs Date
Si_µg/l
6000
5000
4000
3000
2000
1000
0
50
01/07/2012
01/08/2012
01/09/2012
Date
Monitor
Site
MS1B
MS2B
MS3B

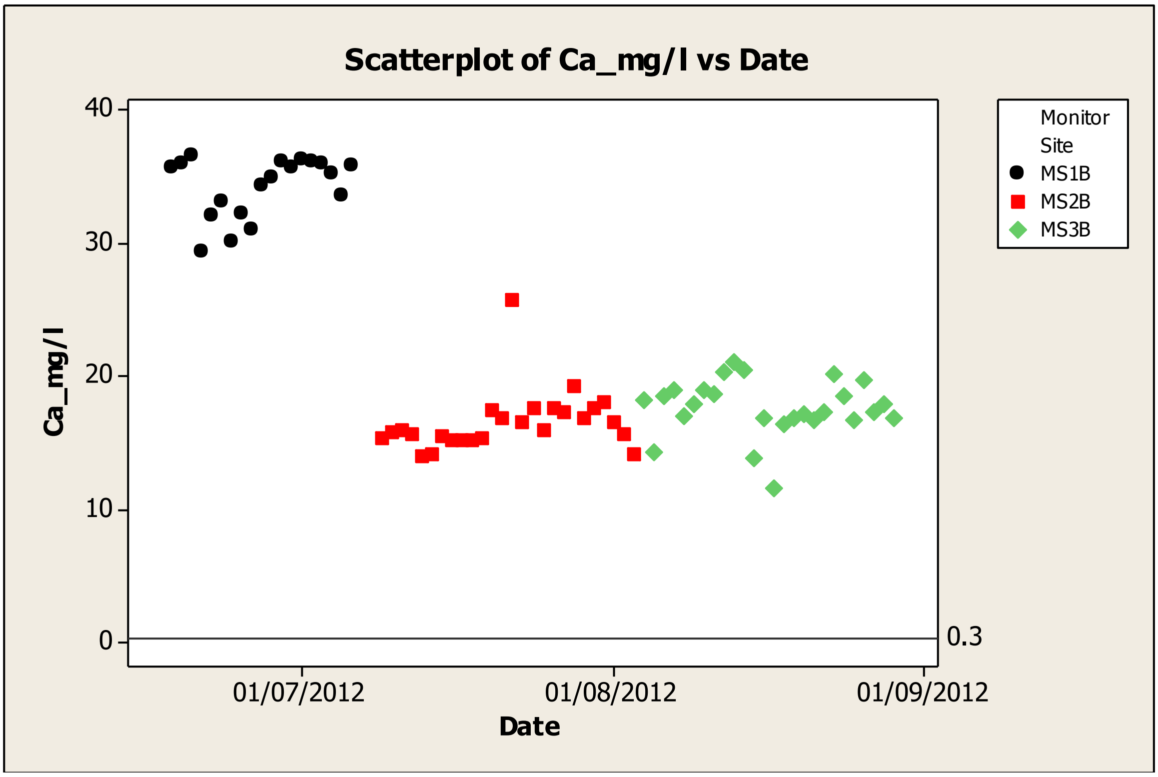


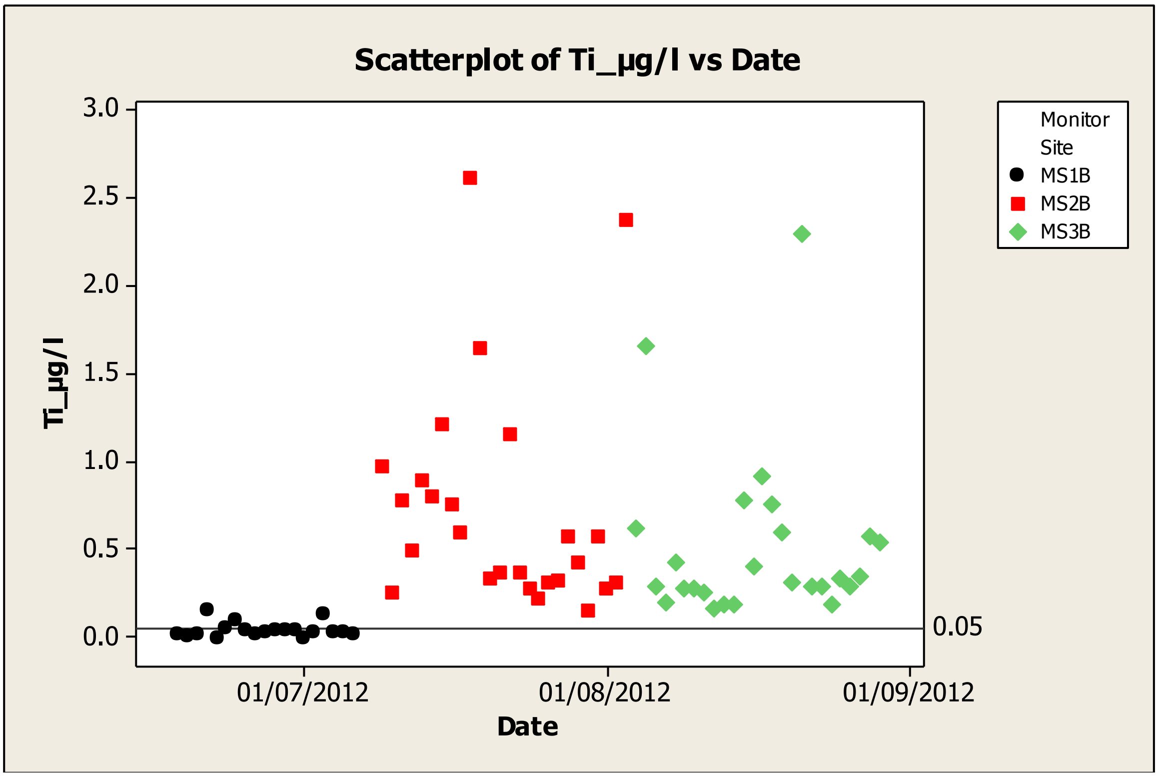
Scatterplot of P_mg/l vs Date
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
P_mg/l
0.01
01/07/2012
01/08/2012
01/09/2012
Date
Monitor Site
MS1B
MS2B
MS3B

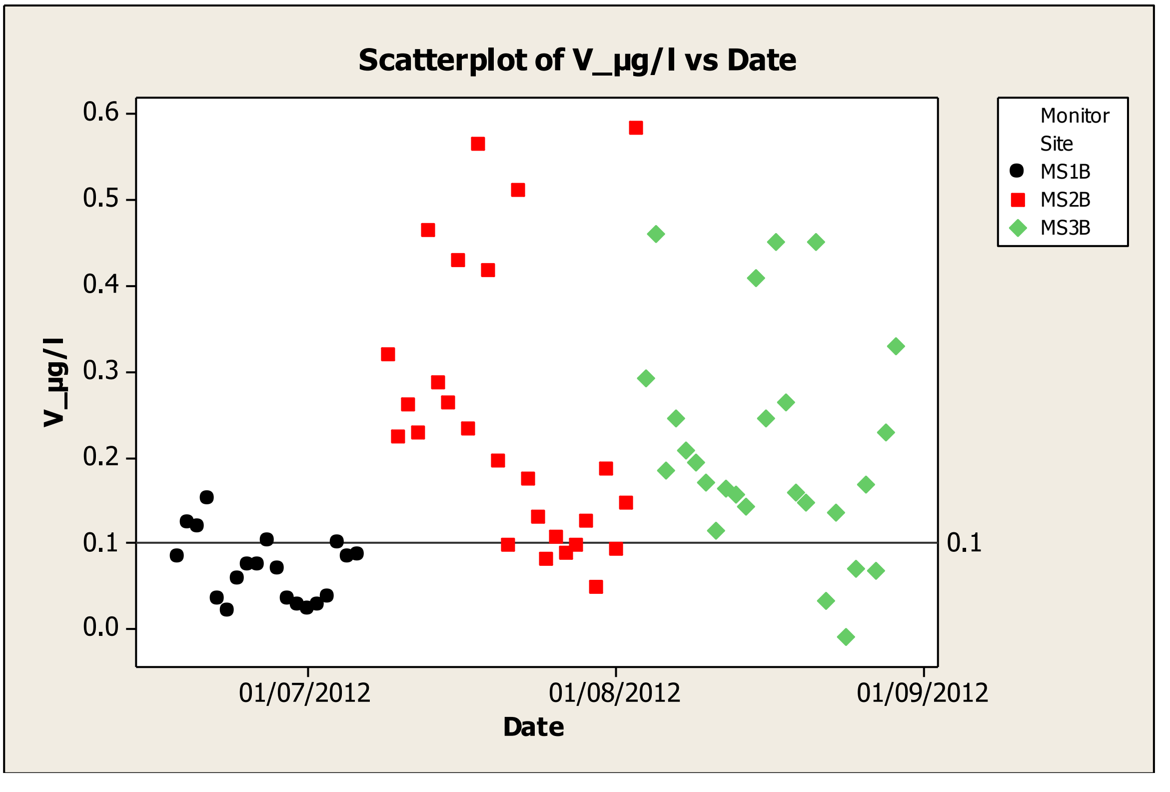


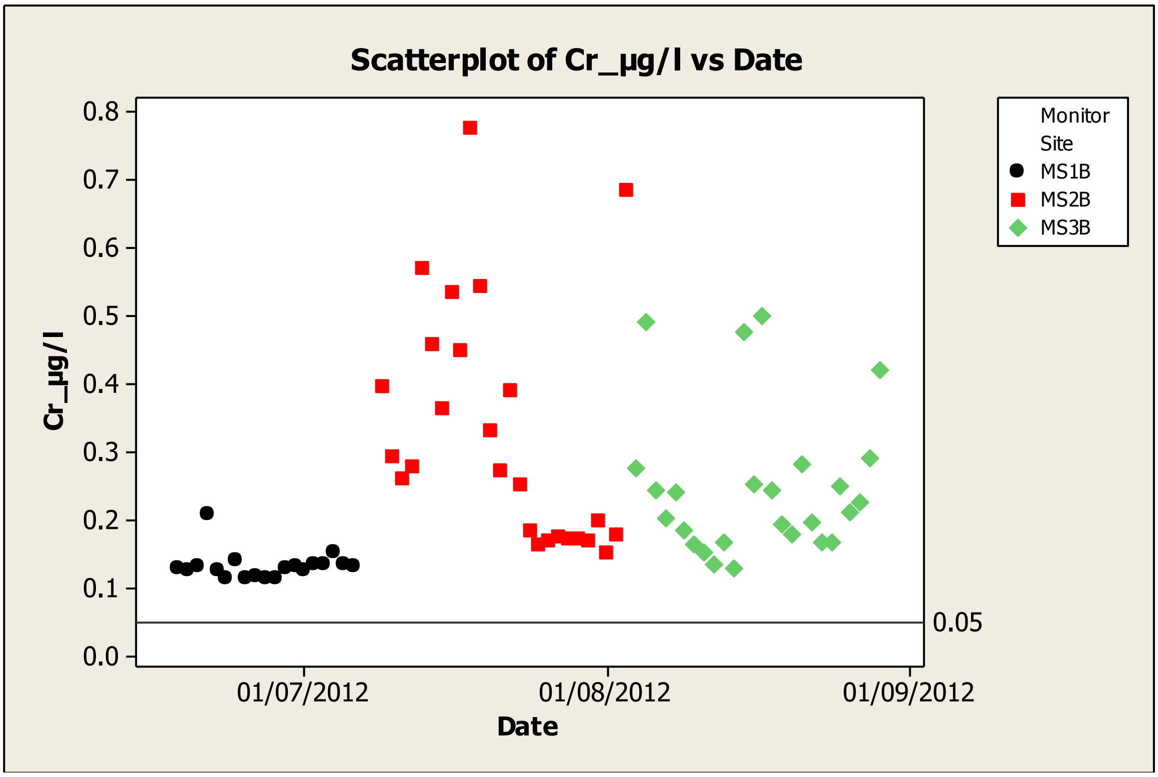
Scatterplot of S_mg/l vs Date
9
8
7
6
5
4
3
2
1
0
S_mg/l
1
01/07/2012
01/08/2012
01/09/2012
Date
Monitor Site
MS1B
MS2B
MS3B

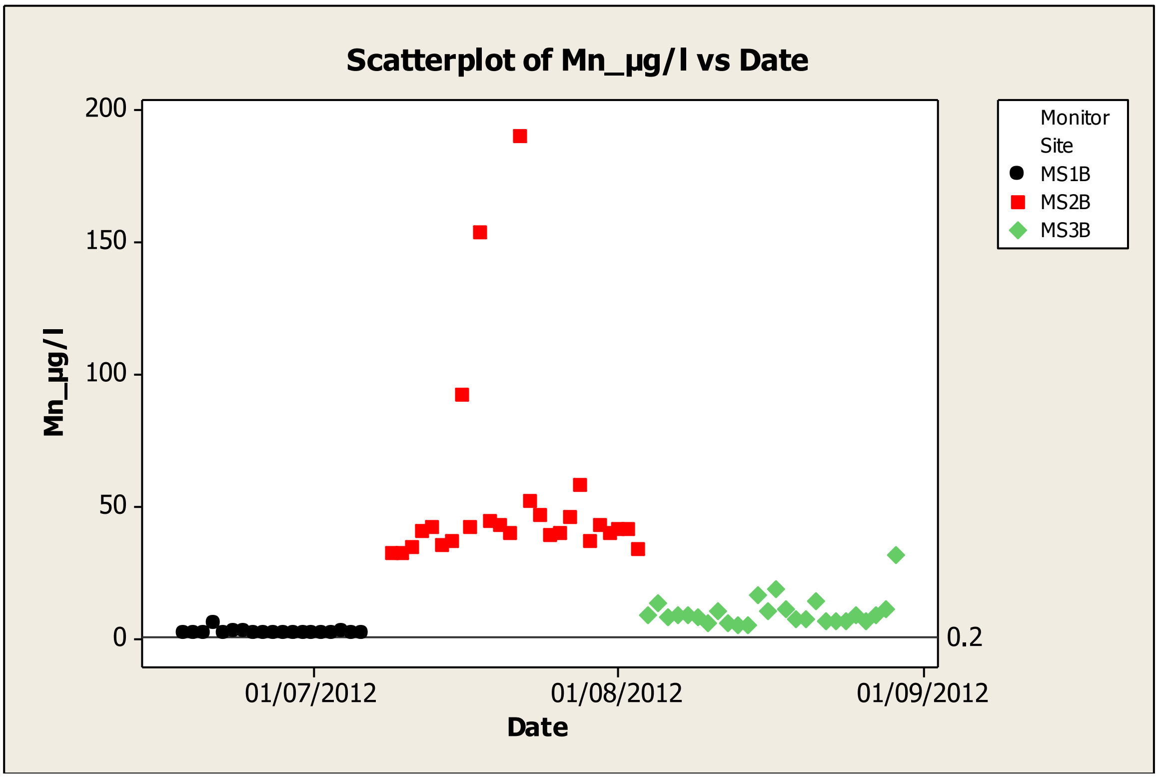

Scatterplot of K_mg/l vs Date
K_mg/l
50
40
30
20
10
0
0.02
01/07/2012
01/08/2012
01/09/2012
Date
Monitor Site
MS1B
MS2B
MS3B

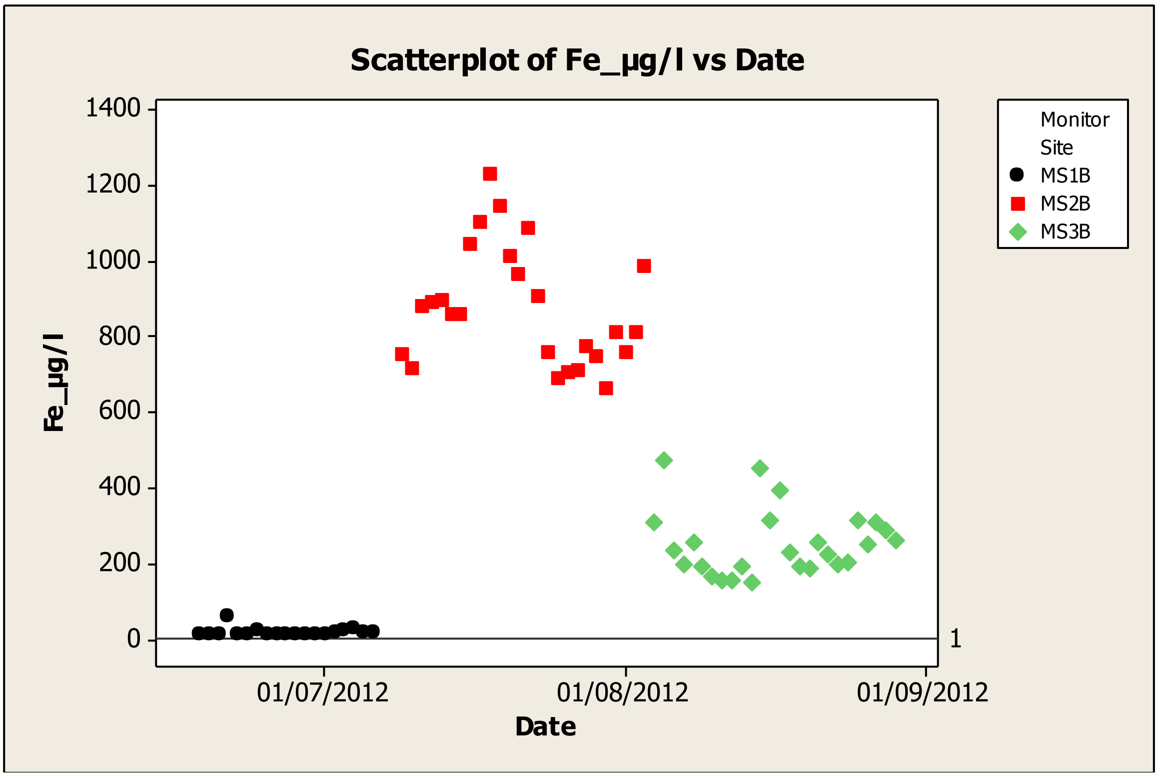

Scatterplot of Ca_mg/l vs Date
Ca_mg/l
40
30
20
10
0
0.3
01/07/2012
01/08/2012
01/09/2012
Date
Monitor Site
MS1B
MS2B
MS3B


Scatterplot of Ti_µg/l vs Date
Ti_µg/l
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.05
01/07/2012
01/08/2012
01/09/2012
Date
Monitor
Site
MS1B
MS2B
MS3B

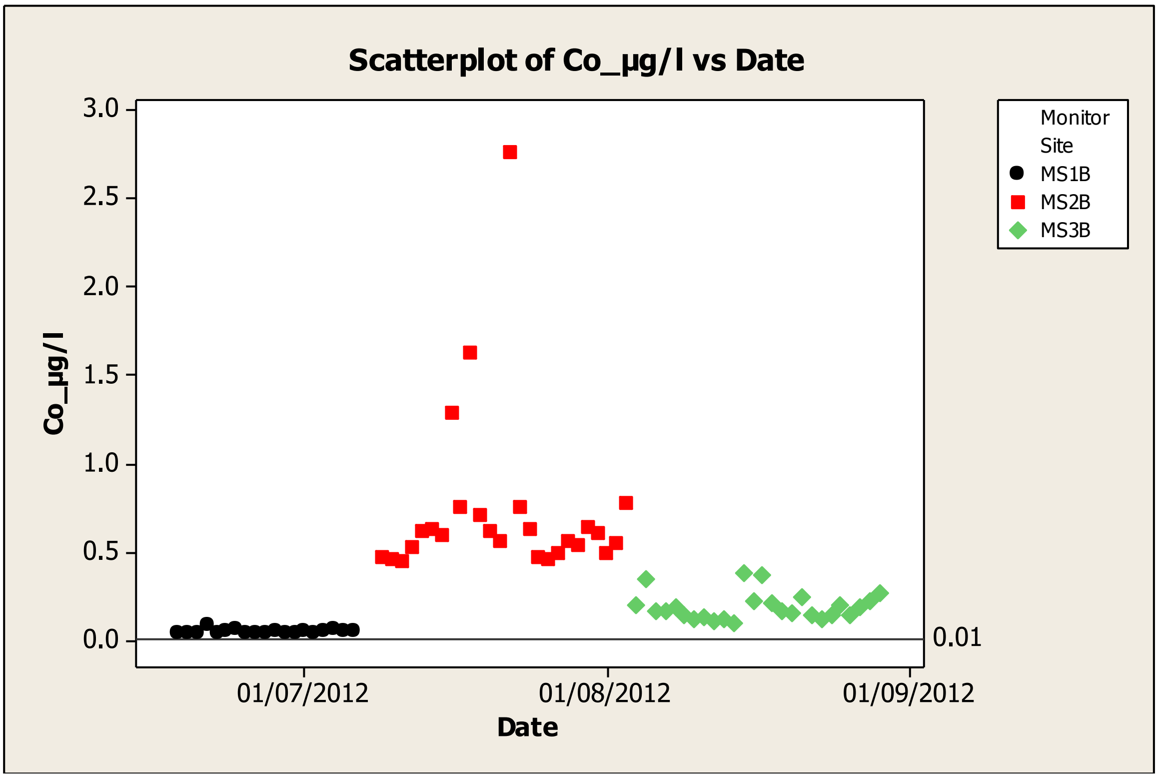

Scatterplot of V_µg/l vs Date
V_µg/l
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.1
01/07/2012
01/08/2012
01/09/2012
Date
Monitor
Site
MS1B
MS2B
MS3B


Scatterplot of Cr_µg/l vs Date
Cr_µg/l
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.05
01/07/2012
01/08/2012
01/09/2012
Date
Monitor Site
MS1B
MS2B
MS3B

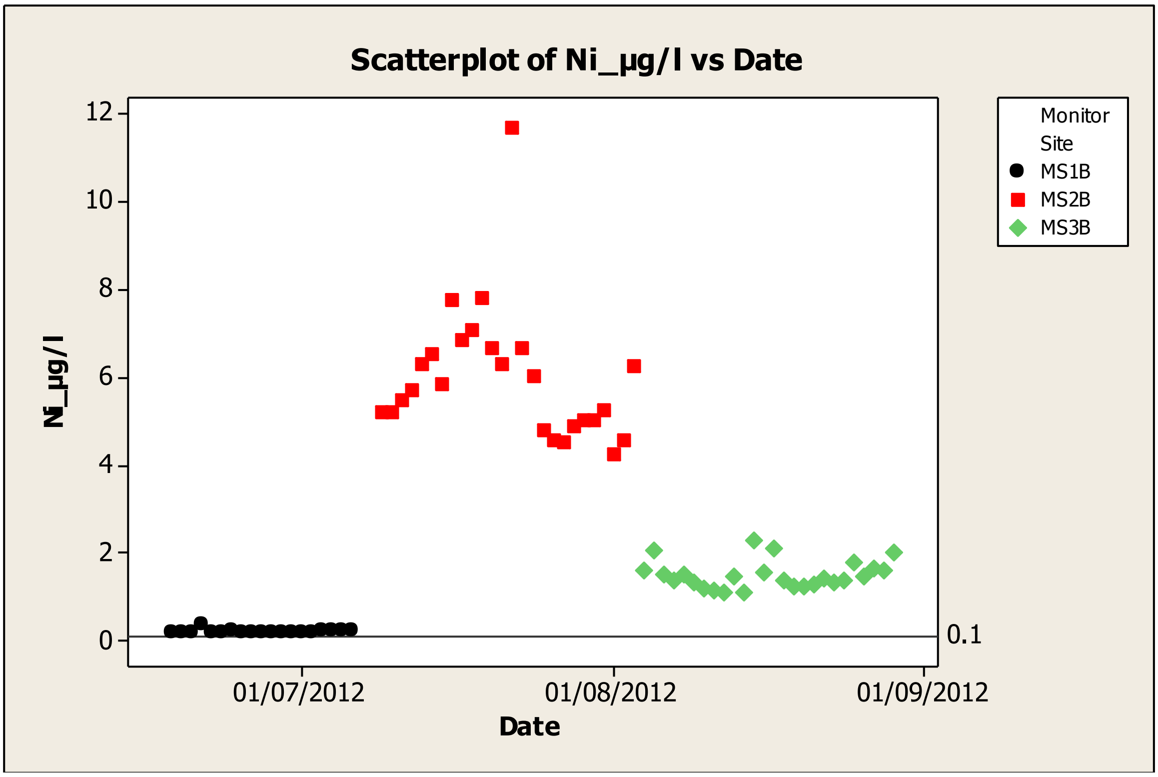

Scatterplot of Mn_µg/l vs Date
Mn_µg/l
200
150
100
50
0
0.2
01/07/2012
01/08/2012
01/09/2012
Date
Monitor Site
MS1B
MS2B
MS3B

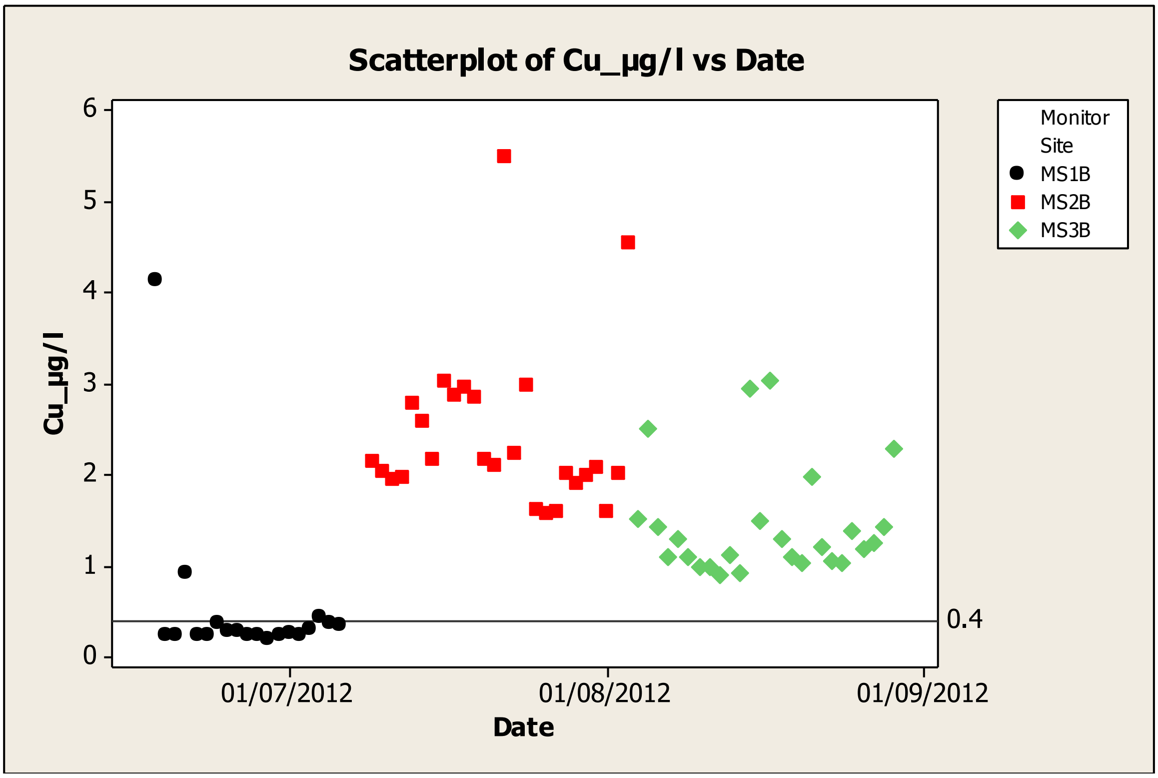


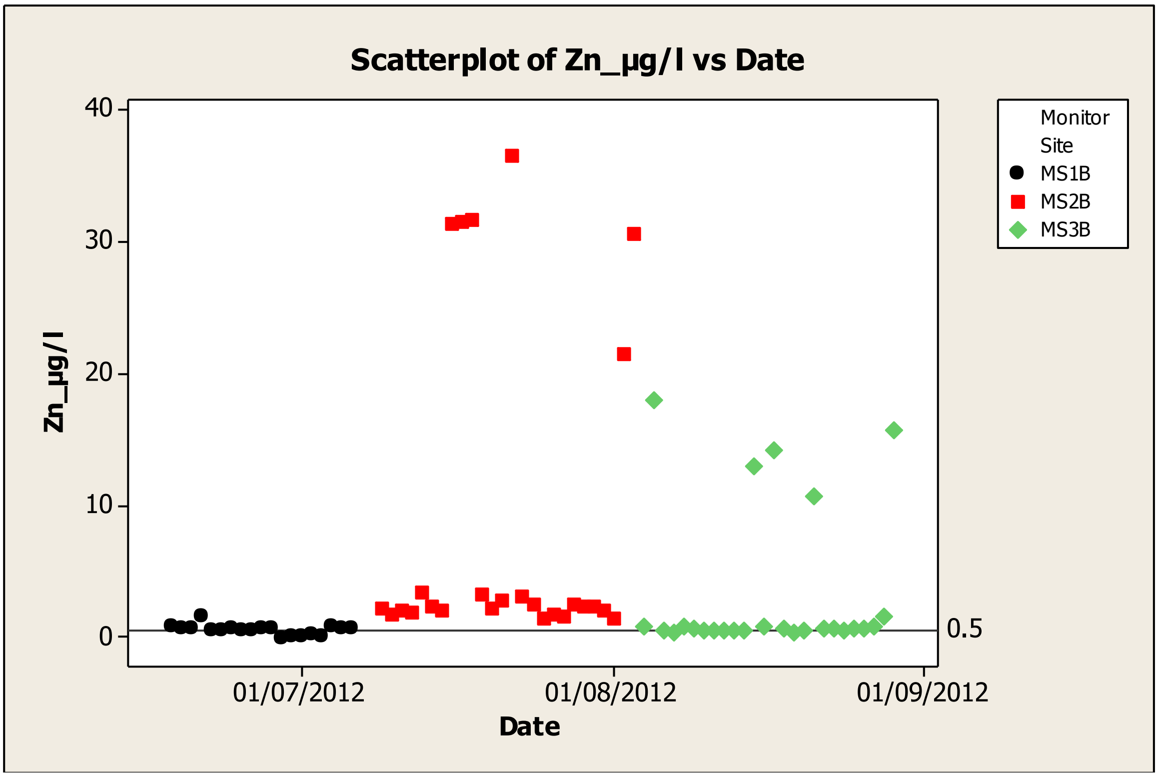
Scatterplot of Fe_µg/l vs Date
Fe_µg/l
1400
1200
1000
800
600
400
200
0
1
01/07/2012
01/08/2012
01/09/2012
Date
Monitor Site
MS1B
MS2B
MS3B



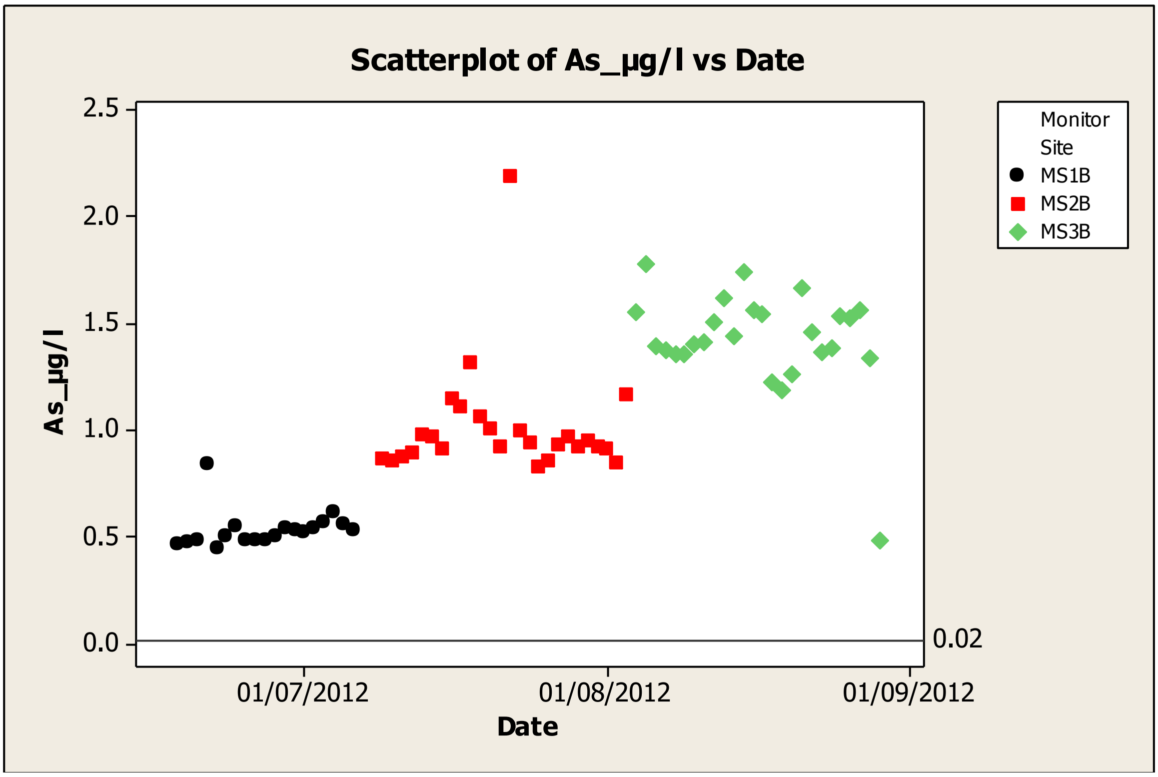
Scatterplot of Co_µg/l vs Date
Co_µg/l
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.01
01/07/2012
01/08/2012
01/09/2012
Date
Monitor Site
MS1B
MS2B
MS3B


Scatterplot of Ni_µg/l vs Date
Ni_µg/l
12
10
8
6
4
2
0
0.1
01/07/2012
01/08/2012
01/09/2012
Date
Monitor
Site
MS1B
MS2B
MS3B

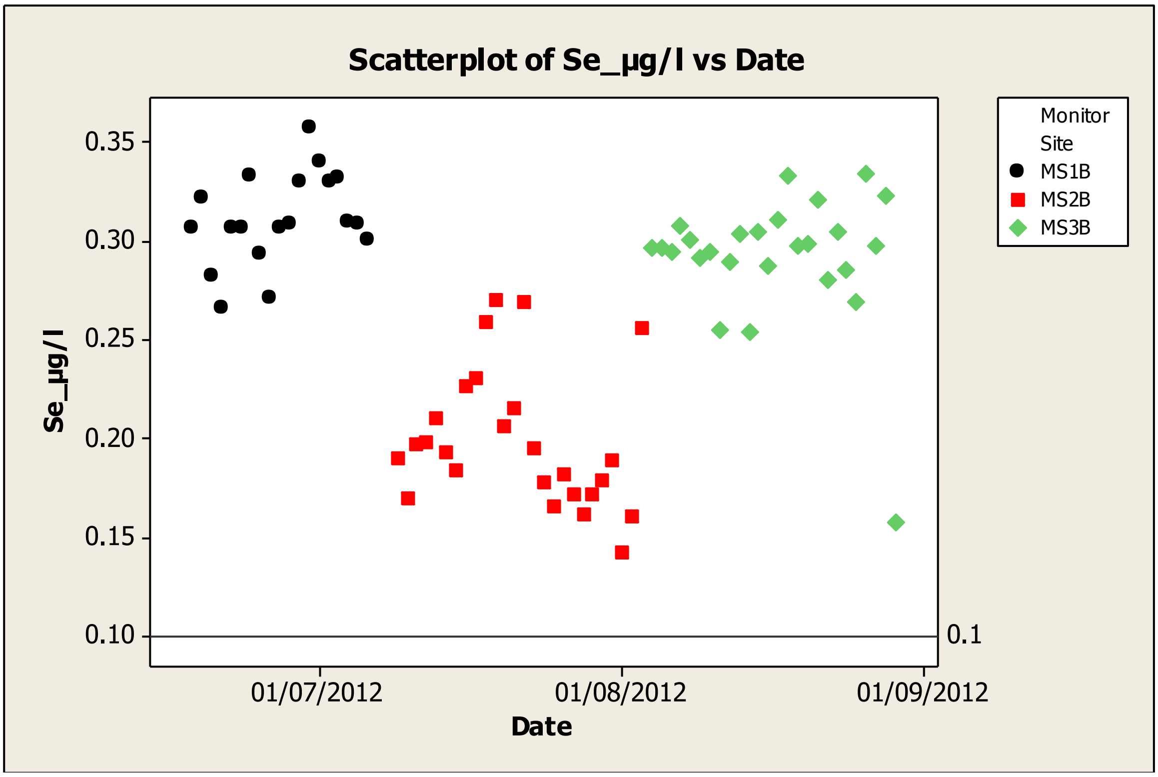

Scatterplot of Cu_µg/l vs Date
Cu_µg/l
6
5
4
3
2
1
0
0.4
01/07/2012
01/08/2012
01/09/2012
Date
Monitor
Site
MS1B
MS2B
MS3B

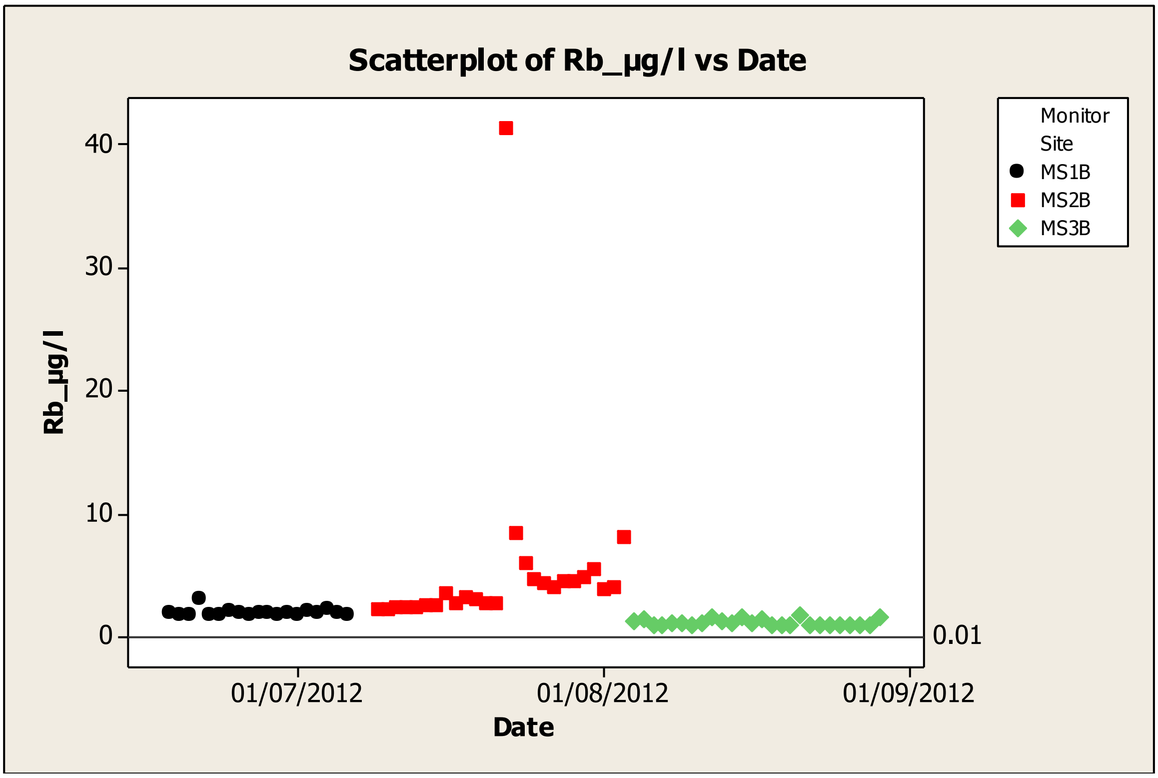


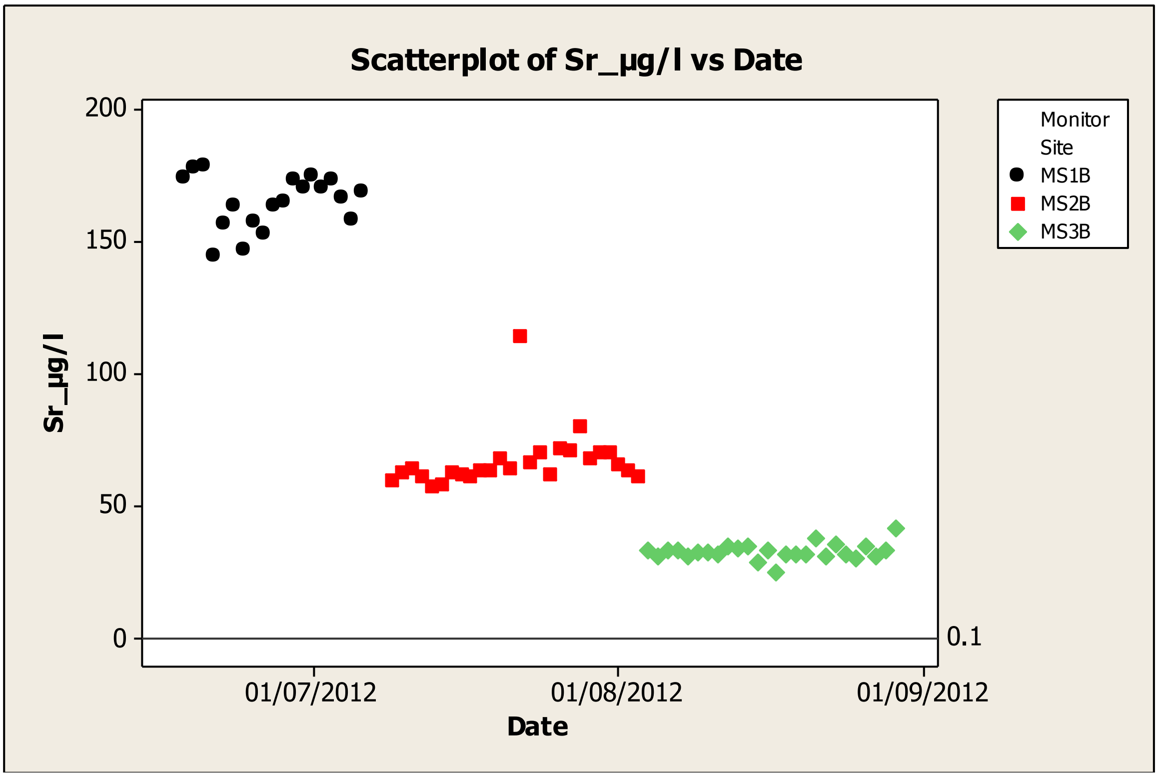
Scatterplot of Zn_µg/l vs Date
Zn_µg/l
40
30
20
10
0
0.5
01/07/2012
01/08/2012
01/09/2012
Date
Monitor Site
MS1B
MS2B
MS3B

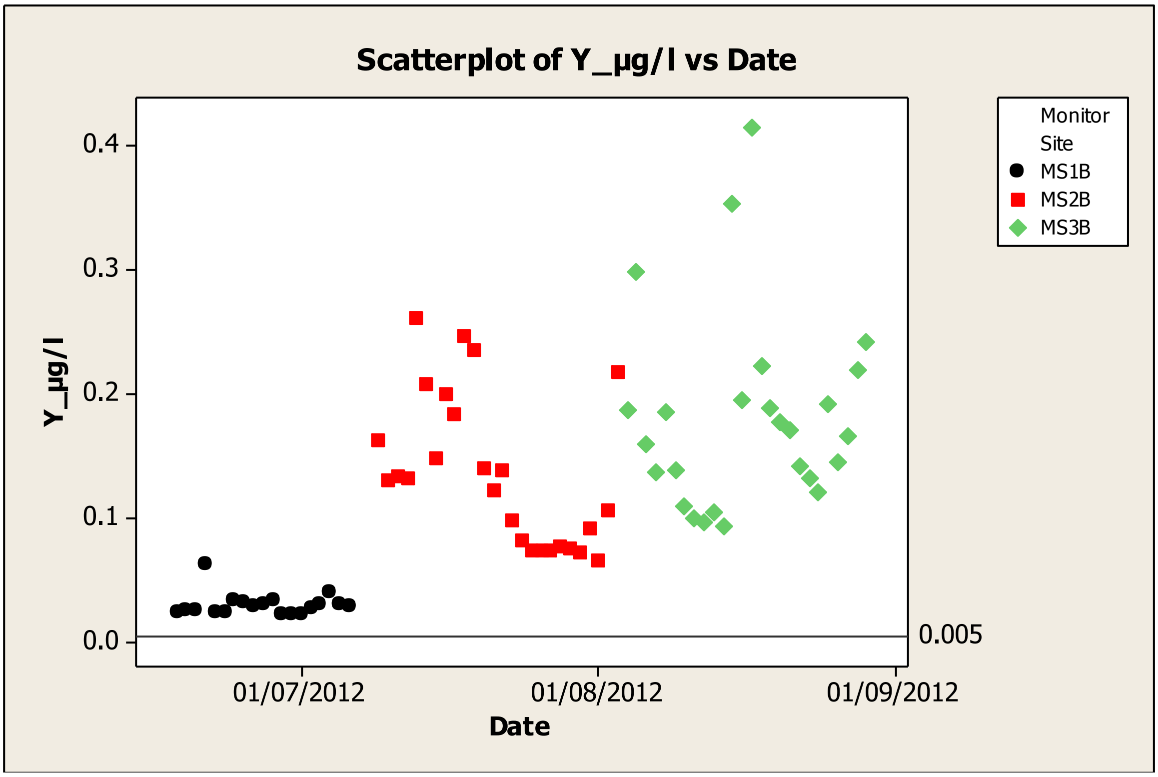


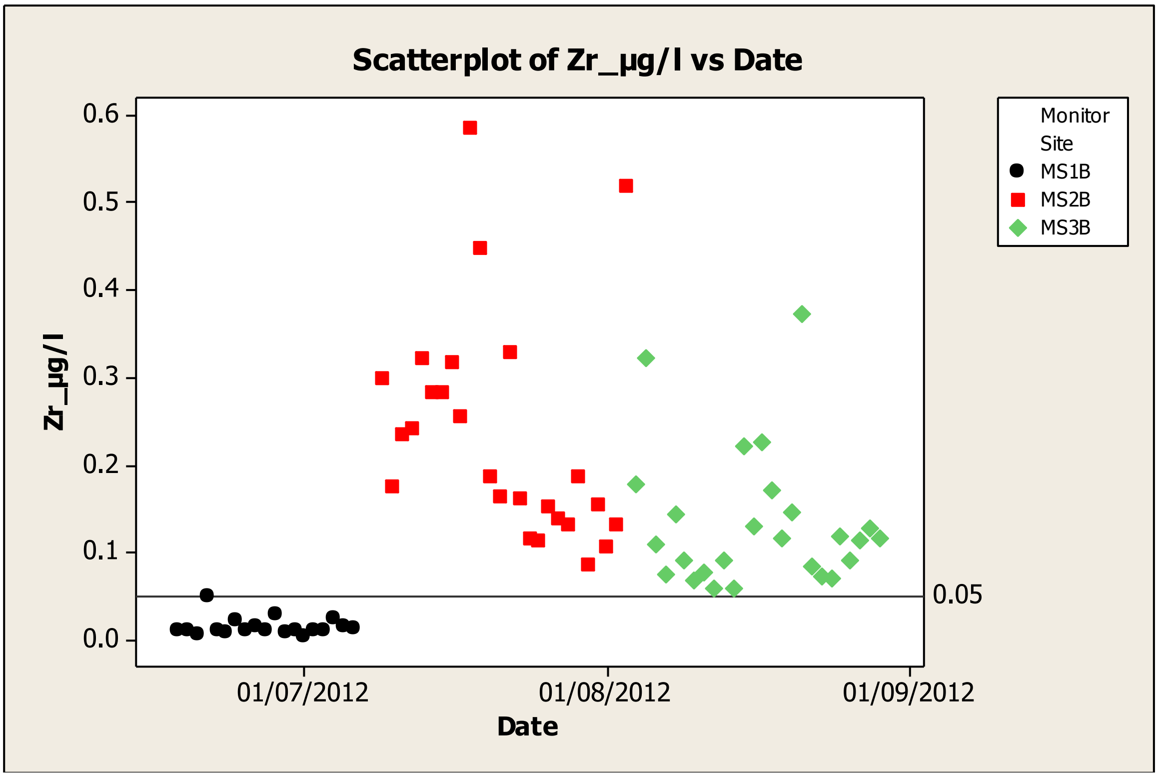
Scatterplot of As_µg/l vs Date
As_µg/l
2.5
2.0
1.5
1.0
0.5
0.0
0.02
01/07/2012
01/08/2012
01/09/2012
Date
Monitor Site
MS1B
MS2B
MS3B


Scatterplot of Se_µg/l vs Date
Se_µg/l
0.35
0.30
0.25
0.20
0.15
0.10
0.1
01/07/2012
01/08/2012
01/09/2012
Date
Monitor Site
MS1B
MS2B
MS3B

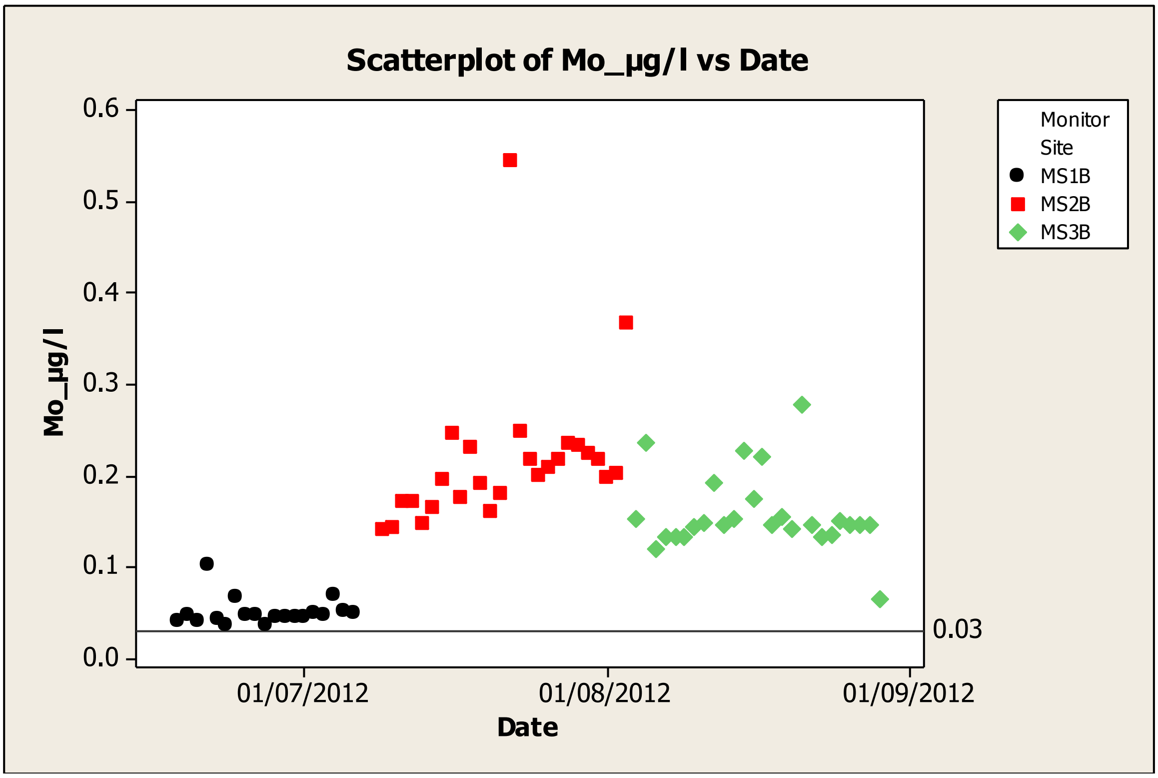

Scatterplot of Rb_µg/l vs Date
Rb_µg/l
40
30
20
10
0
0.01
01/07/2012
01/08/2012
01/09/2012
Date
Monitor Site
MS1B
MS2B
MS3B


Scatterplot of Sr_µg/l vs Date
Sr_µg/l
200
150
100
50
0
0.1
01/07/2012
01/08/2012
01/09/2012
Date
Monitor
Site
MS1B
MS2B
MS3B

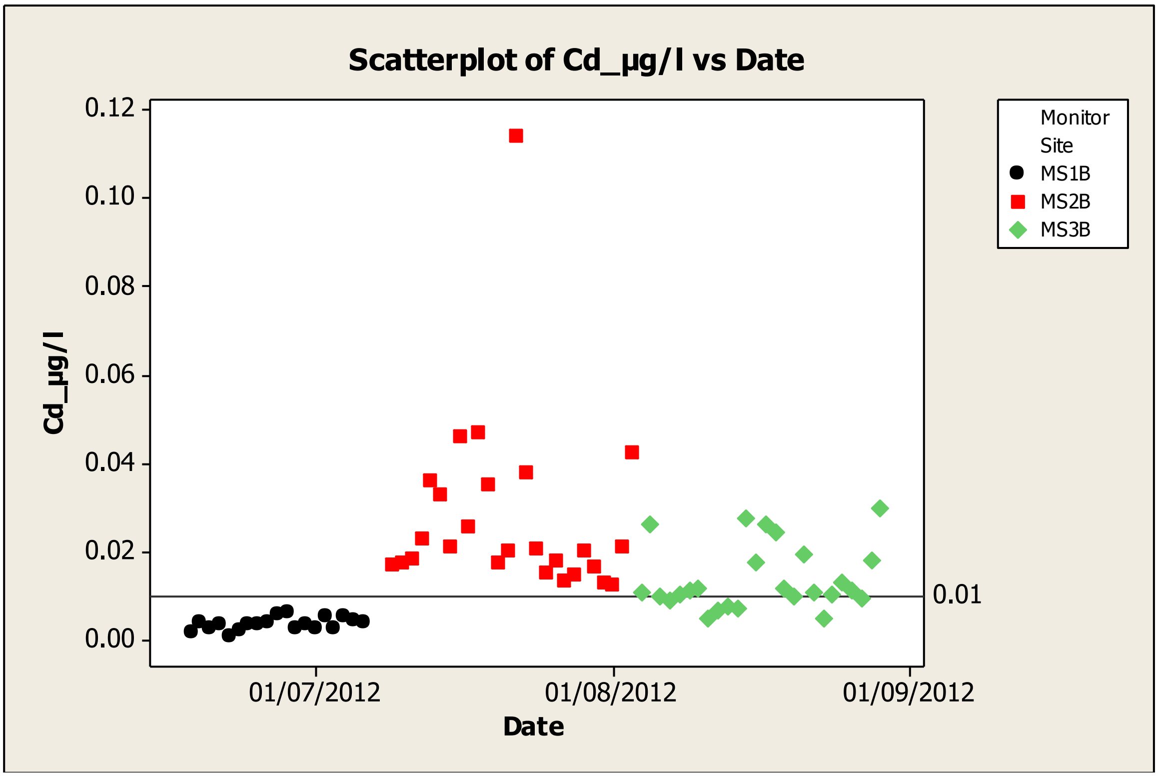

Scatterplot of Y_µg/l vs Date
Y_µg/l
0.4
0.3
0.2
0.1
0.0
0.005
01/07/2012
01/08/2012
01/09/2012
Date
Monitor
Site
MS1B
MS2B
MS3B

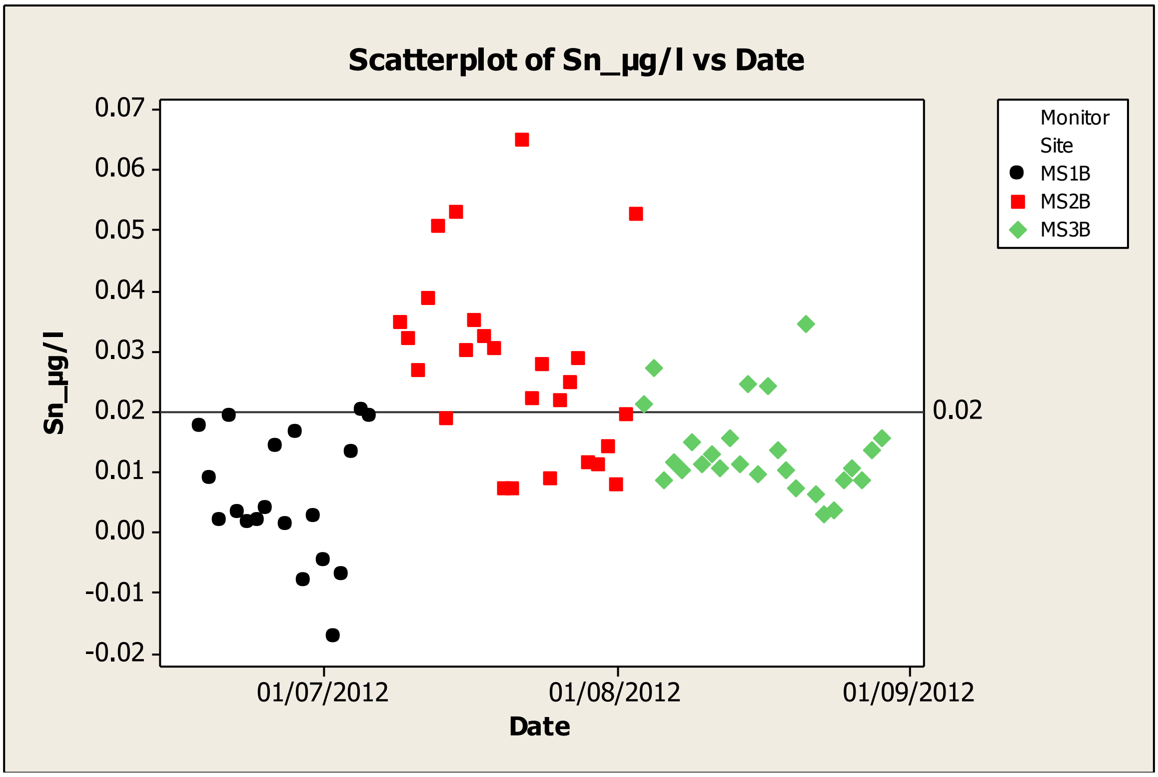


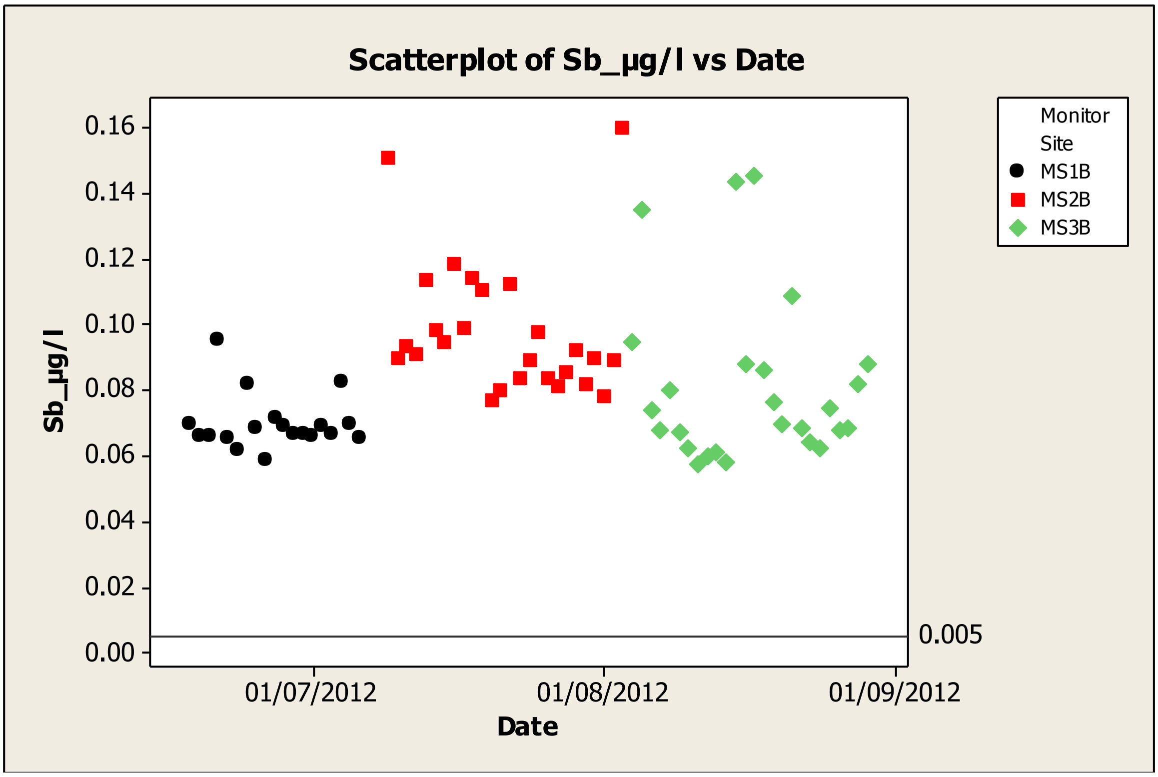
Scatterplot of Zr_µg/l vs Date
Zr_µg/l
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.05
01/07/2012
01/08/2012
01/09/2012
Date
Monitor Site
MS1B
MS2B
MS3B

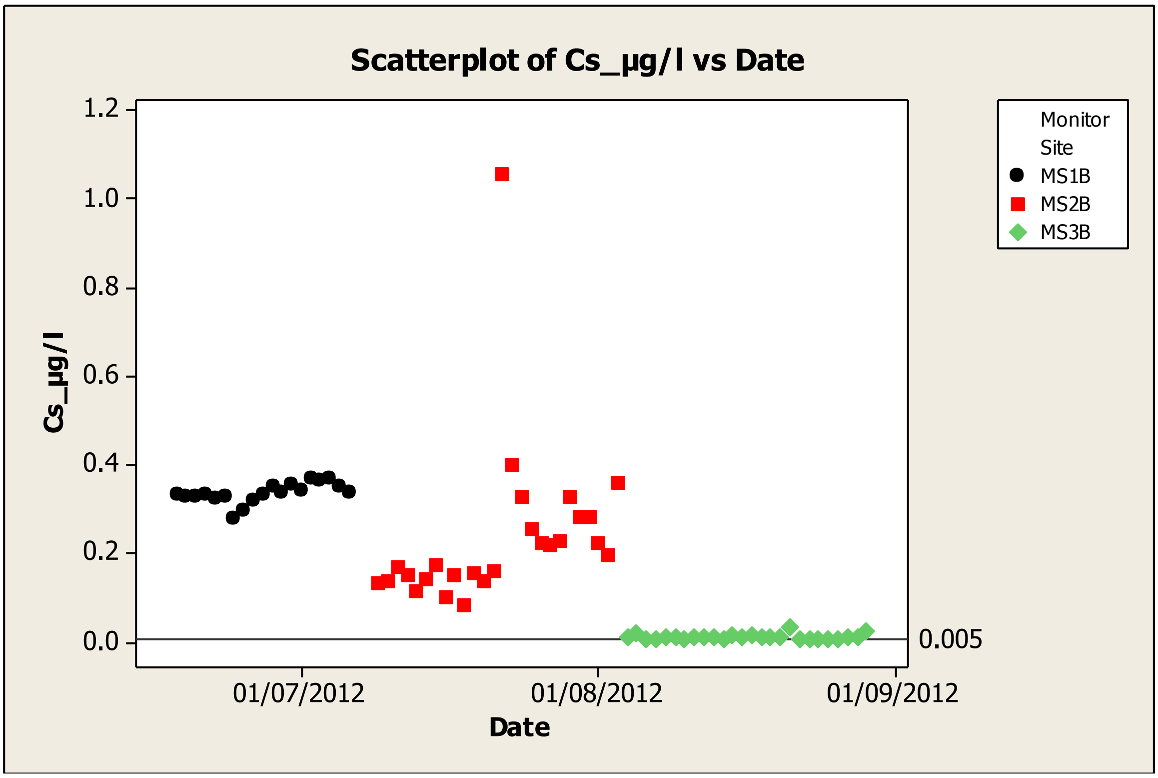


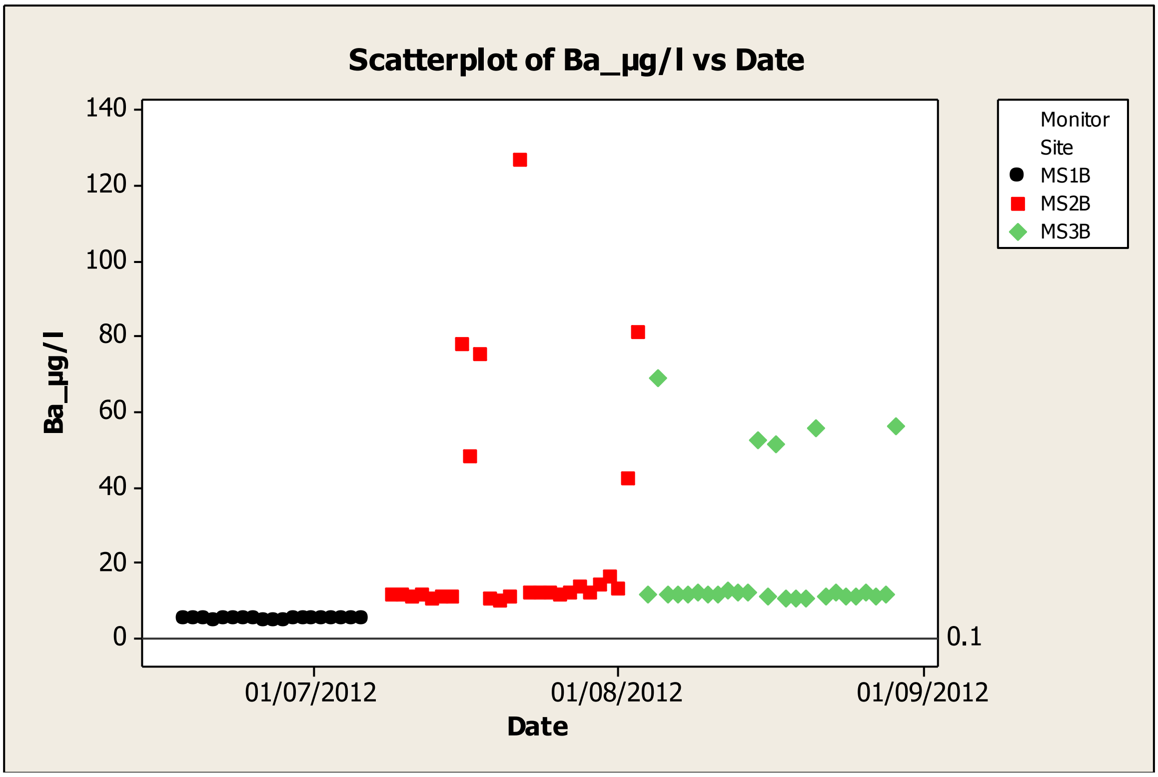
Scatterplot of Mo_µg/l vs Date
Mo_µg/l
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.03
01/07/2012
01/08/2012
01/09/2012
Date
Monitor Site
MS1B
MS2B
MS3B

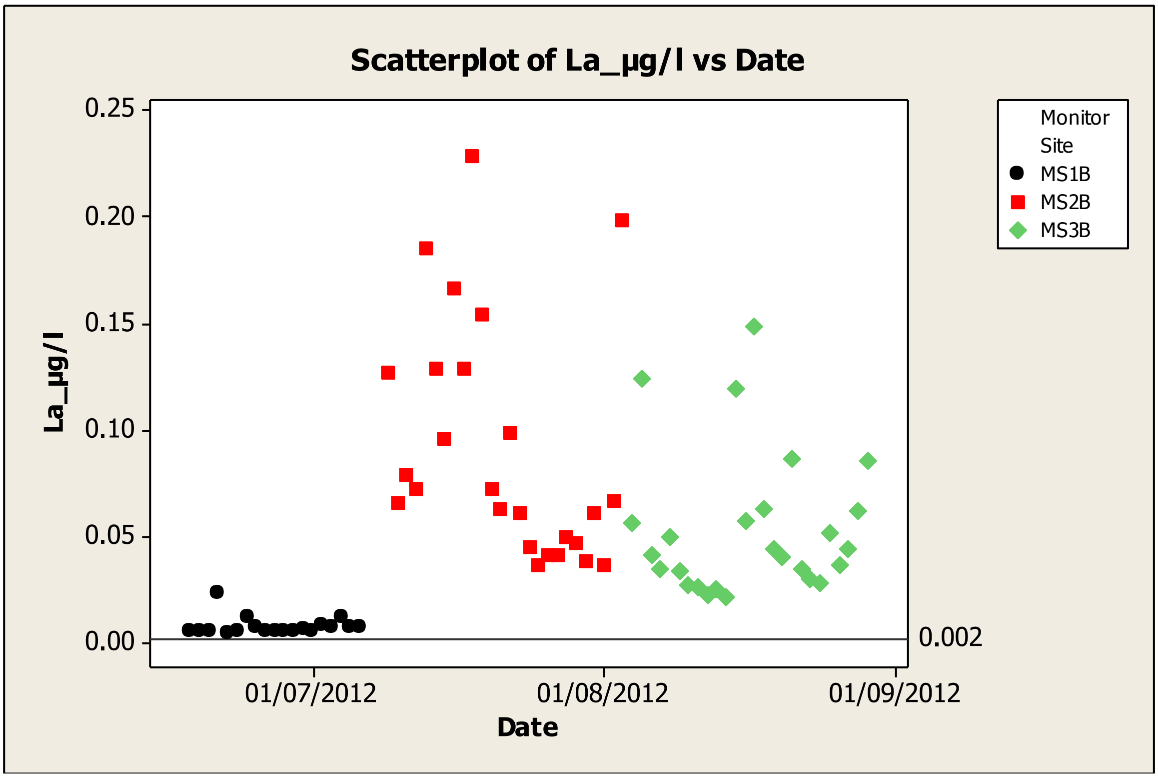

Scatterplot of Cd_µg/l vs Date
Cd_µg/l
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0.01
01/07/2012
01/08/2012
01/09/2012
Date
Monitor Site
MS1B
MS2B
MS3B

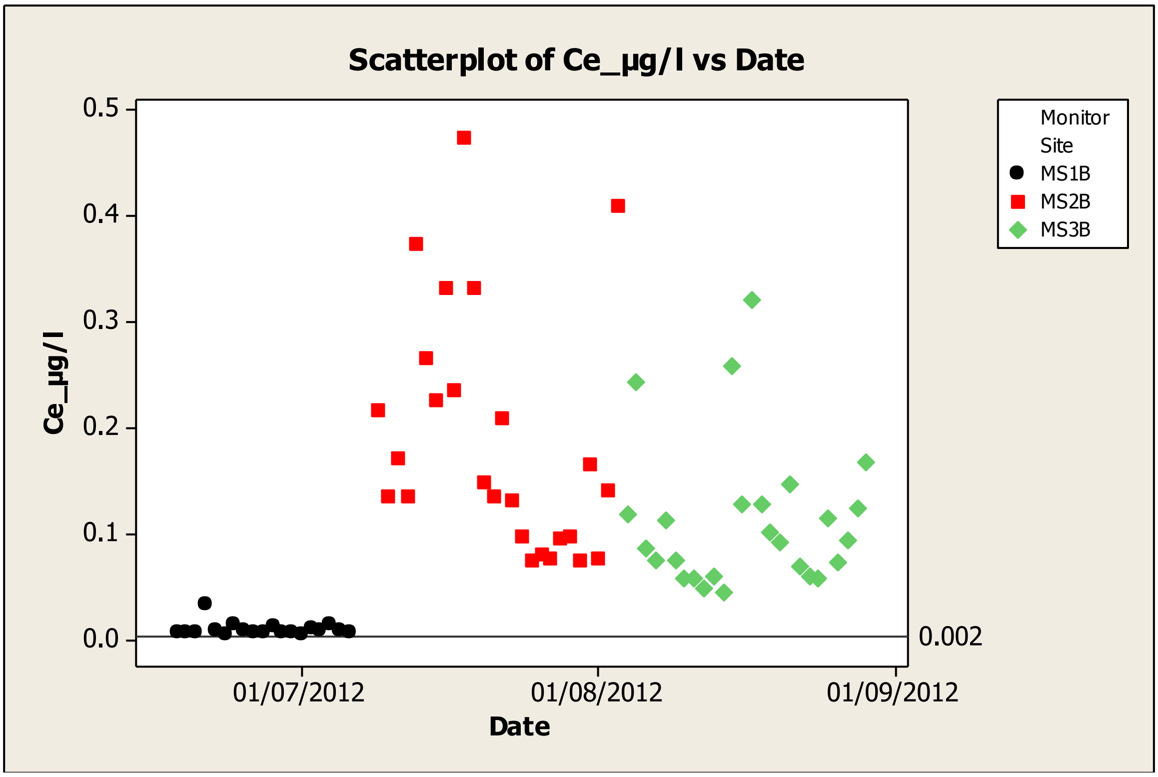

Scatterplot of Sn_µg/l vs Date
Sn_µg/l
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
-0.01
-0.02
0.02
01/07/2012
01/08/2012
01/09/2012
Date
Monitor Site
MS1B
MS2B
MS3B


Scatterplot of Sb_µg/l vs Date
Sb_µg/l
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0.005
01/07/2012
01/08/2012
01/09/2012
Date
Monitor Site
MS1B
MS2B
MS3B

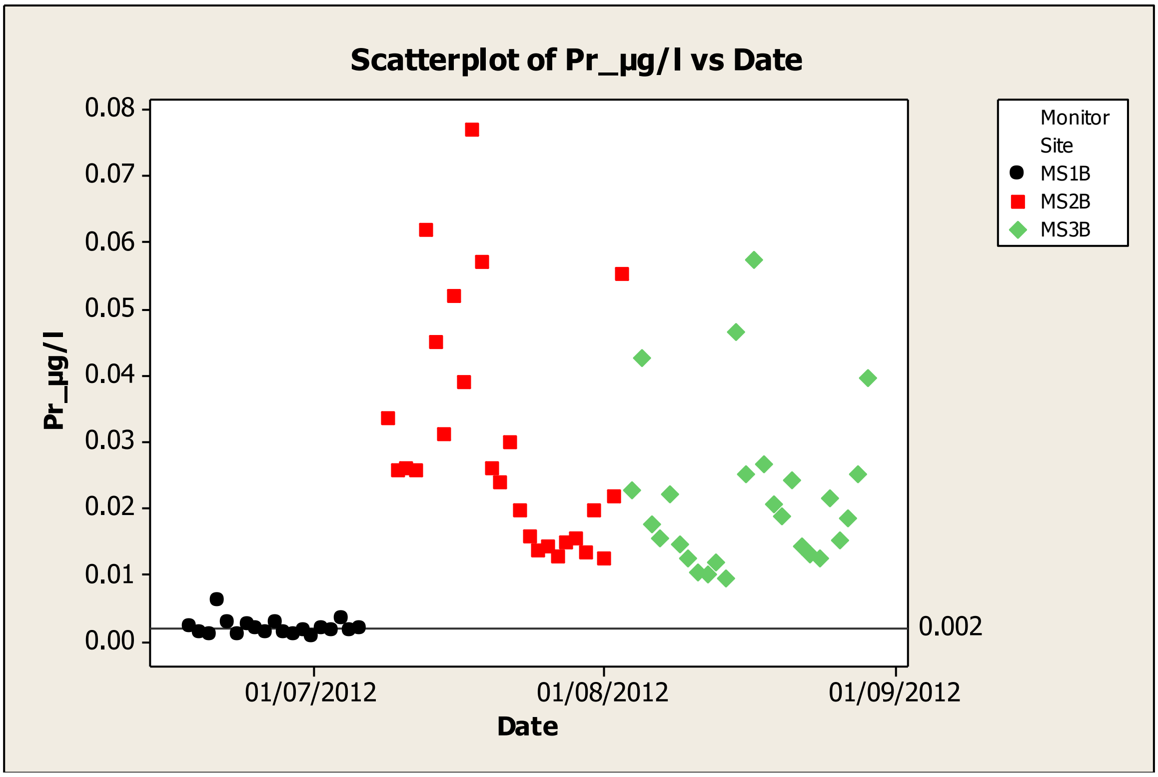

Scatterplot of Cs_µg/l vs Date
Cs_µg/l
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0.005
01/07/2012
01/08/2012
01/09/2012
Date
Monitor Site
MS1B
MS2B
MS3B


Scatterplot of Ba_µg/l vs Date
Ba_µg/l
140
120
100
80
60
40
20
0
0.1
01/07/2012
01/08/2012
01/09/2012
Date
Monitor Site
MS1B
MS2B
MS3B

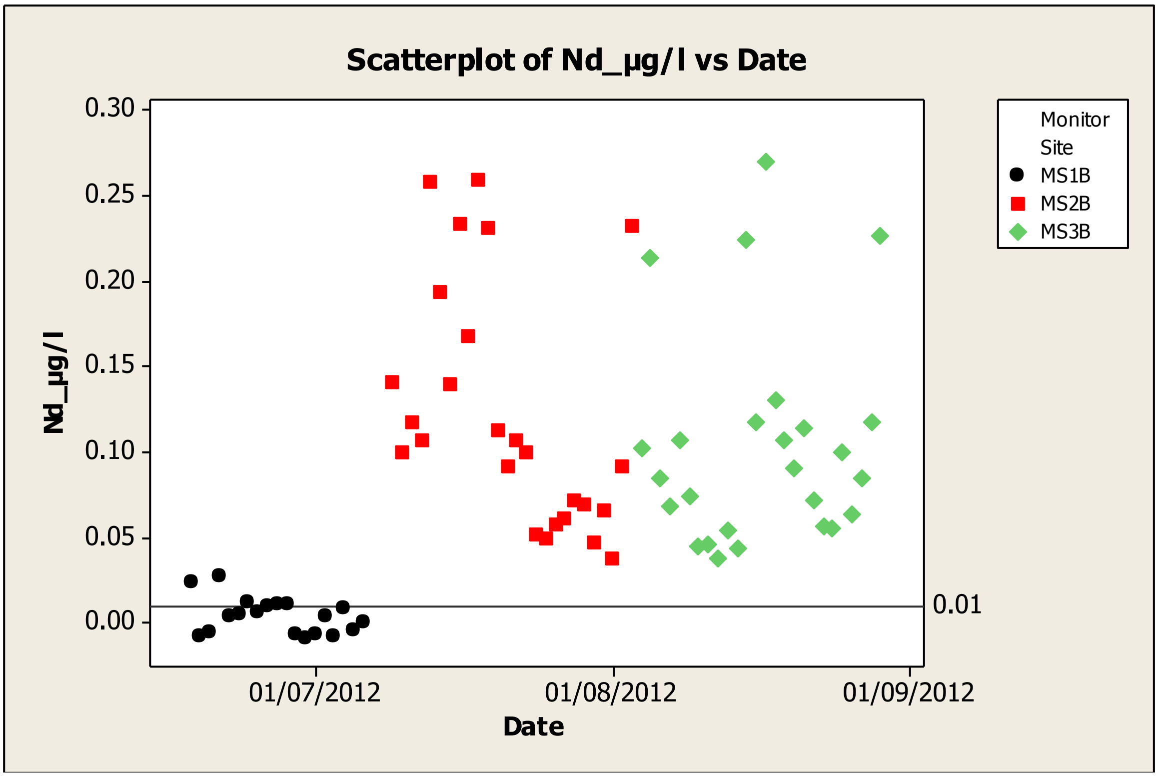

Scatterplot of La_µg/l vs Date
La_µg/l
0.25
0.20
0.15
0.10
0.05
0.00
0.002
01/07/2012
01/08/2012
01/09/2012
Date
Monitor Site
MS1B
MS2B
MS3B

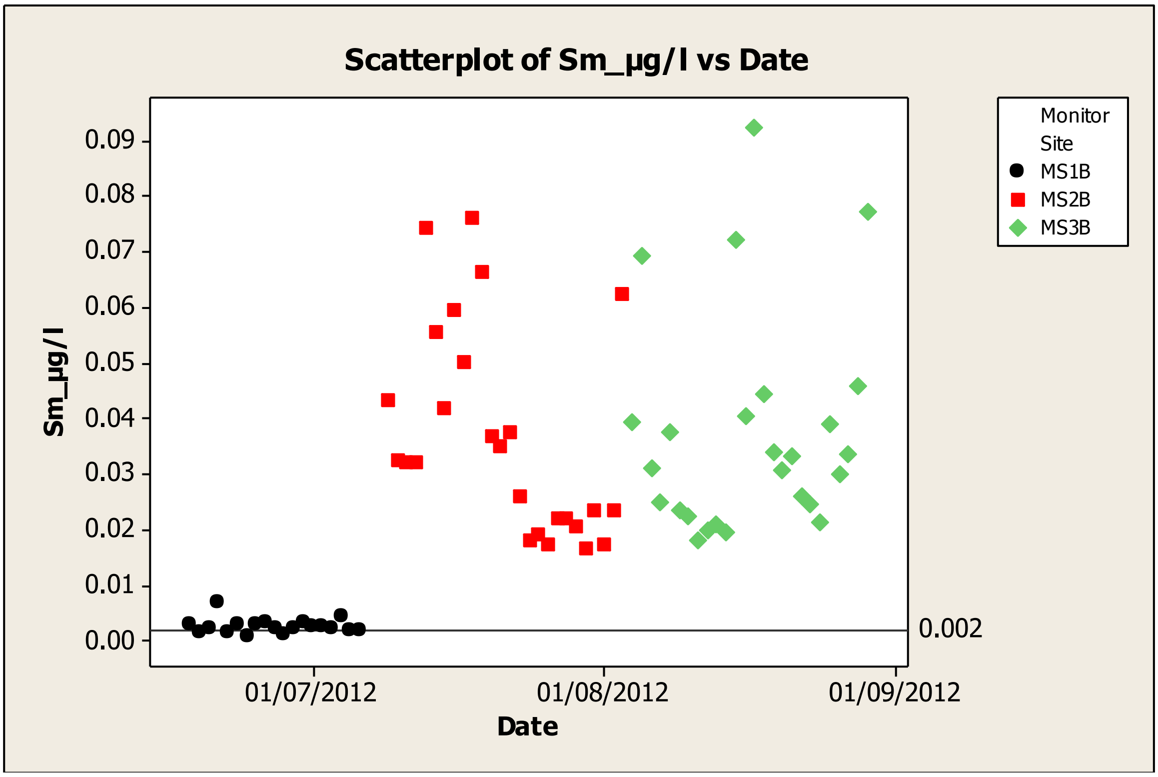


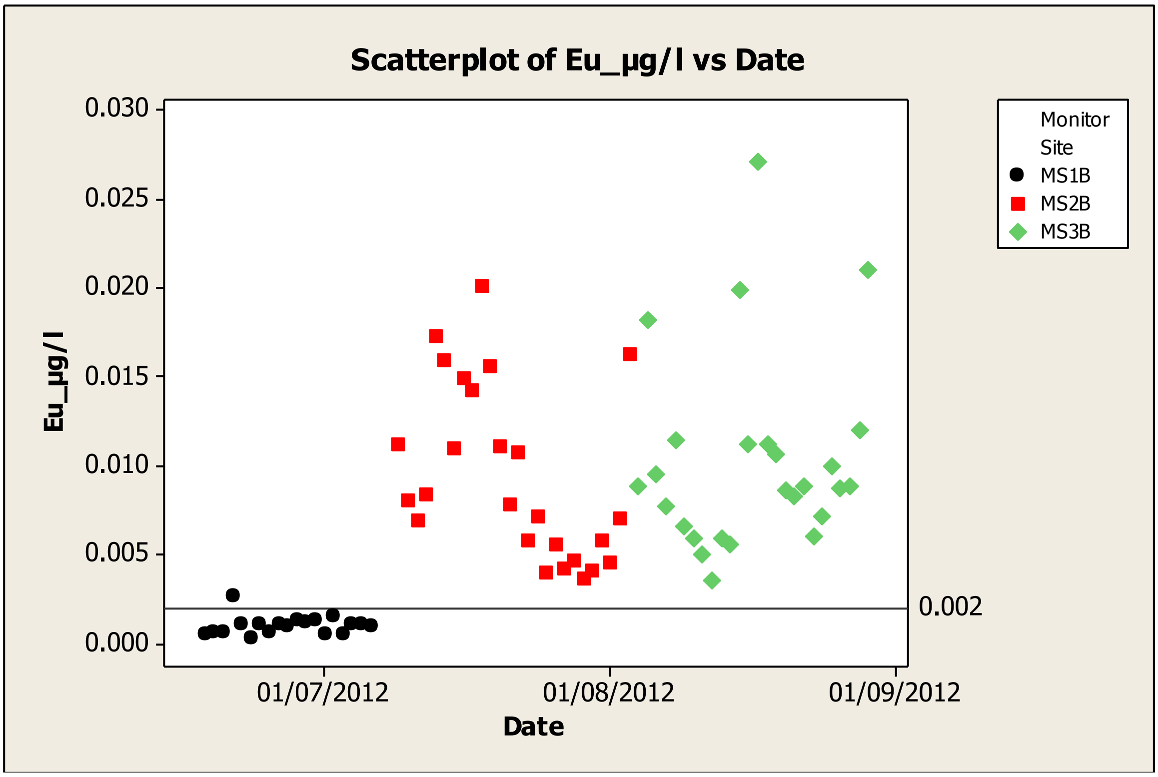
Scatterplot of Ce_µg/l vs Date
Ce_µg/l
0.5
0.4
0.3
0.2
0.1
0.0
0.002
01/07/2012
01/08/2012
01/09/2012
Date
Monitor Site
MS1B
MS2B
MS3B

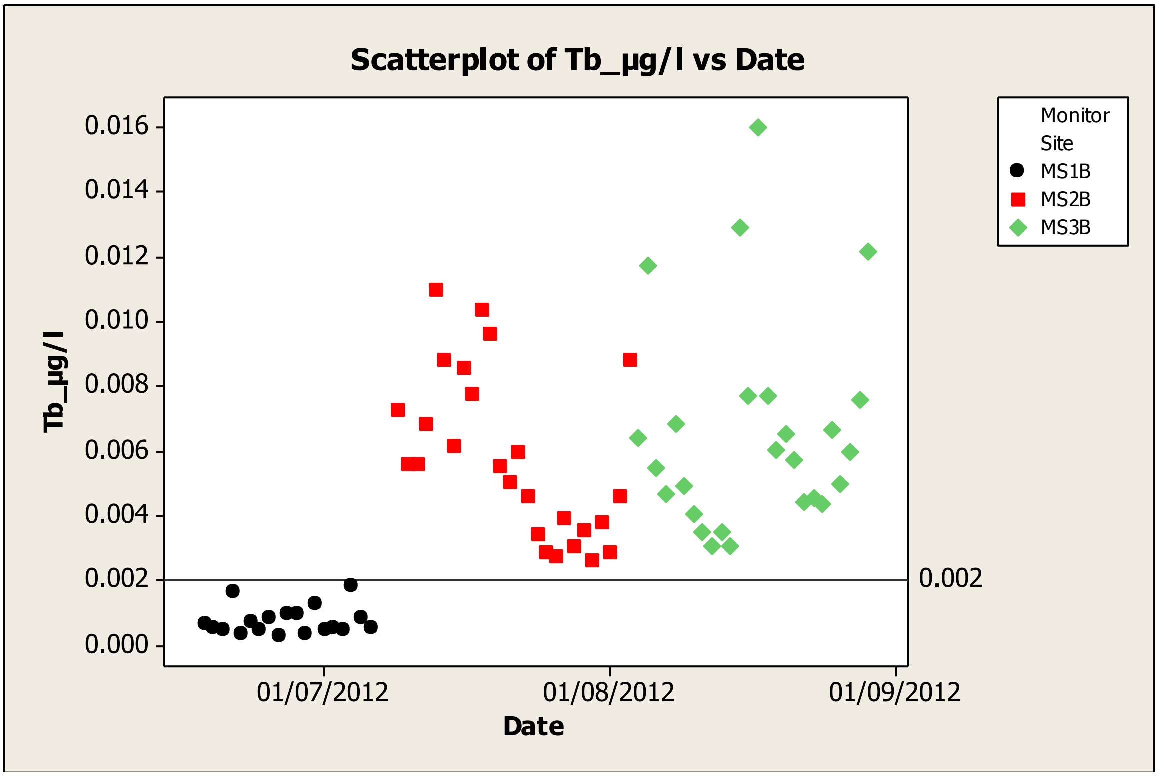


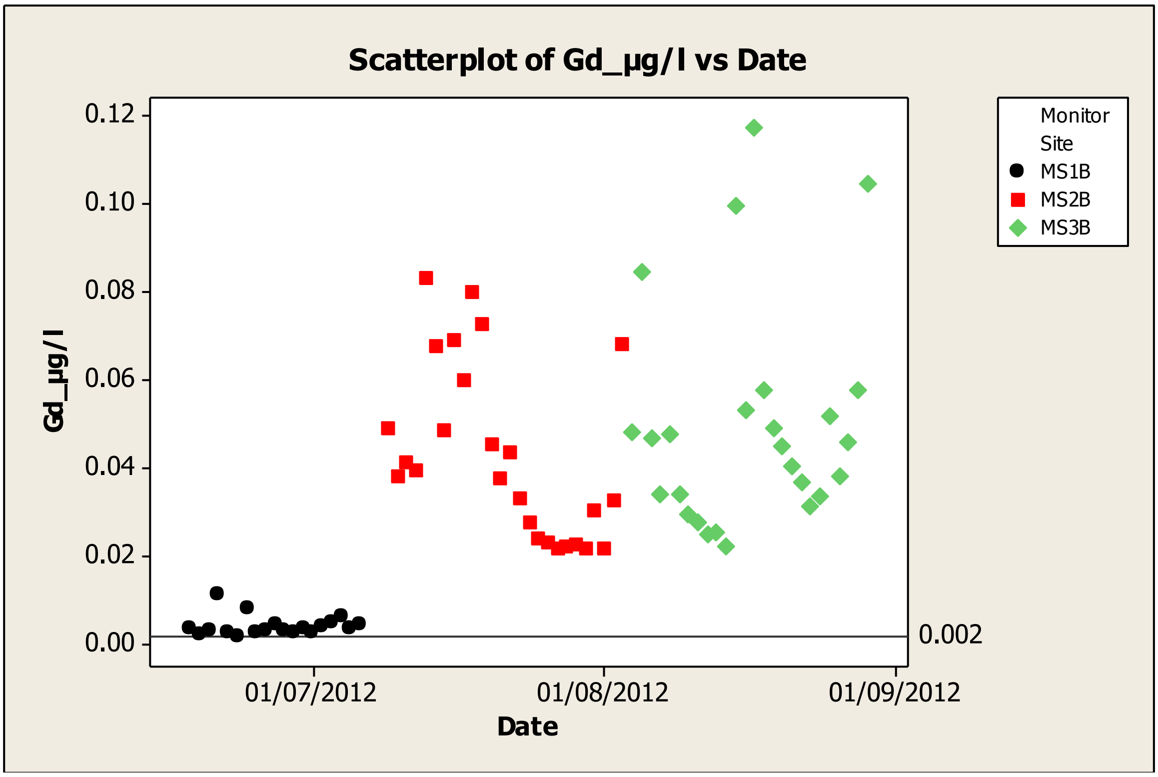
Scatterplot of Pr_µg/l vs Date
Pr_µg/l
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
0.002
01/07/2012
01/08/2012
01/09/2012
Date
Monitor Site
MS1B
MS2B
MS3B


Scatterplot of Nd_µg/l vs Date
Nd_µg/l
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.01
01/07/2012
01/08/2012
01/09/2012
Date
Monitor Site
MS1B
MS2B
MS3B

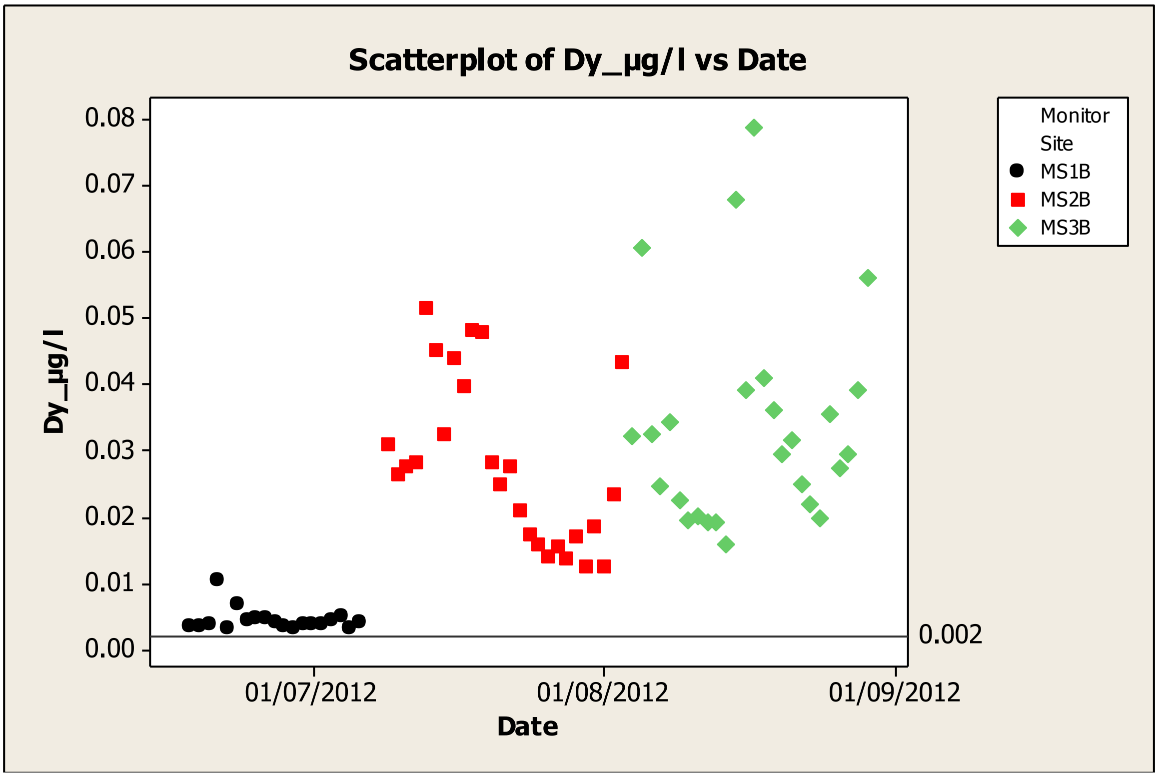

Scatterplot of Sm_µg/l vs Date
Sm_µg/l
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
0.002
01/07/2012
01/08/2012
01/09/2012
Date
Monitor Site
MS1B
MS2B
MS3B


Scatterplot of Eu_µg/l vs Date
Eu_µg/l
0.030
0.025
0.020
0.015
0.010
0.005
0.000
0.002
01/07/2012
01/08/2012
01/09/2012
Date
Monitor Site
MS1B
MS2B
MS3B

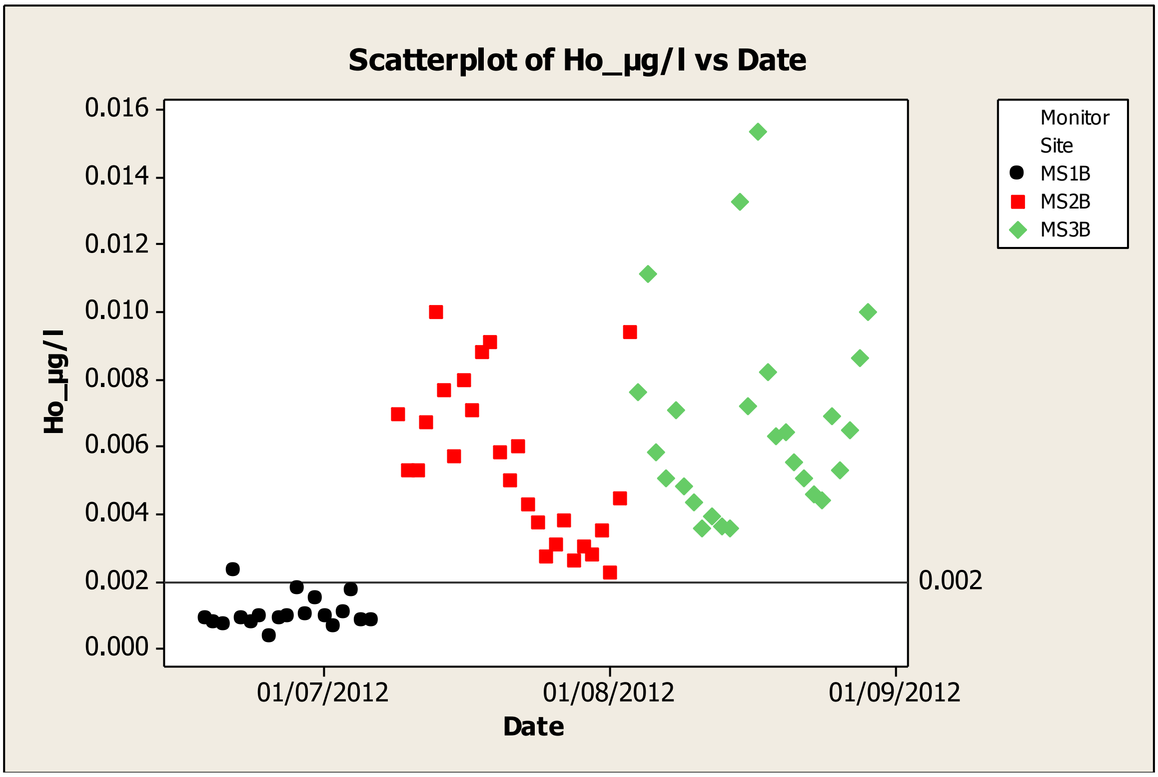

Scatterplot of Tb_µg/l vs Date
Tb_µg/l
0.016
0.014
0.012
0.010
0.008
0.006
0.004
0.002
0.000
0.002
01/07/2012
01/08/2012
01/09/2012
Date
Monitor Site
MS1B
MS2B
MS3B

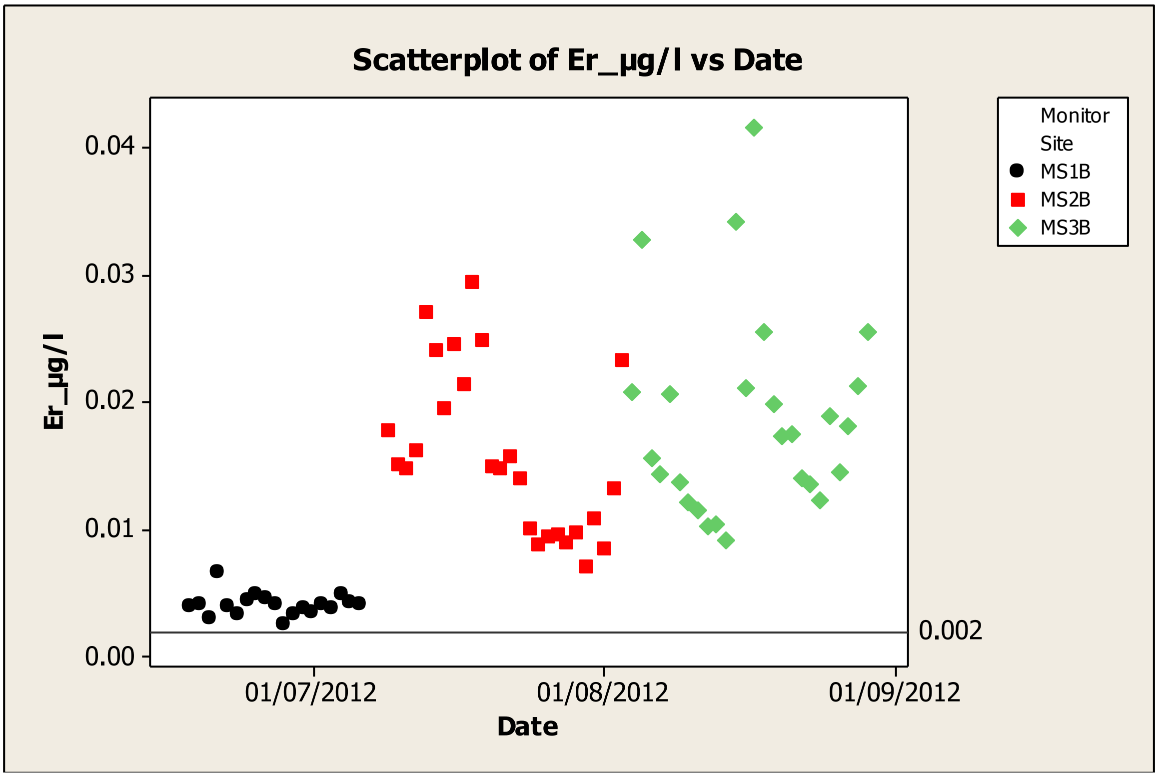


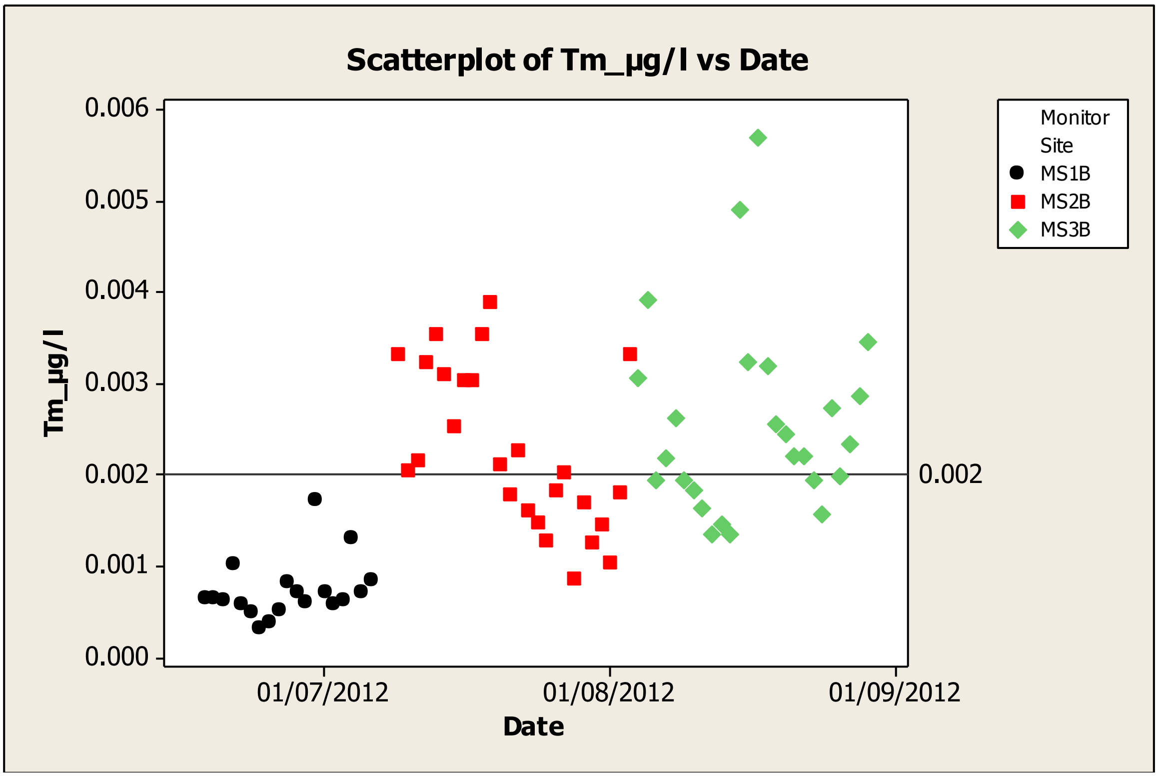
Scatterplot of Gd_µg/l vs Date
Gd_µg/l
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0.002
01/07/2012
01/08/2012
01/09/2012
Date
Monitor
Site
MS1B
MS2B
MS3B

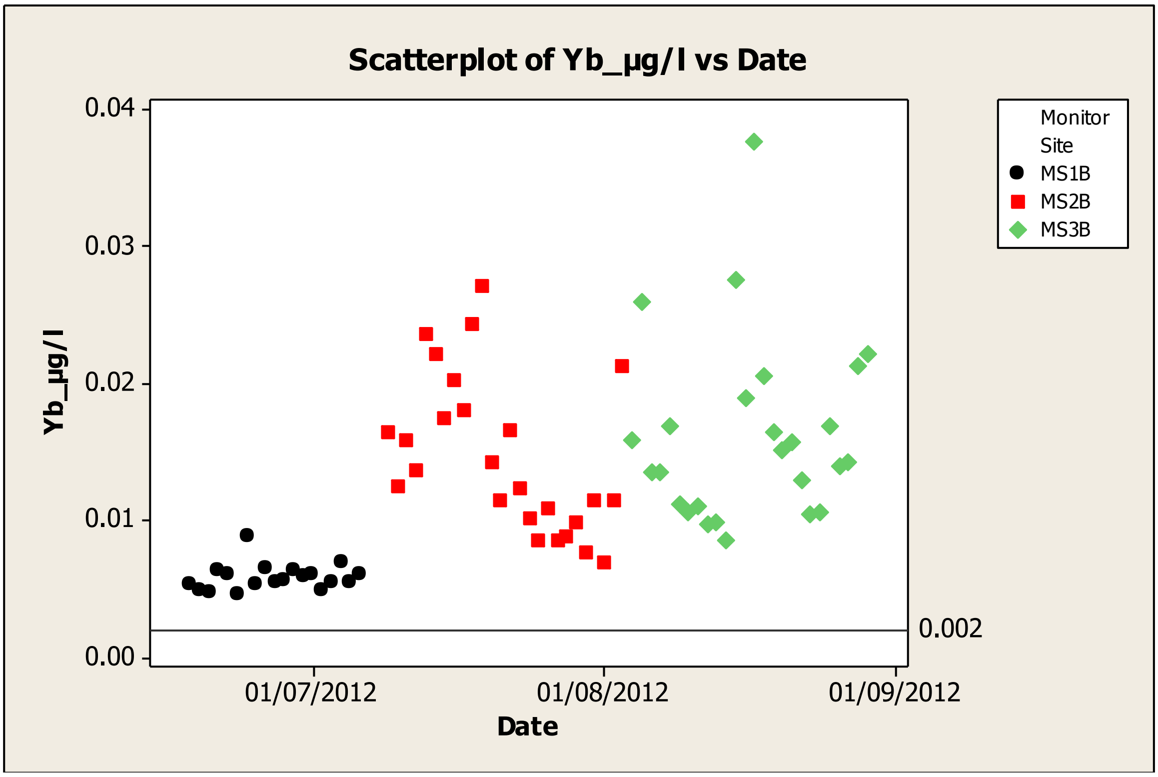


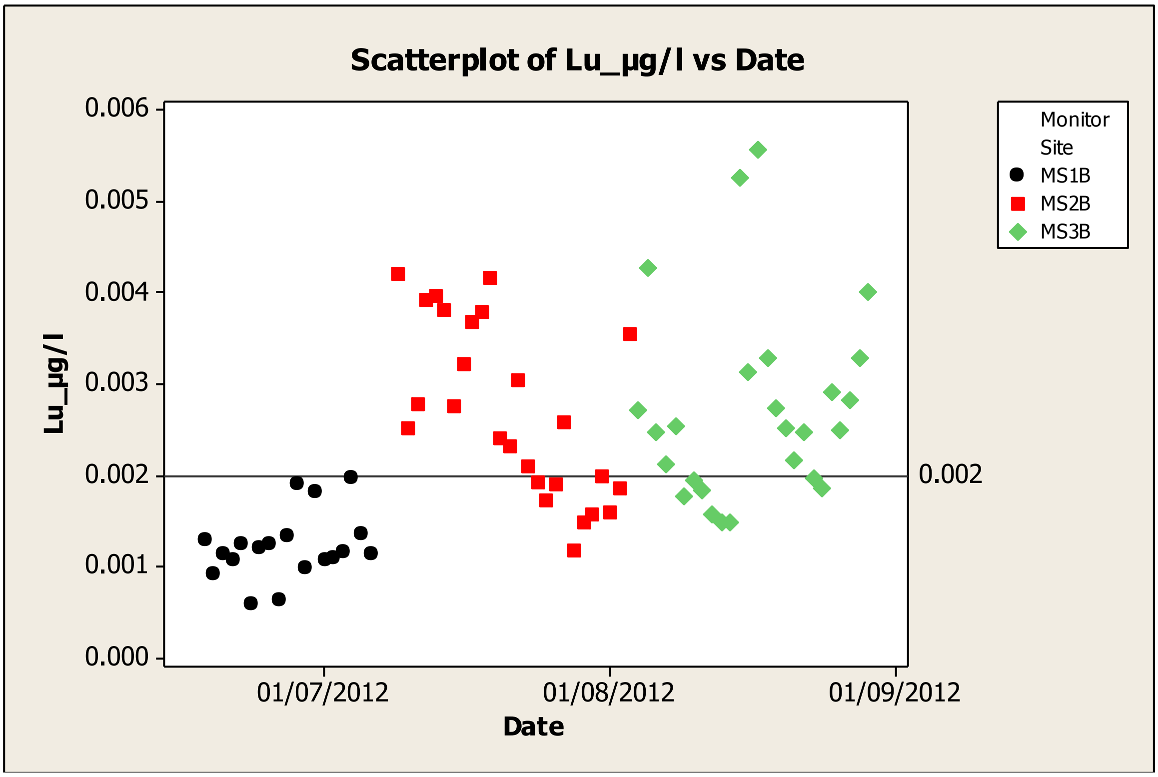
Scatterplot of Dy_µg/l vs Date
Dy_µg/l
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
0.002
01/07/2012
01/08/2012
01/09/2012
Date
Monitor
Site
MS1B
MS2B
MS3B


Scatterplot of Ho_µg/l vs Date
Ho_µg/l
0.016
0.014
0.012
0.010
0.008
0.006
0.004
0.002
0.000
0.002
01/07/2012
01/08/2012
01/09/2012
Date
Monitor Site
MS1B
MS2B
MS3B

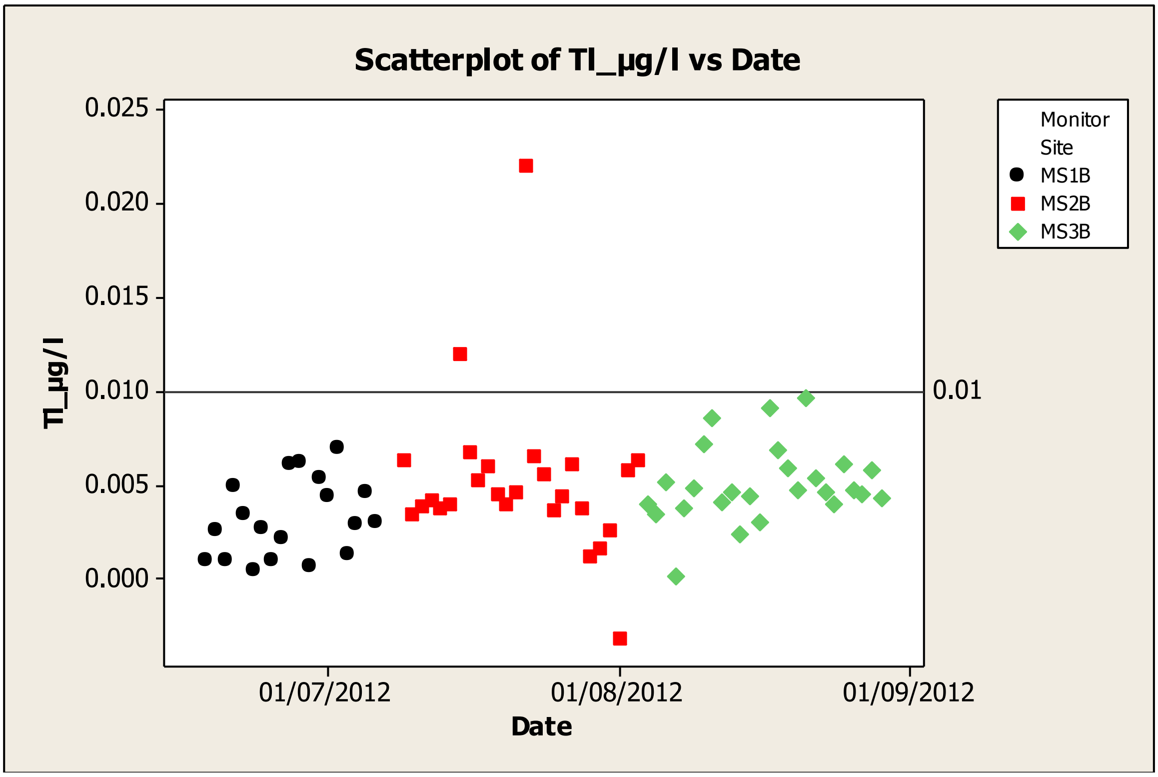

Scatterplot of Er_µg/l vs Date
Er_µg/l
0.04
0.03
0.02
0.01
0.00
0.002
01/07/2012
01/08/2012
01/09/2012
Date
Monitor Site
MS1B
MS2B
MS3B


Scatterplot of Tm_µg/l vs Date
Tm_µg/l
0.006
0.005
0.004
0.003
0.002
0.001
0.000
0.002
01/07/2012
01/08/2012
01/09/2012
Date
Monitor
Site
MS1B
MS2B
MS3B

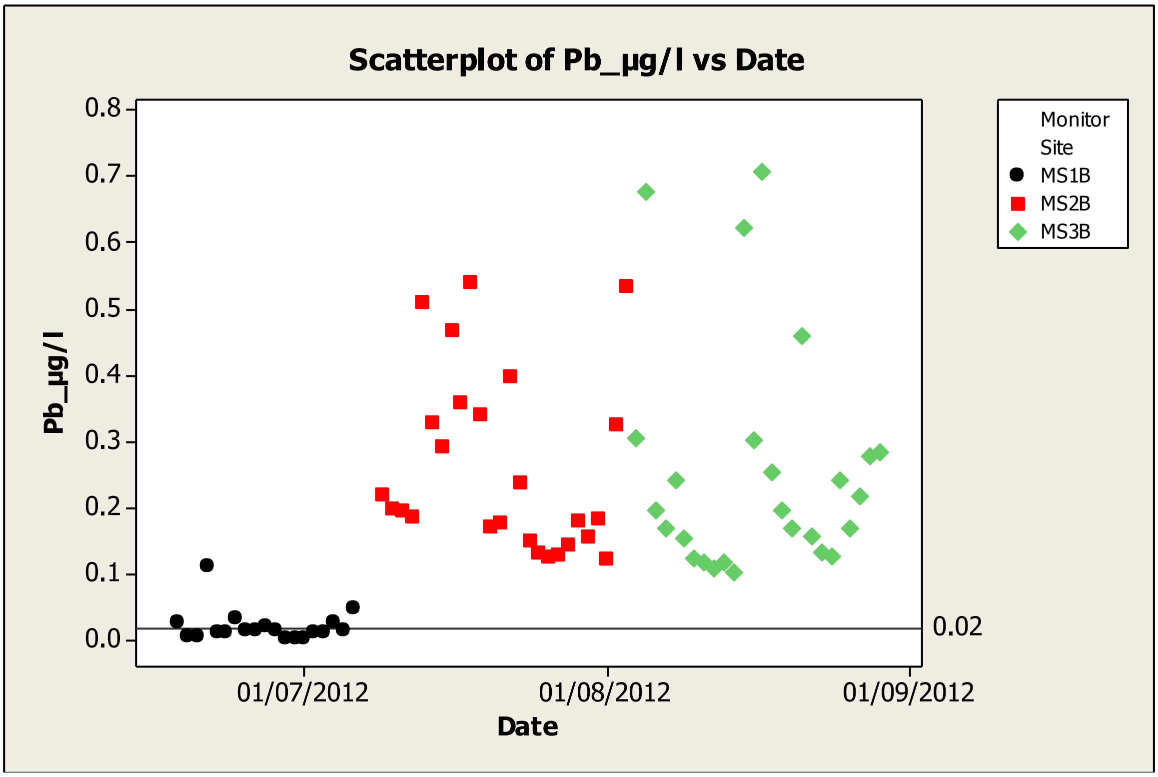

Scatterplot of Yb_µg/l vs Date
Yb_µg/l
0.04
0.03
0.02
0.01
0.00
0.002
01/07/2012
01/08/2012
01/09/2012
Date
Monitor
Site
MS1B
MS2B
MS3B



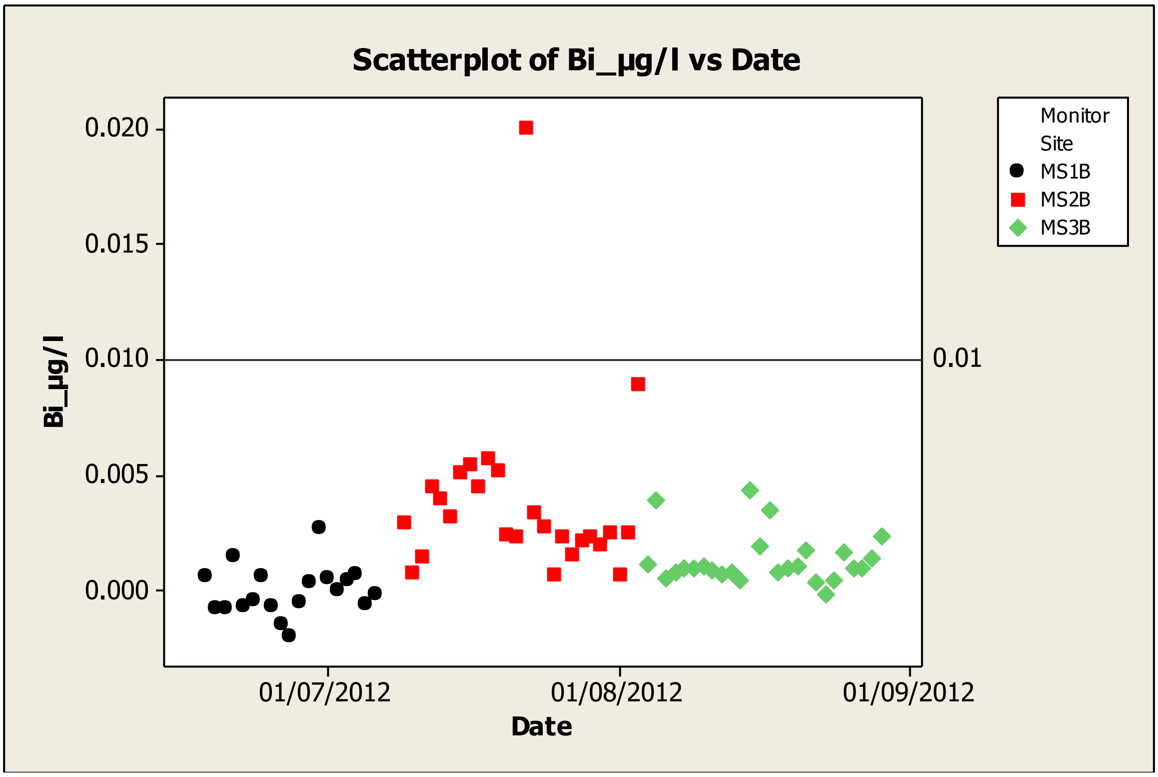
Scatterplot of Lu_µg/l vs Date
Lu_µg/l
0.006
0.005
0.004
0.003
0.002
0.001
0.000
0.002
01/07/2012
01/08/2012
01/09/2012
Date
Monitor Site
MS1B
MS2B
MS3B



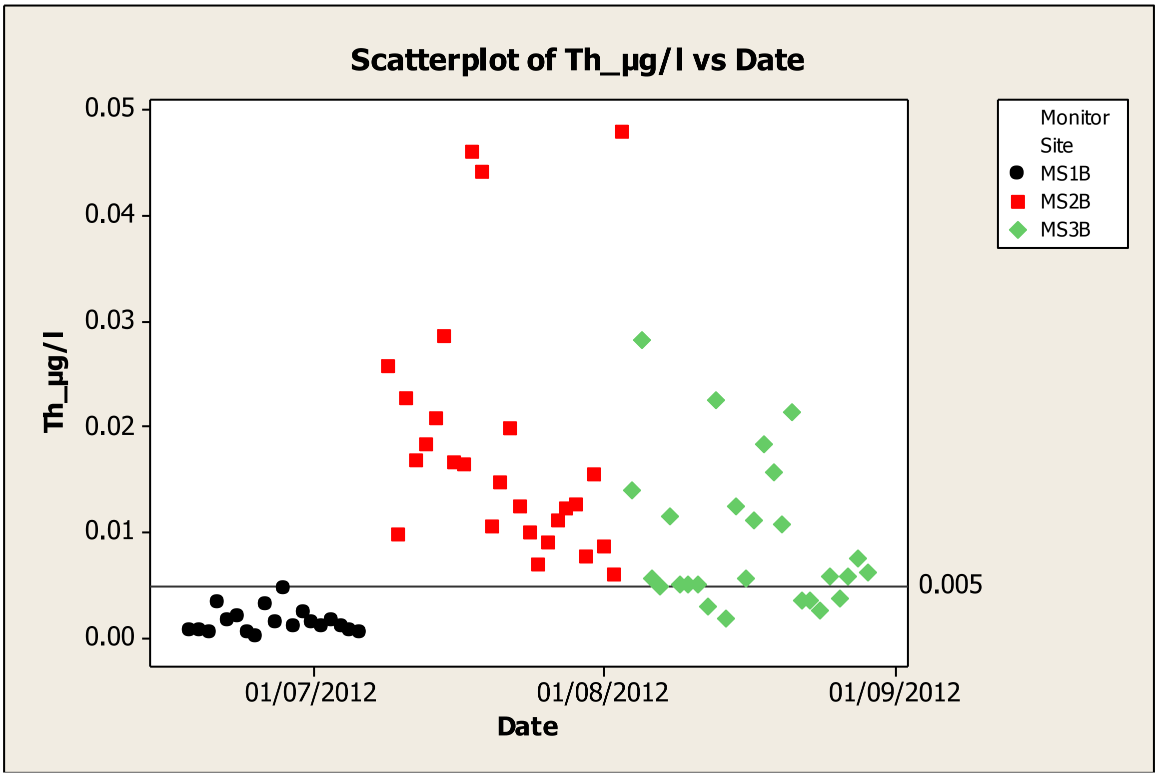
Scatterplot of Tl_µg/l vs Date
Tl_µg/l
0.025
0.020
0.015
0.010
0.005
0.000
0.01
01/07/2012
01/08/2012
01/09/2012
Date
Monitor Site
MS1B
MS2B
MS3B



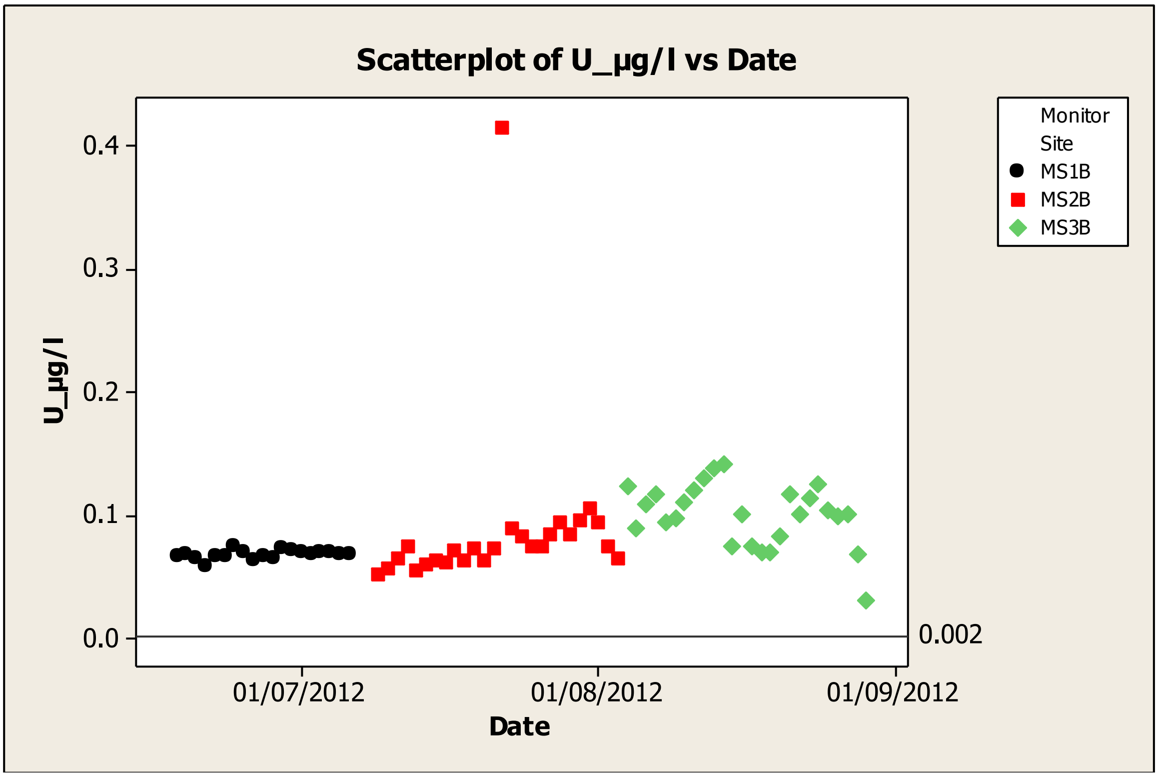
Scatterplot of Pb_µg/l vs Date
Pb_µg/l
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.02
01/07/2012
01/08/2012
01/09/2012
Date
Monitor Site
MS1B
MS2B
MS3B



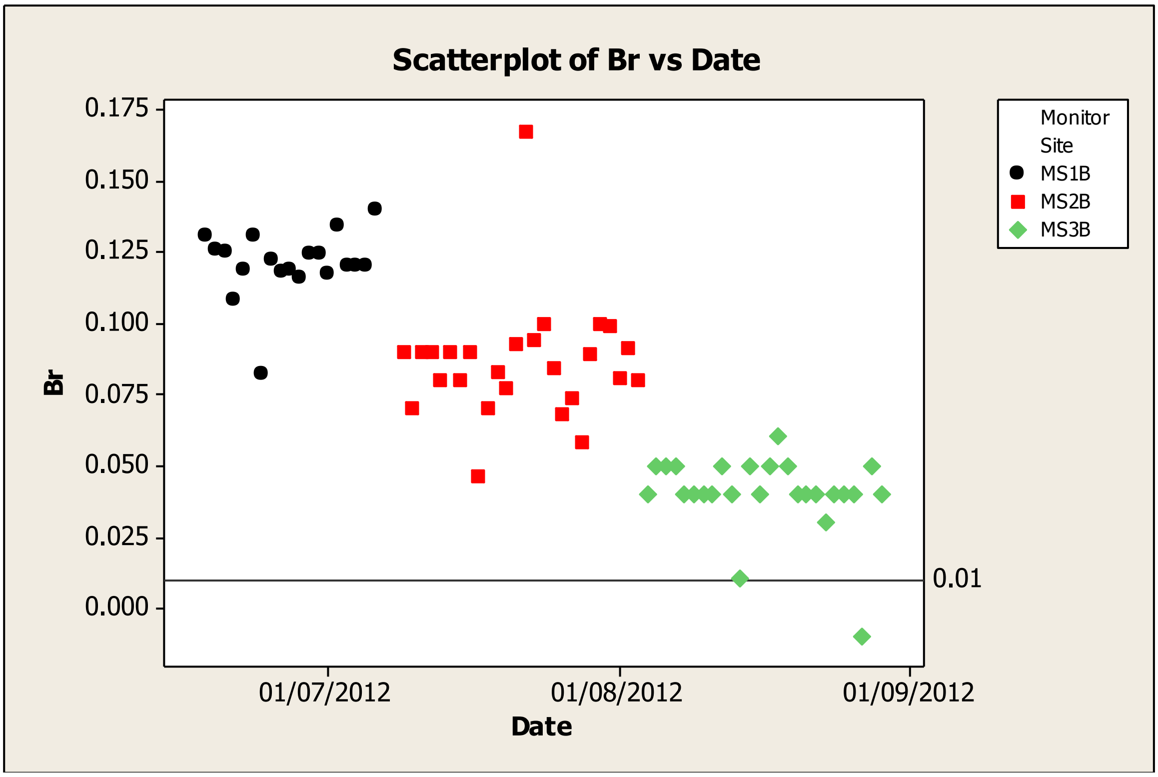
Scatterplot of Bi_µg/l vs Date
Bi_µg/l
0.020
0.015
0.010
0.005
0.000
0.01
01/07/2012
01/08/2012
01/09/2012
Date
Monitor Site
MS1B
MS2B
MS3B

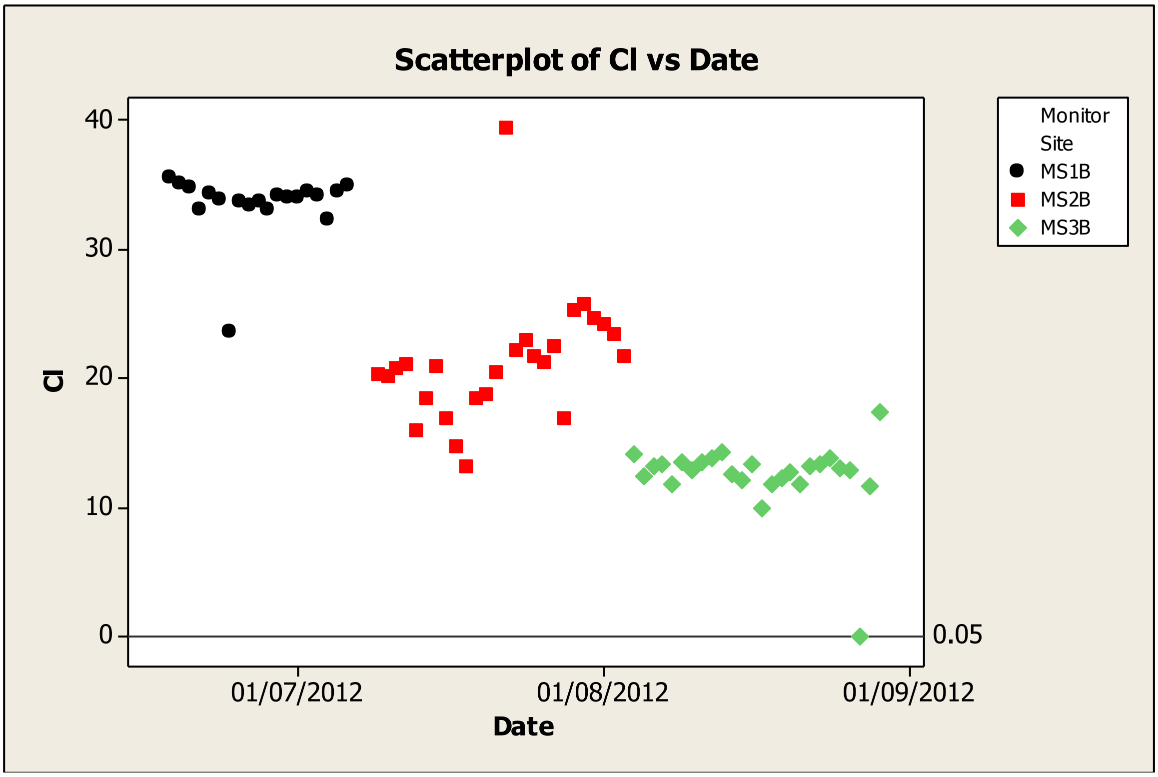


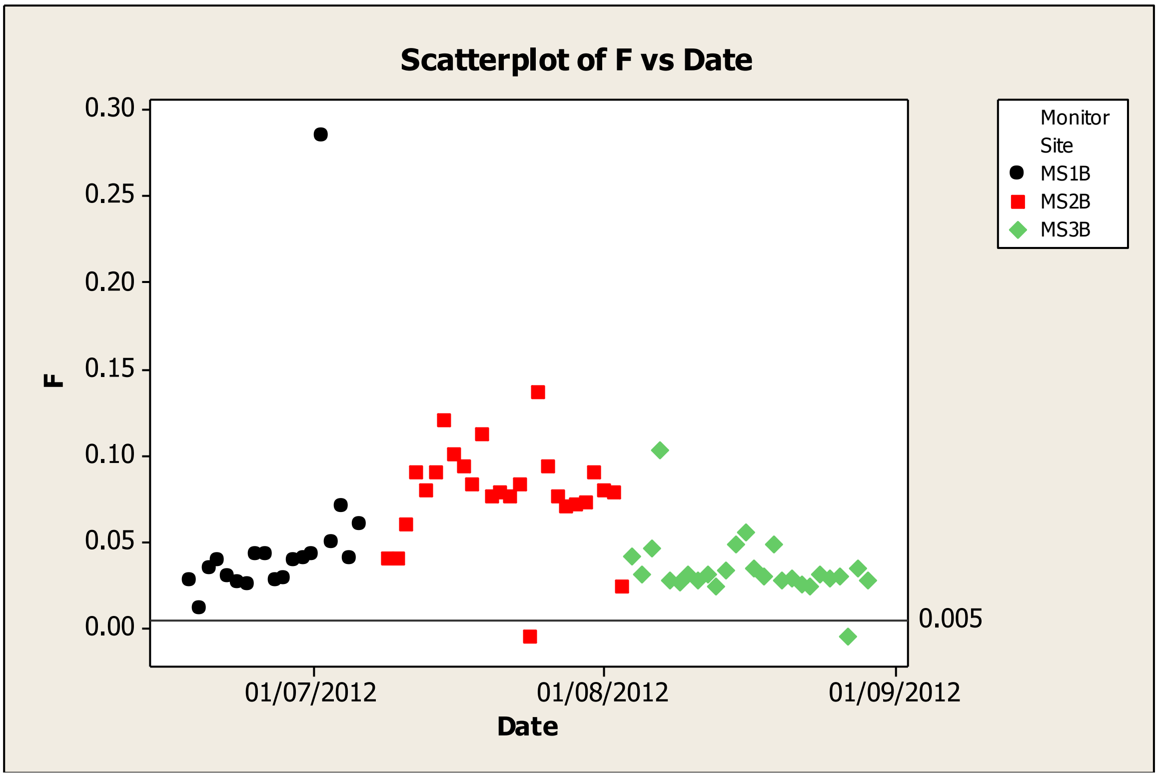
Scatterplot of Th_µg/l vs Date
Th_µg/l
0.05
0.04
0.03
0.02
0.01
0.00
0.005
01/07/2012
01/08/2012
01/09/2012
Date
Monitor Site
MS1B
MS2B
MS3B

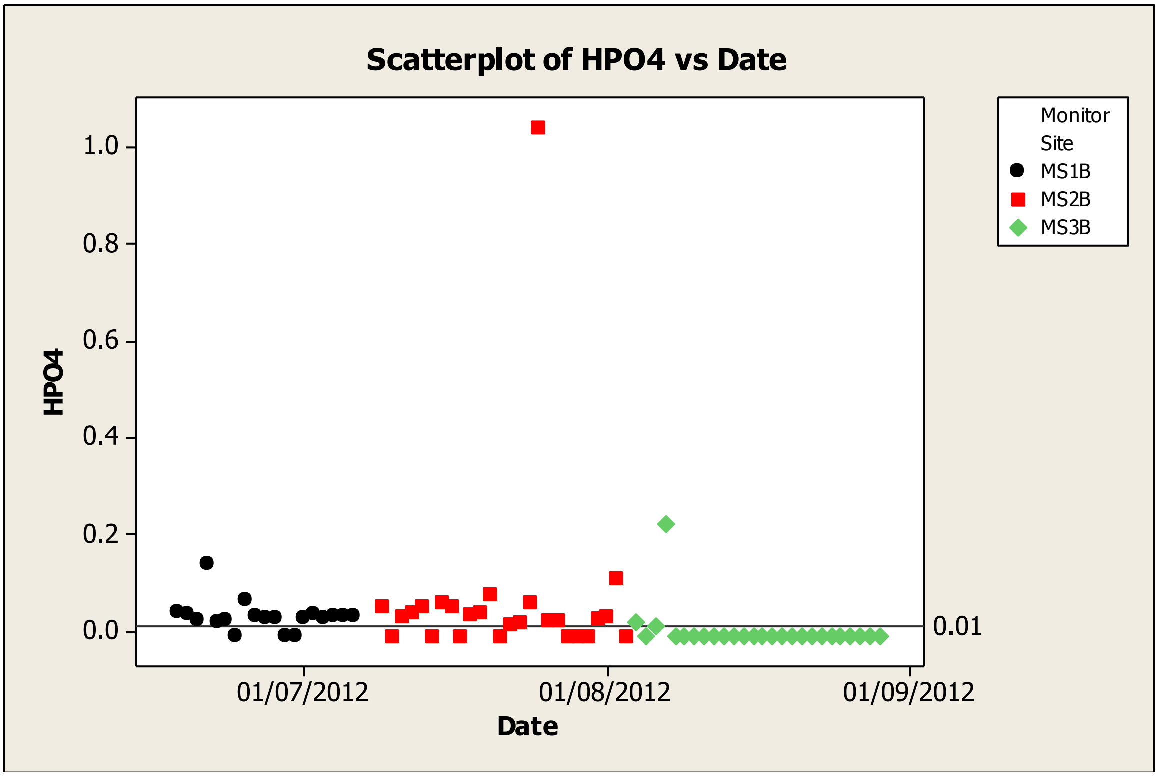


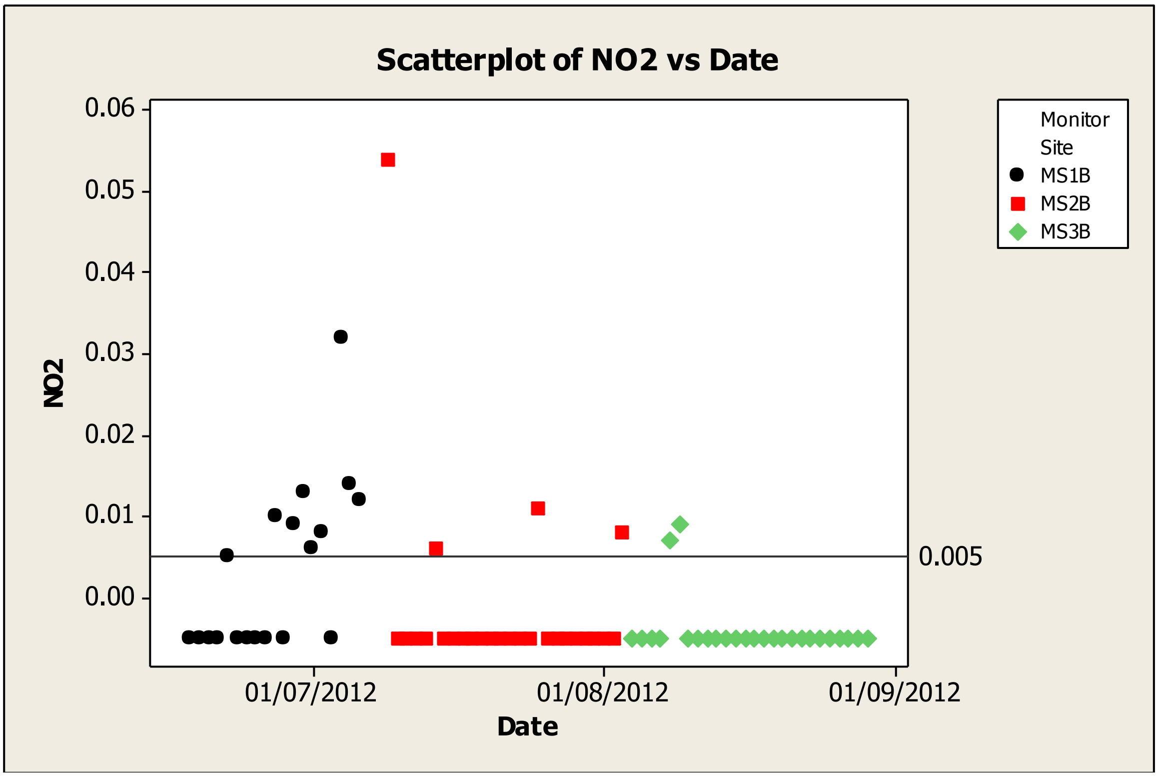
Scatterplot of U_µg/l vs Date
U_µg/l
0.4
0.3
0.2
0.1
0.0
0.002
01/07/2012
01/08/2012
01/09/2012
Date
Monitor Site
MS1B
MS2B
MS3B

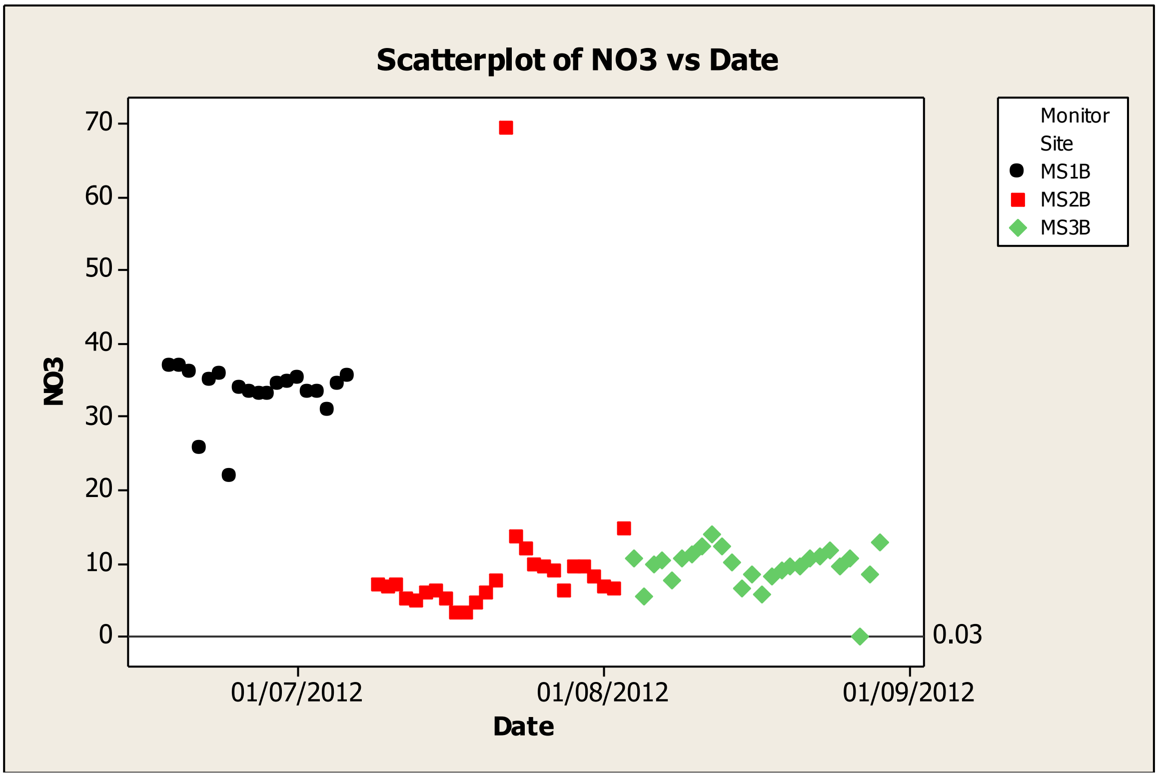

Scatterplot of Br vs Date
Br
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.000
0.01
01/07/2012
01/08/2012
01/09/2012
Date
Monitor Site
MS1B
MS2B
MS3B

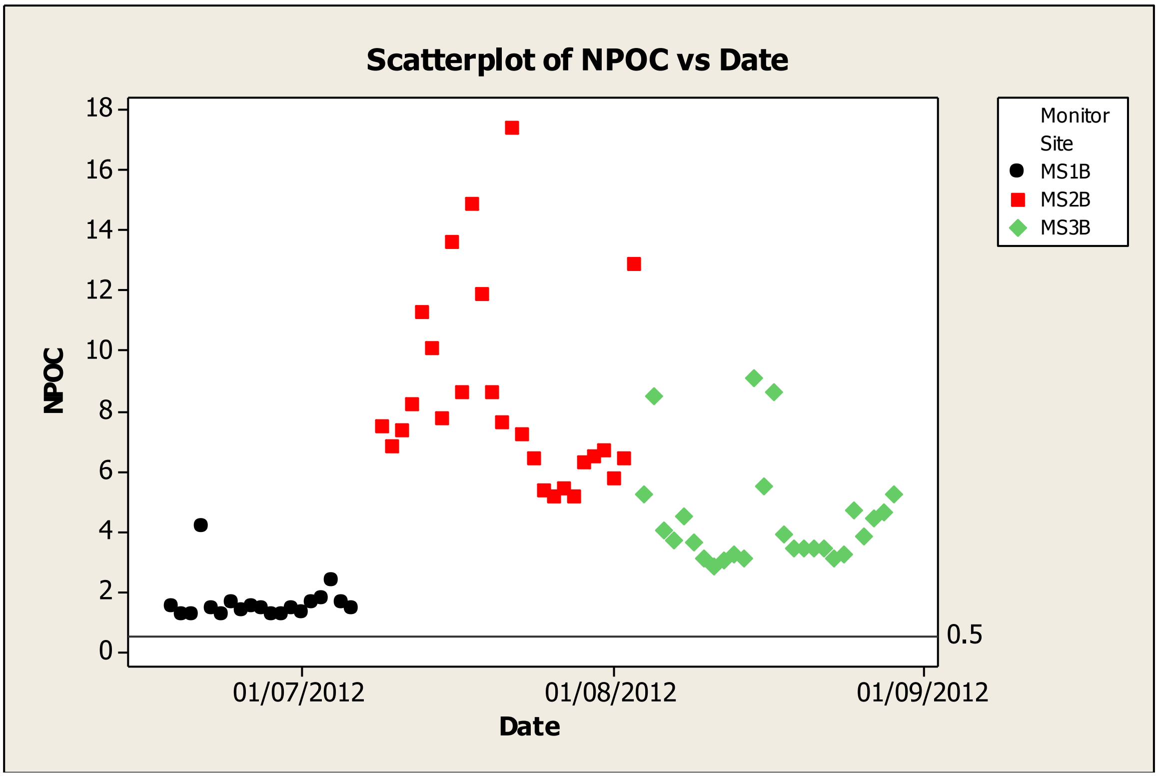

Scatterplot of Cl vs Date
Cl
40
30
20
10
0
0.05
01/07/2012
01/08/2012
01/09/2012
Date
Monitor Site
MS1B
MS2B
MS3B

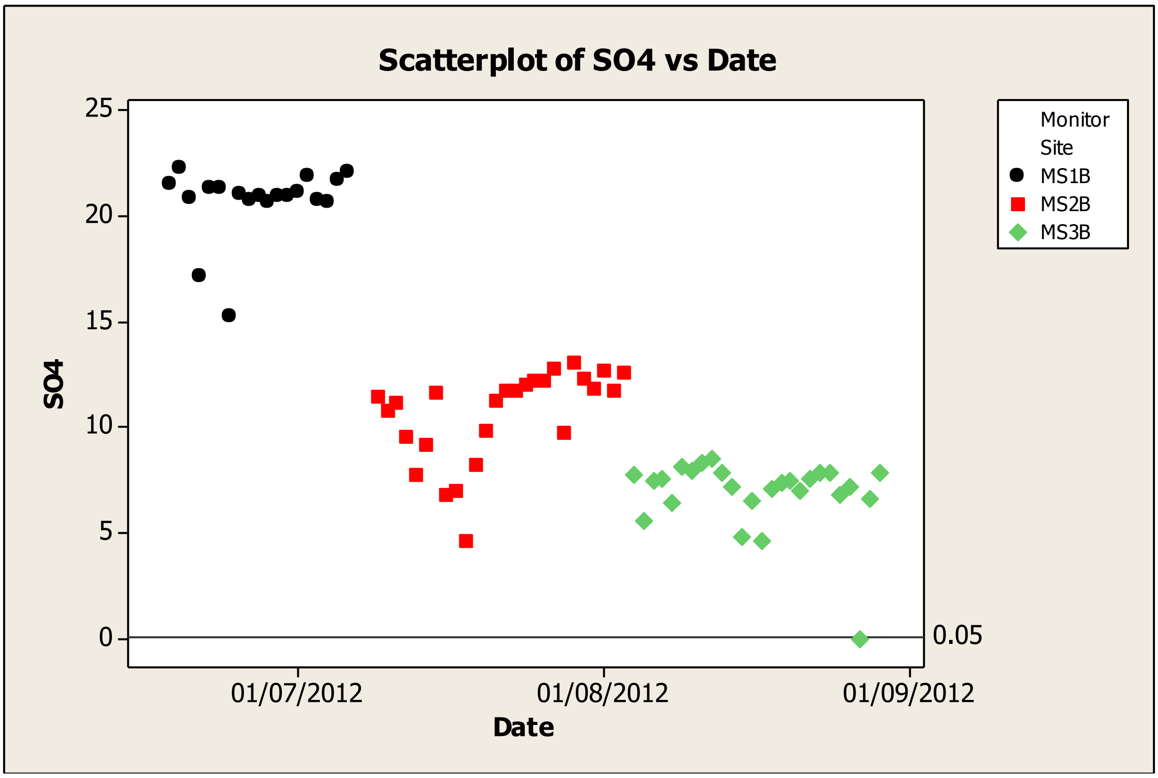

Scatterplot of F vs Date
F
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.005
01/07/2012
01/08/2012
01/09/2012
Date
Monitor
Site
MS1B
MS2B
MS3B


Scatterplot of HPO4 vs Date
HPO4
1.0
0.8
0.6
0.4
0.2
0.0
0.01
01/07/2012
01/08/2012
01/09/2012
Date
Monitor
Site
MS1B
MS2B
MS3B


Scatterplot of NO2 vs Date
NO2
0.06
0.05
0.04
0.03
0.02
0.01
0.00
0.005
01/07/2012
01/08/2012
01/09/2012
Date
Monitor Site
MS1B
MS2B
MS3B


Scatterplot of NO3 vs Date
NO3
70
60
50
40
30
20
10
0
0.03
01/07/2012
01/08/2012
01/09/2012
Date
Monitor Site
MS1B
MS2B
MS3B


Scatterplot of NPOC vs Date
NPOC
18
16
14
12
10
8
6
4
2
0
0.5
01/07/2012
01/08/2012
01/09/2012
Date
Monitor Site
MS1B
MS2B
MS3B


Scatterplot of SO4 vs Date
SO4
25
20
15
10
5
0
0.05
01/07/2012
01/08/2012
01/09/2012
Date
Monitor Site
MS1B
MS2B
MS3B

Appendix 7 Charge balance errors in excess of ±10%

Sample Number	Charge balance	Error	Action	Total cations	Total anions	Ca (meq/L)	Mg (meq/L)	Na (meq/L)	K (meq/L)	HCO3 (meq/L)	SO4 (meq/L)	Cl (meq/L)	NO3 (meq/L)
472599	-35.93	Low TDS	No correction for low TDS	0.521	-1.105	0.178	0.120	0.197	0.026	-0.799	-0.066	-0.226	-0.0144
472502	-30.28	Low TDS	No correction for low TDS	0.191	-0.359	0.022	0.038	0.126	0.005	-0.200	-0.021	-0.138	-0.0002
475295	-29.35	Alkalinity , yellow cloudy sample	Caution HCO3	2.123	-3.887	0.663	0.430	0.980	0.049	-2.518	-0.057	-1.216	-0.0961
474941	-26.22	Alkalinity , black sample	Caution HCO3	7.545	-12.908	5.272	0.336	1.547	0.389	-9.611	-0.252	-1.142	-1.9032
472554	-22.42	Alkalinity	Caution HCO3	1.900	-2.998	1.189	0.260	0.333	0.118	-2.238	-0.202	-0.367	-0.1919
474043	-20.75	Alkalinity	Caution HCO3	3.446	-5.250	1.956	0.409	0.962	0.119	-3.457	-0.548	-1.230	-0.0163
473397	-19.74	Alkalinity	Caution HCO3	4.319	-6.444	3.148	0.597	0.484	0.091	-5.435	-0.194	-0.505	-0.3097
470957	-19.62	Indeterminate	Caution	1.695	-2.522	0.410	0.375	0.778	0.132	-0.999	-0.274	-0.740	-0.5095
472293	-19.43	Alkalinity	Caution HCO3	1.265	-1.875	0.516	0.282	0.380	0.086	-1.179	-0.160	-0.460	-0.0760
471682	-18.16	Alkalinity , yellow-brown sample	Caution HCO3	4.315	-6.231	1.278	0.836	1.018	1.183	-3.756	-0.244	-1.111	-1.1194
473481	-17.36	Low TDS	No correction for low TDS	0.773	-1.098	0.301	0.177	0.277	0.019	-0.699	-0.091	-0.285	-0.0226
475347	-16.21	Alkalinity	Caution HCO3	2.223	-3.083	1.147	0.342	0.562	0.172	-1.678	-0.172	-0.728	-0.5048
470740	-15.90	Indeterminate	Caution	1.873	-2.581	0.619	0.518	0.682	0.053	-0.809	-0.289	-1.281	-0.2016
474851	-15.35	Alkalinity , cloudy sample	Caution HCO3	2.597	-3.538	0.909	0.697	0.895	0.096	-2.378	-0.014	-1.145	-0.0016
473113	-15.21	Alkalinity	Caution HCO3	1.046	-1.421	0.340	0.271	0.407	0.028	-0.719	-0.202	-0.375	-0.1242
475391	-14.80	Alkalinity	Caution HCO3	1.367	-1.842	0.622	0.235	0.470	0.041	-1.039	-0.139	-0.561	-0.1024
472198	-14.73	Low TDS	No correction for low TDS	0.662	-0.891	0.240	0.111	0.275	0.036	-0.474	-0.053	-0.327	-0.0371
472538	-14.54	Alkalinity	Caution HCO3	1.079	-1.446	0.480	0.250	0.311	0.038	-0.959	-0.106	-0.280	-0.1005
471157	-14.42	Alkalinity	Caution HCO3	1.611	-2.154	0.892	0.255	0.377	0.087	-1.223	-0.250	-0.438	-0.2437
473741	-13.93	Alkalinity	Caution HCO3	2.786	-3.687	1.472	0.604	0.599	0.110	-2.338	-0.269	-0.671	-0.4097
472931	-13.90	Low TDS	No correction for low TDS	0.388	-0.514	0.067	0.070	0.234	0.018	-0.280	-0.035	-0.196	-0.0031
474137	-13.64	Low TDS	No correction for low TDS	0.645	-0.849	0.152	0.105	0.372	0.016	-0.320	-0.092	-0.437	-0.0002
471045	-13.48	Alkalinity	Caution HCO3	2.857	-3.747	1.020	0.551	0.620	0.665	-2.258	-0.166	-0.698	-0.6261
470962	-13.34	Alkalinity , cloudy sample	Caution HCO3	3.070	-4.014	0.997	0.586	0.955	0.532	-2.136	-0.203	-1.019	-0.6556

Sample Number	Charge balance	Error	Action	Total cations	Total anions	Ca (meq/L)	Mg (meq/L)	Na (meq/L)	K (meq/L)	HCO3 (meq/L)	SO4 (meq/L)	Cl (meq/L)	NO3 (meq/L)
472567	-13.11	Alkalinity	Caution HCO3	1.385	-1.803	0.627	0.372	0.332	0.054	-1.099	-0.146	-0.364	-0.1935
473695	-13.02	Low TDS	No correction for low TDS	0.644	-0.837	0.198	0.149	0.239	0.058	-0.519	-0.048	-0.264	-0.0060
471046	-12.98	Alkalinity	Caution HCO3	1.308	-1.699	0.654	0.210	0.350	0.094	-1.219	-0.063	-0.337	-0.0800
471772	-12.95	Low TDS	No correction for low TDS	0.405	-0.525	0.113	0.108	0.178	0.006	-0.320	-0.048	-0.155	-0.0025
470258	-12.85	Alkalinity	Caution HCO3	3.065	-3.969	1.544	0.712	0.762	0.046	-2.058	-0.433	-0.942	-0.5355
470559	-12.62	Indeterminate	Caution	2.268	-2.923	0.823	0.684	0.736	0.024	-0.979	-0.294	-0.973	-0.6774
472544	-12.57	Low TDS	No correction for low TDS	0.199	-0.256	0.029	0.041	0.123	0.006	-0.086	-0.028	-0.141	-0.0006
472546	-12.53	Low TDS	No correction for low TDS	0.857	-1.102	0.385	0.124	0.315	0.034	-0.480	-0.146	-0.395	-0.0815
471340	-12.53	Indeterminate	Caution	2.120	-2.728	0.651	0.476	0.719	0.275	-1.071	-0.165	-0.832	-0.6597
473349	-12.45	Indeterminate	Caution	1.674	-2.150	0.873	0.377	0.390	0.034	-1.399	-0.208	-0.361	-0.1823
473200	-11.95	Indeterminate	Caution	1.031	-1.311	0.371	0.198	0.425	0.037	-0.559	-0.152	-0.463	-0.1369
473065	-11.80	Low TDS	No correction for low TDS	0.962	-1.219	0.400	0.208	0.323	0.030	-0.779	-0.115	-0.288	-0.0379
472550	-11.66	Low TDS	No correction for low TDS	0.343	-0.433	0.049	0.061	0.206	0.026	-0.120	-0.073	-0.231	-0.0092
474656	-11.61	Alkalinity	Caution HCO3	7.378	-9.315	5.847	0.420	1.049	0.061	-6.753	-0.595	-1.413	-0.5532
472683	-11.59	Indeterminate	Caution	1.067	-1.347	0.484	0.225	0.315	0.043	-0.739	-0.108	-0.327	-0.1726
473723	-11.47	Alkalinity	Caution HCO3	2.557	-3.219	1.616	0.329	0.404	0.209	-2.018	-0.271	-0.542	-0.3887
474189	-11.43	Low TDS	No correction for low TDS	0.877	-1.104	0.243	0.156	0.464	0.014	-0.619	-0.058	-0.426	-0.0002
473220	-11.36	Low TDS	No correction for low TDS	0.764	-0.960	0.255	0.197	0.283	0.029	-0.539	-0.092	-0.302	-0.0274
474107	-11.29	Alkalinity	Caution HCO3	3.190	-4.002	1.732	0.470	0.599	0.388	-2.977	-0.364	-0.573	-0.0882
475247	-11.25	Alkalinity	Caution HCO3	7.717	-9.673	5.202	0.929	1.442	0.144	-8.672	-0.037	-0.962	-0.0024
472582	-11.23	Low TDS	No correction for low TDS	0.200	-0.251	0.041	0.038	0.116	0.005	-0.086	-0.021	-0.140	-0.0044
472658	-11.12	Low TDS	No correction for low TDS	0.621	-0.777	0.267	0.092	0.237	0.026	-0.406	-0.083	-0.233	-0.0548
474997	-11.08	Alkalinity	Caution HCO3	11.202	-13.994	5.820	1.642	1.217	2.523	-9.671	-0.053	-2.666	-1.6048
472876	-10.98	Alkalinity	Caution HCO3	2.283	-2.846	0.722	0.645	0.842	0.075	-1.778	-0.235	-0.773	-0.0600
472516	-10.89	Alkalinity	Caution HCO3	1.769	-2.201	1.018	0.343	0.377	0.031	-1.279	-0.166	-0.460	-0.2968
472563	-10.88	Low TDS	No correction for low TDS	0.252	-0.314	0.039	0.053	0.149	0.010	-0.116	-0.028	-0.169	-0.0015
472504	-10.61	Alkalinity	Caution HCO3	1.737	-2.150	1.127	0.225	0.330	0.055	-1.359	-0.174	-0.412	-0.2048

Sample Number	Charge balance	Error	Action	Total cations	Total anions	Ca (meq/L)	Mg (meq/L)	Na (meq/L)	K (meq/L)	HCO3 (meq/L)	SO4 (meq/L)	Cl (meq/L)	NO3 (meq/L)
471759	-10.59	Low TDS	No correction for low TDS	0.545	-0.674	0.241	0.092	0.203	0.008	-0.420	-0.070	-0.167	-0.0176
472286	-10.51	Low TDS	No correction for low TDS	0.287	-0.354	0.030	0.052	0.193	0.011	-0.102	-0.033	-0.219	-0.0002
472906	-10.49	Low TDS	No correction for low TDS	0.909	-1.123	0.344	0.217	0.287	0.060	-0.659	-0.094	-0.350	-0.0195
472581	-10.44	Low TDS	No correction for low TDS	0.297	-0.366	0.028	0.050	0.202	0.016	-0.160	-0.034	-0.172	-0.0006
470271	-10.35	Indeterminate, close to 10%	Caution	2.338	-2.877	0.812	0.640	0.811	0.075	-0.979	-0.450	-0.999	-0.4500
470018	-10.34	Indeterminate, close to 10%	Caution	2.288	-2.815	0.697	0.813	0.751	0.027	-1.039	-0.350	-0.928	-0.4984
472509	-10.30	Low TDS	No correction for low TDS	0.364	-0.448	0.057	0.061	0.226	0.019	-0.158	-0.047	-0.240	-0.0035
474995	-10.29	Indeterminate, close to 10%	Caution	10.198	-12.537	6.357	0.942	1.781	1.119	-9.271	-0.020	-2.144	-1.1016
472115	-10.26	Low TDS	No correction for low TDS	0.294	-0.362	0.020	0.043	0.217	0.013	-0.074	-0.063	-0.220	-0.0043
470063	-10.23	Indeterminate, close to 10%	Caution	2.234	-2.742	1.050	0.552	0.588	0.044	-1.379	-0.223	-0.793	-0.3484
472600	-10.15	Low TDS	No correction for low TDS	0.417	-0.511	0.101	0.063	0.235	0.018	-0.178	-0.066	-0.253	-0.0142
472785	-10.11	Low TDS	No correction for low TDS	0.402	-0.492	0.070	0.067	0.251	0.015	-0.164	-0.075	-0.253	-0.0005
470602	10.04	Indeterminate, close to 10%	Caution	2.098	-1.715	0.808	0.543	0.664	0.083	-0.699	-0.235	-0.635	-0.1455
471031	10.07	Indeterminate, close to 10%	Caution	1.665	-1.360	0.755	0.323	0.460	0.127	-0.879	-0.053	-0.407	-0.0206
470652	10.07	Indeterminate, close to 10%	Caution	1.584	-1.294	0.467	0.476	0.583	0.058	-0.559	-0.130	-0.491	-0.1140
473800	10.09	Indeterminate, close to 10%	Caution	3.087	-2.521	1.645	0.299	0.740	0.403	-1.159	-0.483	-0.784	-0.0948
473632	10.14	Indeterminate, close to 10%	Caution	1.912	-1.560	0.845	0.389	0.445	0.233	-0.959	-0.085	-0.443	-0.0734
473583	10.19	Indeterminate, close to 10%	Caution	3.002	-2.447	1.615	0.717	0.576	0.094	-1.499	-0.308	-0.640	-0.0002
472939	10.26	Low TDS	No correction for low TDS	0.638	-0.519	0.178	0.105	0.328	0.027	-0.194	-0.047	-0.262	-0.0163
473610	10.36	Low TDS	No correction for low TDS	1.067	-0.866	0.552	0.190	0.248	0.076	-0.599	-0.047	-0.206	-0.0140
471019	10.42	Indeterminate, close to 10%	Caution	1.519	-1.233	0.722	0.344	0.389	0.064	-0.799	-0.070	-0.320	-0.0429
470339	10.44	Indeterminate, close to 10%	Caution	4.280	-3.470	1.696	0.935	1.405	0.244	-0.959	-0.477	-1.568	-0.4661
472491	10.47	Indeterminate, close to 10%	Caution	1.244	-1.008	0.576	0.280	0.312	0.076	-0.599	-0.085	-0.296	-0.0282
470607	10.55	Indeterminate, close to 10%	Caution	2.163	-1.750	0.822	0.570	0.656	0.115	-0.699	-0.269	-0.674	-0.1079
475086	10.66	Indeterminate, close to 10%	Caution	12.228	-9.873	5.158	0.892	6.083	0.095	-2.558	-1.278	-6.037	-0.0005
472495	10.71	Low TDS	No correction for low TDS	1.140	-0.919	0.495	0.239	0.300	0.106	-0.539	-0.088	-0.273	-0.0189
473921	10.76	Indeterminate, close to 10%	Caution	1.443	-1.163	0.249	0.289	0.857	0.048	-0.202	-0.160	-0.801	-0.0002
471295	10.78	Indeterminate, close to 10%	Caution	2.053	-1.654	1.202	0.330	0.467	0.054	-1.159	-0.038	-0.453	-0.0040

Sample Number	Charge balance	Error	Action	Total cations	Total anions	Ca (meq/L)	Mg (meq/L)	Na (meq/L)	K (meq/L)	HCO3 (meq/L)	SO4 (meq/L)	Cl (meq/L)	NO3 (meq/L)
471857	10.84	Indeterminate, close to 10%	Caution	3.131	-2.518	1.315	0.941	0.787	0.088	-1.479	-0.248	-0.494	-0.2984
471898	10.91	Indeterminate, close to 10%	Caution	2.159	-1.734	1.020	0.496	0.571	0.072	-0.859	-0.289	-0.449	-0.1369
470041	10.94	Indeterminate, close to 10%	Caution	5.436	-4.364	3.550	0.711	1.047	0.127	-3.217	-0.225	-0.733	-0.1887
473380	11.02	Low TDS	No correction for low TDS	0.515	-0.413	0.094	0.103	0.306	0.012	-0.116	-0.020	-0.274	-0.0032
472914	11.14	Indeterminate	Caution	1.775	-1.419	0.892	0.326	0.485	0.071	-0.899	-0.097	-0.423	-0.0002
475337	11.15	Low TDS	No correction for low TDS	0.306	-0.245	0.031	0.048	0.203	0.024	-0.028	-0.049	-0.166	-0.0018
474171	11.16	Indeterminate	Caution	2.528	-2.020	1.334	0.616	0.530	0.047	-1.119	-0.246	-0.578	-0.0774
472909	11.19	Low TDS	No correction for low TDS	0.226	-0.180	0.030	0.044	0.142	0.010	-0.044	-0.011	-0.124	-0.0005
472802	11.19	Indeterminate	Caution	1.458	-1.165	0.634	0.284	0.354	0.187	-0.679	-0.077	-0.378	-0.0305
470297	11.29	Indeterminate	Caution	2.228	-1.775	0.726	0.580	0.845	0.075	-0.699	-0.189	-0.671	-0.2161
474288	11.32	Indeterminate	Caution	1.790	-1.426	0.825	0.224	0.696	0.044	-0.256	-0.348	-0.652	-0.1710
470318	11.47	Indeterminate	Caution	7.254	-5.761	4.235	1.163	1.802	0.054	-2.997	-0.452	-1.873	-0.4387
473924	11.51	Indeterminate	Caution	1.651	-1.311	0.757	0.412	0.463	0.020	-0.679	-0.231	-0.401	-0.0002
474303	11.60	Indeterminate	Caution	1.879	-1.488	0.803	0.307	0.672	0.097	-0.719	-0.204	-0.553	-0.0126
473669	11.65	Indeterminate	Caution	1.881	-1.488	0.858	0.343	0.348	0.331	-0.779	-0.262	-0.302	-0.1448
473697	11.67	Low TDS	No correction for low TDS	1.082	-0.856	0.472	0.200	0.275	0.136	-0.480	-0.074	-0.240	-0.0621
470367	11.79	Indeterminate	Caution	4.028	-3.178	1.886	0.958	1.102	0.082	-1.858	-0.212	-0.733	-0.3742
474182	11.81	Indeterminate	Caution	1.316	-1.038	0.490	0.282	0.503	0.041	-0.240	-0.281	-0.511	-0.0068
472684	11.81	Indeterminate	Caution	1.721	-1.357	0.655	0.379	0.643	0.044	-0.460	-0.179	-0.606	-0.1119
470201	11.85	Indeterminate	Caution	3.389	-2.671	1.373	0.924	0.889	0.203	-0.480	-0.537	-1.182	-0.4726
474097	11.86	Indeterminate	Caution	6.632	-5.226	4.557	0.498	1.411	0.167	-4.276	-0.516	-0.392	-0.0419
470350	11.91	Indeterminate	Caution	5.546	-4.366	2.209	1.825	1.387	0.126	-1.918	-0.433	-1.368	-0.6468
470130	11.97	Indeterminate	Caution	2.119	-1.666	0.160	1.141	0.793	0.026	-0.839	-0.077	-0.745	-0.0053
473061	12.02	Indeterminate	Caution	1.628	-1.278	0.694	0.364	0.501	0.069	-0.500	-0.174	-0.528	-0.0769
472809	12.03	Indeterminate	Caution	2.228	-1.750	0.805	0.654	0.521	0.249	-0.979	-0.159	-0.477	-0.1352
474053	12.08	Indeterminate	Caution	5.614	-4.403	4.202	0.415	0.902	0.094	-3.537	-0.454	-0.389	-0.0235
470891	12.20	Indeterminate	Caution	1.314	-1.028	0.483	0.344	0.446	0.040	-0.422	-0.112	-0.316	-0.1785
473746	12.25	Indeterminate	Caution	3.843	-3.005	2.250	0.853	0.660	0.080	-1.978	-0.287	-0.739	-0.0002

Sample Number	Charge balance	Error	Action	Total cations	Total anions	Ca (meq/L)	Mg (meq/L)	Na (meq/L)	K (meq/L)	HCO3 (meq/L)	SO4 (meq/L)	Cl (meq/L)	NO3 (meq/L)
473689	12.40	Low TDS	No correction for low TDS	1.193	-0.930	0.588	0.156	0.420	0.029	-0.400	-0.082	-0.449	-0.0005
474204	12.45	Low TDS	No correction for low TDS	0.364	-0.284	0.049	0.059	0.239	0.018	-0.050	-0.039	-0.195	-0.0002
471318	12.46	Low TDS	No correction for low TDS	1.041	-0.811	0.460	0.220	0.257	0.104	-0.519	-0.053	-0.220	-0.0184
472936	12.51	Indeterminate	Caution	2.504	-1.949	1.275	0.357	0.705	0.166	-1.239	-0.162	-0.341	-0.2065
470915	12.51	Low TDS	No correction for low TDS	0.437	-0.340	0.103	0.057	0.257	0.021	-0.084	-0.021	-0.234	-0.0002
470287	12.52	Indeterminate	Caution	1.116	-0.868	0.405	0.185	0.487	0.039	-0.204	-0.072	-0.501	-0.0905
471900	12.56	Indeterminate	Caution	4.633	-3.602	2.589	0.963	1.035	0.045	-1.359	-0.414	-1.360	-0.4694
471482	12.60	Indeterminate	Caution	2.445	-1.899	0.959	0.623	0.696	0.166	-1.119	-0.203	-0.477	-0.1008
472457	12.60	Indeterminate	Caution	1.301	-1.010	0.655	0.241	0.305	0.100	-0.599	-0.096	-0.280	-0.0345
470386	12.72	Indeterminate	Caution	6.652	-5.151	0.793	3.742	2.064	0.053	-2.597	-0.414	-2.031	-0.1081
473036	12.80	Indeterminate	Caution	1.772	-1.370	0.886	0.380	0.423	0.083	-0.539	-0.164	-0.530	-0.1361
470229	12.80	Indeterminate	Caution	4.767	-3.685	1.556	1.506	1.603	0.101	-1.339	-0.433	-1.391	-0.5226
473618	12.84	Low TDS	No correction for low TDS	1.271	-0.982	0.542	0.244	0.293	0.191	-0.539	-0.144	-0.243	-0.0553
470505	12.86	Indeterminate	Caution	2.721	-2.101	1.093	0.779	0.776	0.074	-0.879	-0.239	-0.618	-0.3645
474283	12.99	Indeterminate	Caution	5.702	-4.391	3.009	0.677	1.676	0.340	-3.197	-0.377	-0.654	-0.1629
470354	13.00	Indeterminate	Caution	5.460	-4.204	2.580	1.468	1.305	0.107	-2.218	-0.410	-1.114	-0.4613
474610	13.15	Indeterminate	Caution	6.105	-4.686	5.278	0.220	0.562	0.045	-4.496	-0.088	-0.077	-0.0252
470721	13.16	Indeterminate	Caution	2.306	-1.770	1.072	0.532	0.677	0.024	-0.979	-0.156	-0.474	-0.1606
472494	13.39	Low TDS	No correction for low TDS	1.163	-0.889	0.568	0.218	0.291	0.086	-0.539	-0.069	-0.254	-0.0260
470243	13.39	Indeterminate	Caution	2.921	-2.231	1.093	0.964	0.810	0.054	-0.579	-0.381	-0.937	-0.3339
470323	13.45	Indeterminate	Caution	6.775	-5.169	1.225	3.574	1.860	0.116	-2.737	-0.541	-1.642	-0.2484
470370	13.48	Indeterminate	Caution	3.764	-2.870	0.596	1.888	1.250	0.029	-1.359	-0.171	-1.334	-0.0055
473654	13.55	Low TDS	No correction for low TDS	1.115	-0.849	0.537	0.230	0.316	0.032	-0.242	-0.114	-0.353	-0.1410
473607	13.59	Low TDS	No correction for low TDS	0.983	-0.748	0.415	0.194	0.284	0.089	-0.420	-0.059	-0.239	-0.0302
470527	13.62	Indeterminate	Caution	1.994	-1.516	1.110	0.391	0.435	0.058	-0.899	-0.112	-0.261	-0.2435
470385	13.65	Indeterminate	Caution	6.245	-4.745	1.498	2.906	1.732	0.109	-2.058	-0.454	-1.738	-0.4952
470822	13.79	Indeterminate	Caution	2.847	-2.156	1.130	0.692	0.858	0.166	-1.339	-0.207	-0.546	-0.0645
471481	13.86	Low TDS	No correction for low TDS	0.621	-0.470	0.185	0.092	0.295	0.048	-0.166	-0.045	-0.241	-0.0173

Sample Number	Charge balance	Error	Action	Total cations	Total anions	Ca (meq/L)	Mg (meq/L)	Na (meq/L)	K (meq/L)	HCO3 (meq/L)	SO4 (meq/L)	Cl (meq/L)	NO3 (meq/L)
473328	13.87	Low TDS	No correction for low TDS	0.664	-0.502	0.181	0.119	0.349	0.015	-0.046	-0.075	-0.310	-0.0706
470214	13.89	Alkalinity	Caution HCO3	3.498	-2.645	1.657	0.919	0.856	0.066	-0.240	-0.358	-1.145	-0.9016
472741	14.15	Low TDS	No correction for low TDS	0.379	-0.285	0.064	0.067	0.238	0.010	-0.046	-0.043	-0.195	-0.0018
474607	14.50	Indeterminate	Caution	6.840	-5.108	5.673	0.359	0.745	0.064	-4.755	-0.118	-0.168	-0.0668
470407	14.66	Indeterminate	Caution	2.824	-2.102	1.130	0.794	0.822	0.079	-1.039	-0.314	-0.550	-0.1984
473354	14.68	Low TDS	No correction for low TDS	0.573	-0.426	0.122	0.109	0.330	0.012	-0.024	-0.061	-0.282	-0.0594
470692	14.68	Indeterminate	Caution	6.475	-4.817	2.695	1.355	1.603	0.822	-1.738	-0.595	-2.186	-0.2968
474240	14.71	Alkalinity	Caution HCO3	1.582	-1.176	0.649	0.244	0.661	0.029	-0.254	-0.429	-0.454	-0.0395
472331	14.84	Indeterminate	Caution	2.065	-1.531	1.002	0.396	0.621	0.046	-0.979	-0.164	-0.316	-0.0719
473211	14.87	Low TDS	No correction for low TDS	0.526	-0.390	0.185	0.124	0.202	0.015	-0.080	-0.063	-0.230	-0.0169
470111	15.06	Alkalinity	Caution HCO3	4.532	-3.346	0.699	2.232	1.455	0.146	-1.539	-0.191	-1.540	-0.0761
472651	15.24	Indeterminate	Caution	2.209	-1.625	0.939	0.579	0.627	0.064	-0.879	-0.227	-0.406	-0.1127
473542	15.52	Indeterminate	Caution	5.113	-3.741	3.427	0.892	0.633	0.162	-3.736	-0.001	-0.002	-0.0015
472865	15.59	Alkalinity	Caution HCO3	1.504	-1.098	0.519	0.459	0.475	0.051	-0.440	-0.169	-0.395	-0.0948
470136	15.67	Alkalinity	Caution HCO3	3.156	-2.301	1.729	0.750	0.589	0.088	-1.279	-0.331	-0.691	-0.0002
473561	15.67	Alkalinity	Caution HCO3	2.505	-1.826	0.783	0.613	1.018	0.090	-0.462	-0.221	-0.762	-0.3823
473576	15.72	Indeterminate	Caution	2.344	-1.708	1.229	0.583	0.491	0.041	-0.939	-0.244	-0.525	-0.0002
474629	15.79	Indeterminate	Caution	6.752	-4.911	3.707	0.995	1.888	0.162	-4.136	-0.304	-0.471	-0.0002
473612	15.80	Low TDS	No correction for low TDS	1.373	-0.998	0.595	0.302	0.276	0.201	-0.579	-0.092	-0.239	-0.0879
473435	15.86	Indeterminate	Caution	1.860	-1.351	1.064	0.453	0.310	0.034	-0.799	-0.147	-0.291	-0.1139
475287	15.95	Indeterminate	Caution	3.158	-2.289	1.160	0.522	1.423	0.053	-0.919	-0.389	-0.934	-0.0473
474943	16.04	Alkalinity	Caution HCO3	6.225	-4.504	3.629	0.876	1.595	0.125	-2.258	-0.523	-1.385	-0.3387
470343	16.04	Alkalinity	Caution HCO3	3.100	-2.243	0.323	1.680	1.045	0.051	-1.239	-0.120	-0.855	-0.0294
474622	16.41	Indeterminate	Caution	2.022	-1.452	0.895	0.288	0.779	0.060	-0.739	-0.217	-0.482	-0.0139
473937	16.48	Alkalinity	Caution HCO3	1.463	-1.050	0.487	0.297	0.649	0.030	-0.312	-0.055	-0.683	-0.0002
475160	16.65	Alkalinity	Caution HCO3	6.716	-4.799	4.096	1.979	0.531	0.110	-3.477	-0.275	-0.680	-0.3677
470516	16.70	Alkalinity	Caution HCO3	2.554	-1.823	0.781	0.907	0.775	0.091	-0.919	-0.153	-0.530	-0.2210
470120	16.88	Alkalinity	Caution HCO3	3.598	-2.559	1.055	1.312	1.098	0.133	-1.465	-0.437	-0.516	-0.1405

Sample Number	Charge balance	Error	Action	Total cations	Total anions	Ca (meq/L)	Mg (meq/L)	Na (meq/L)	K (meq/L)	HCO3 (meq/L)	SO4 (meq/L)	Cl (meq/L)	NO3 (meq/L)
470338	16.99	Alkalinity	Caution HCO3	3.036	-2.154	0.477	1.501	1.009	0.049	-1.079	-0.159	-0.863	-0.0527
474861	17.01	Alkalinity	Caution HCO3	6.246	-4.430	4.612	0.661	0.877	0.097	-2.458	-0.656	-1.089	-0.2274
470357	17.05	Indeterminate	Caution	1.958	-1.388	0.597	0.424	0.852	0.085	-0.246	-0.210	-0.666	-0.2661
470324	17.16	Indeterminate	Caution	5.038	-3.562	1.265	2.301	1.408	0.064	-1.938	-0.254	-1.196	-0.1742
470506	17.25	Indeterminate	Caution	2.160	-1.525	1.058	0.474	0.595	0.033	-0.939	-0.117	-0.333	-0.1361
471217	17.47	Low TDS	No correction for low TDS	1.354	-0.951	0.579	0.371	0.367	0.037	-0.440	-0.143	-0.295	-0.0739
470413	17.70	Indeterminate	Caution	3.298	-2.306	1.485	0.822	0.837	0.154	-1.419	-0.235	-0.491	-0.1611
473398	17.81	Indeterminate	Caution	1.600	-1.117	0.718	0.281	0.552	0.050	-0.739	-0.051	-0.279	-0.0469
471192	17.88	Indeterminate	Caution	1.965	-1.369	0.674	0.440	0.797	0.054	-0.739	-0.132	-0.394	-0.1032
471668	18.05	Indeterminate	Caution	2.591	-1.799	1.242	0.632	0.601	0.116	-1.239	-0.176	-0.288	-0.0963
470409	18.72	Alkalinity	Caution HCO3	2.661	-1.822	1.075	0.726	0.803	0.057	-0.739	-0.231	-0.606	-0.2452
471529	19.01	Indeterminate	Caution	2.432	-1.655	1.200	0.407	0.783	0.043	-1.079	-0.069	-0.161	-0.3468
470716	19.11	Indeterminate	Caution	1.990	-1.352	0.946	0.482	0.519	0.044	-0.859	-0.104	-0.273	-0.1155
475245	19.26	Alkalinity	Caution HCO3	6.007	-4.067	3.606	1.126	1.173	0.102	-2.298	-0.510	-1.236	-0.0234
470153	19.27	Alkalinity	Caution HCO3	3.222	-2.181	2.209	0.525	0.463	0.025	-1.259	-0.212	-0.491	-0.2194
473337	19.54	Low TDS	No correction for low TDS	0.612	-0.412	0.210	0.099	0.281	0.023	-0.028	-0.077	-0.256	-0.0513
470374	19.96	Indeterminate	Caution	2.430	-1.622	0.275	1.287	0.828	0.040	-0.759	-0.128	-0.731	-0.0040
470335	20.12	Indeterminate	Caution	2.243	-1.491	0.542	0.897	0.737	0.066	-0.739	-0.165	-0.406	-0.1806
470531	20.21	Alkalinity	Caution HCO3	2.308	-1.532	1.249	0.553	0.453	0.054	-0.899	-0.154	-0.258	-0.2210
471992	20.28	Alkalinity	Caution HCO3	5.133	-3.402	3.102	1.079	0.904	0.048	-1.978	-0.310	-0.858	-0.2565
470143	20.37	Alkalinity	Caution HCO3	3.721	-2.461	1.547	0.935	1.149	0.091	-0.725	-0.999	-0.635	-0.1019
474681	20.41	Indeterminate	Caution	3.553	-2.348	1.782	0.611	1.053	0.107	-2.058	-0.089	-0.201	-0.0005
473765	20.50	Alkalinity	Caution HCO3	4.866	-3.210	3.571	0.534	0.532	0.228	-2.358	-0.098	-0.714	-0.0403
470090	20.54	Alkalinity	Caution HCO3	5.991	-3.949	4.320	0.674	0.893	0.104	-2.378	-0.339	-1.066	-0.1661
470442	20.58	Alkalinity	Caution HCO3	2.441	-1.608	0.876	0.741	0.763	0.061	-0.519	-0.404	-0.528	-0.1569
470286	20.91	Low TDS	No correction for low TDS	0.905	-0.592	0.316	0.136	0.429	0.025	-0.128	-0.047	-0.415	-0.0030
470348	20.94	Alkalinity	Caution HCO3	4.634	-3.029	1.965	1.101	1.458	0.109	-1.459	-0.289	-1.159	-0.1216
473606	22.16	Alkalinity	Caution HCO3	2.237	-1.426	1.192	0.579	0.433	0.034	-0.879	-0.148	-0.347	-0.0515

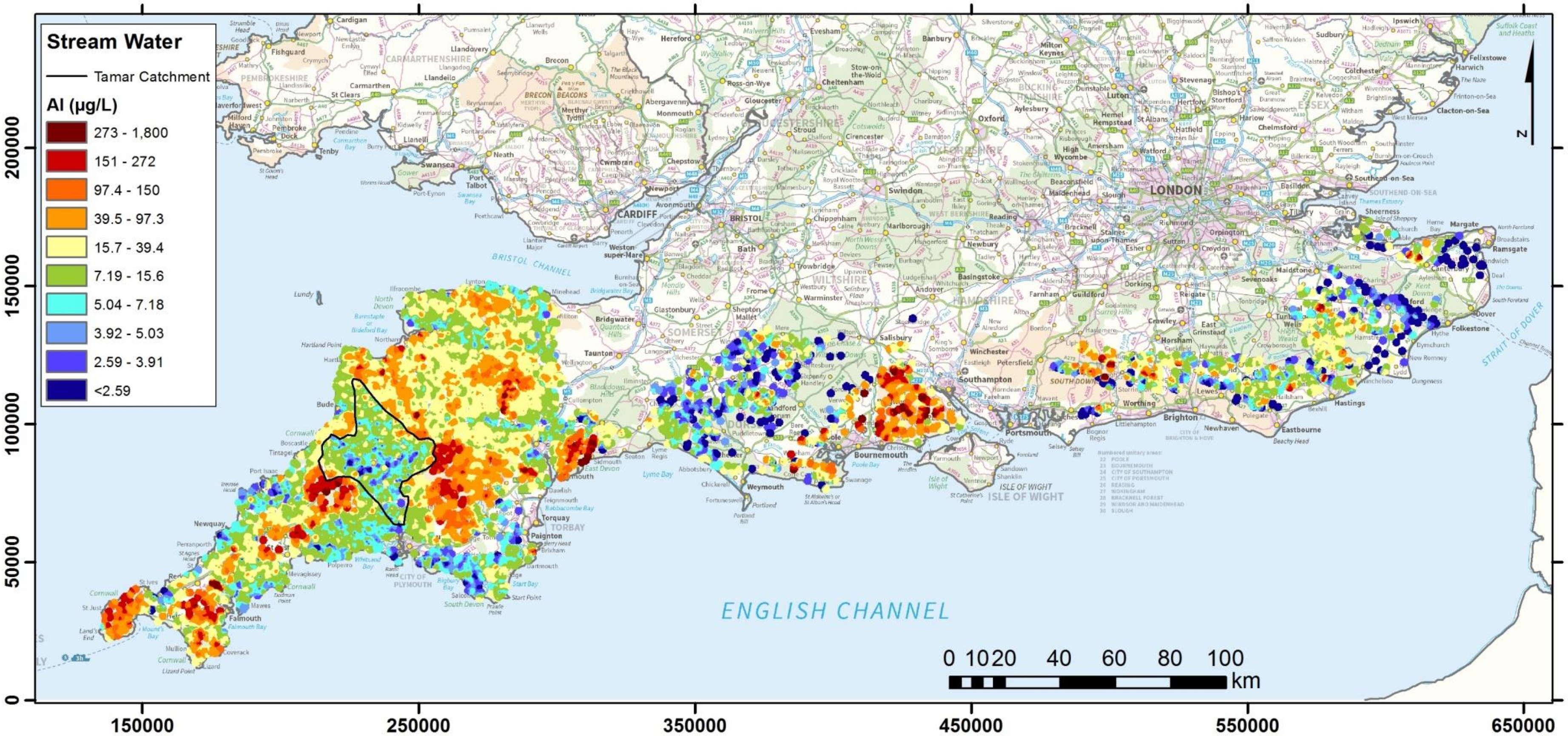
Sample Number	Charge balance	Error	Action	Total cations	Total anions	Ca (meq/L)	Mg (meq/L)	Na (meq/L)	K (meq/L)	HCO3 (meq/L)	SO4 (meq/L)	Cl (meq/L)	NO3 (meq/L)
474993	22.27	Indeterminate	Caution	6.016	-3.825	5.002	0.390	0.543	0.081	-2.897	-0.346	-0.559	-0.0237
470446	22.36	Low TDS	No correction for low TDS	1.576	-1.000	0.863	0.352	0.302	0.059	-0.999	-0.001	-0.001	-0.0002
473485	22.54	Indeterminate	Caution	1.608	-1.020	0.570	0.298	0.684	0.056	-0.332	-0.125	-0.437	-0.1258
471344	22.59	Low TDS	No correction for low TDS	1.499	-0.947	0.534	0.240	0.673	0.053	-0.523	-0.066	-0.293	-0.0644
470166	22.81	Low TDS	No correction for low TDS	1.163	-0.731	0.117	0.195	0.829	0.023	-0.124	-0.092	-0.502	-0.0135
475376	23.38	Indeterminate	Caution	5.979	-3.718	3.935	0.774	0.942	0.328	-3.716	-0.001	-0.001	-0.0002
472981	23.41	Indeterminate	Caution	3.942	-2.447	2.231	0.879	0.771	0.061	-1.179	-0.319	-0.725	-0.2242
470733	23.55	Indeterminate	Caution	3.321	-2.055	1.267	0.783	0.955	0.315	-1.149	-0.112	-0.480	-0.3145
473908	23.57	Alkalinity	Caution HCO3	1.990	-1.231	0.510	0.323	1.095	0.063	-0.020	-0.185	-1.021	-0.0044
473708	23.67	Alkalinity	Caution HCO3	3.336	-2.059	2.229	0.314	0.479	0.315	-1.019	-0.248	-0.688	-0.1042
473166	24.97	Alkalinity	Caution HCO3	3.300	-1.981	1.720	0.674	0.677	0.229	-0.334	-0.258	-0.829	-0.5597
470124	25.10	Alkalinity	Caution HCO3	2.188	-1.310	0.844	0.412	0.872	0.060	-0.318	-0.190	-0.544	-0.2581
470383	25.29	Alkalinity	Caution HCO3	3.009	-1.794	1.480	0.664	0.805	0.060	-1.279	-0.081	-0.278	-0.1565
470108	26.04	Alkalinity	Caution HCO3	2.347	-1.377	0.912	0.372	0.970	0.093	-0.220	-0.194	-0.657	-0.3065
473486	26.30	Low TDS	No correction for low TDS	1.399	-0.821	0.750	0.285	0.311	0.053	-0.819	-0.001	-0.001	-0.0002
474291	26.45	Alkalinity	Caution HCO3	4.729	-2.750	3.577	0.350	0.687	0.114	-1.598	-0.485	-0.652	-0.0152
470662	26.63	Alkalinity	Caution HCO3	2.349	-1.361	0.886	0.657	0.752	0.055	-0.573	-0.185	-0.465	-0.1373
470536	26.93	Indeterminate	Caution	3.032	-1.745	1.139	0.899	0.906	0.088	-1.119	-0.163	-0.353	-0.1105
474948	28.09	Alkalinity	Caution HCO3	4.386	-2.463	3.793	0.190	0.374	0.031	-1.818	-0.231	-0.372	-0.0411
474155	29.08	Low TDS	No correction for low TDS	0.996	-0.548	0.364	0.237	0.384	0.011	-0.150	-0.028	-0.370	-0.0002
470904	29.44	Alkalinity	Caution HCO3	3.314	-1.807	1.548	0.653	0.928	0.185	-0.136	-0.329	-1.032	-0.3100
471336	29.85	Alkalinity	Caution HCO3	2.077	-1.122	1.242	0.340	0.459	0.036	-0.440	-0.142	-0.449	-0.0916
471754	30.20	Alkalinity	Caution HCO3	3.007	-1.612	1.765	0.566	0.591	0.085	-0.478	-0.273	-0.592	-0.2694
470980	30.27	Indeterminate	Caution	2.753	-1.475	0.500	0.356	1.763	0.134	-0.440	-0.001	-0.935	-0.0995
470421	30.81	Low TDS	No correction for low TDS	1.809	-0.957	0.591	0.408	0.762	0.048	-0.390	-0.080	-0.370	-0.1176
470444	30.85	Sulphate	Caution IC SO4, ICP-MS data preferred	5.499	-2.908	2.905	0.694	1.765	0.135	-0.228	-0.001	-2.457	-0.2226
472359	31.41	Low TDS	No correction for low TDS	1.203	-0.628	0.661	0.175	0.346	0.021	-0.056	-0.128	-0.389	-0.0550
471405	32.27	Alkalinity	Caution HCO3	2.792	-1.430	1.464	0.645	0.614	0.069	-0.939	-0.092	-0.222	-0.1758

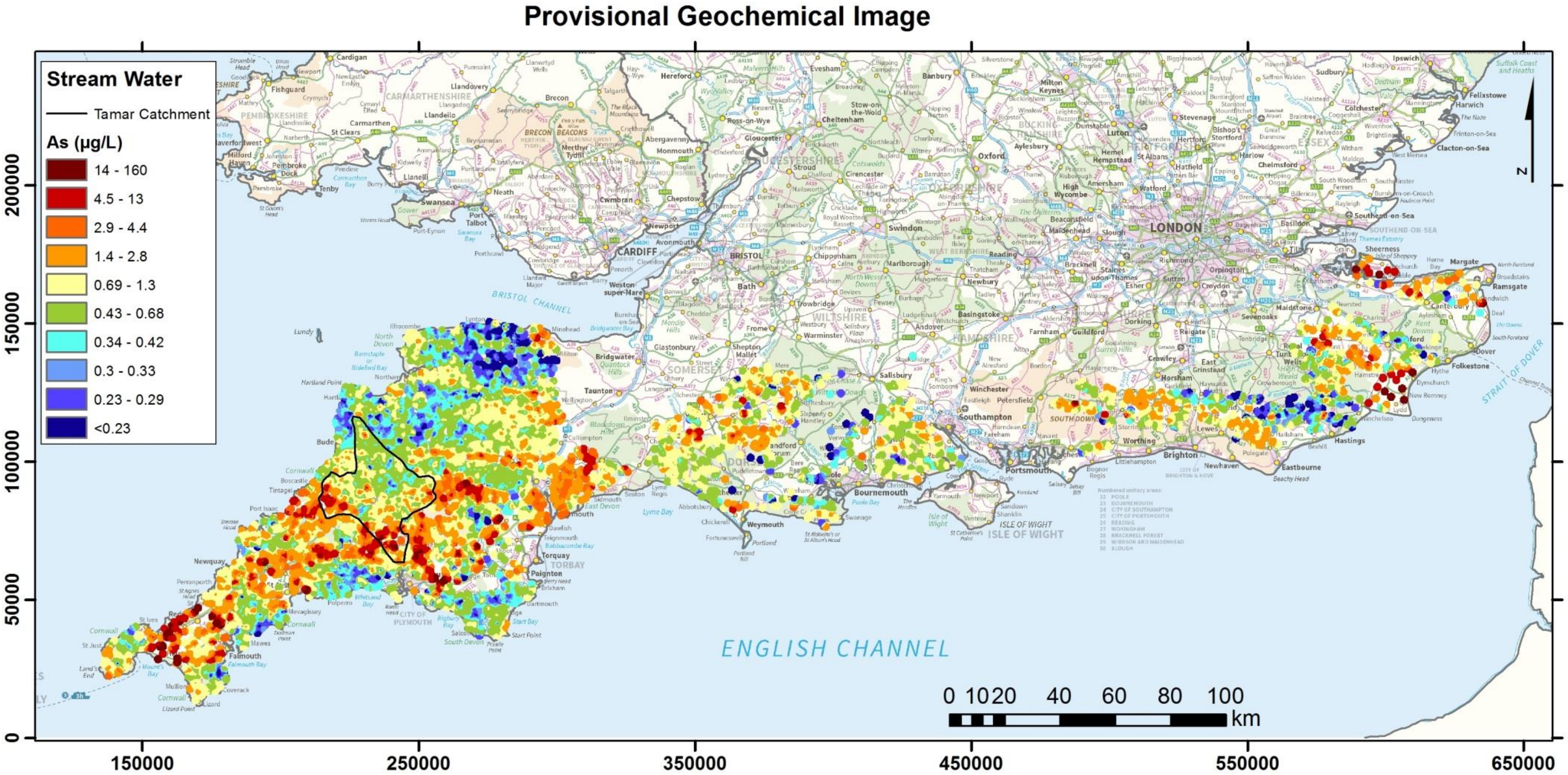
Sample Number	Charge balance	Error	Action	Total cations	Total anions	Ca (meq/L)	Mg (meq/L)	Na (meq/L)	K (meq/L)	HCO3 (meq/L)	SO4 (meq/L)	Cl (meq/L)	NO3 (meq/L)
470777	32.96	Anions	Caution anions	2.768	-1.400	1.542	0.544	0.636	0.045	-1.399	-0.001	-0.001	-0.0002
471779	33.80	Alkalinity	Caution HCO3	2.193	-1.085	1.269	0.393	0.508	0.024	-0.208	-0.200	-0.474	-0.2032
471150	34.18	Alkalinity	Caution HCO3	2.233	-1.096	0.789	0.915	0.491	0.039	-0.893	-0.039	-0.078	-0.0853
470443	34.65	Alkalinity	Caution HCO3	2.781	-1.350	0.978	0.890	0.837	0.076	-0.466	-0.450	-0.355	-0.0792
470701	35.18	Low TDS	No correction for low TDS	1.214	-0.582	0.326	0.228	0.602	0.058	-0.210	-0.085	-0.235	-0.0519
470241	36.41	Indeterminate	Caution	2.555	-1.191	0.863	0.761	0.875	0.056	-0.629	-0.177	-0.319	-0.0658
470541	36.46	Indeterminate	Caution	2.351	-1.095	0.937	0.675	0.687	0.052	-0.759	-0.095	-0.157	-0.0842
470484	36.56	Alkalinity	Caution HCO3	2.881	-1.338	0.740	0.729	1.292	0.120	-0.258	-0.212	-0.615	-0.2532
470356	40.71	Alkalinity	Caution HCO3	9.720	-4.096	6.616	1.178	1.705	0.221	-1.558	-0.441	-1.701	-0.3952
470486	40.92	Low TDS	No correction for low TDS	1.309	-0.549	0.447	0.184	0.617	0.062	-0.312	-0.040	-0.169	-0.0282
473736	52.33	Alkalinity	Caution HCO3	3.822	-1.197	2.806	0.381	0.465	0.170	-0.202	-0.377	-0.618	-0.0002
470778	59.64	Low TDS	No correction for low TDS	1.664	-0.425	0.673	0.412	0.532	0.047	-0.424	-0.001	-0.001	-0.0002

Appendix 8 Provisional geochemical images

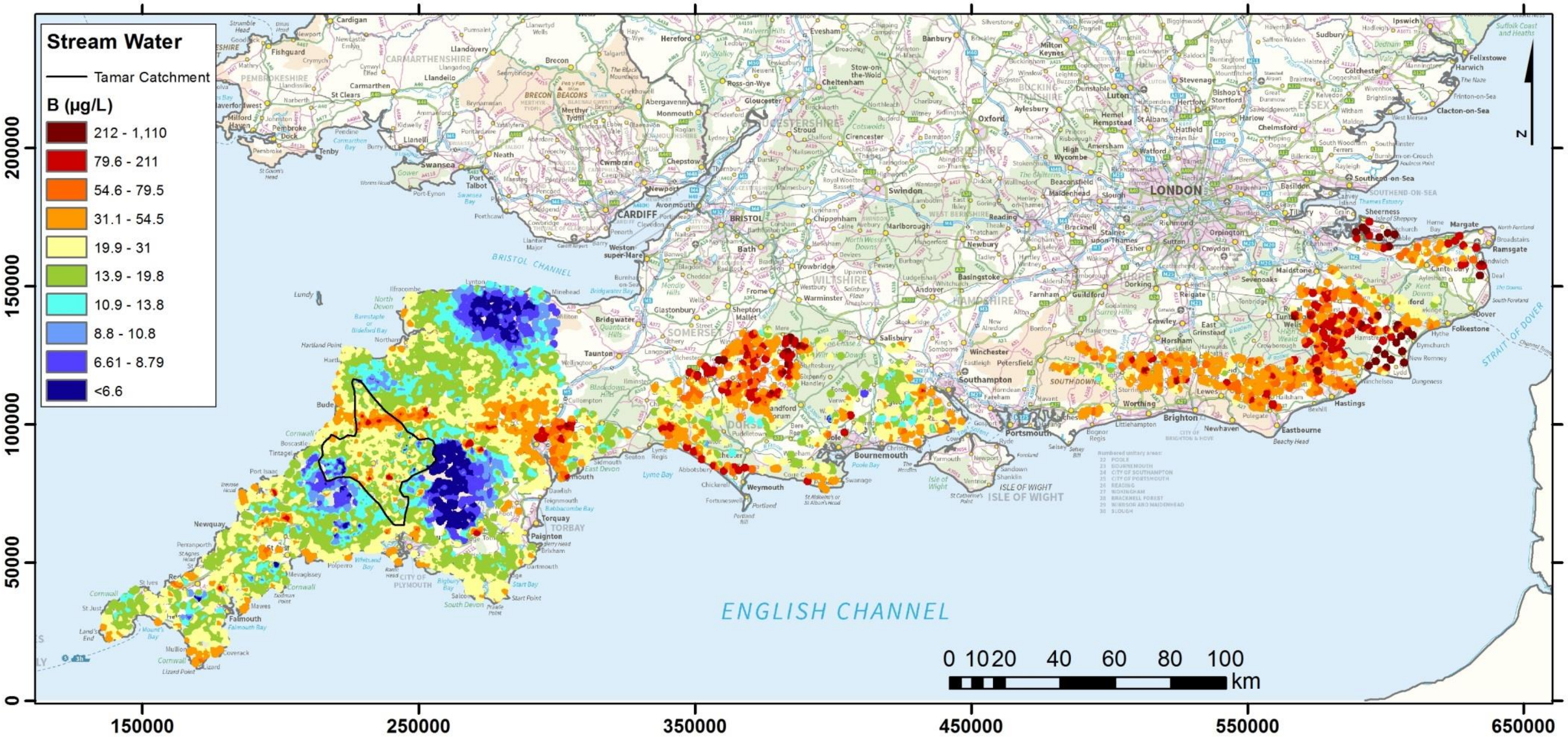
The following pages present provisional geochemical images of the 2012 and 2013 data. Where available these include the Tamar catchment data.

Provisional Geochemical Image

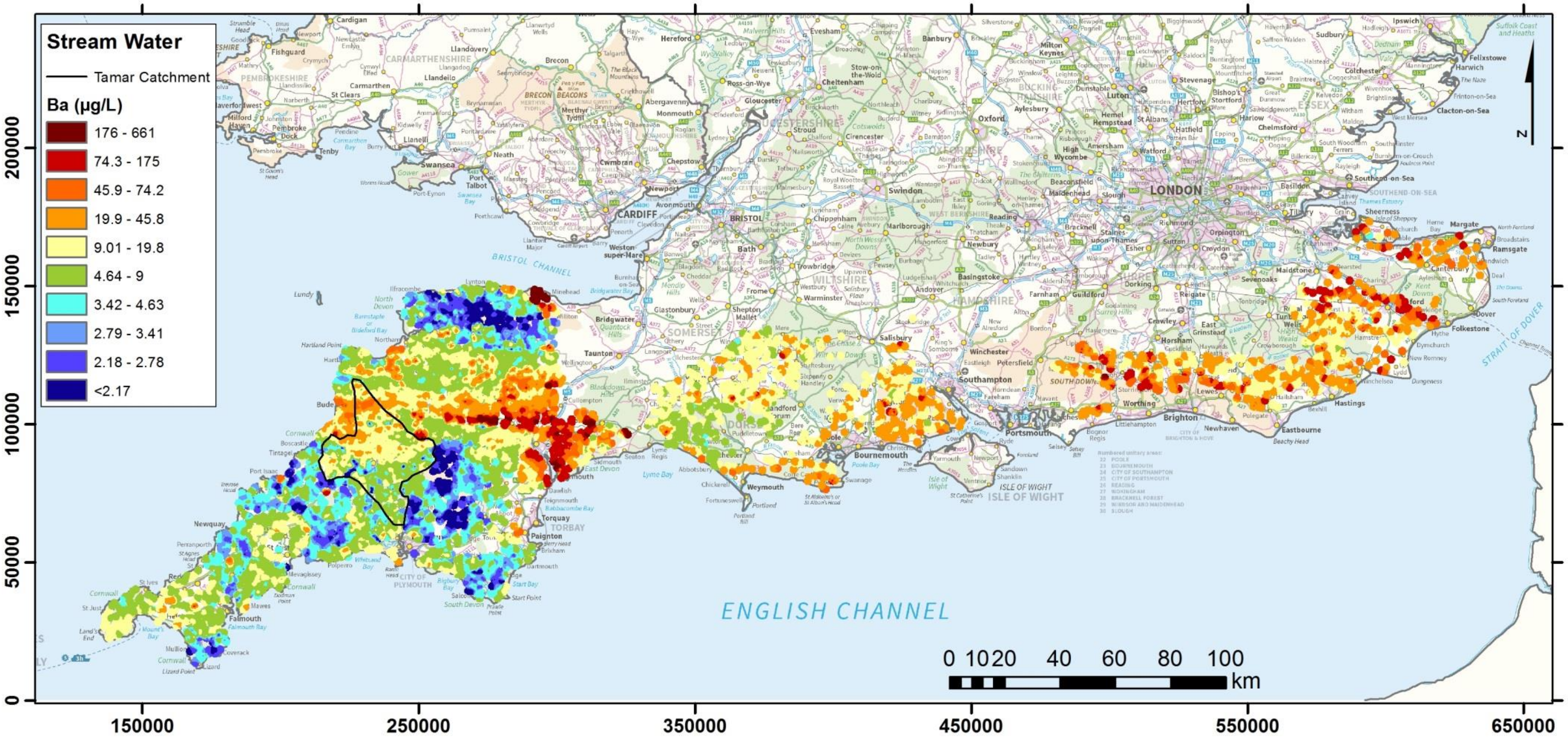



Provisional Geochemical Image
Stream Water
Tamar Catchment
As (µg/L)
14 - 160
4.5 - 13
2.9 - 4.4
1.4 - 2.8
0.69 - 1.3
0.43 - 0.68
0.34 - 0.42
0.3 - 0.33
0.23 - 0.29
<0.23
200000
150000
100000
50000
0
150000
250000
350000
450000
550000
650000
0 10 20 40 60 80 100
km
N
ENGLISH CHANNEL
BRISTOL CHANNEL
LONDON
CARDIFF
BRISTOL

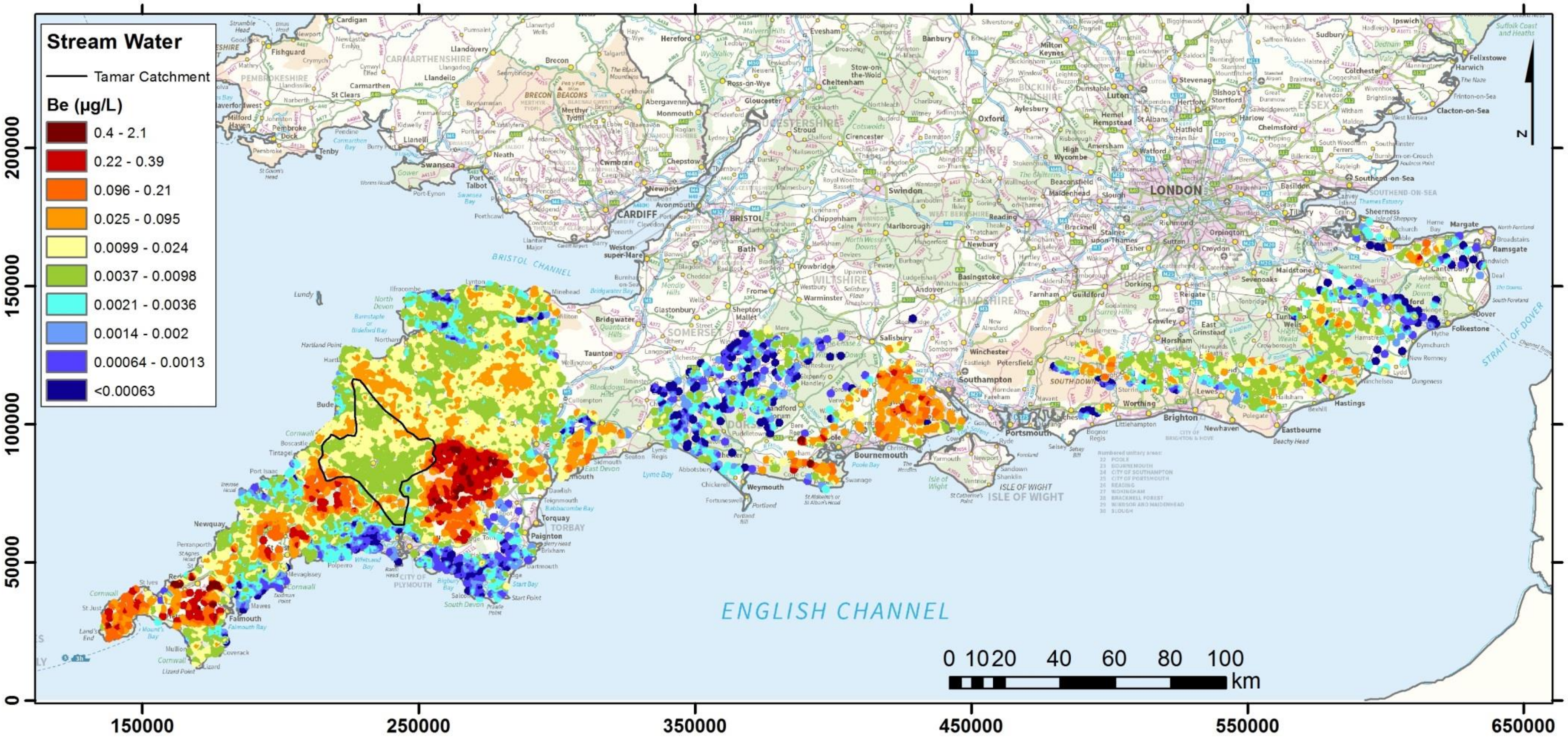
Provisional Geochemical Image



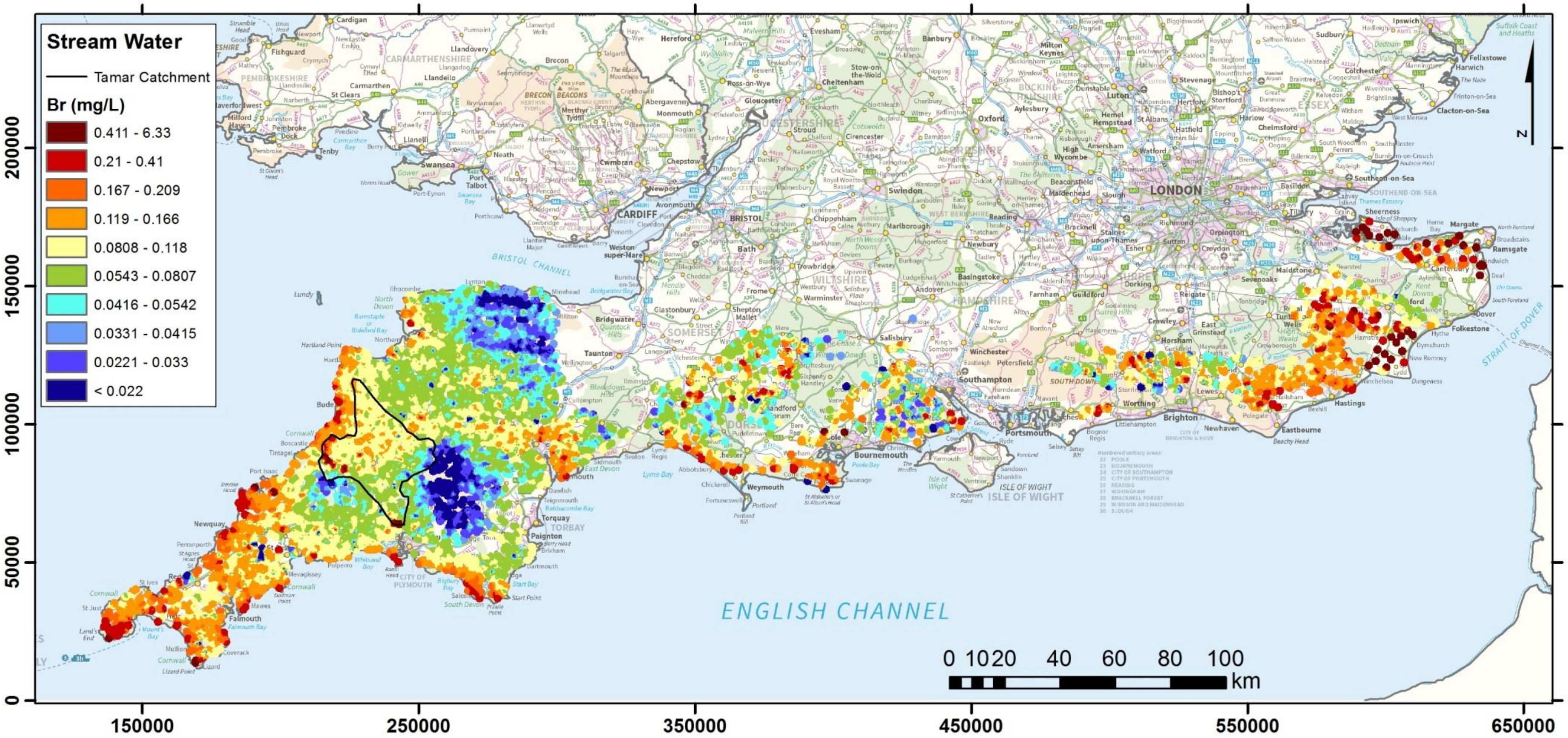
Provisional Geochemical Image



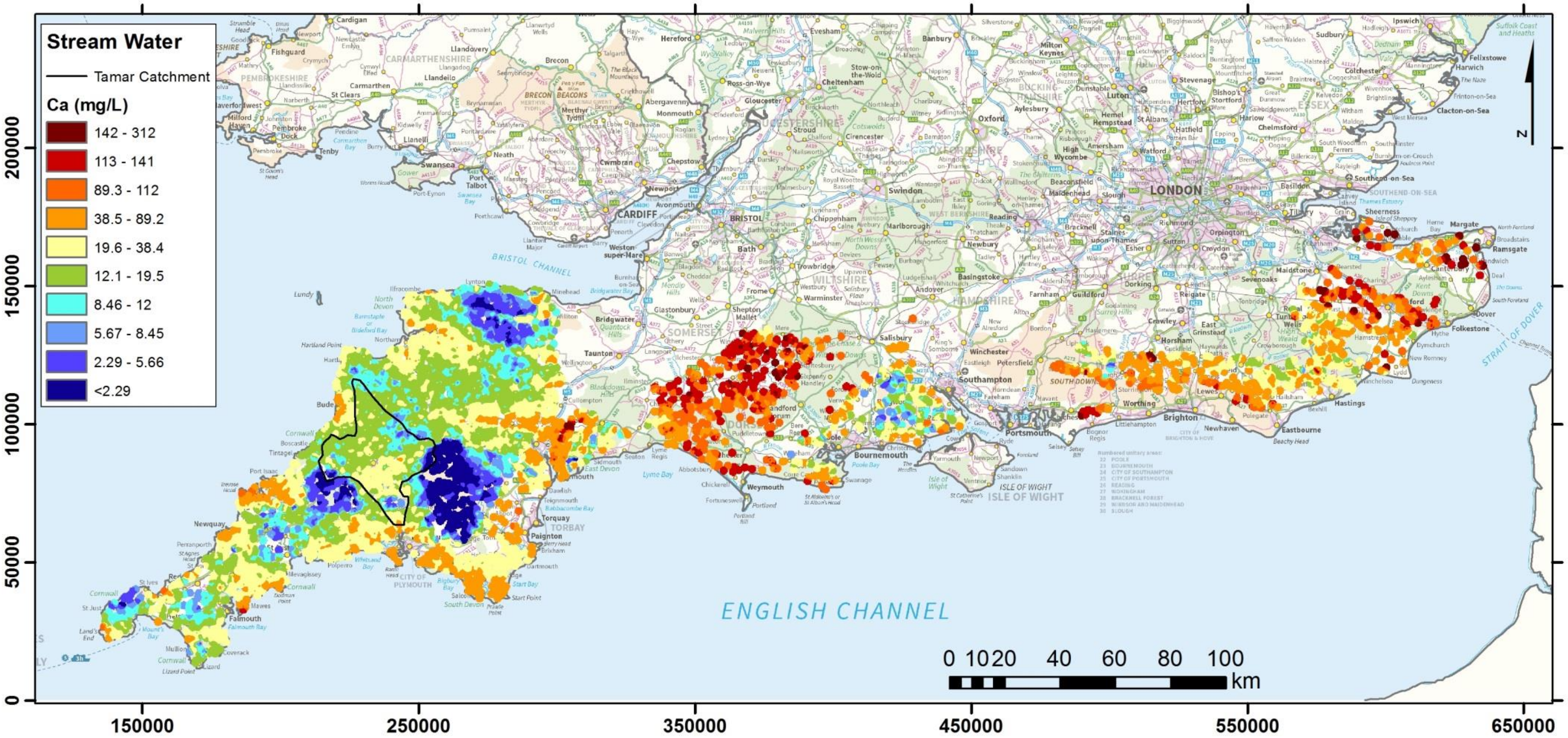
Provisional Geochemical Image



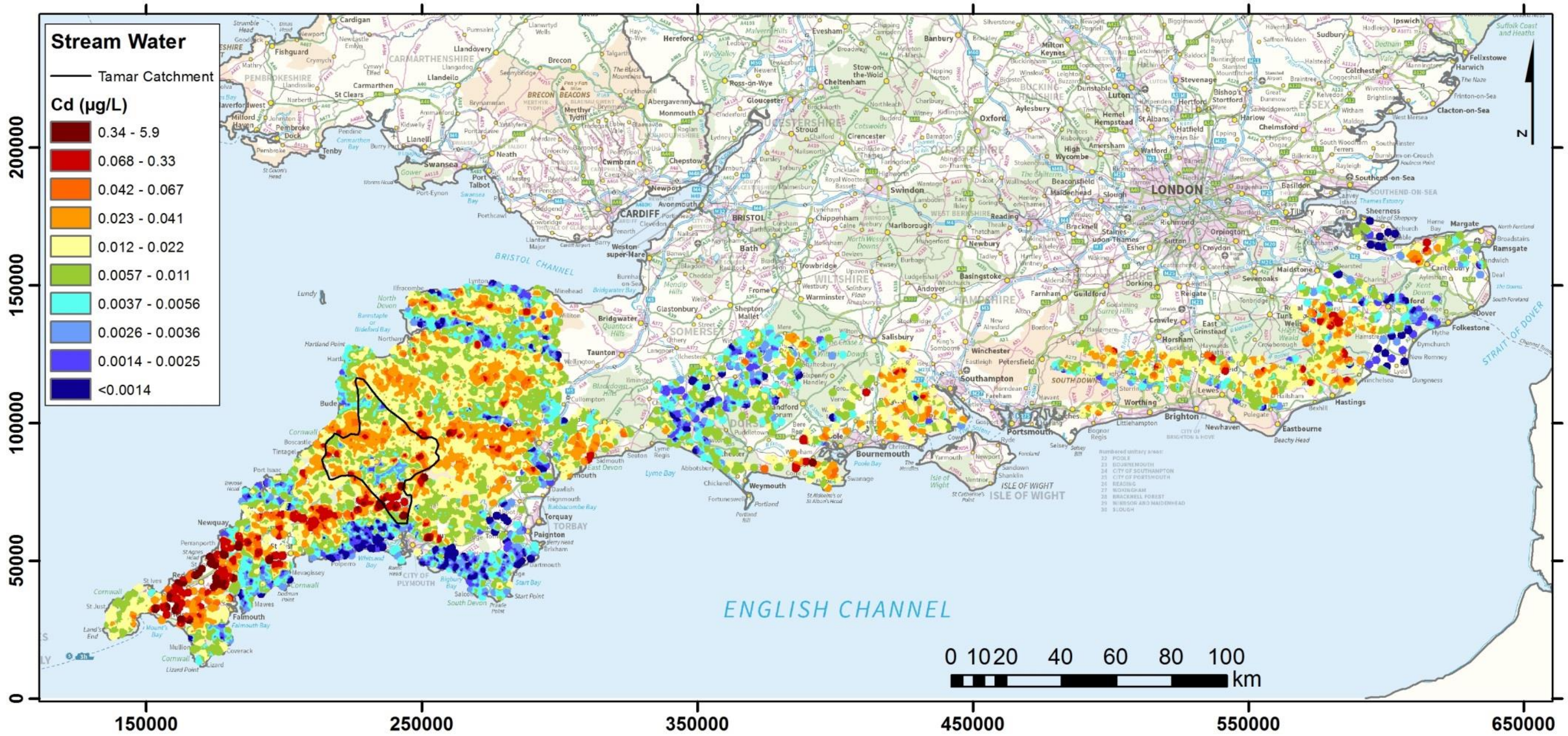
Provisional Geochemical Image



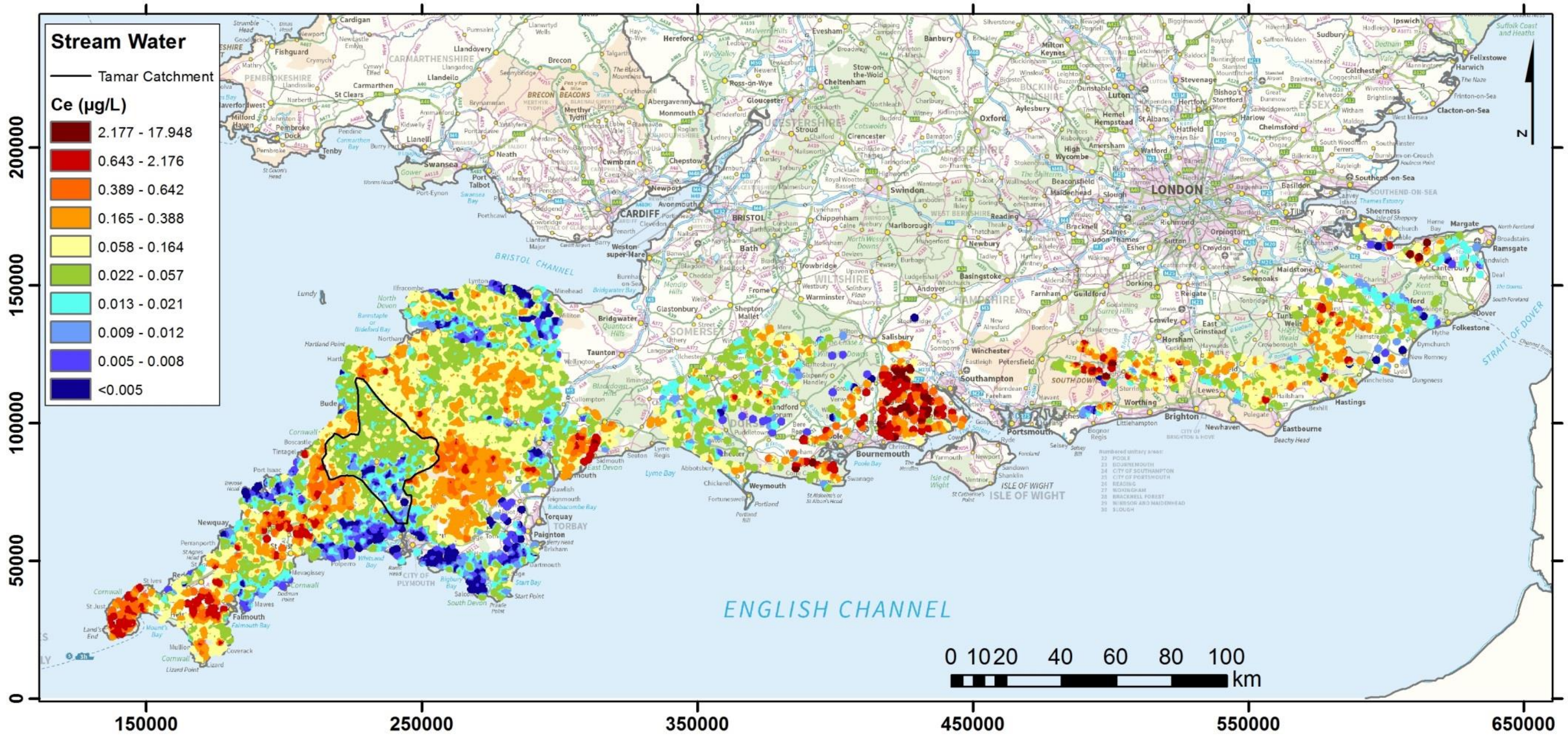
Provisional Geochemical Image

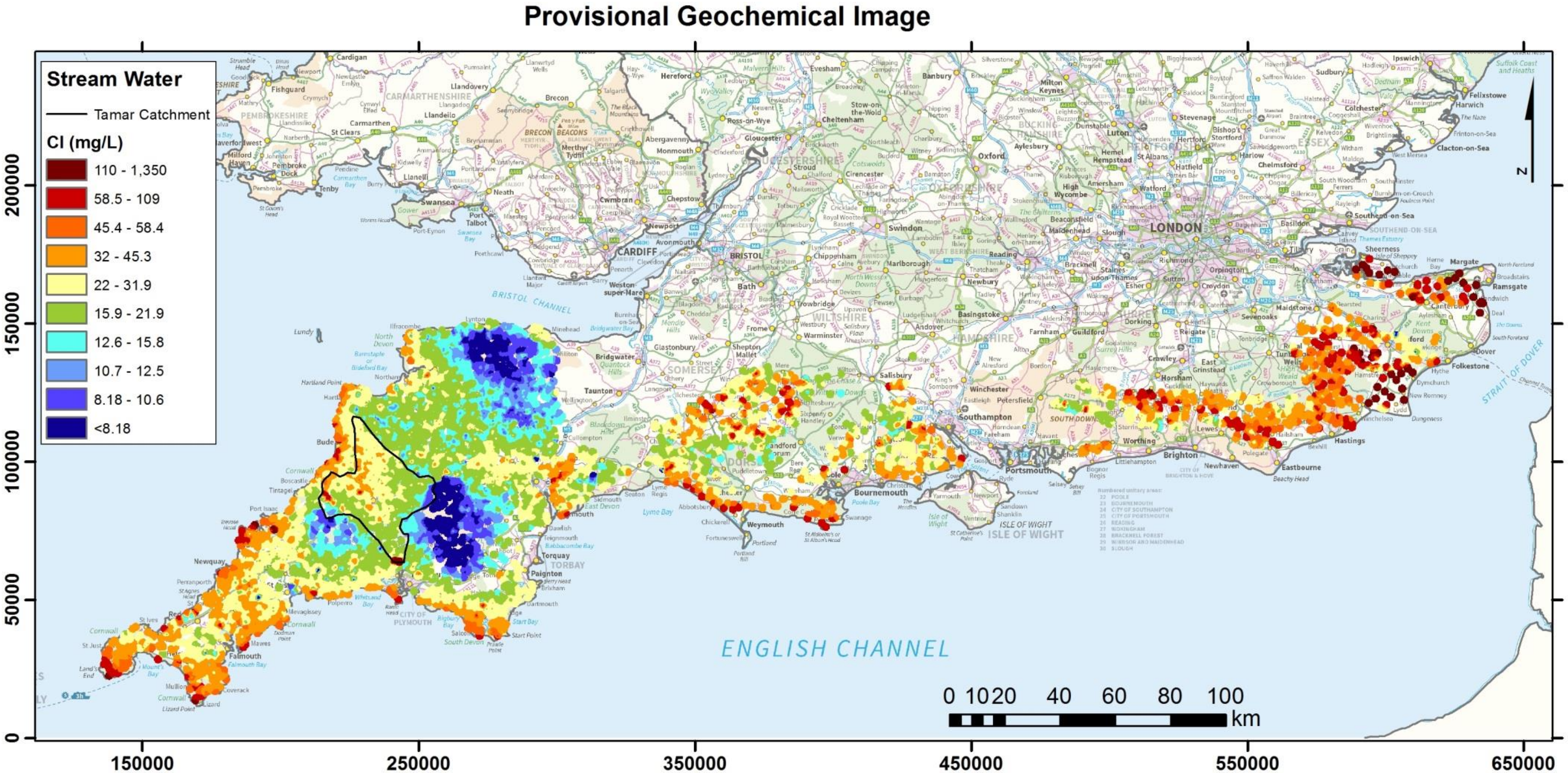


Provisional Geochemical Image

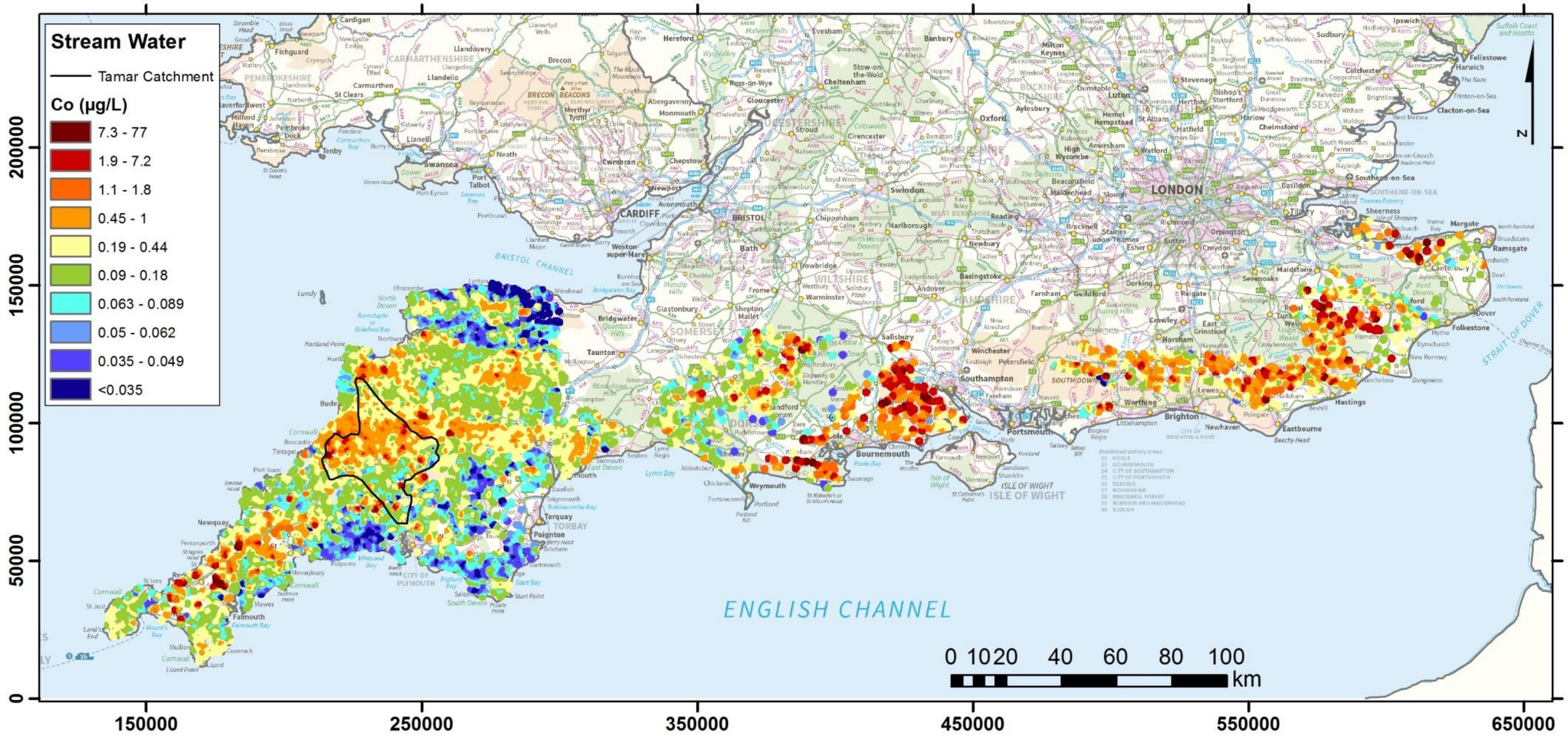


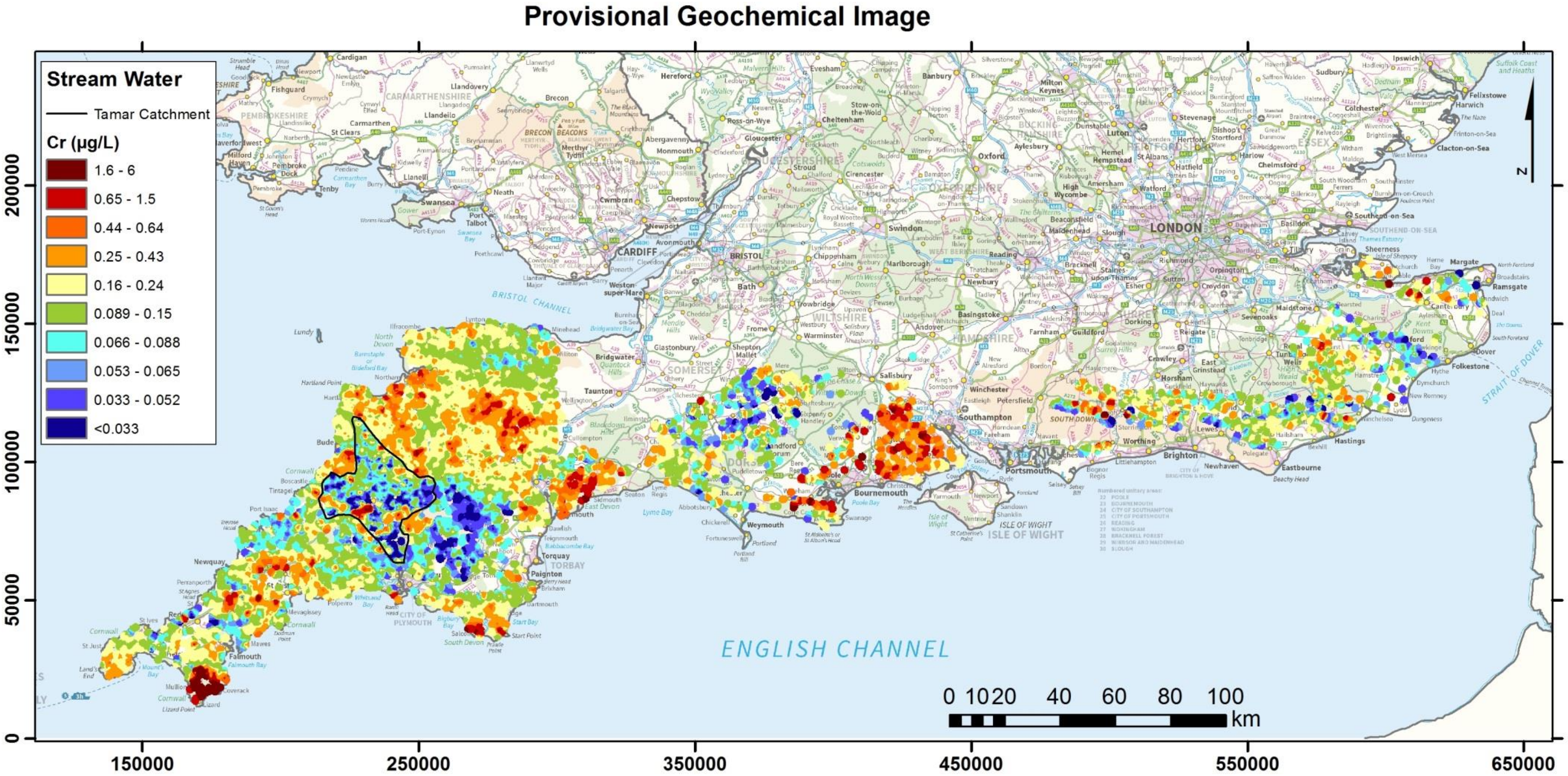
Provisional Geochemical Image



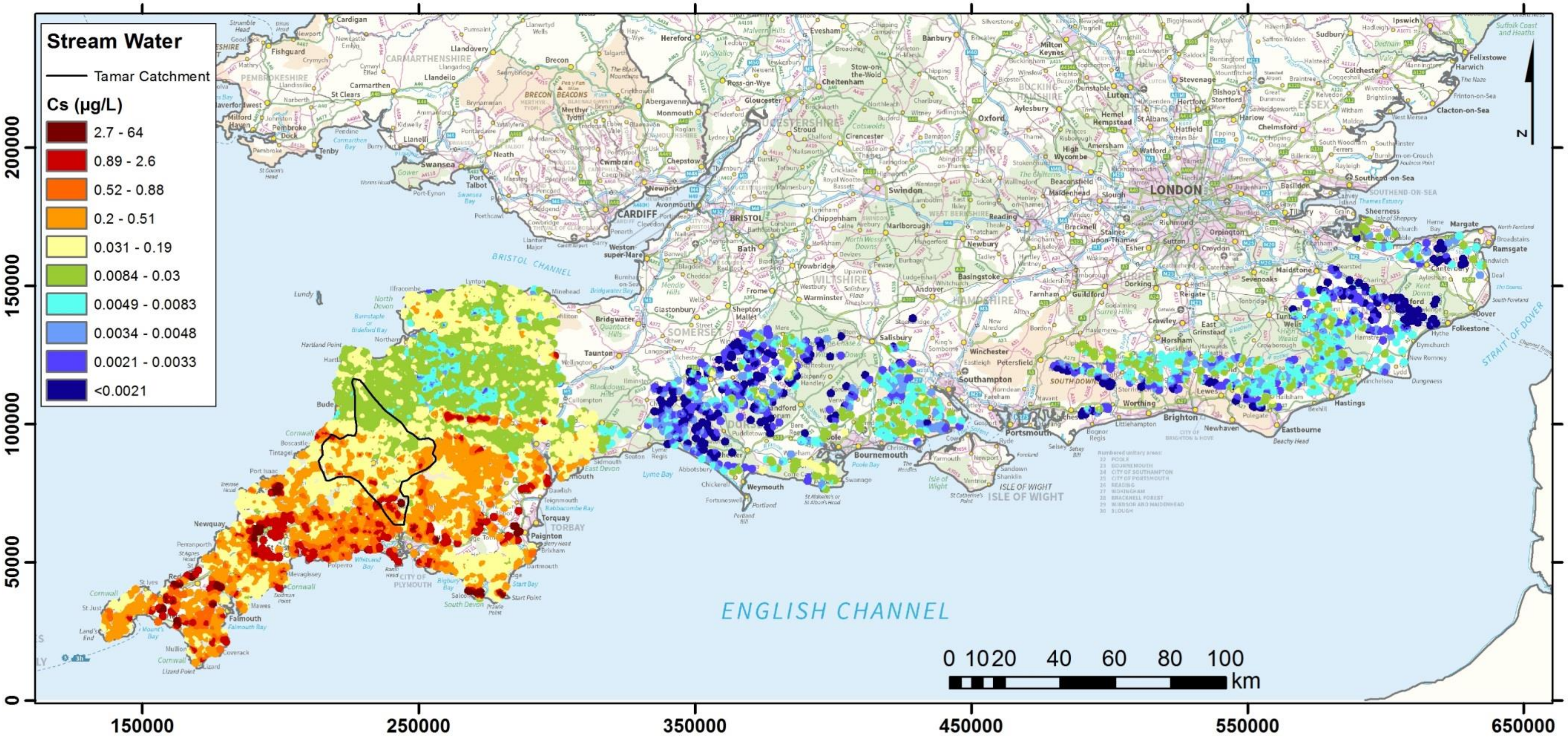

Provisional Geochemical Image
Stream Water
Tamar Catchment
Cl (mg/L)
110 - 1,350
58.5 - 109
45.4 - 58.4
32 - 45.3
22 - 31.9
15.9 - 21.9
12.6 - 15.8
10.7 - 12.5
8.18 - 10.6
<8.18
ENGLISH CHANNEL
LONDON
BRISTOL CHANNEL
0 10 20 40 60 80 100
km
N
0
50000
100000
150000
200000
150000
250000
350000
450000
550000
650000

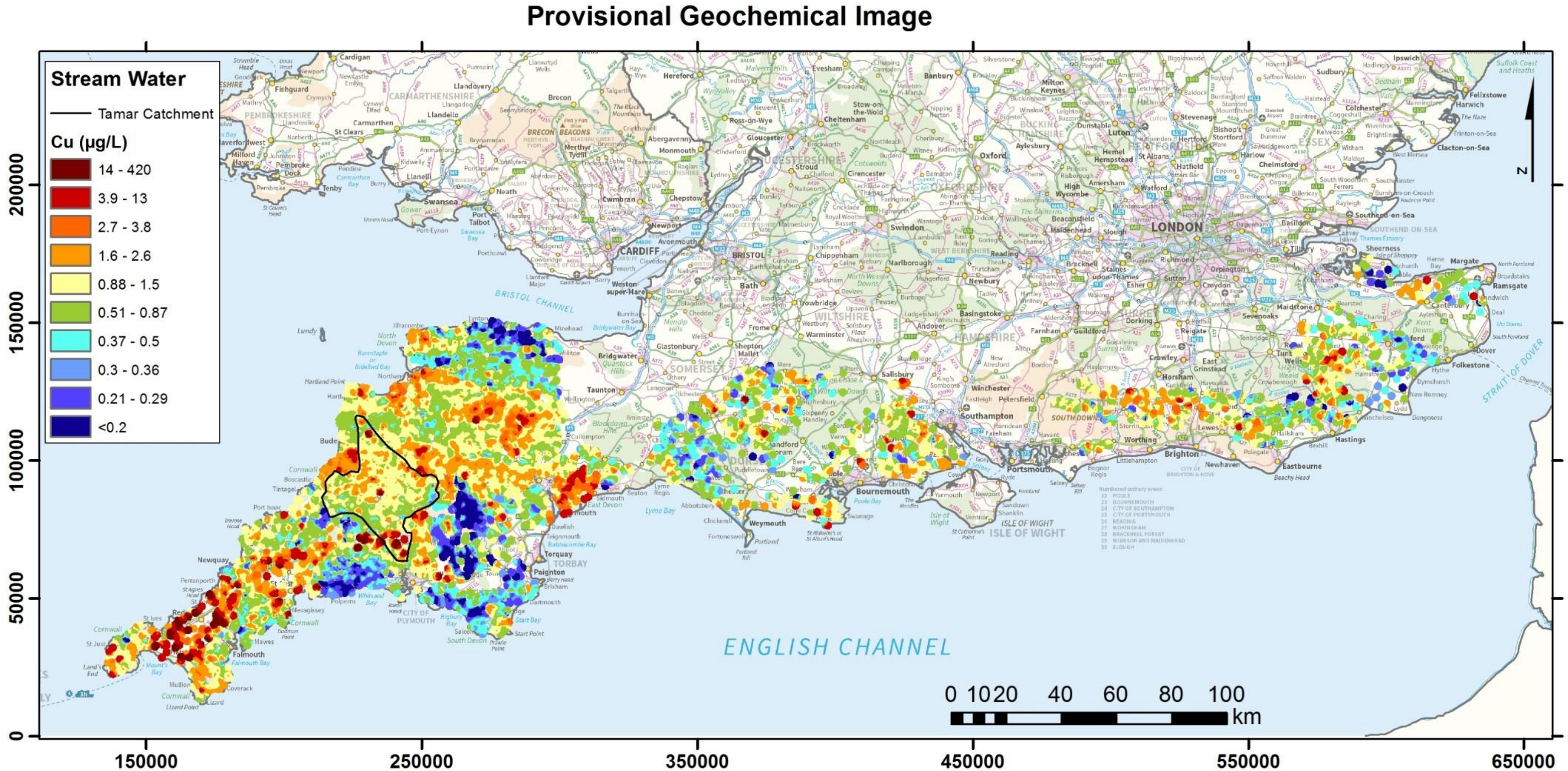
Provisional Geochemical Image

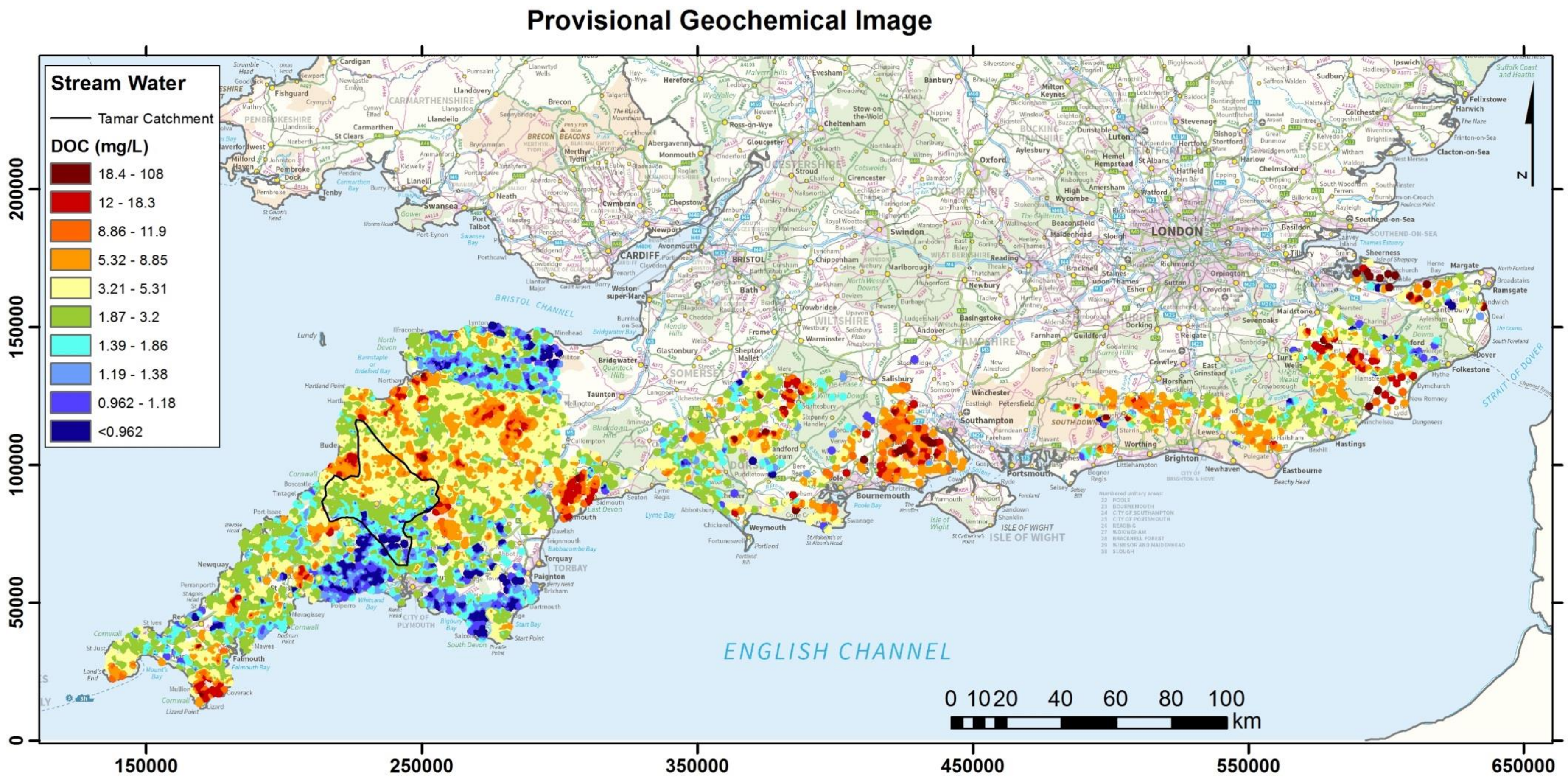



Provisional Geochemical Image
Stream Water
Tamar Catchment
Cr (µg/L)
1.6 - 6
0.65 - 1.5
0.44 - 0.64
0.25 - 0.43
0.16 - 0.24
0.089 - 0.15
0.066 - 0.088
0.053 - 0.065
0.033 - 0.052
<0.033
N
ENGLISH CHANNEL
BRISTOL CHANNEL
0 10 20 40 60 80 100 km
0
50000
100000
150000
200000
150000
250000
350000
450000
550000
650000

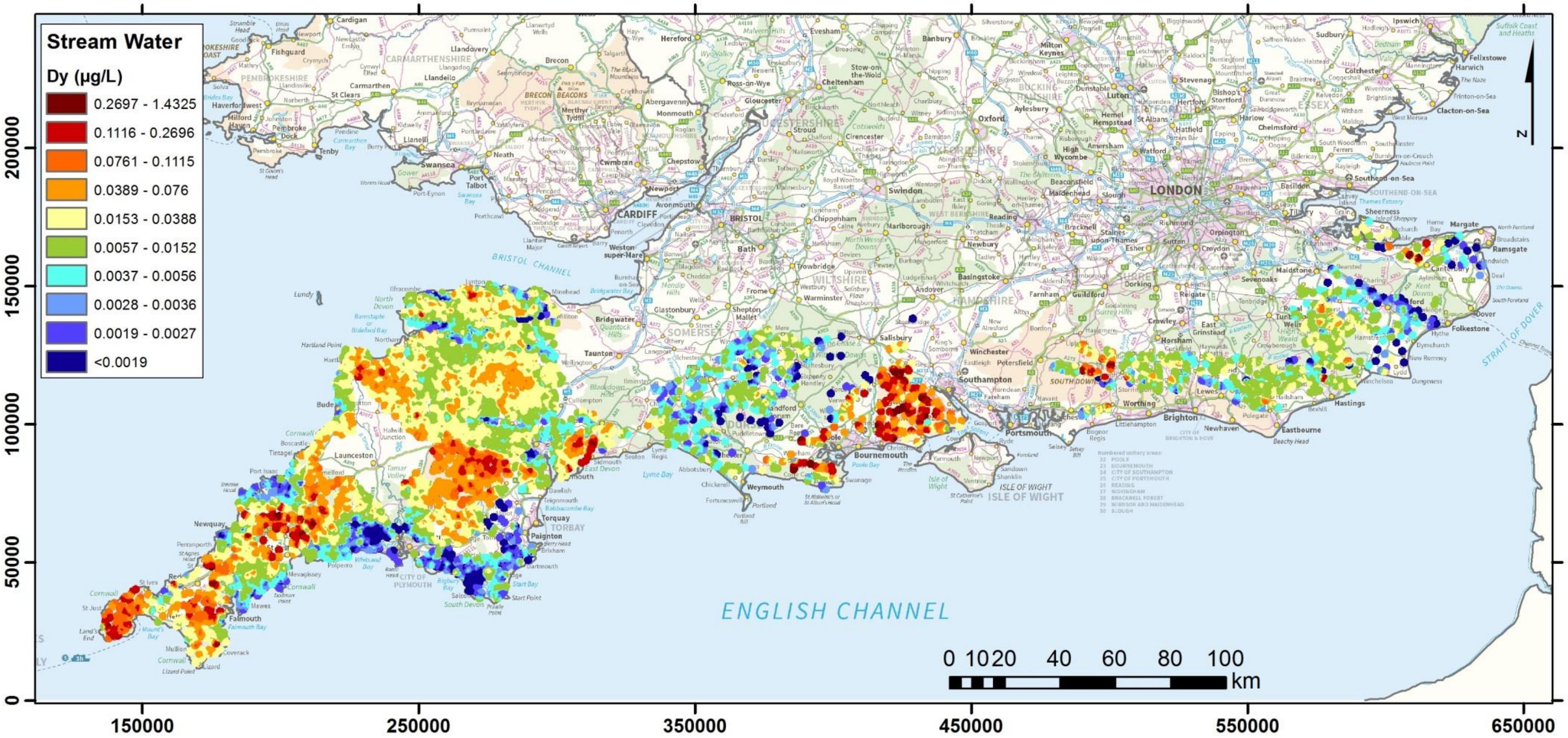
Provisional Geochemical Image

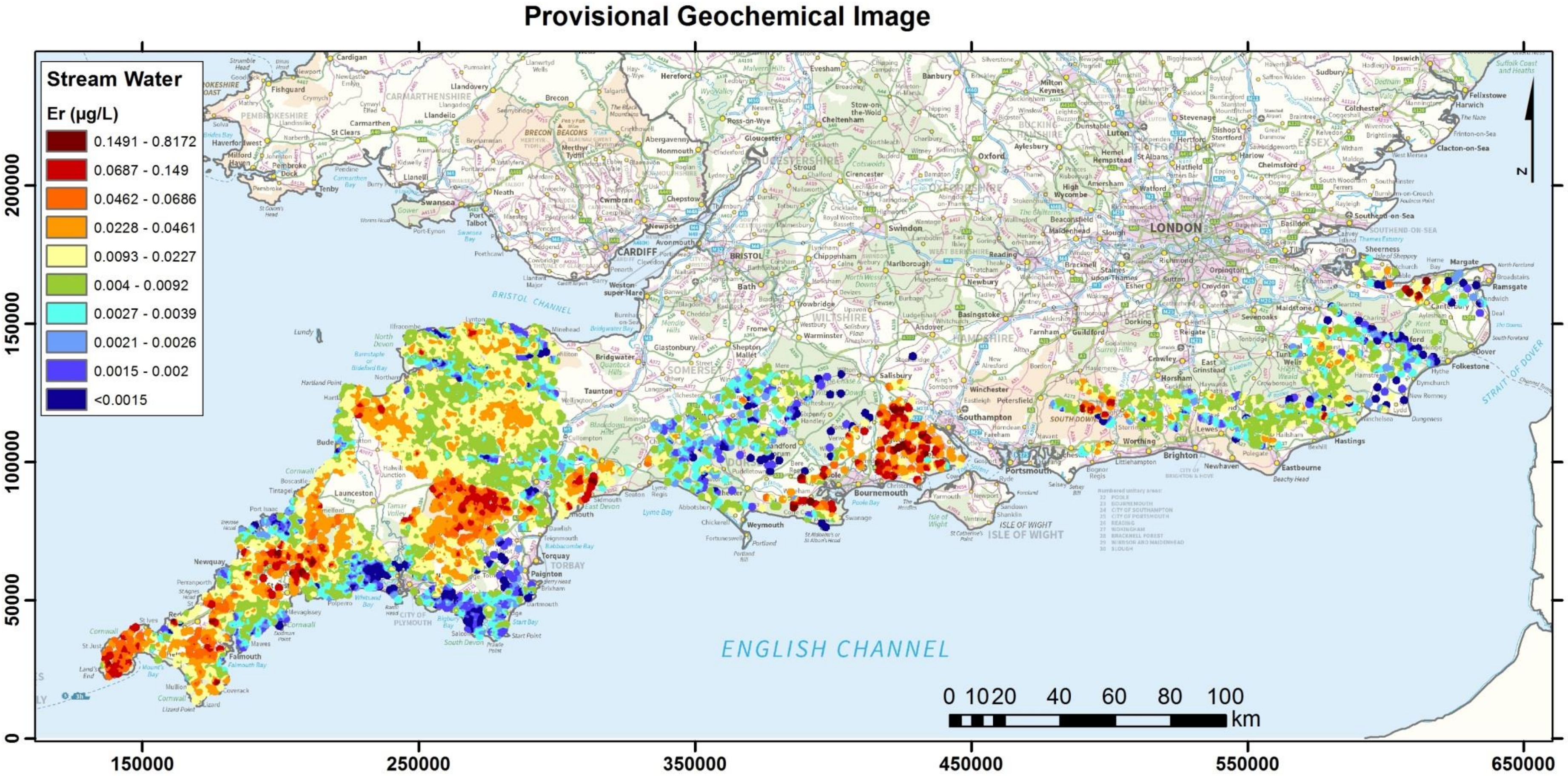



Provisional Geochemical Image
Stream Water
Tamar Catchment
Cu (µg/L)
14 - 420
3.9 - 13
2.7 - 3.8
1.6 - 2.6
0.88 - 1.5
0.51 - 0.87
0.37 - 0.5
0.3 - 0.36
0.21 - 0.29
<0.2
ENGLISH CHANNEL
BRISTOL CHANNEL
LONDON
0 10 20 40 60 80 100
km
N
0
50000
100000
150000
200000
150000
250000
350000
450000
550000
650000

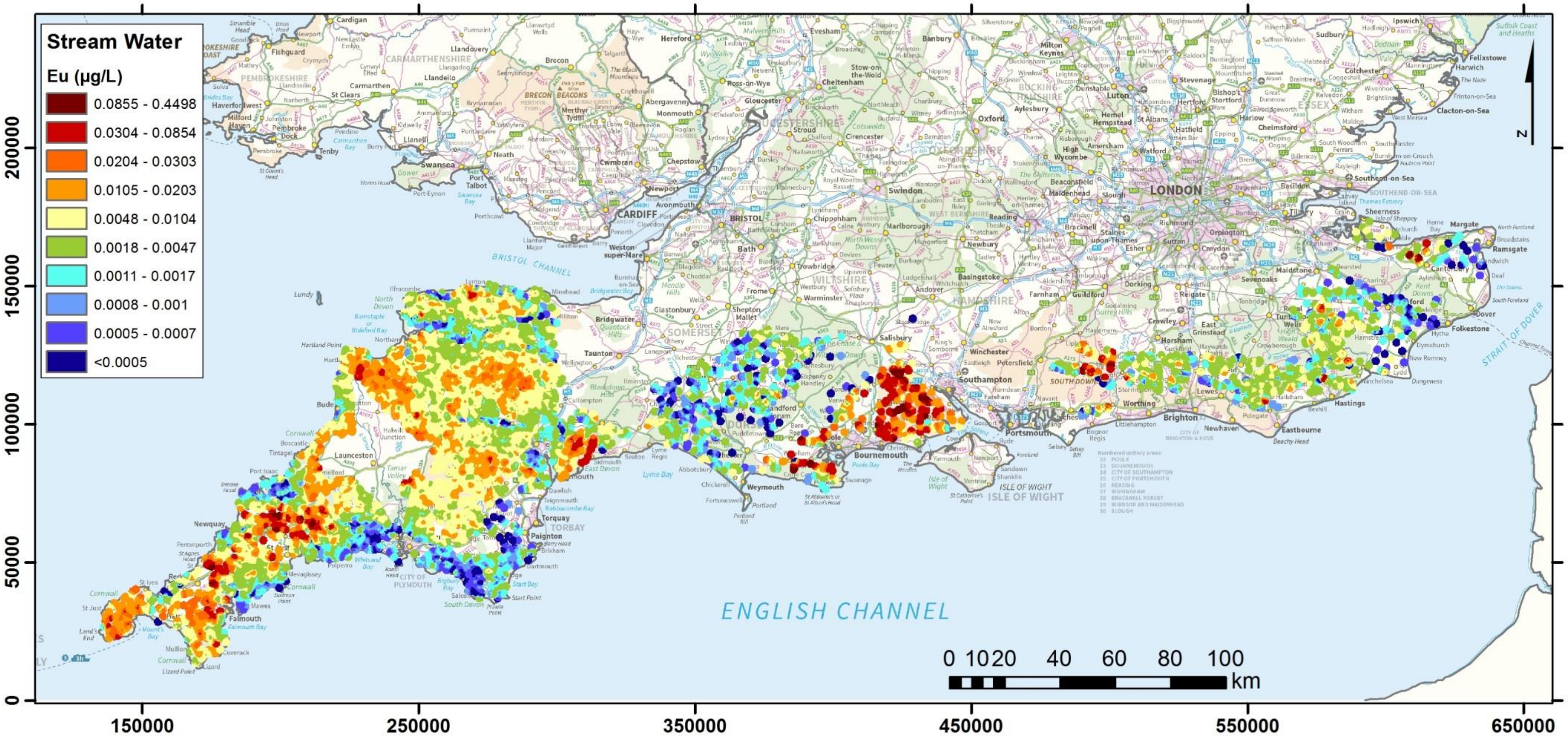

Provisional Geochemical Image
Stream Water
Tamar Catchment
DOC (mg/L)
18.4 - 108
12 - 18.3
8.86 - 11.9
5.32 - 8.85
3.21 - 5.31
1.87 - 3.2
1.39 - 1.86
1.19 - 1.38
0.962 - 1.18
<0.962
N
ENGLISH CHANNEL
BRISTOL CHANNEL
LONDON
0 10 20 40 60 80 100 km
0
50000
100000
150000
200000
150000
250000
350000
450000
550000
650000

Provisional Geochemical Image

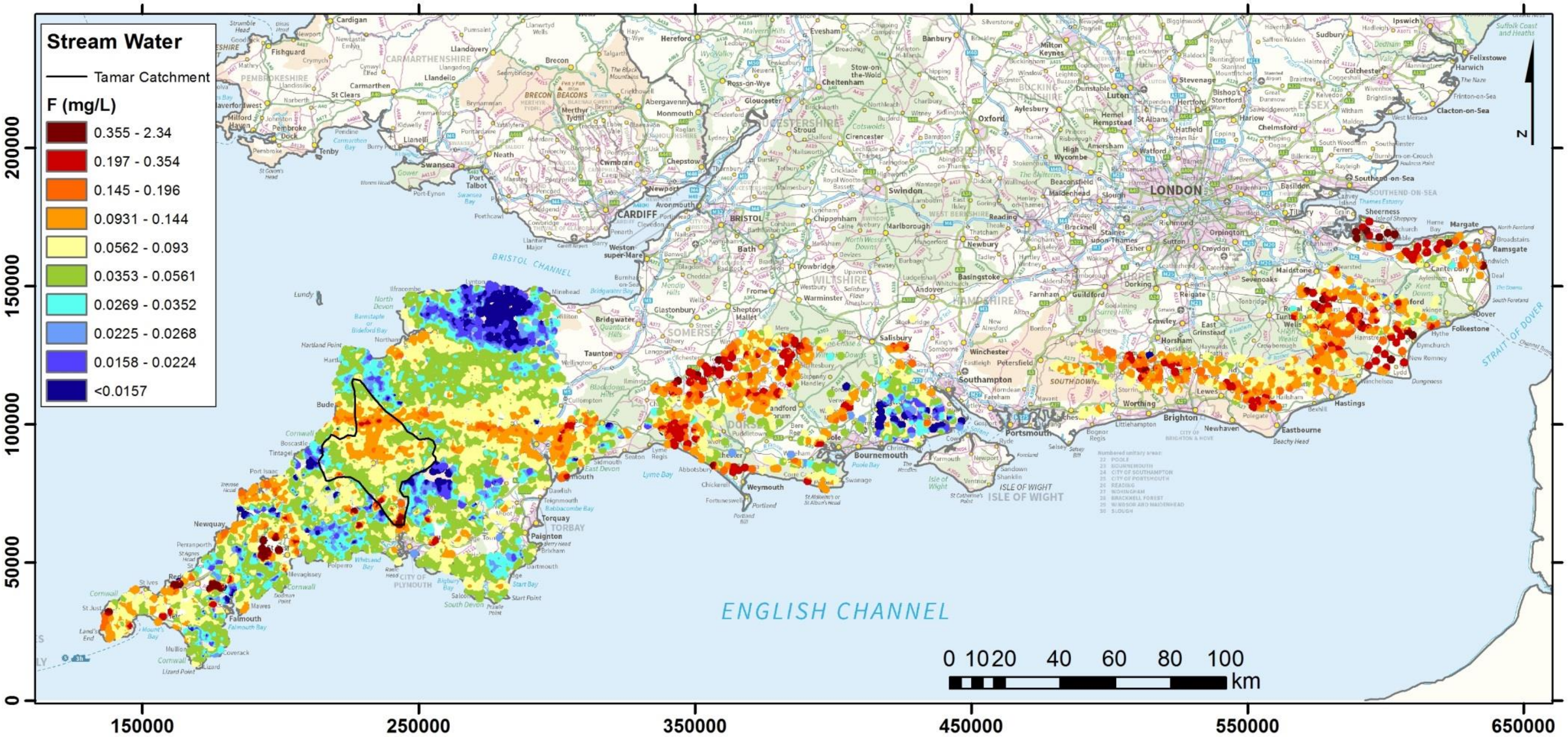


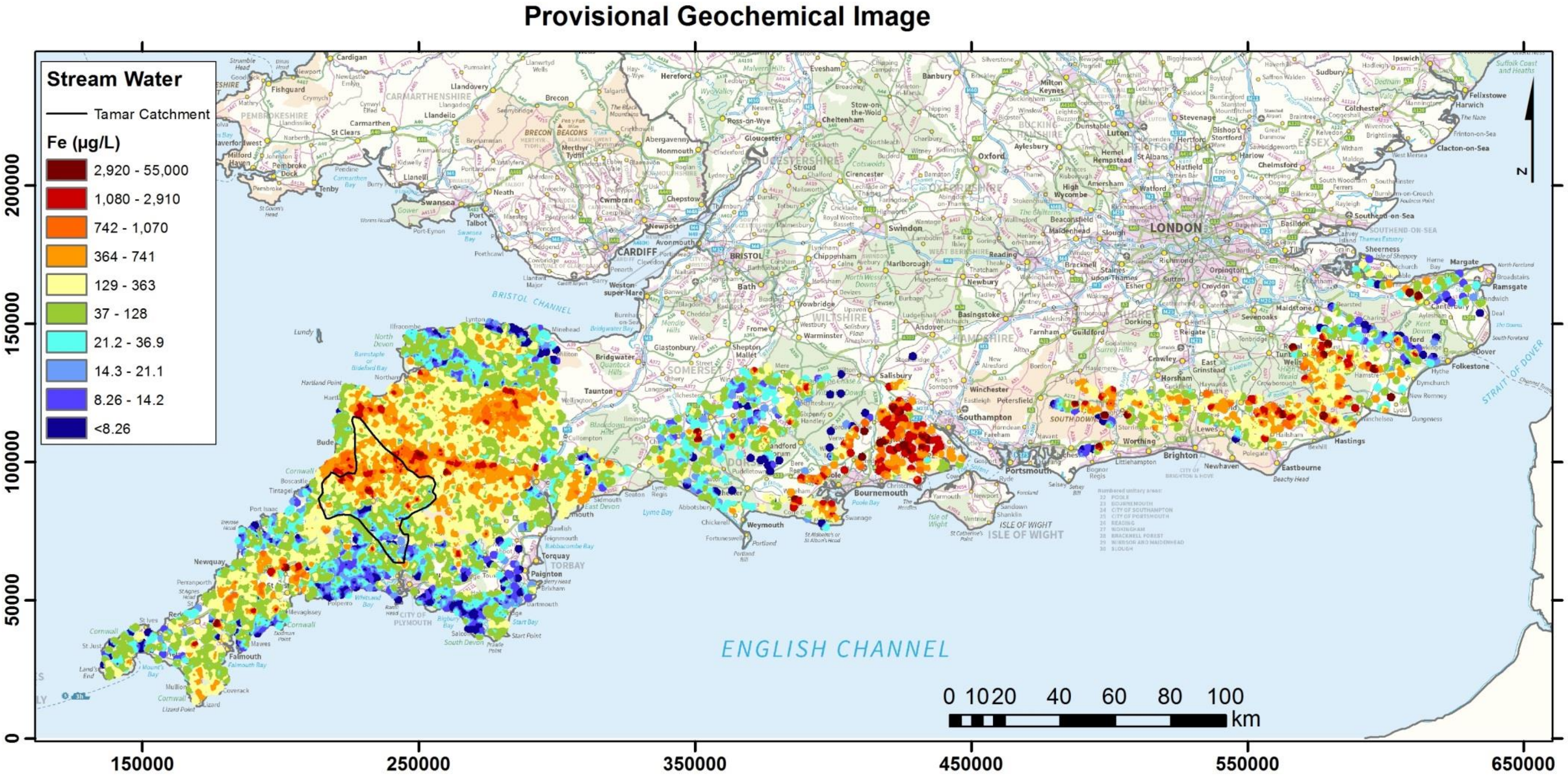

Provisional Geochemical Image
Stream Water
Er (µg/L)
0.1491 - 0.8172
0.0687 - 0.149
0.0462 - 0.0686
0.0228 - 0.0461
0.0093 - 0.0227
0.004 - 0.0092
0.0027 - 0.0039
0.0021 - 0.0026
0.0015 - 0.002
<0.0015
ENGLISH CHANNEL
0 10 20 40 60 80 100 km
N
150000
250000
350000
450000
550000
650000
0
50000
100000
150000
200000

Provisional Geochemical Image



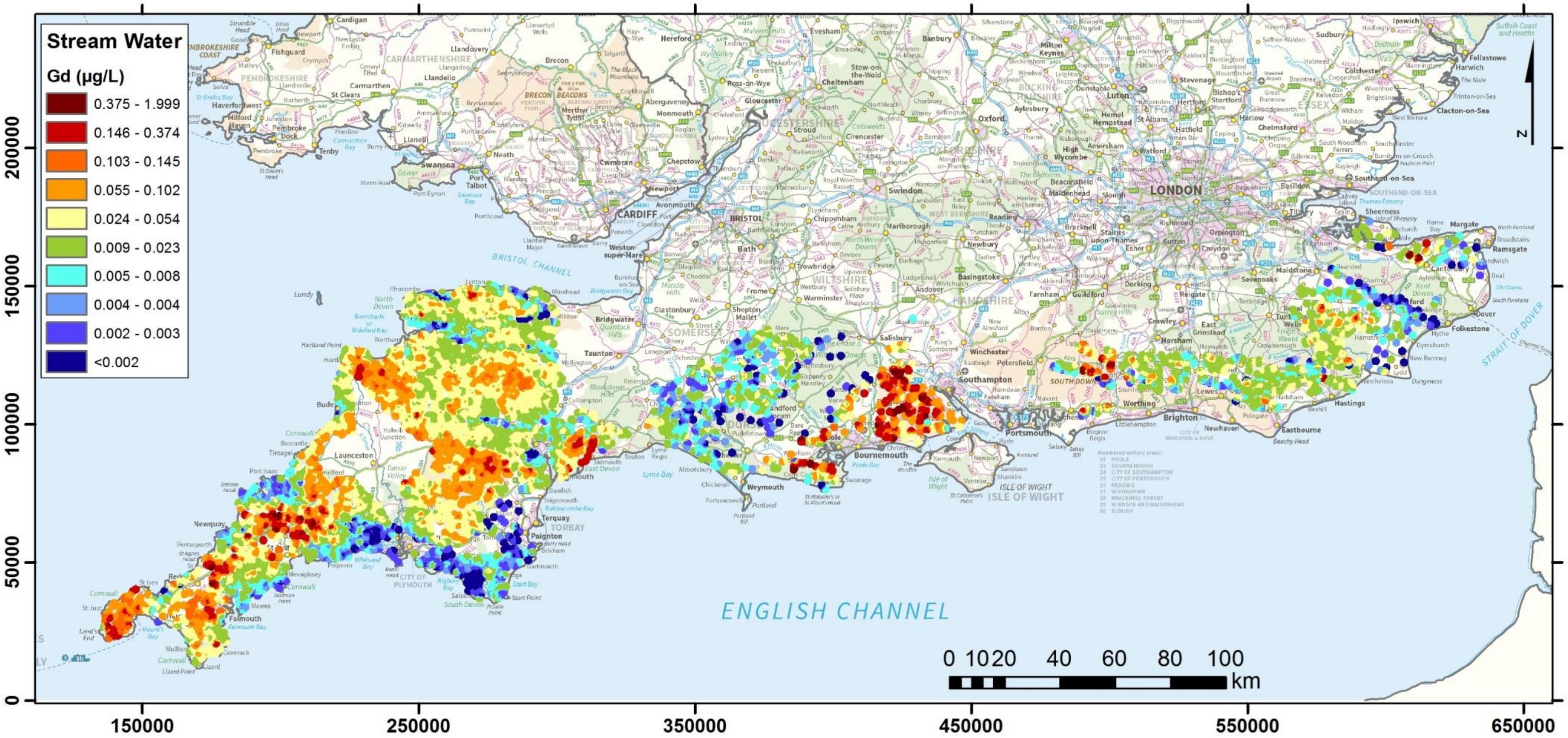
Provisional Geochemical Image



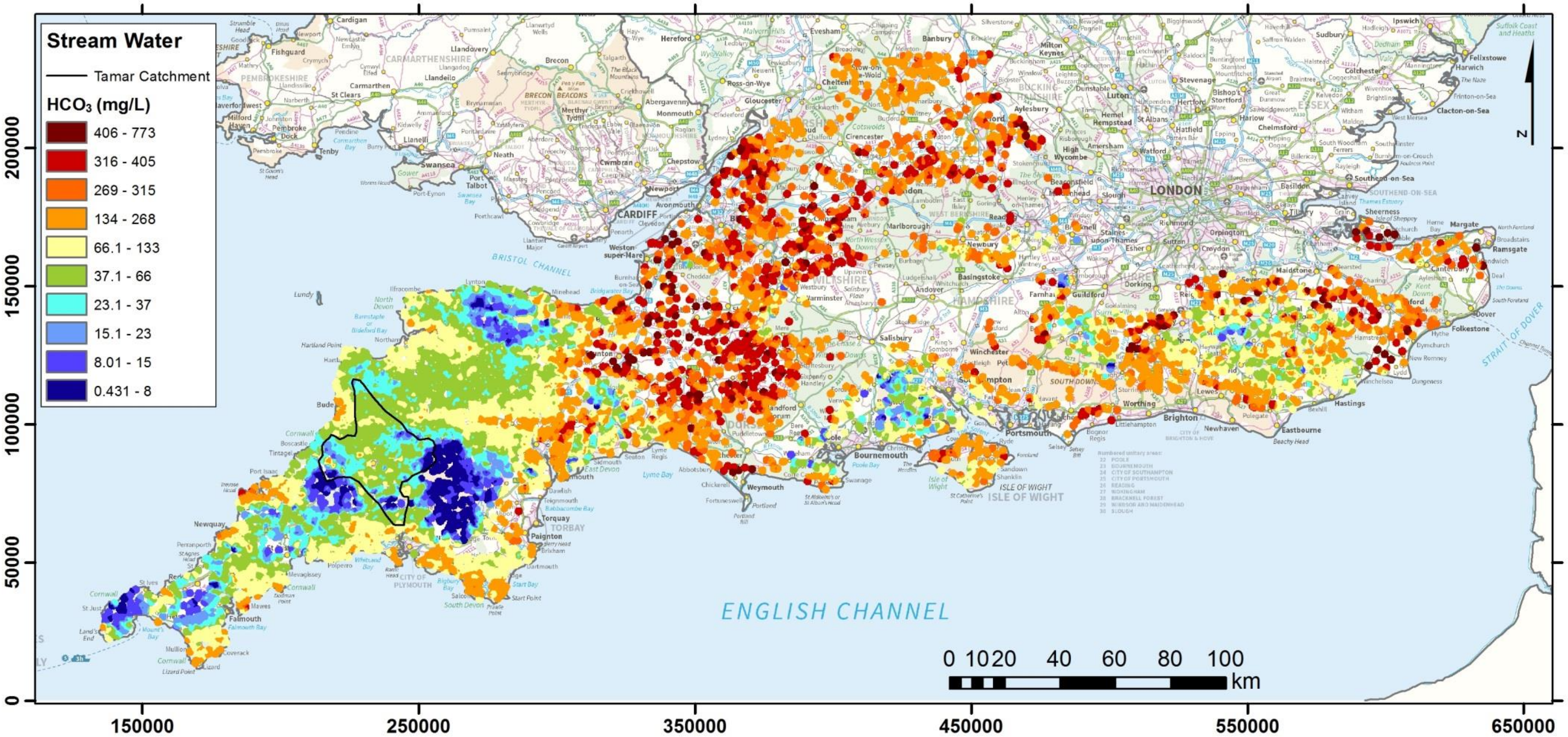


Provisional Geochemical Image
Stream Water
Tamar Catchment
Fe (µg/L)
2,920 - 55,000
1,080 - 2,910
742 - 1,070
364 - 741
129 - 363
37 - 128
21.2 - 36.9
14.3 - 21.1
8.26 - 14.2
<8.26
ENGLISH CHANNEL
0 10 20 40 60 80 100 km
N

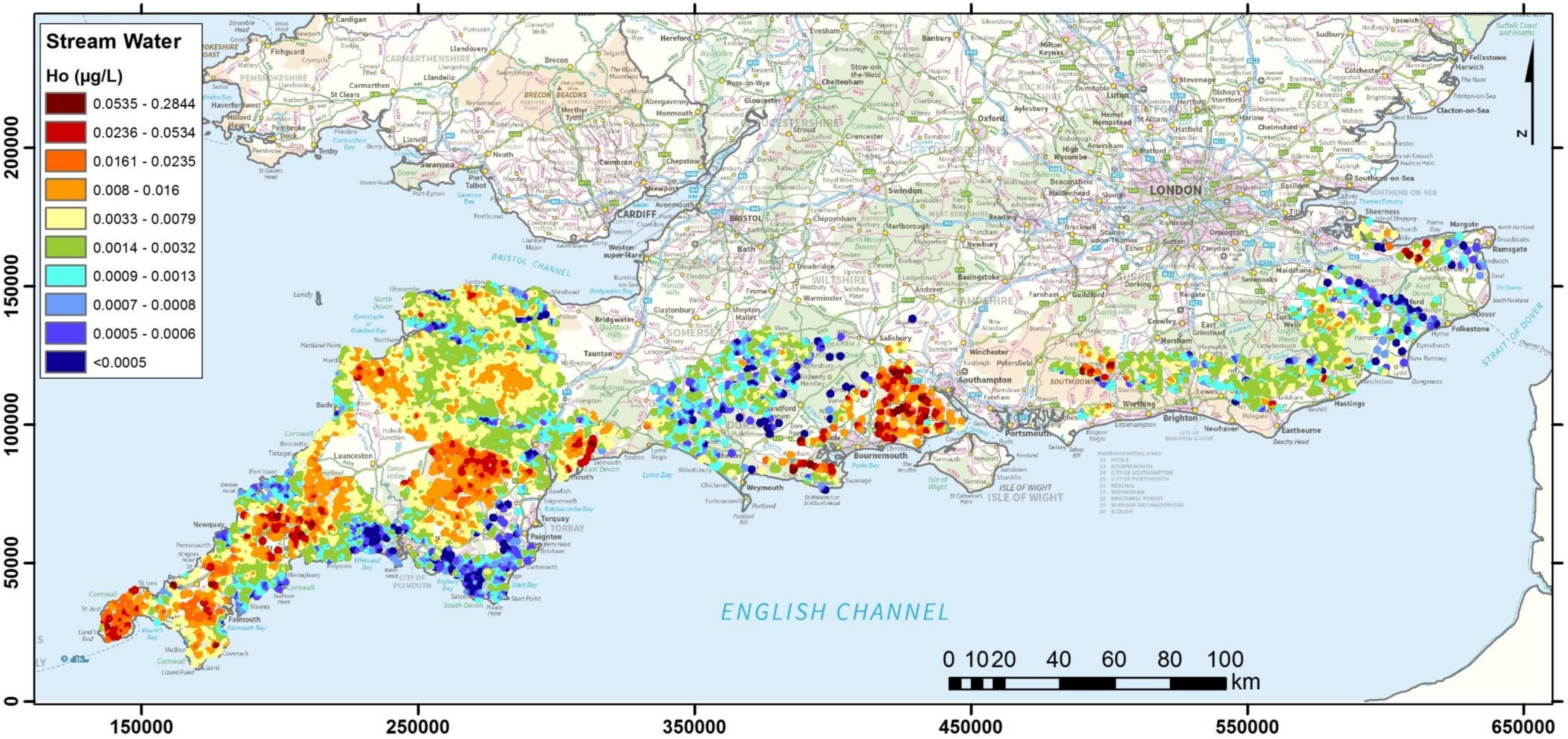
Provisional Geochemical Image



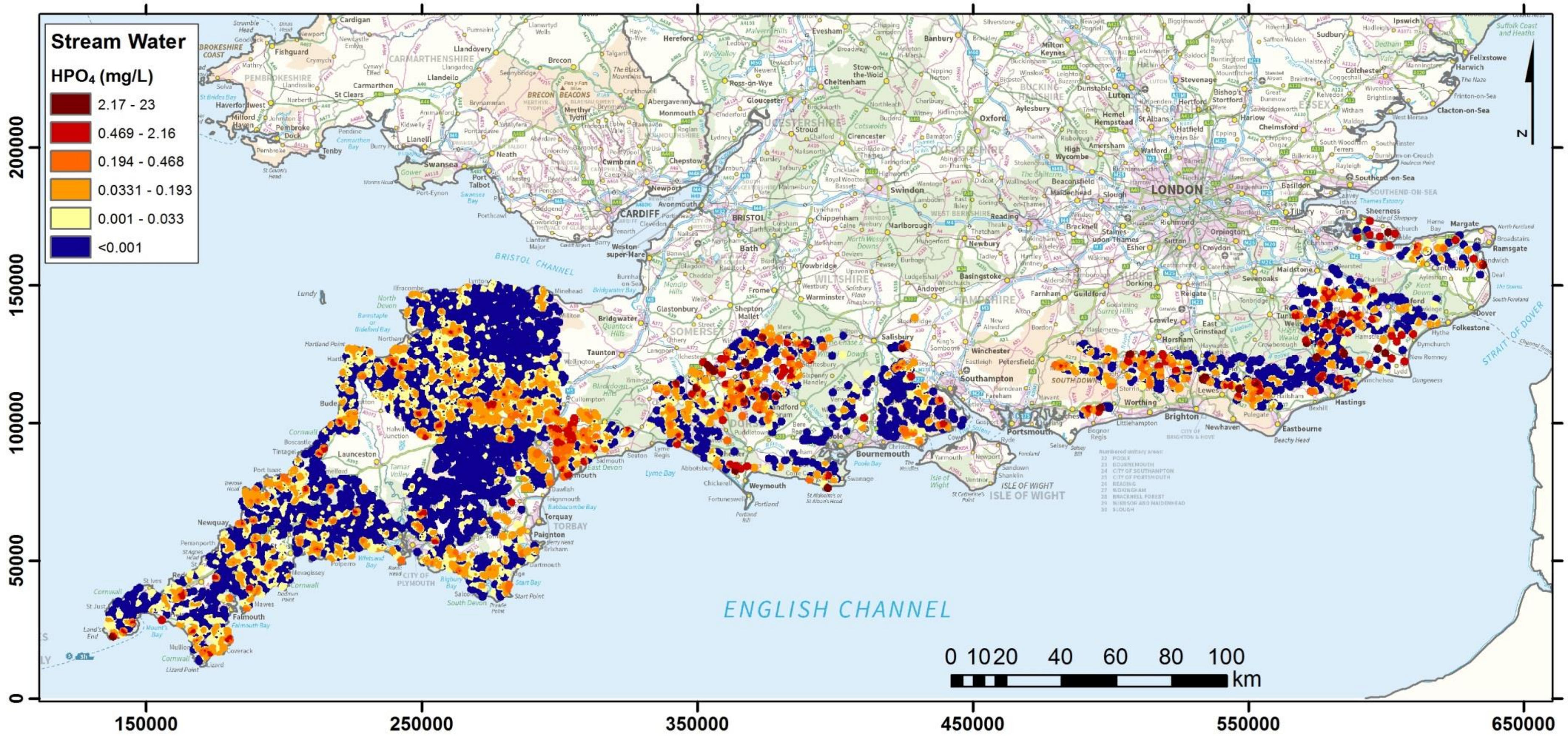
Provisional Geochemical Image



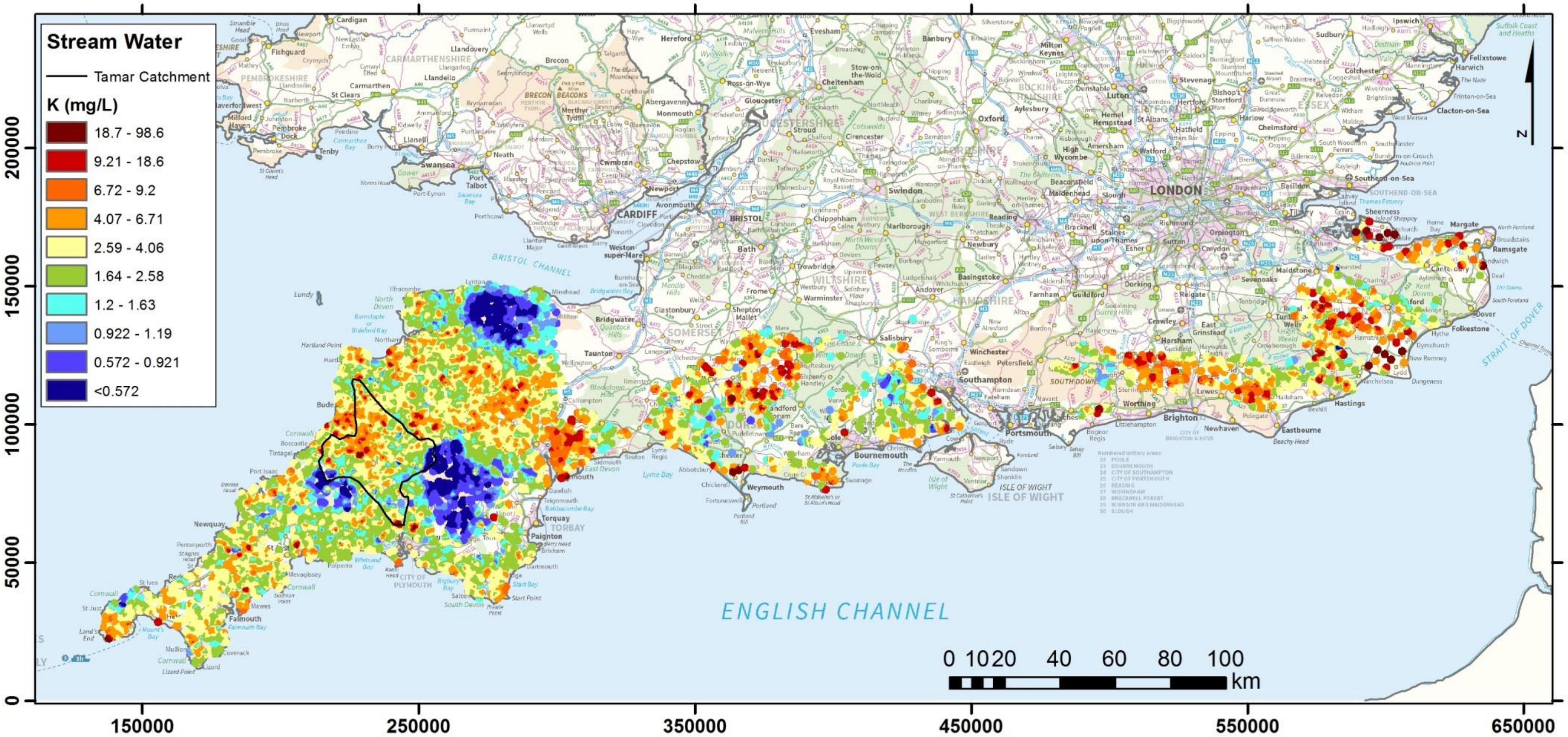
Provisional Geochemical Image



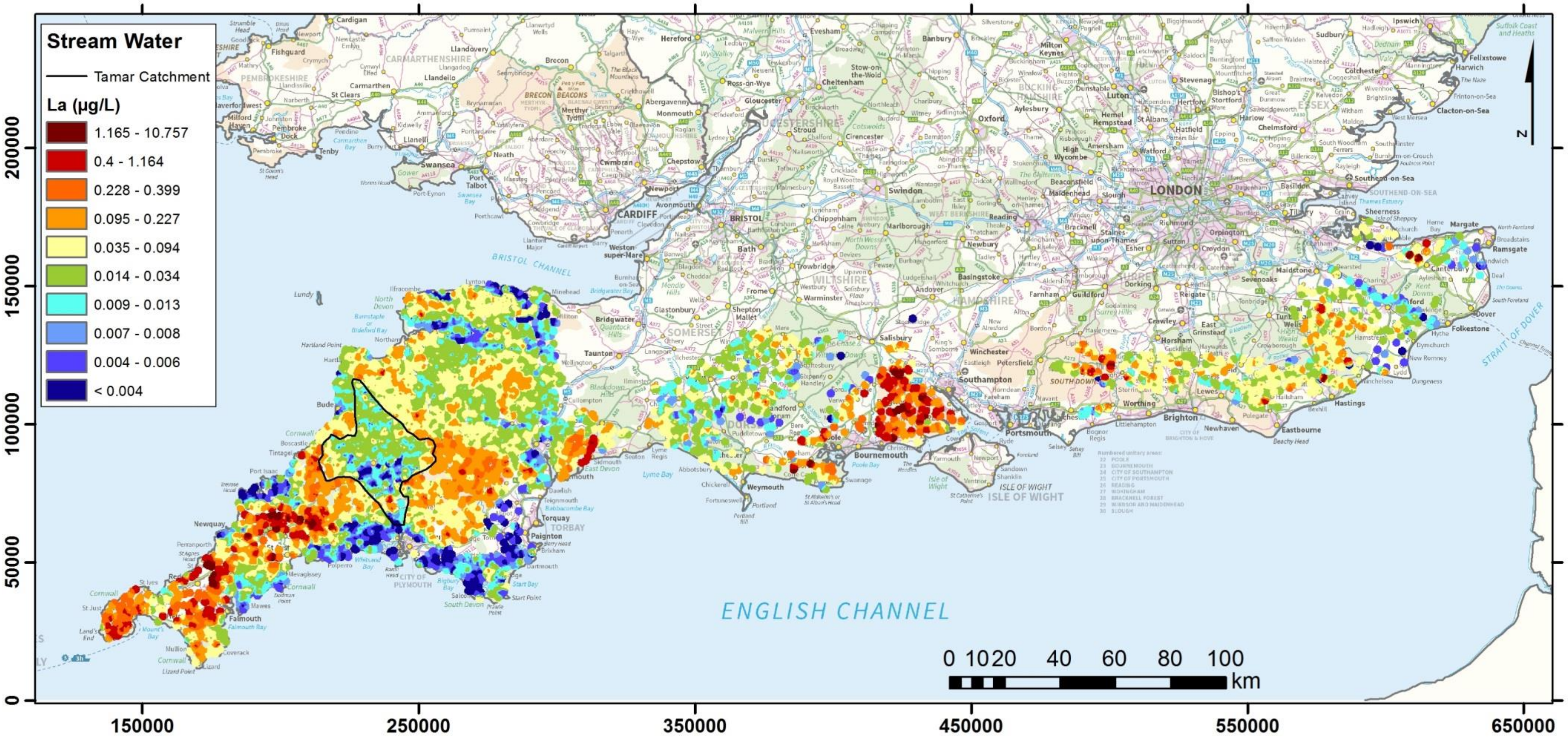
Provisional Geochemical Image

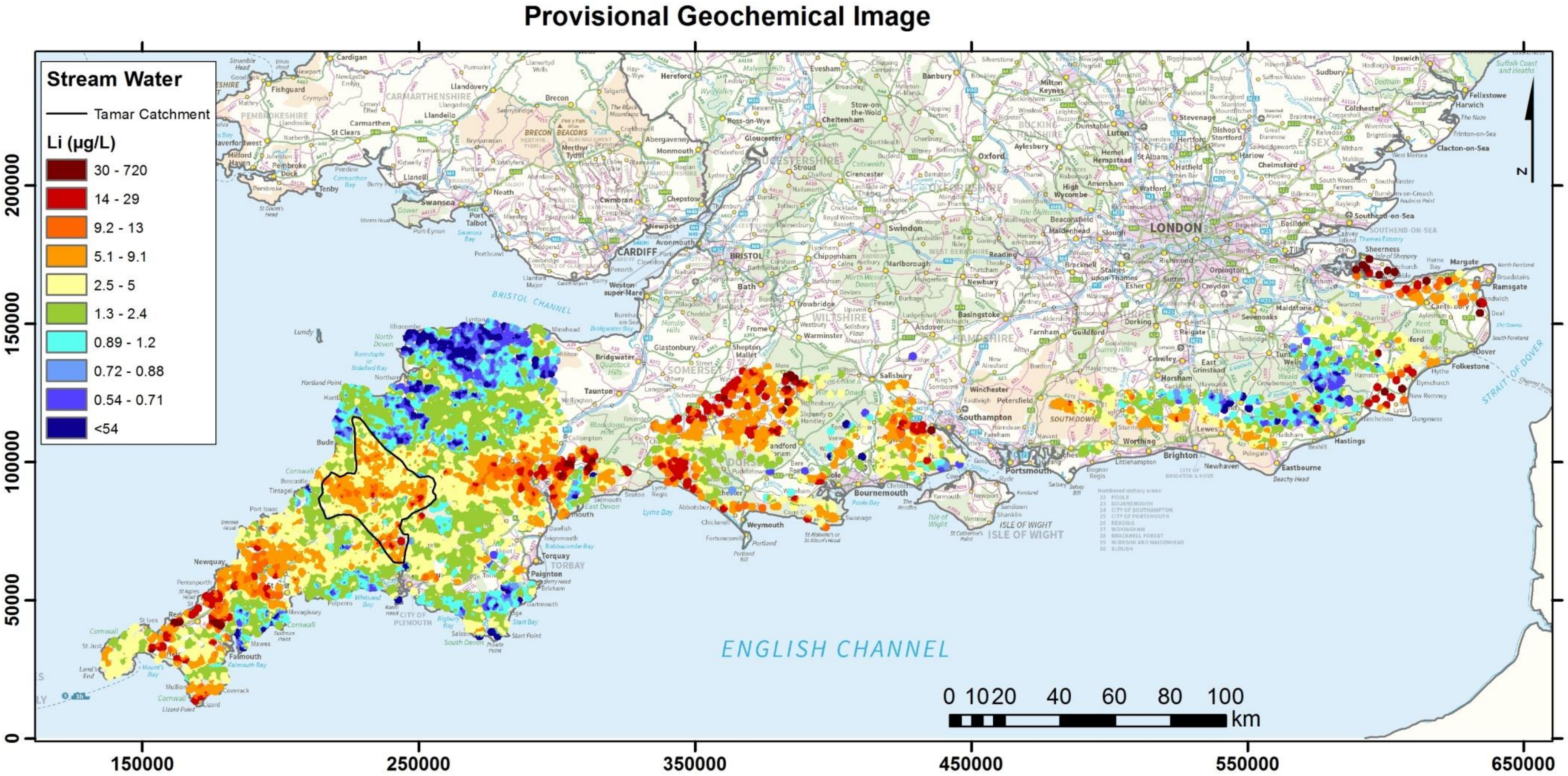


Provisional Geochemical Image

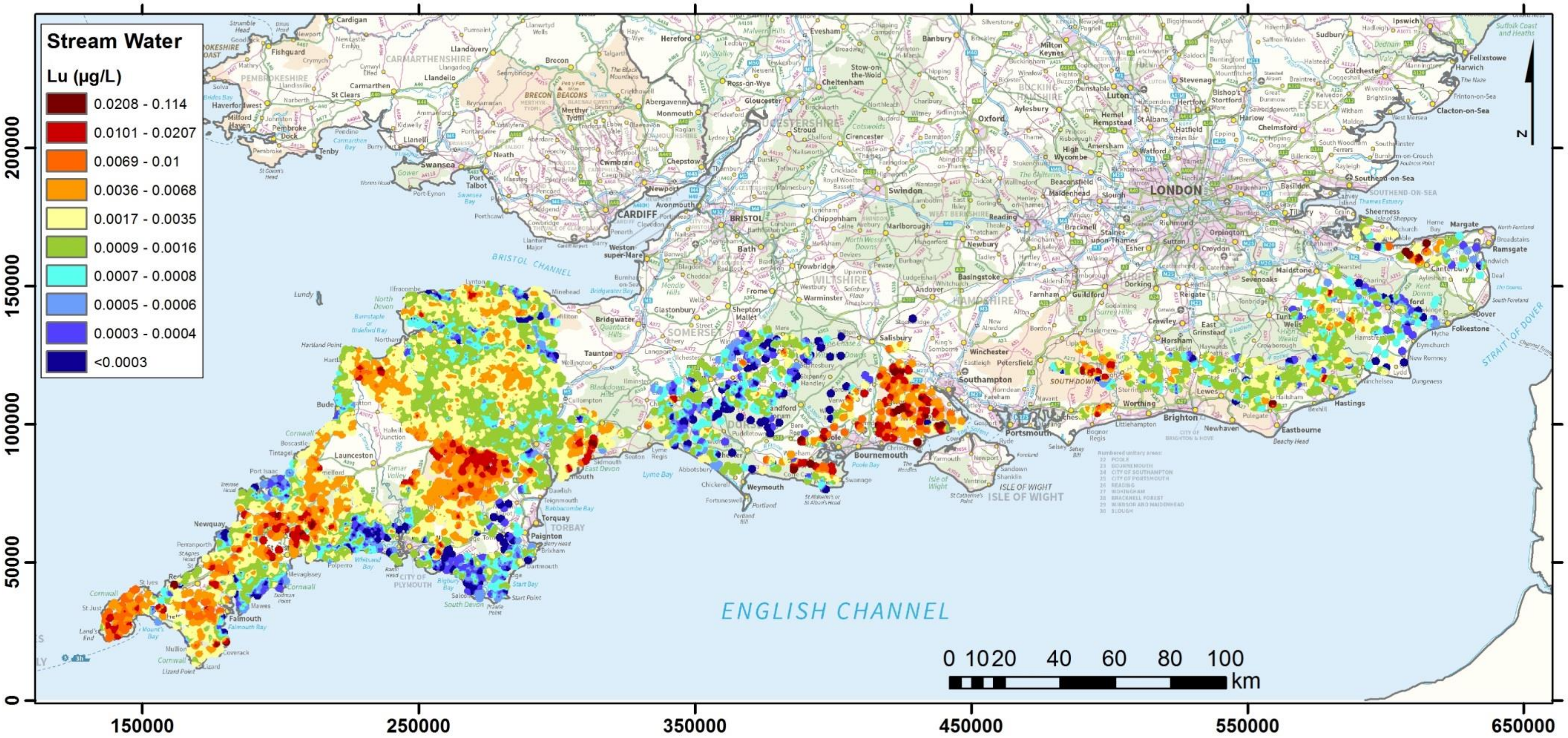


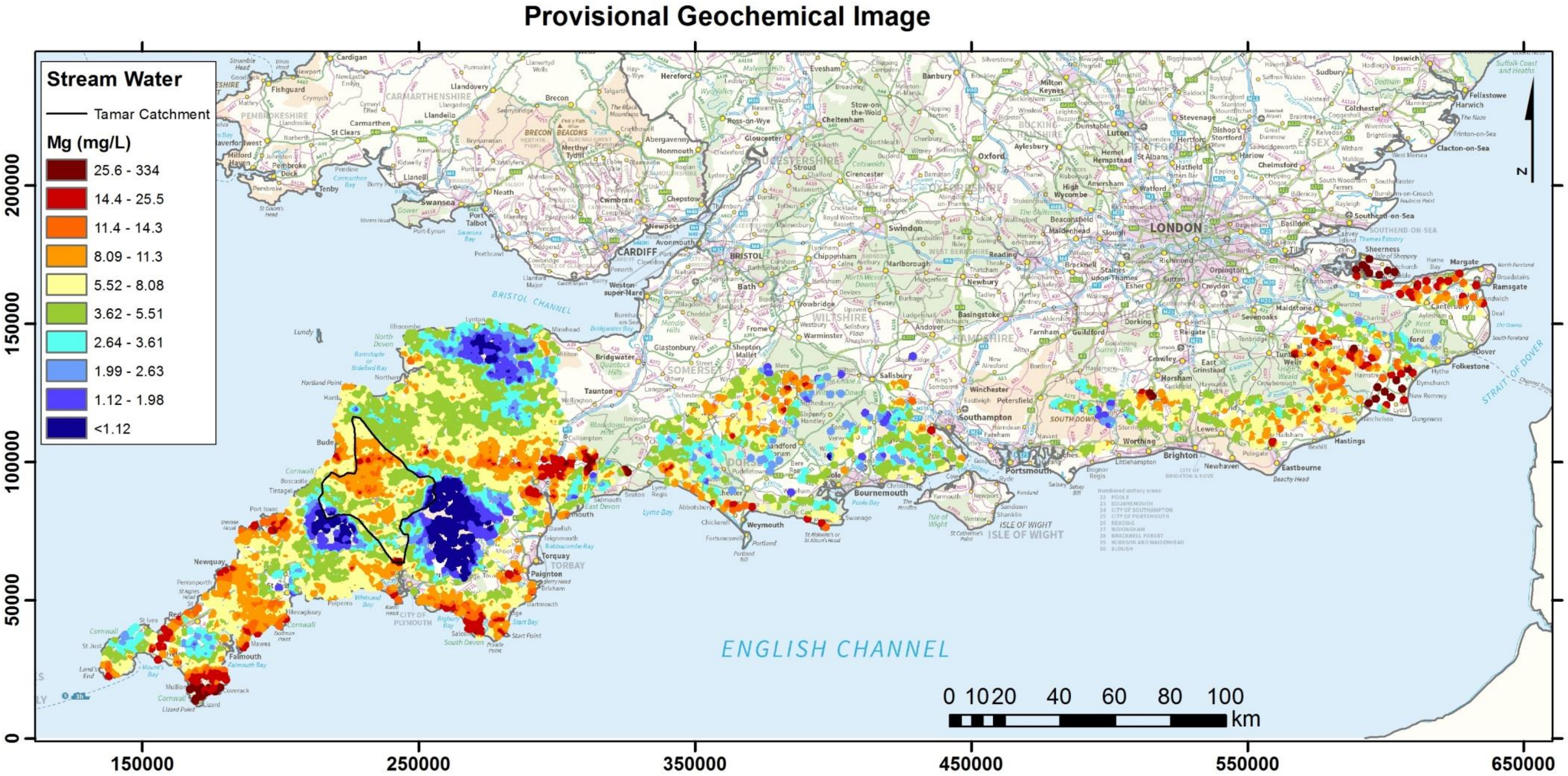
Provisional Geochemical Image



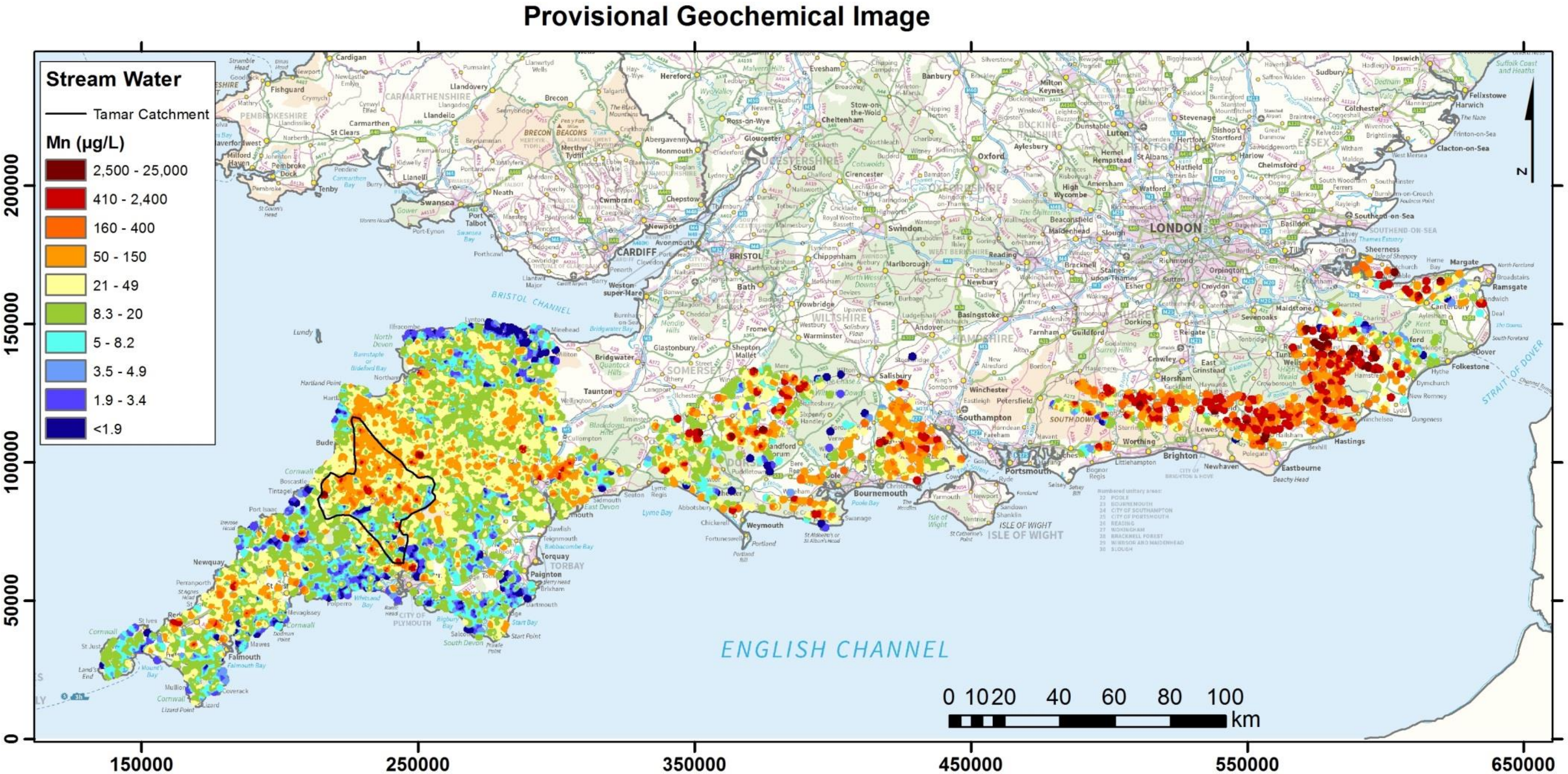

Provisional Geochemical Image
Stream Water
Tamar Catchment
Li (µg/L)
30 - 720
14 - 29
9.2 - 13
5.1 - 9.1
2.5 - 5
1.3 - 2.4
0.89 - 1.2
0.72 - 0.88
0.54 - 0.71
<54
ENGLISH CHANNEL
BRISTOL CHANNEL
0 10 20 40 60 80 100
km
N
0
50000
100000
150000
200000
150000
250000
350000
450000
550000
650000

Provisional Geochemical Image



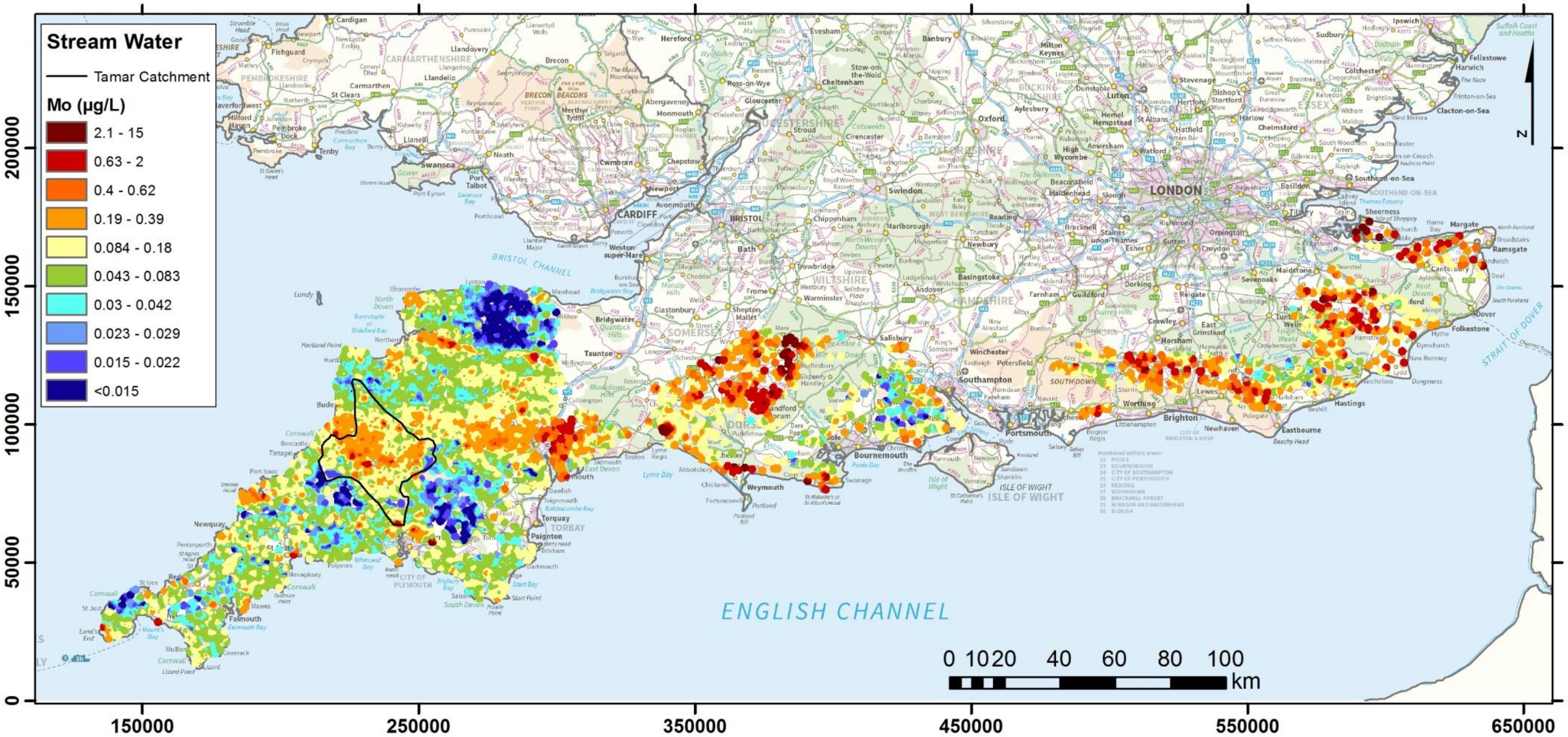


Provisional Geochemical Image
Stream Water
Tamar Catchment
Mg (mg/L)
25.6 - 334
14.4 - 25.5
11.4 - 14.3
8.09 - 11.3
5.52 - 8.08
3.62 - 5.51
2.64 - 3.61
1.99 - 2.63
1.12 - 1.98
<1.12
ENGLISH CHANNEL
BRISTOL CHANNEL
LONDON
0 10 20 40 60 80 100
km
N
0
50000
100000
150000
200000
150000
250000
350000
450000
550000
650000

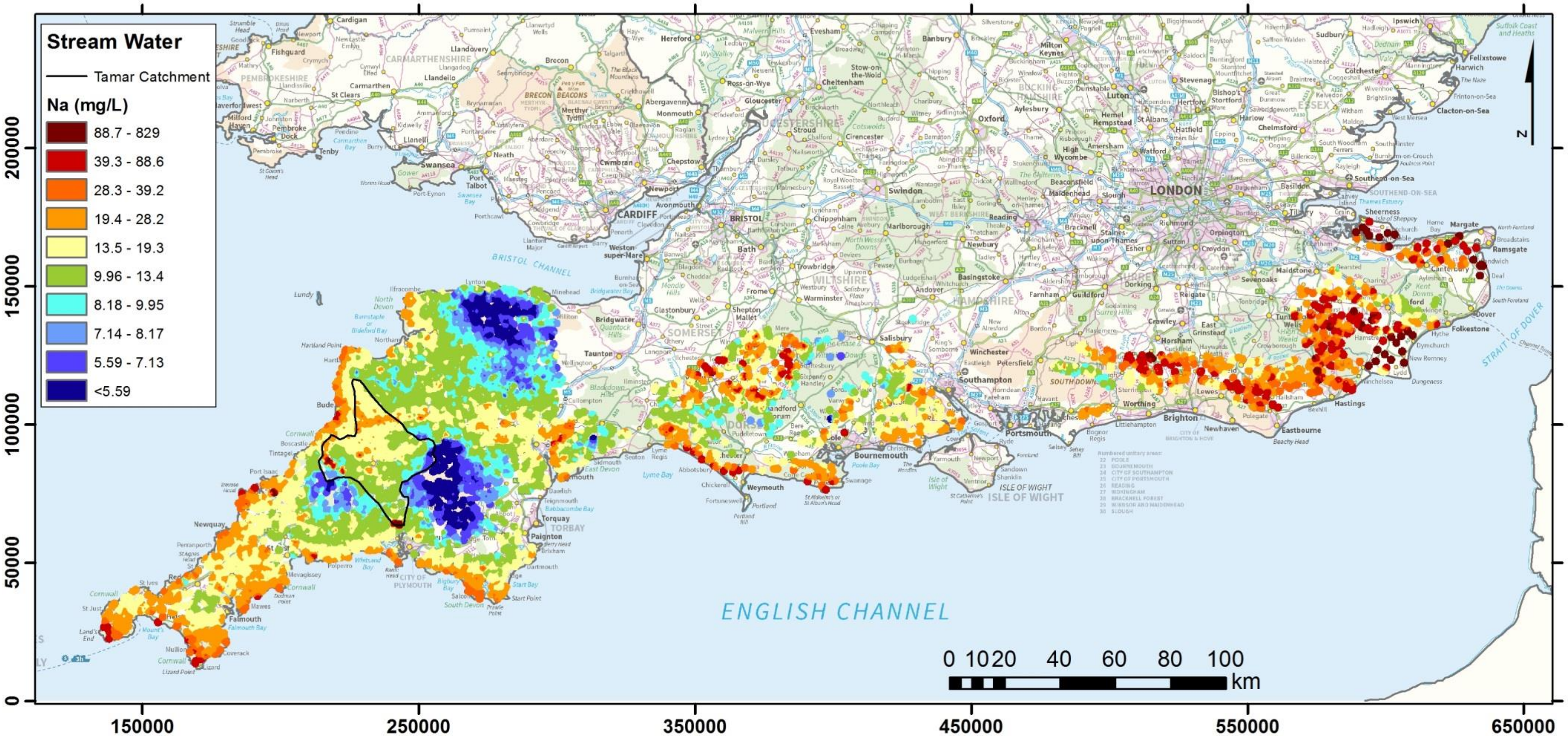


Provisional Geochemical Image
Stream Water
Tamar Catchment
Mn (µg/L)
2,500 - 25,000
410 - 2,400
160 - 400
50 - 150
21 - 49
8.3 - 20
5 - 8.2
3.5 - 4.9
1.9 - 3.4
<1.9
ENGLISH CHANNEL
0 10 20 40 60 80 100
km
150000
250000
350000
450000
550000
650000
0
50000
100000
150000
200000

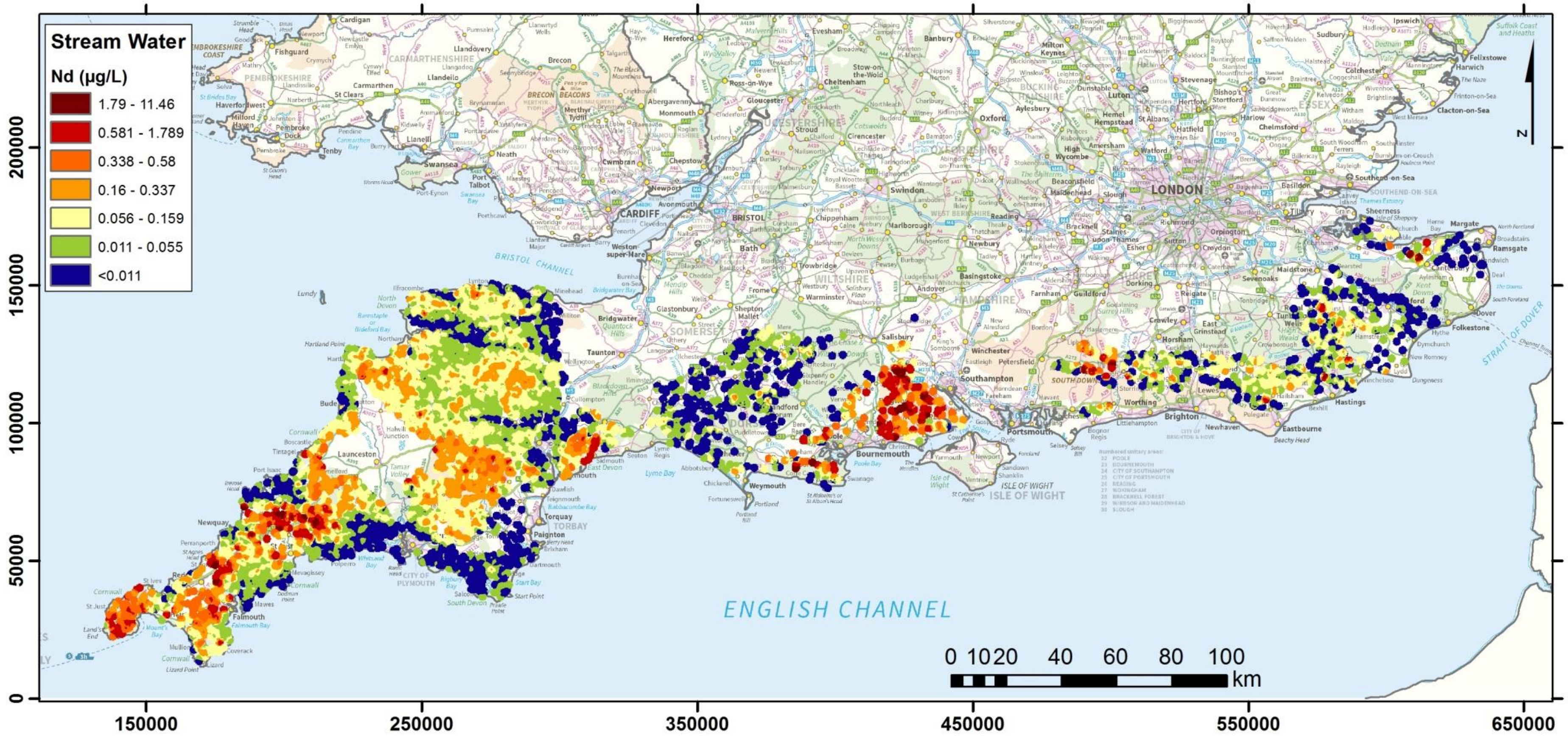
Provisional Geochemical Image



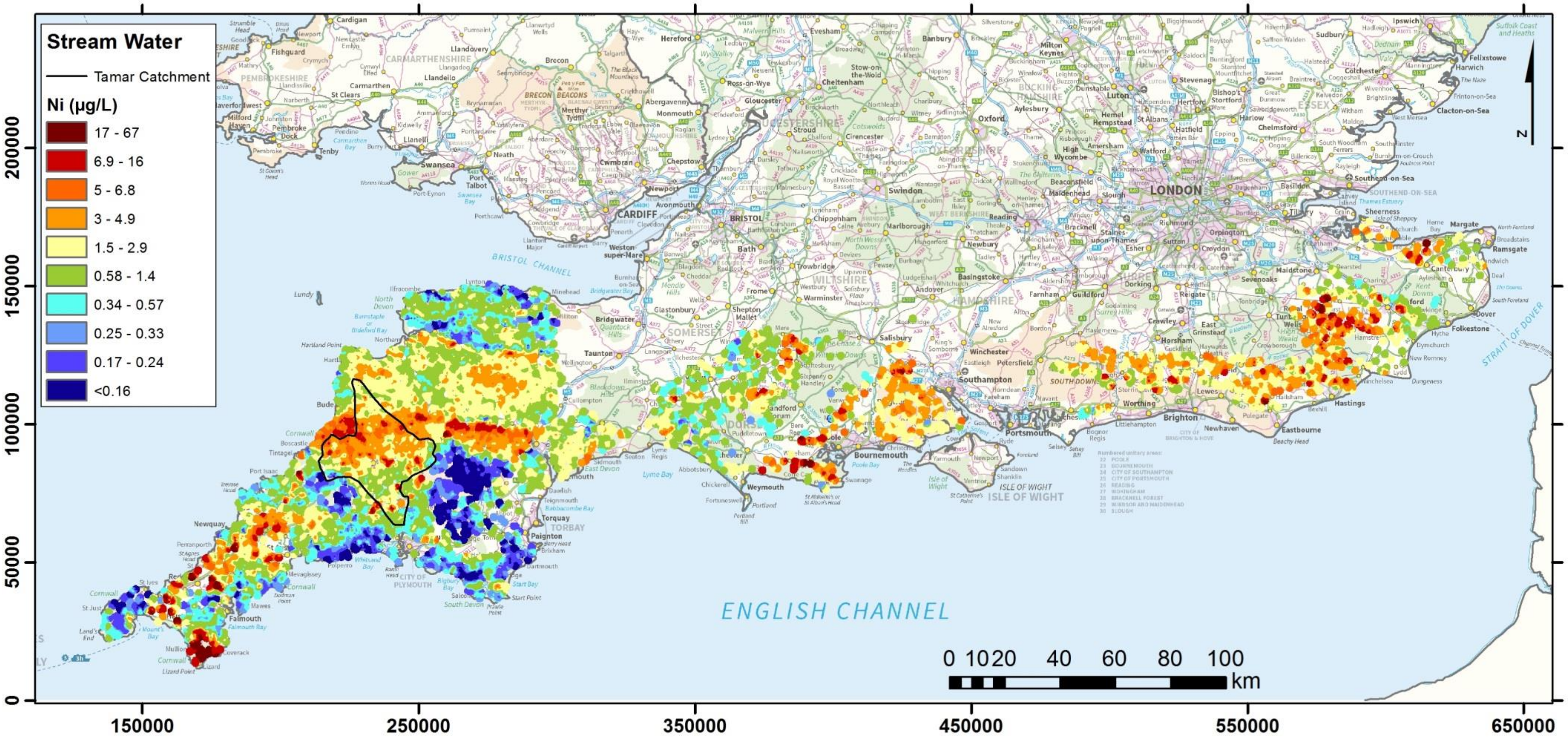
Provisional Geochemical Image



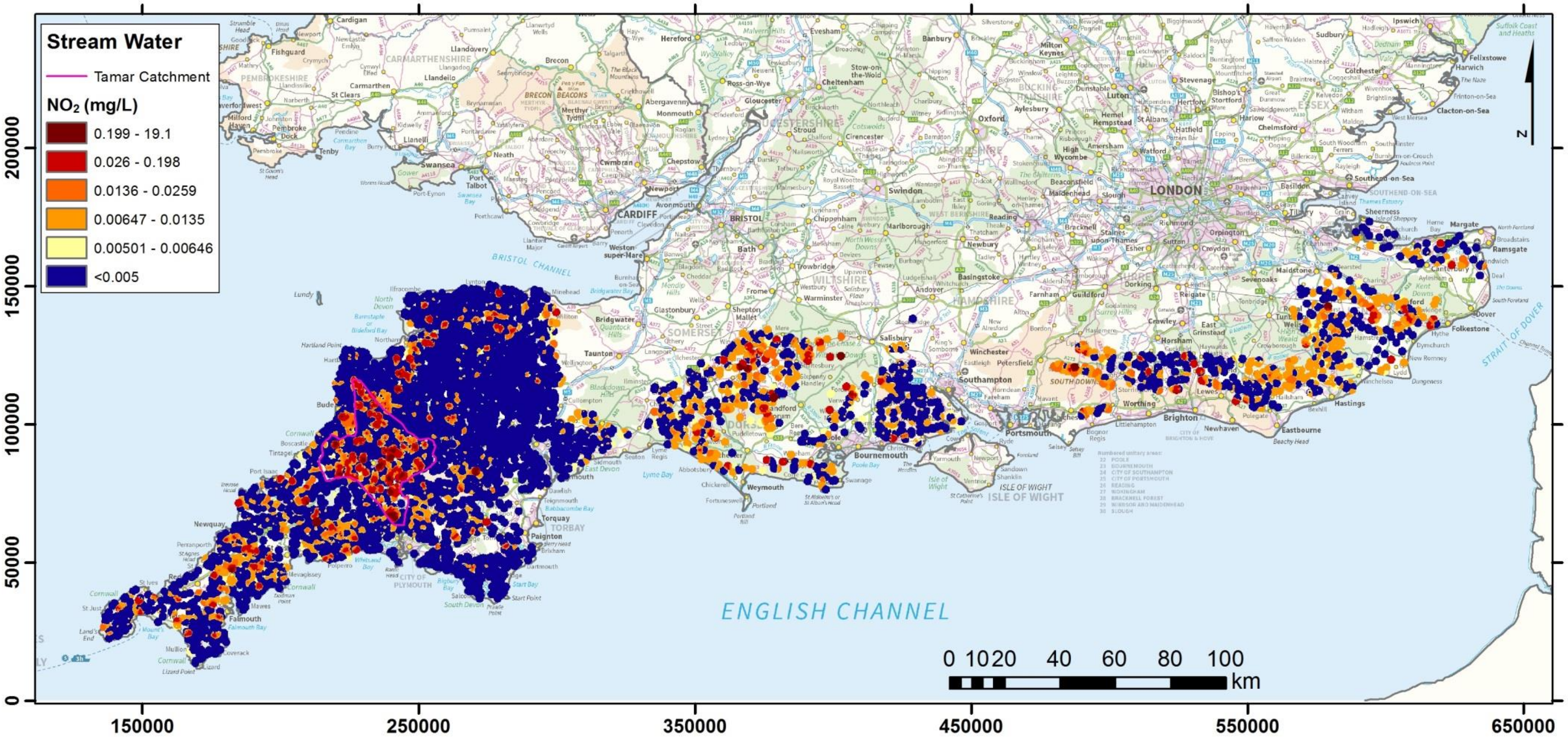
Provisional Geochemical Image

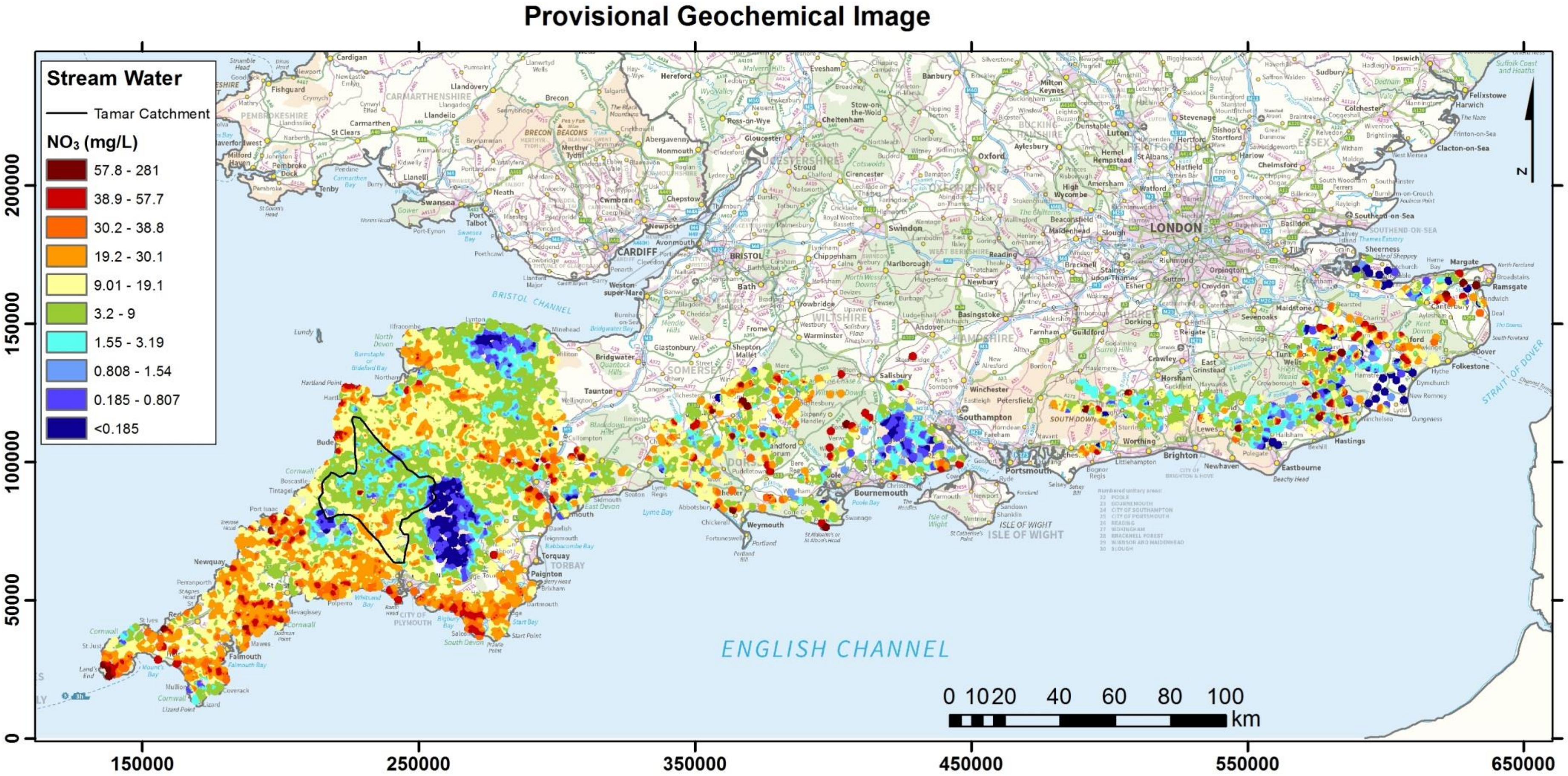


Provisional Geochemical Image

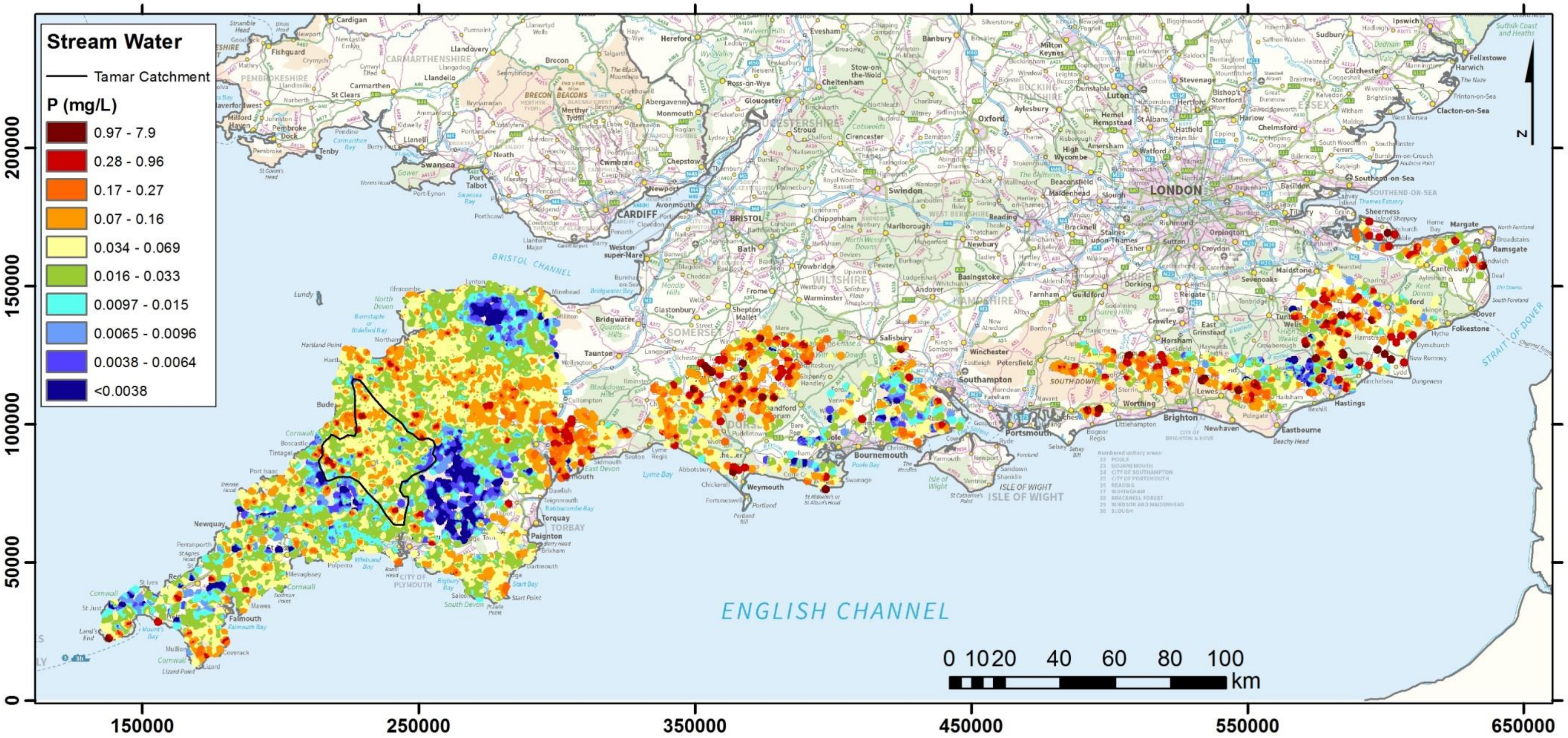


Provisional Geochemical Image

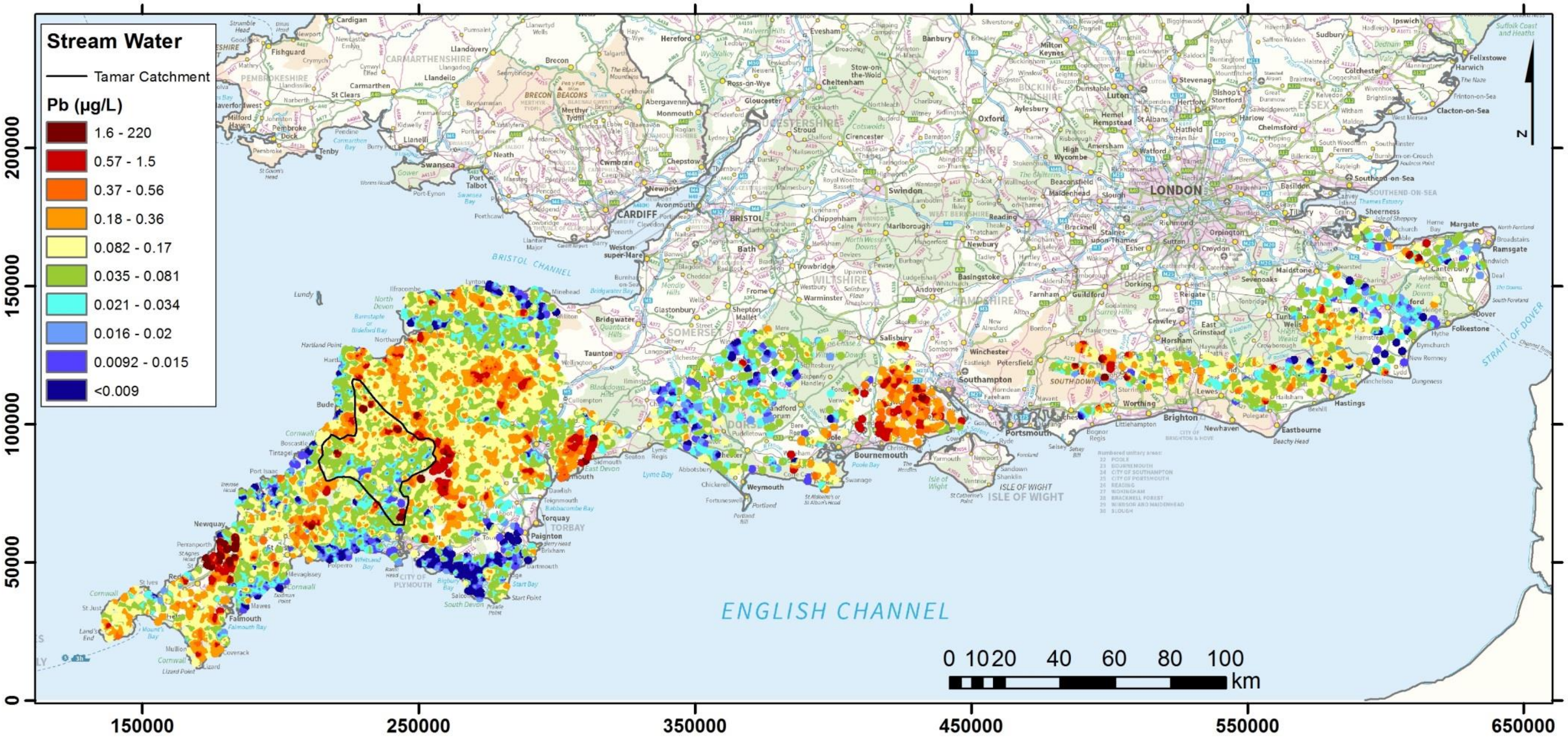



Provisional Geochemical Image
Stream Water
Tamar Catchment
NO_3 (mg/L)
57.8 - 281
38.9 - 57.7
30.2 - 38.8
19.2 - 30.1
9.01 - 19.1
3.2 - 9
1.55 - 3.19
0.808 - 1.54
0.185 - 0.807
<0.185
ENGLISH CHANNEL
0 10 20 40 60 80 100
km
N
0
50000
100000
150000
200000
150000
250000
350000
450000
550000
650000

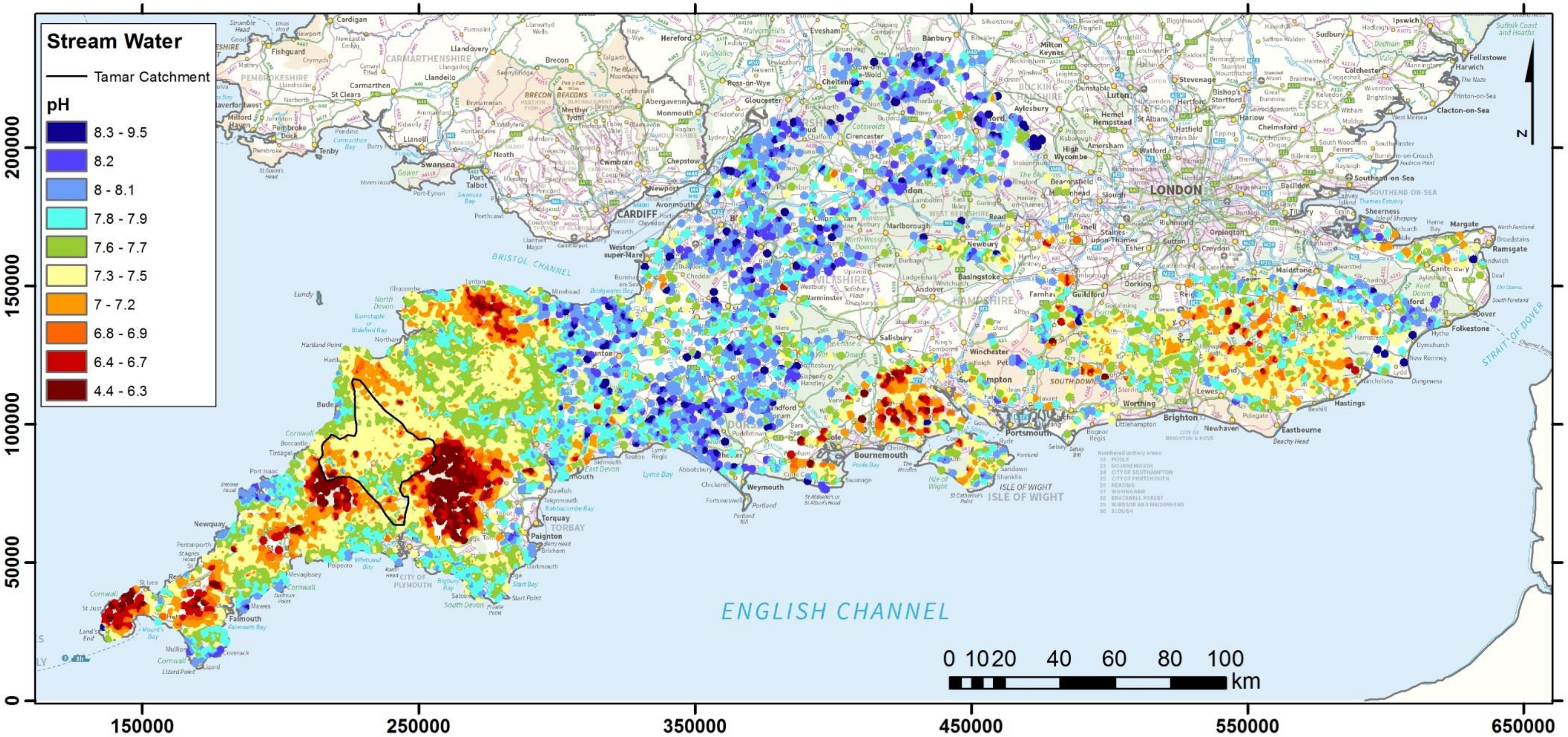
Provisional Geochemical Image



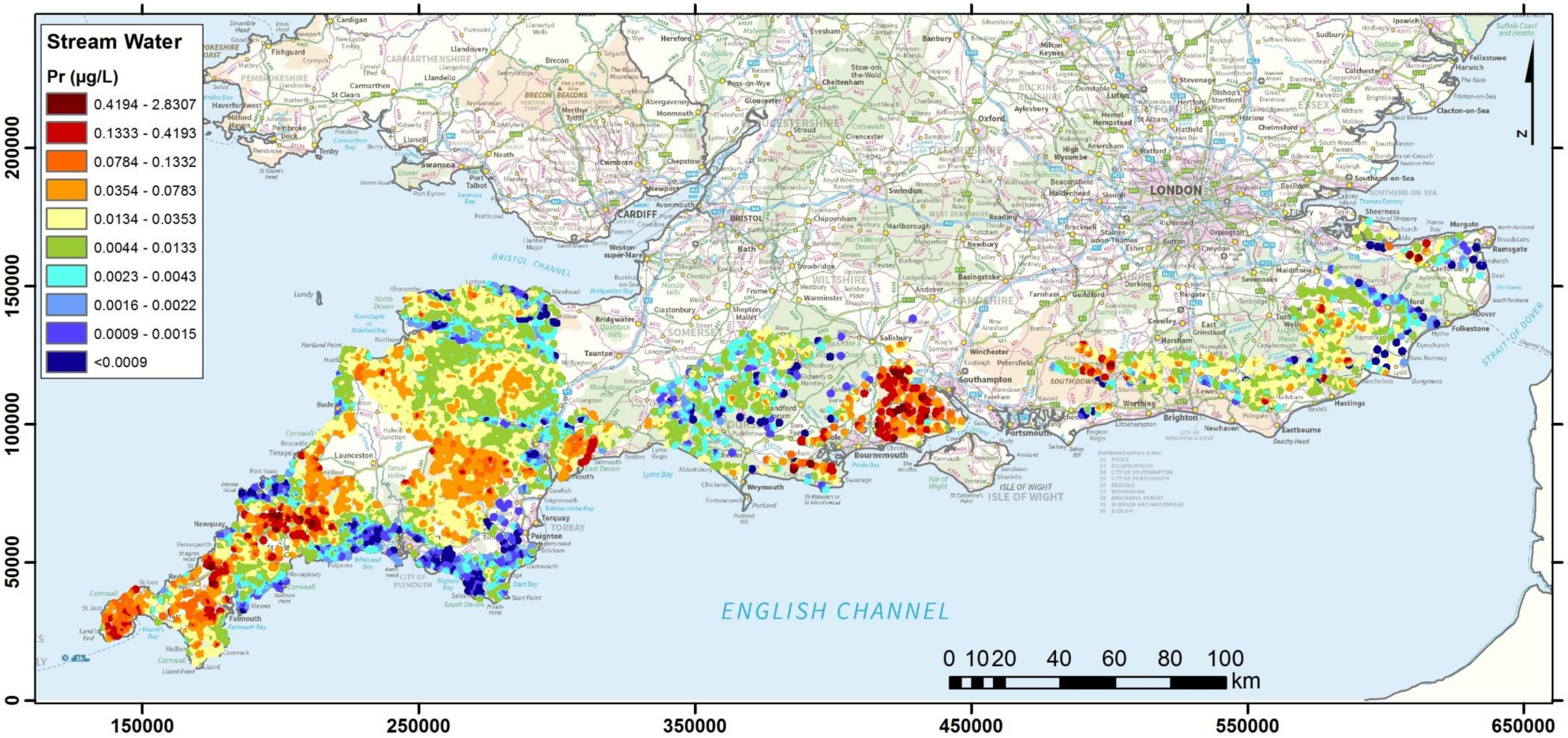
Provisional Geochemical Image

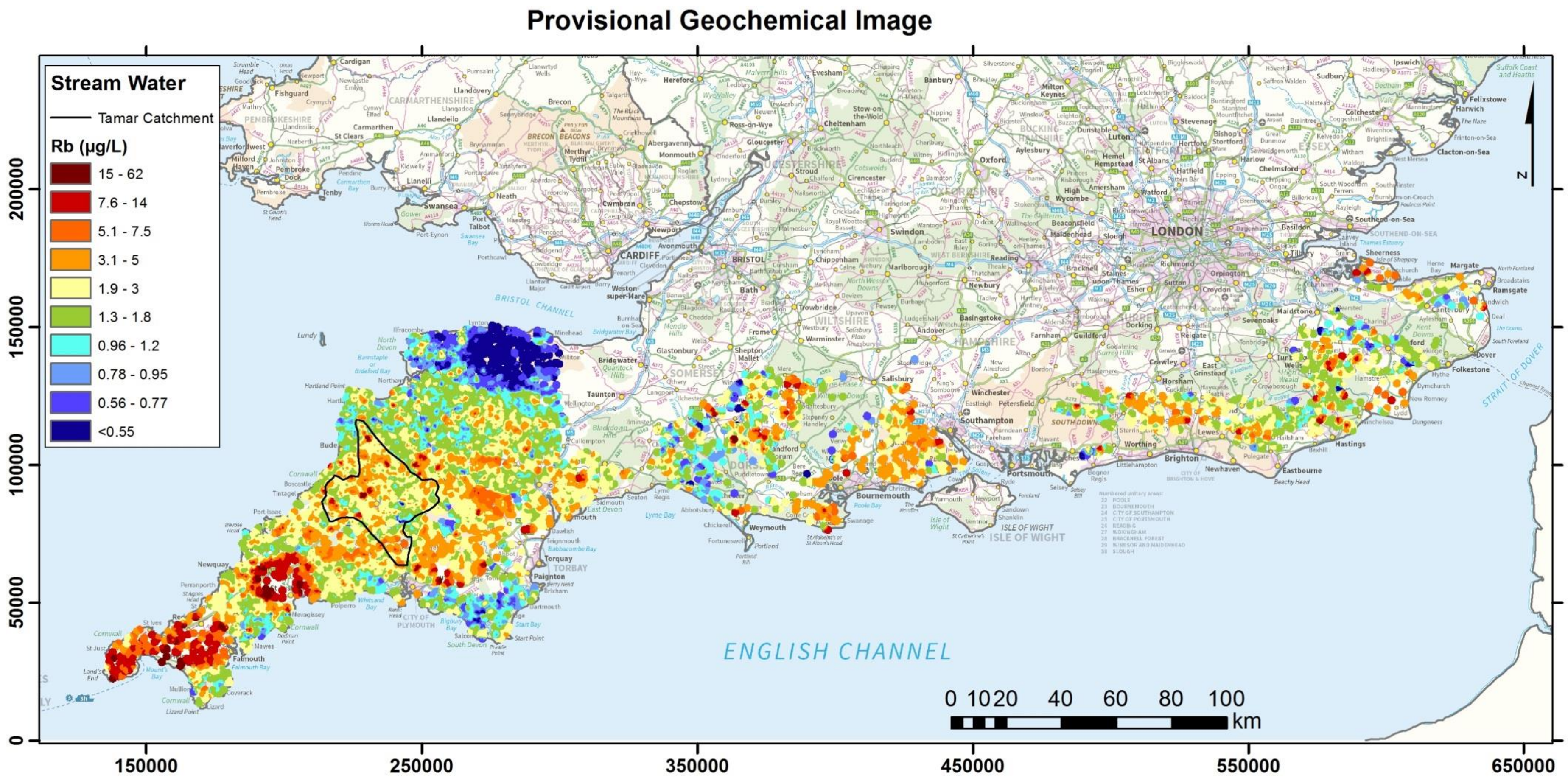


Provisional Geochemical Image

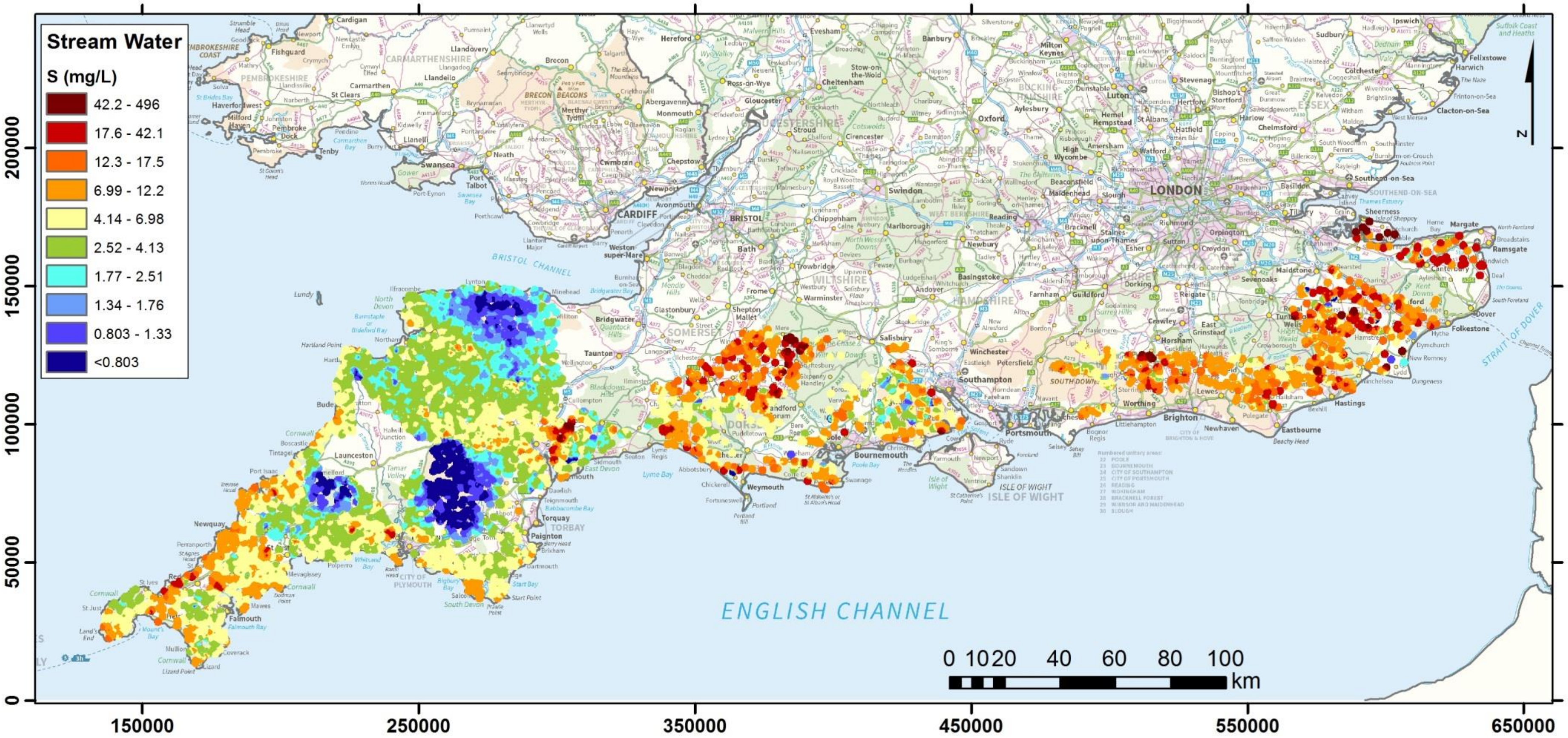


Provisional Geochemical Image

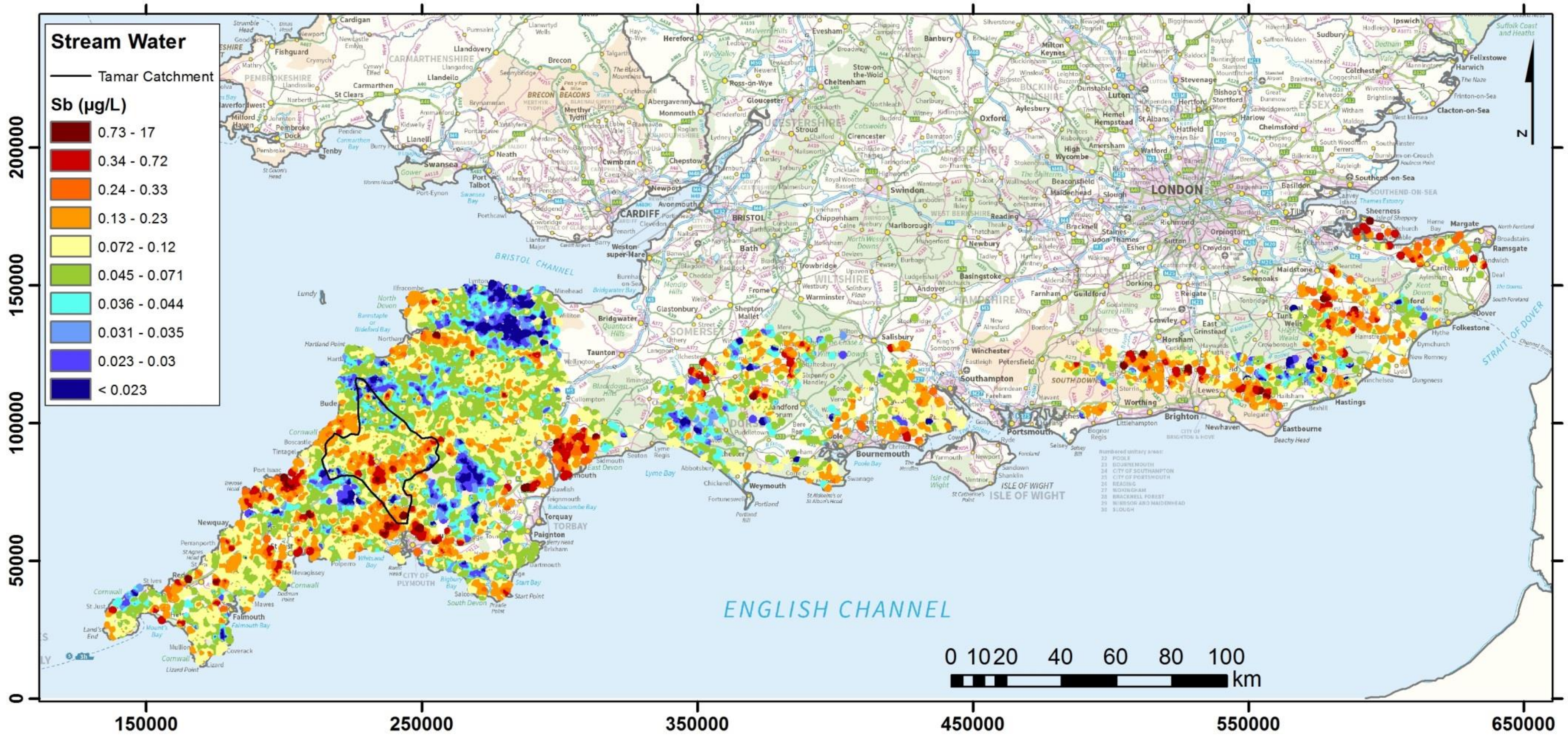



Provisional Geochemical Image
Stream Water
Tamar Catchment
Rb (µg/L)
15 - 62
7.6 - 14
5.1 - 7.5
3.1 - 5
1.9 - 3
1.3 - 1.8
0.96 - 1.2
0.78 - 0.95
0.56 - 0.77
<0.55
ENGLISH CHANNEL
0 10 20 40 60 80 100
km
N
0
50000
100000
150000
200000
150000
250000
350000
450000
550000
650000

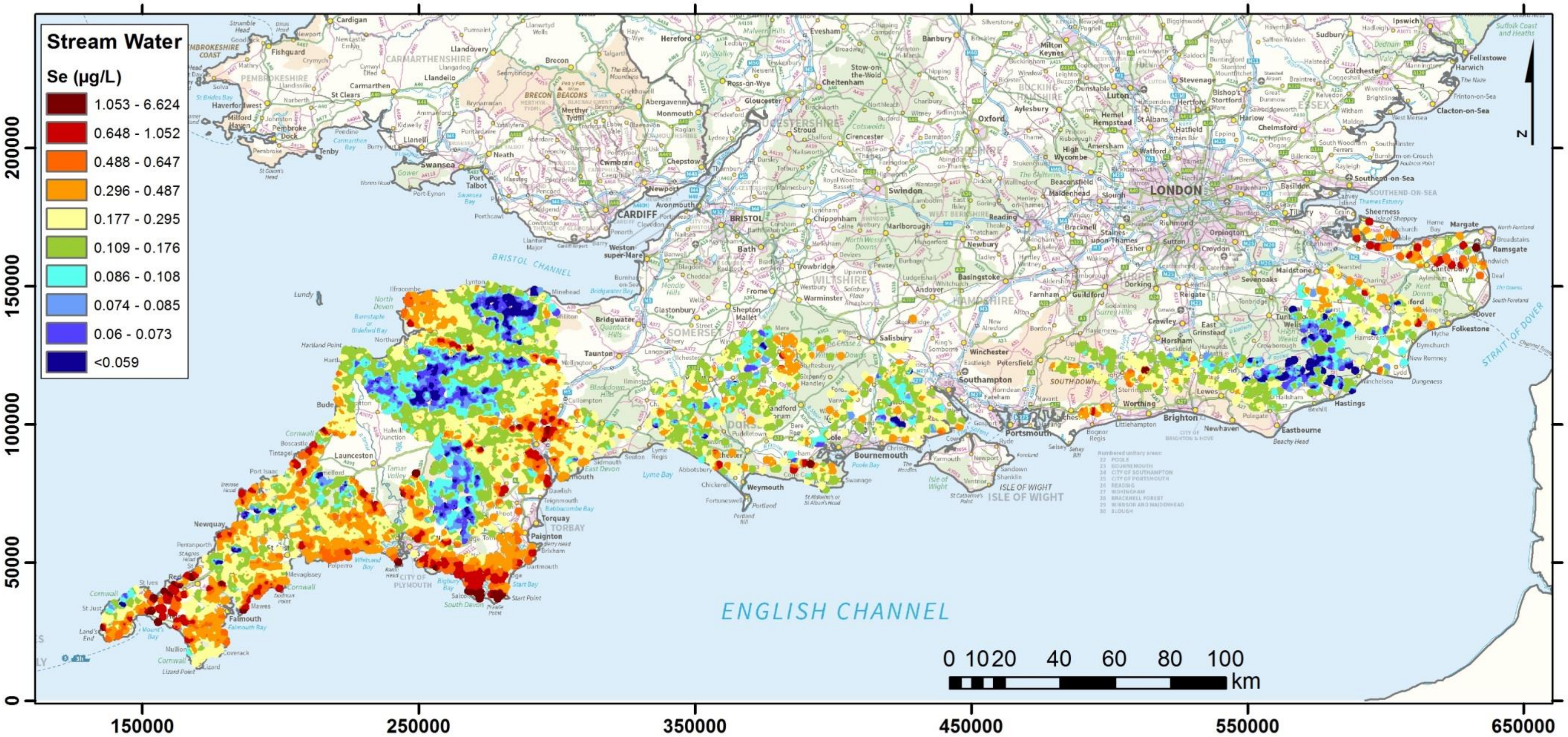
Provisional Geochemical Image

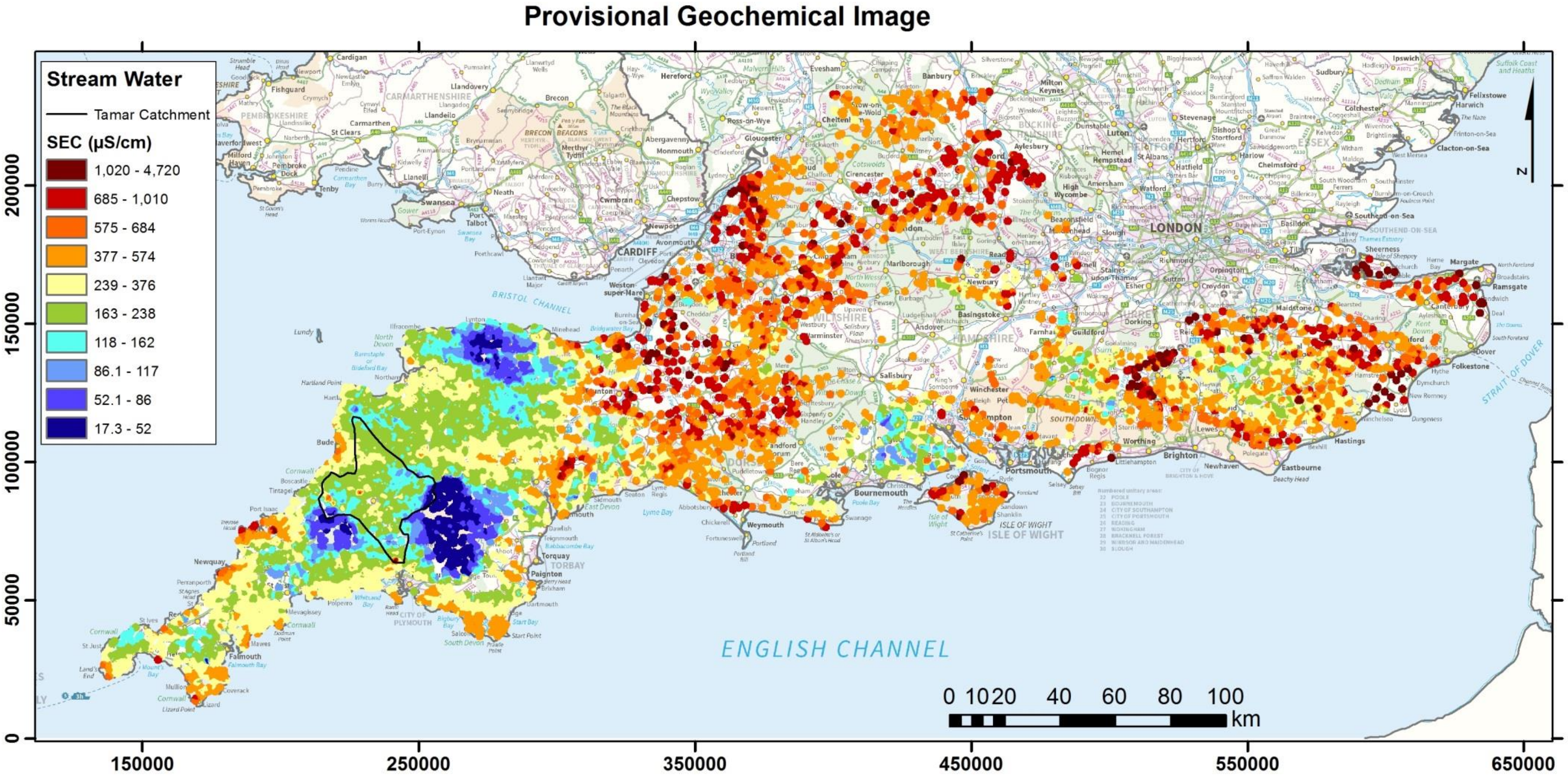


Provisional Geochemical Image

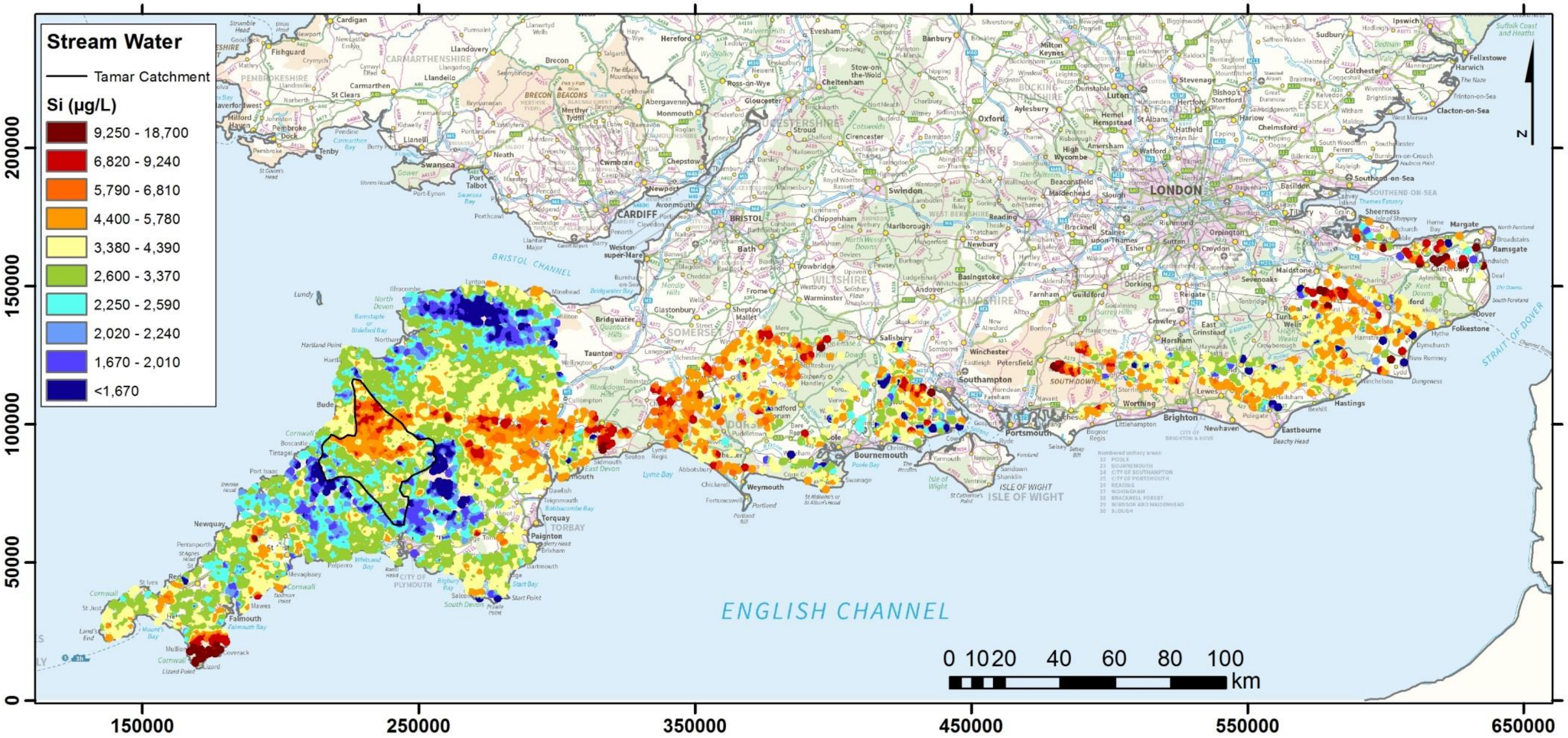


Provisional Geochemical Image

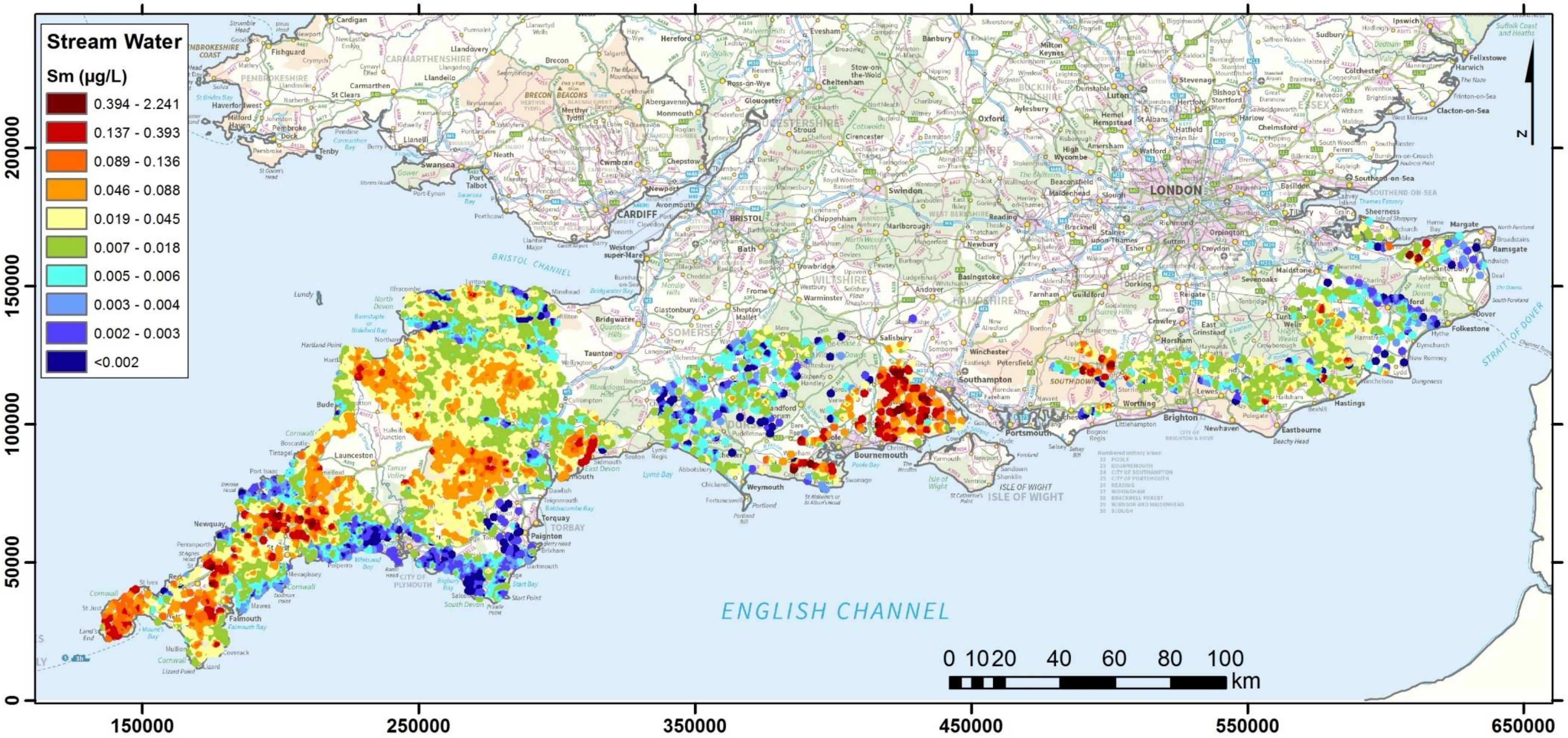


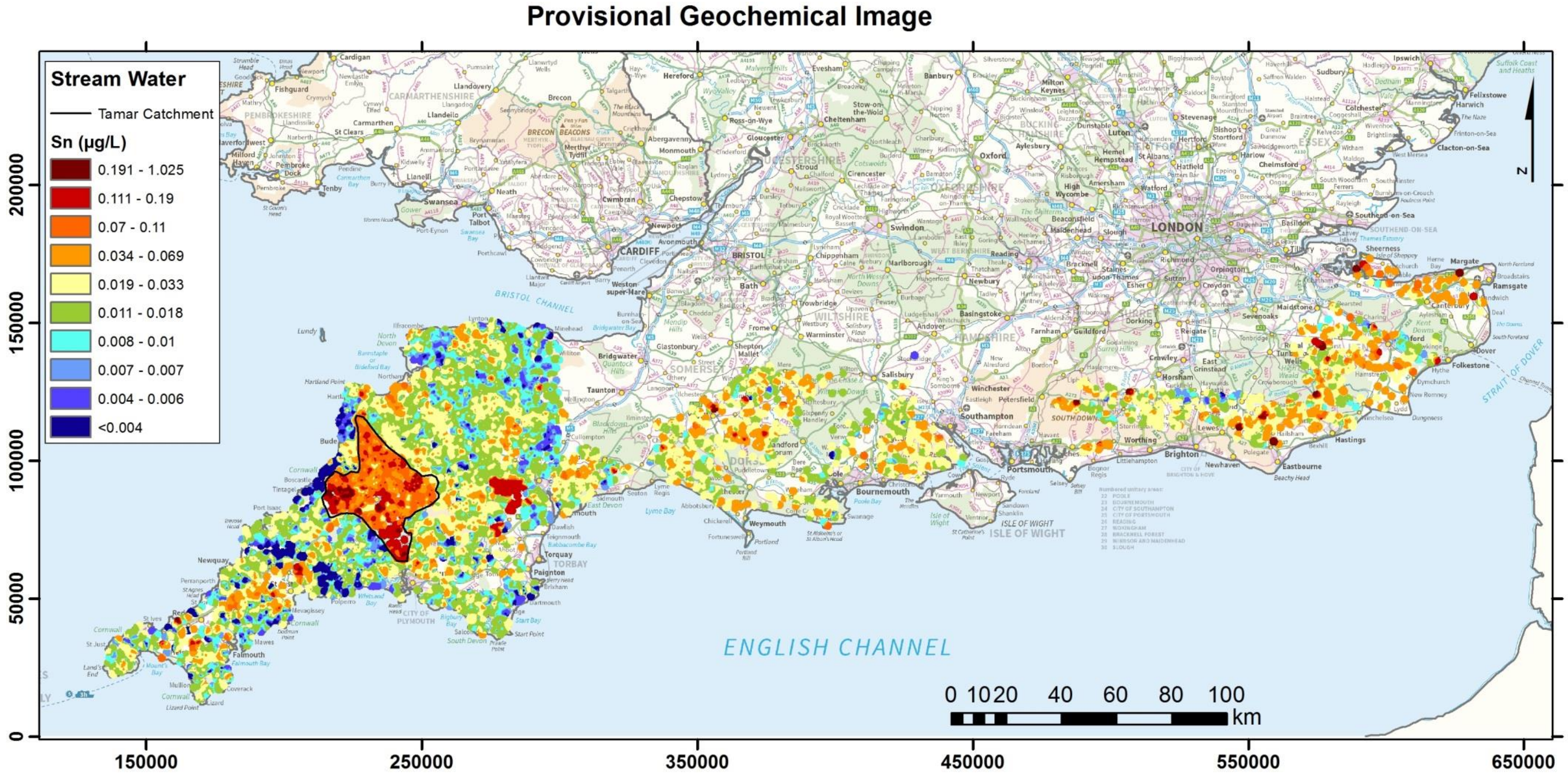

Provisional Geochemical Image
Stream Water
Tamar Catchment
SEC (µS/cm)
1,020 - 4,720
685 - 1,010
575 - 684
377 - 574
239 - 376
163 - 238
118 - 162
86.1 - 117
52.1 - 86
17.3 - 52
ENGLISH CHANNEL
0 10 20 40 60 80 100
km
N
0
50000
100000
150000
200000
150000
250000
350000
450000
550000
650000

Provisional Geochemical Image



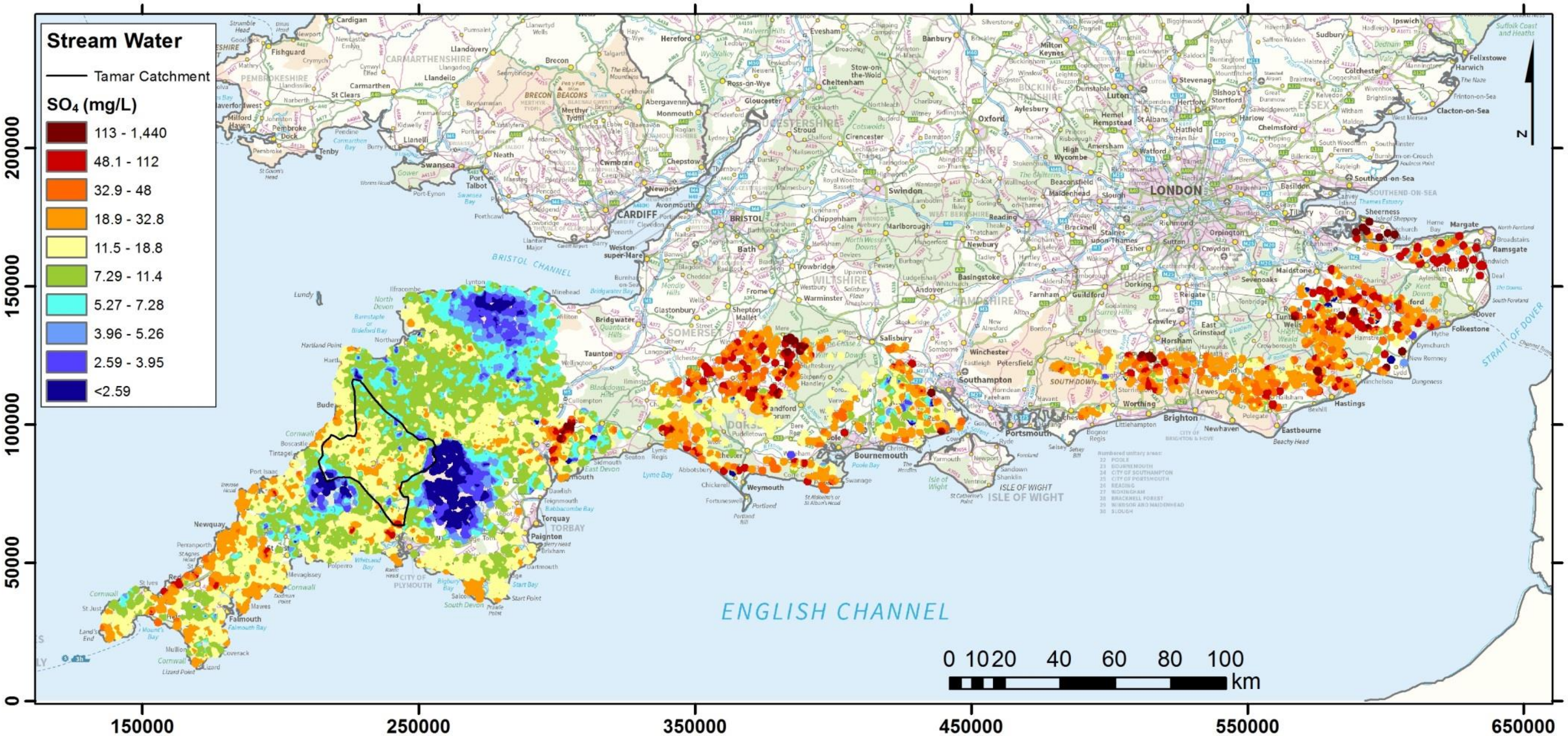
Provisional Geochemical Image



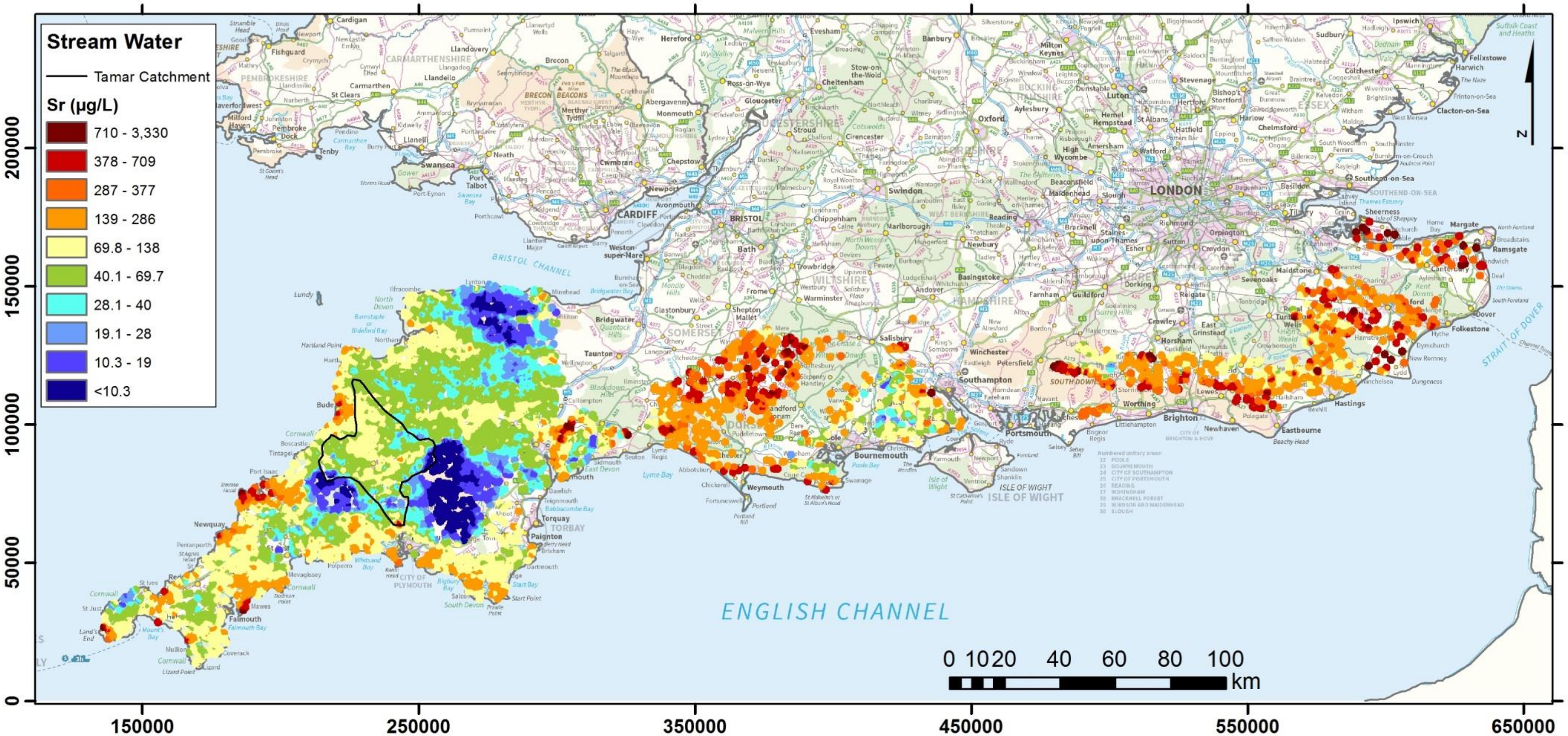


Provisional Geochemical Image
Stream Water
Tamar Catchment
Sn (µg/L)
0.191 - 1.025
0.111 - 0.19
0.07 - 0.11
0.034 - 0.069
0.019 - 0.033
0.011 - 0.018
0.008 - 0.01
0.007 - 0.007
0.004 - 0.006
<0.004
ENGLISH CHANNEL
0 10 20 40 60 80 100
km
150000
250000
350000
450000
550000
650000
0
50000
100000
150000
200000
N

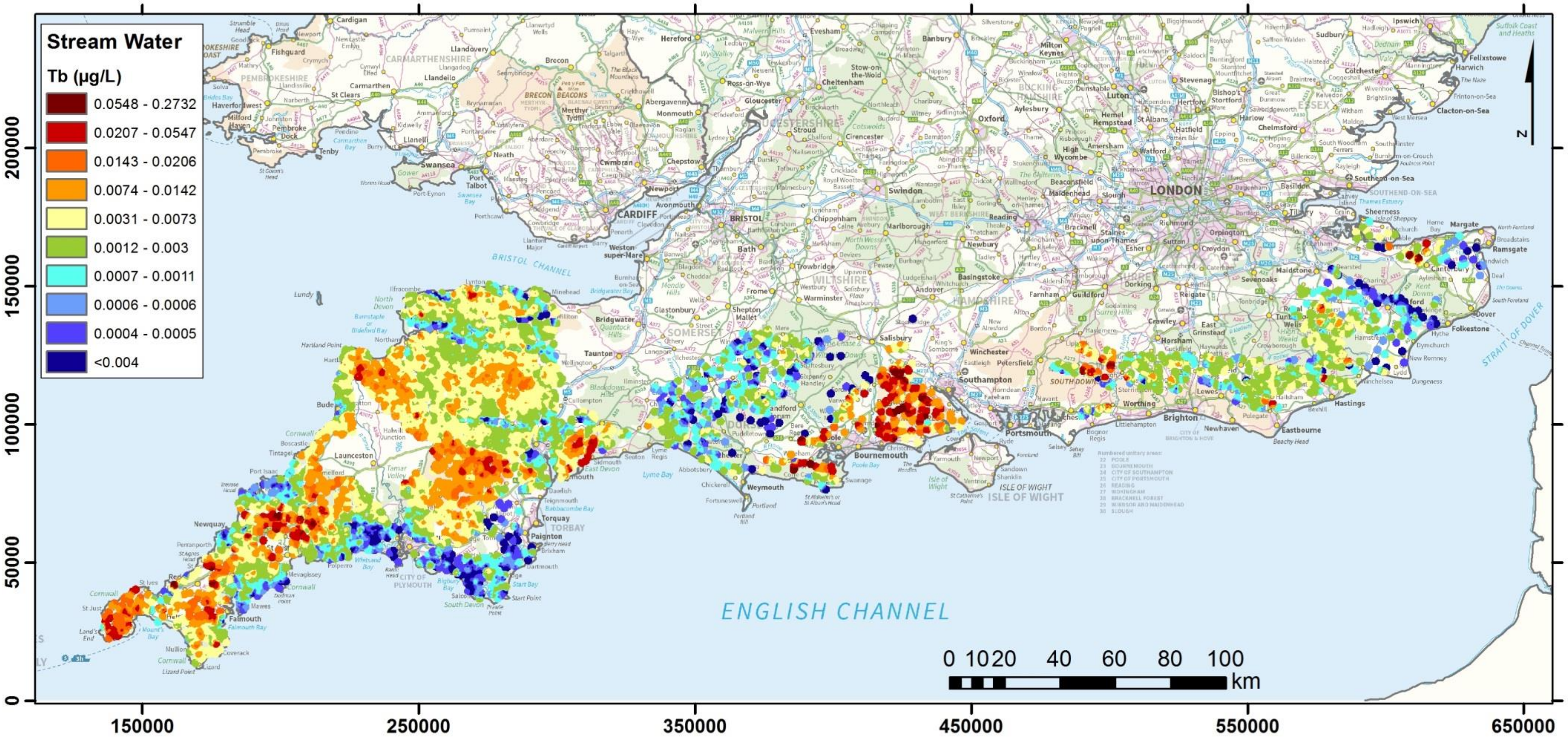
Provisional Geochemical Image



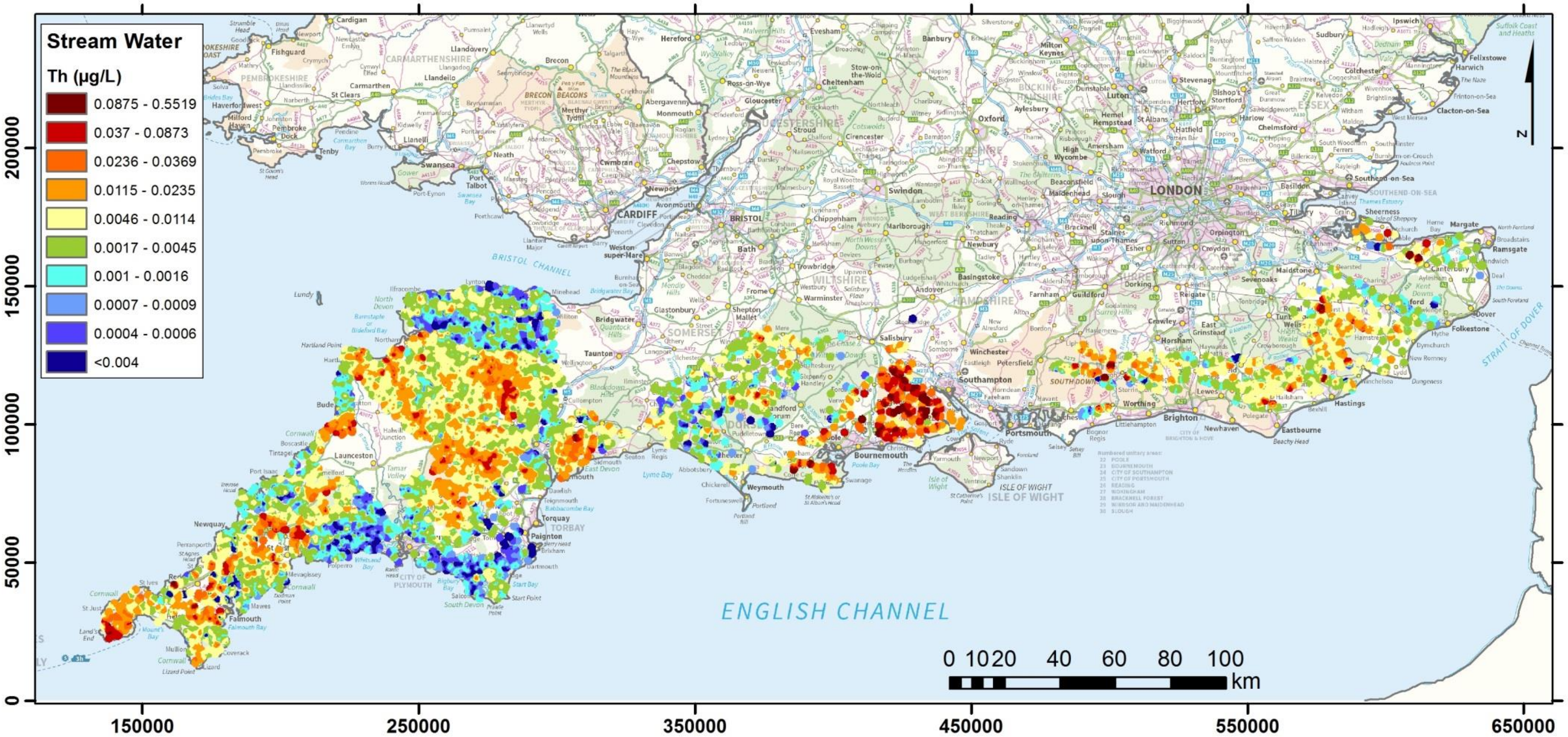
Provisional Geochemical Image



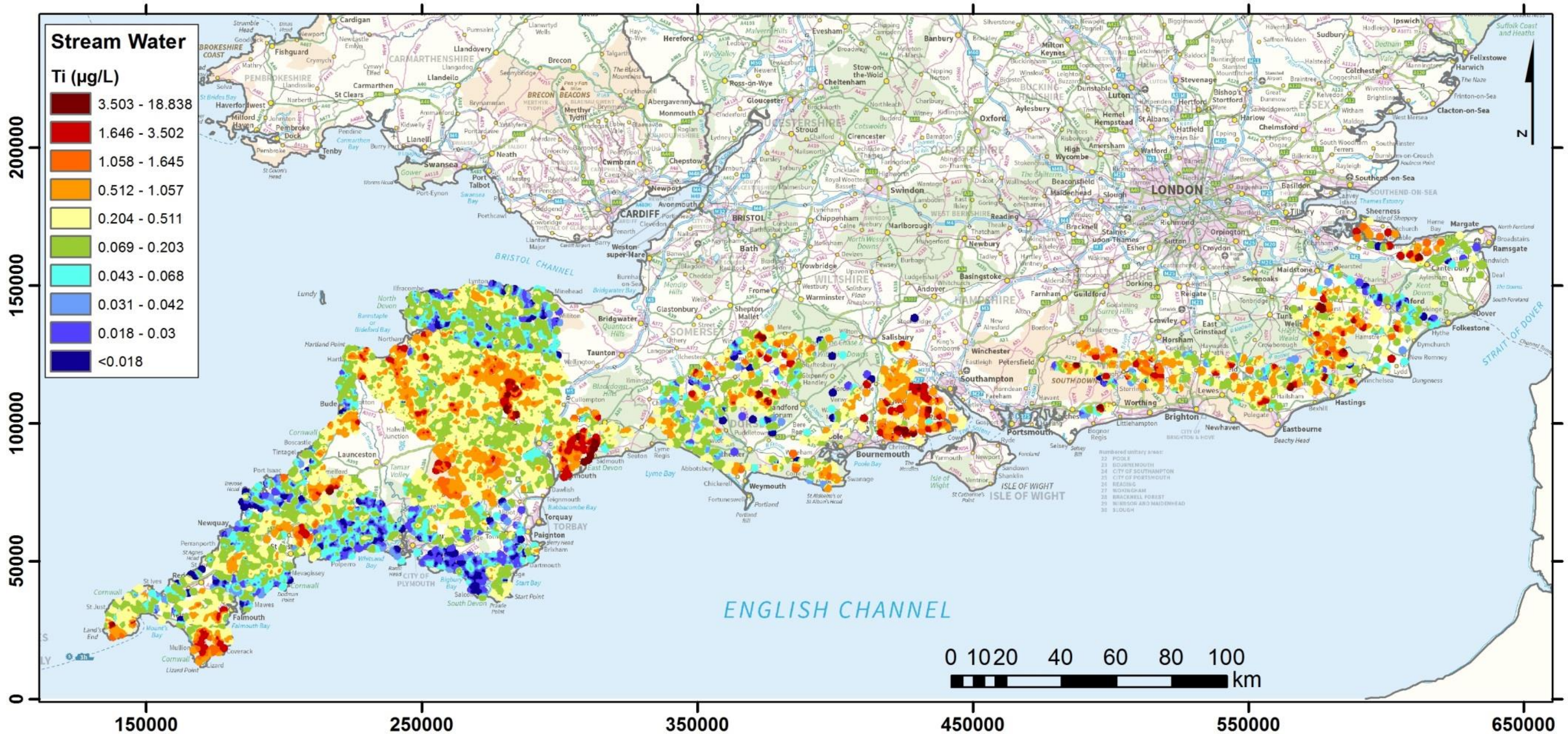
Provisional Geochemical Image

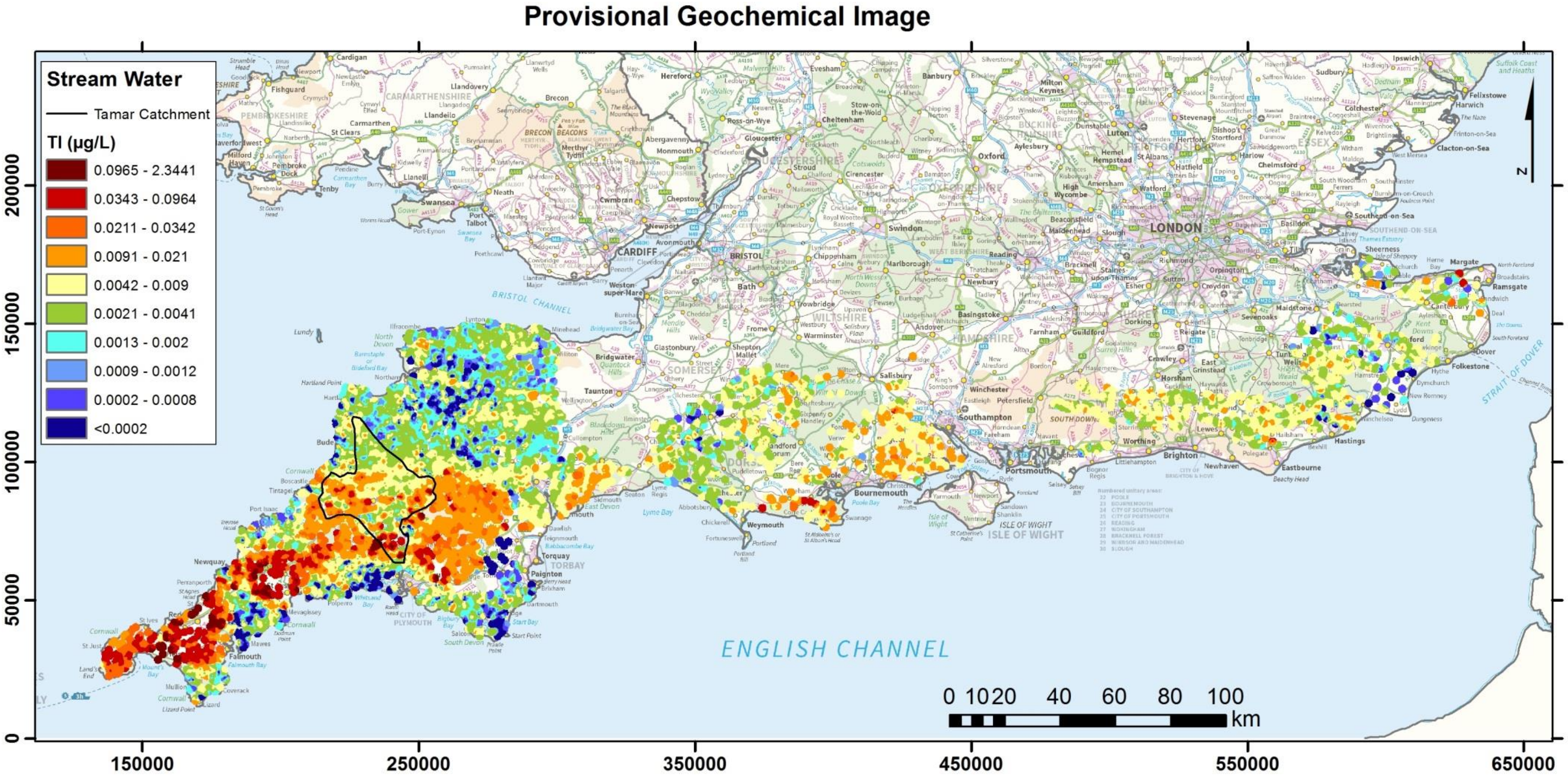


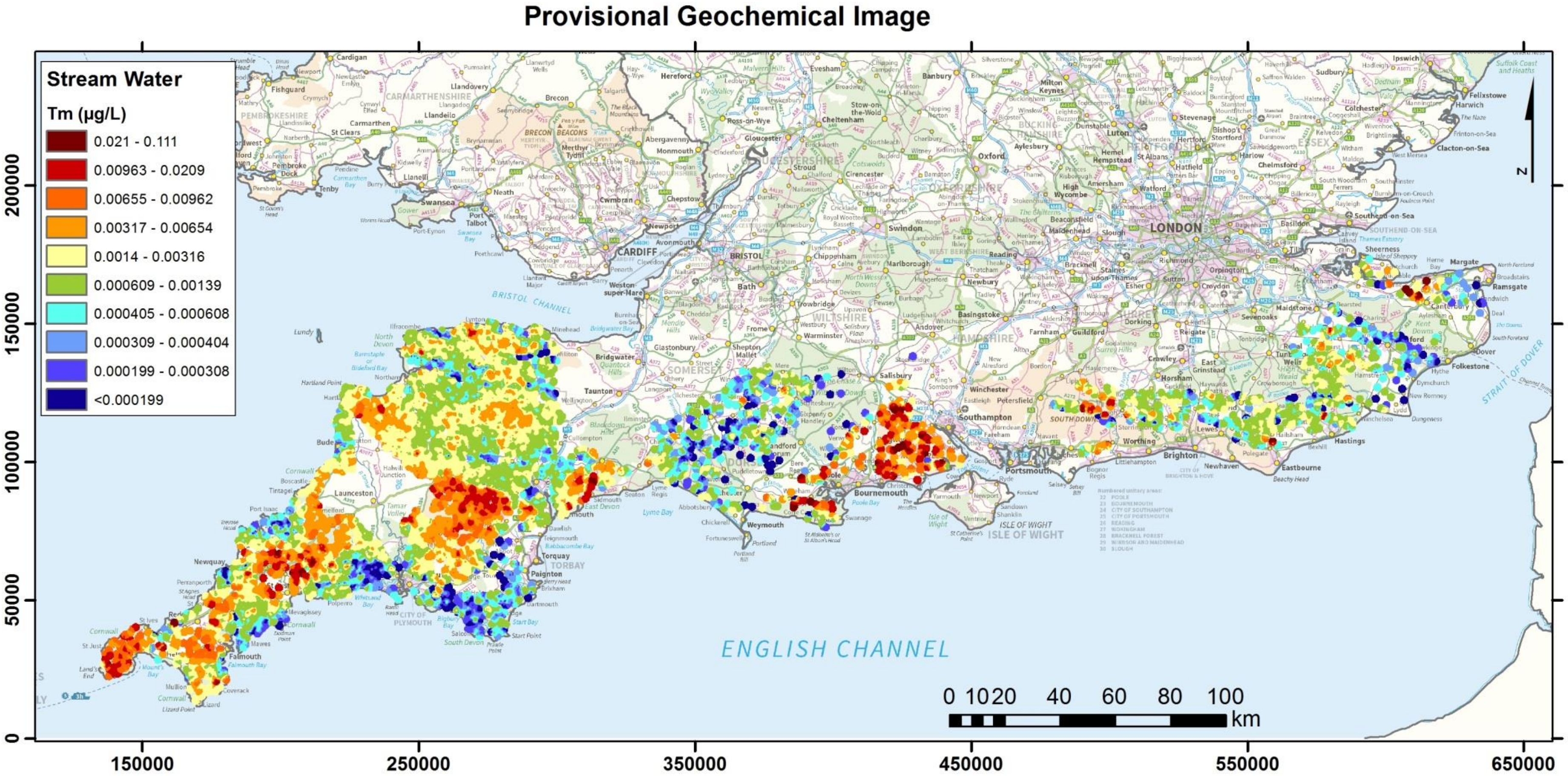
Provisional Geochemical Image



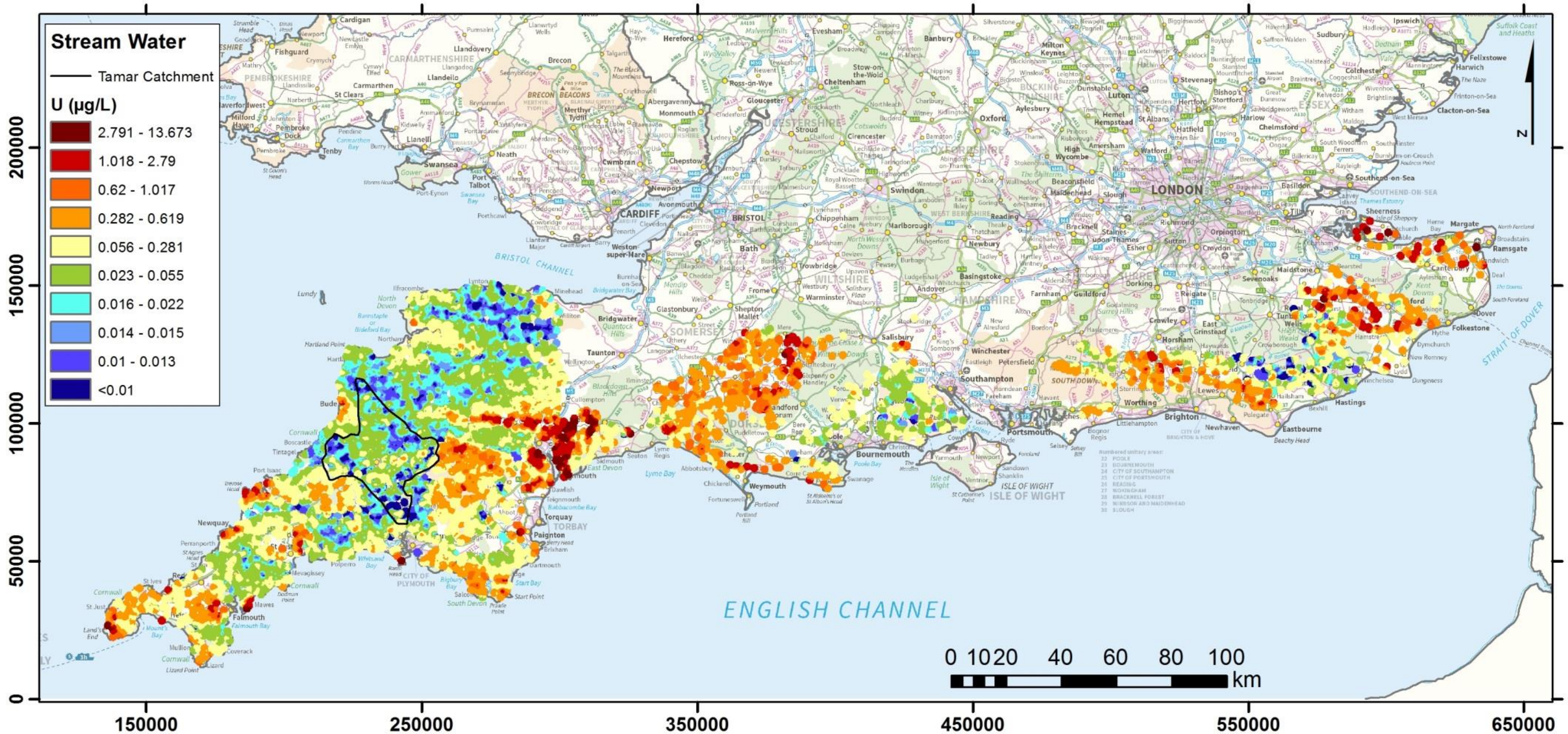
Provisional Geochemical Image



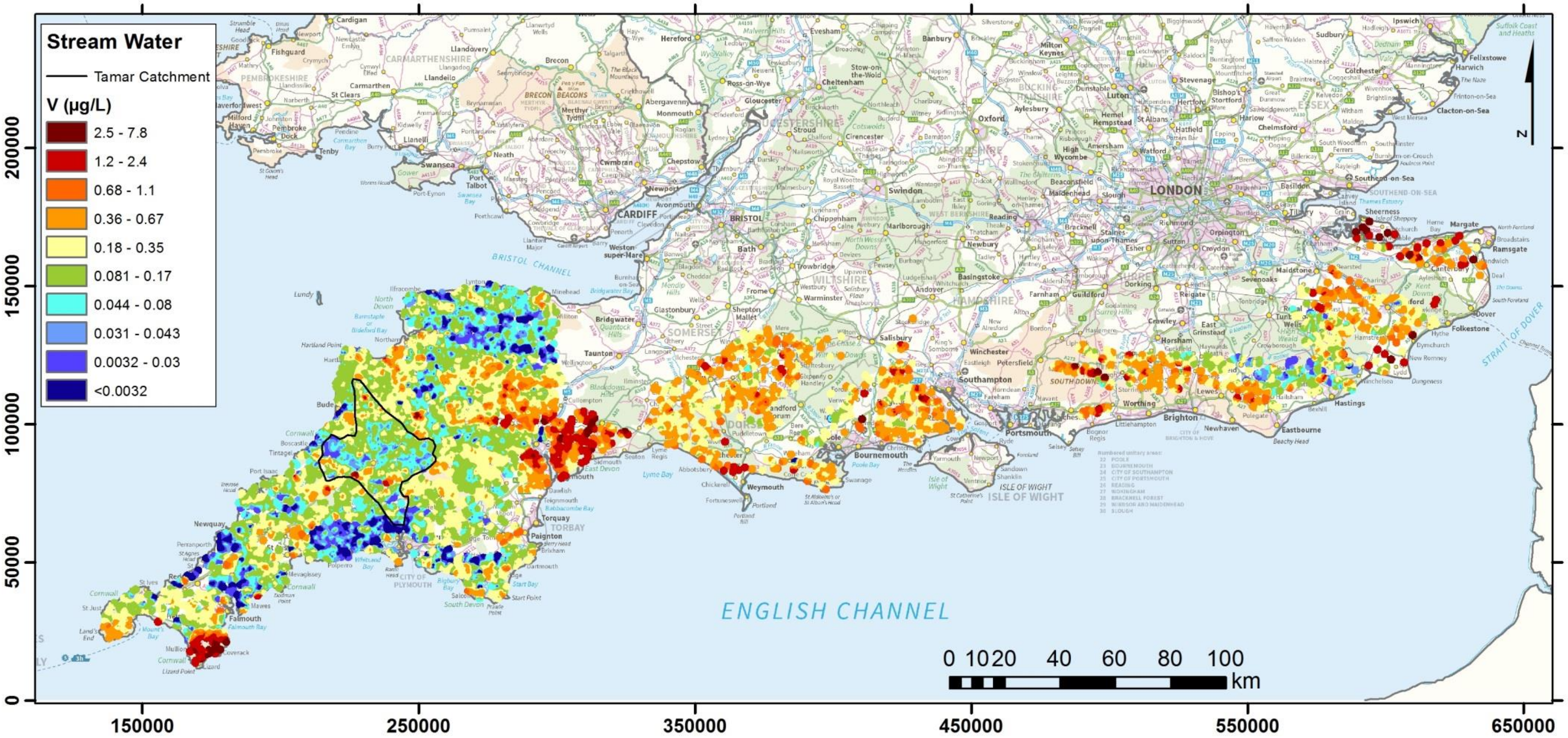

Provisional Geochemical Image
Stream Water
Tamar Catchment
Tl (µg/L)
0.0965 - 2.3441
0.0343 - 0.0964
0.0211 - 0.0342
0.0091 - 0.021
0.0042 - 0.009
0.0021 - 0.0041
0.0013 - 0.002
0.0009 - 0.0012
0.0002 - 0.0008
<0.0002
ENGLISH CHANNEL
BRISTOL CHANNEL
LONDON
0 10 20 40 60 80 100
km
N
0
50000
100000
150000
200000
150000
250000
350000
450000
550000
650000


Provisional Geochemical Image
Stream Water
Tm (µg/L)
0.021 - 0.111
0.00963 - 0.0209
0.00655 - 0.00962
0.00317 - 0.00654
0.0014 - 0.00316
0.000609 - 0.00139
0.000405 - 0.000608
0.000309 - 0.000404
0.000199 - 0.000308
<0.000199
ENGLISH CHANNEL
0 10 20 40 60 80 100 km
150000
250000
350000
450000
550000
650000
0
50000
100000
150000
200000
N

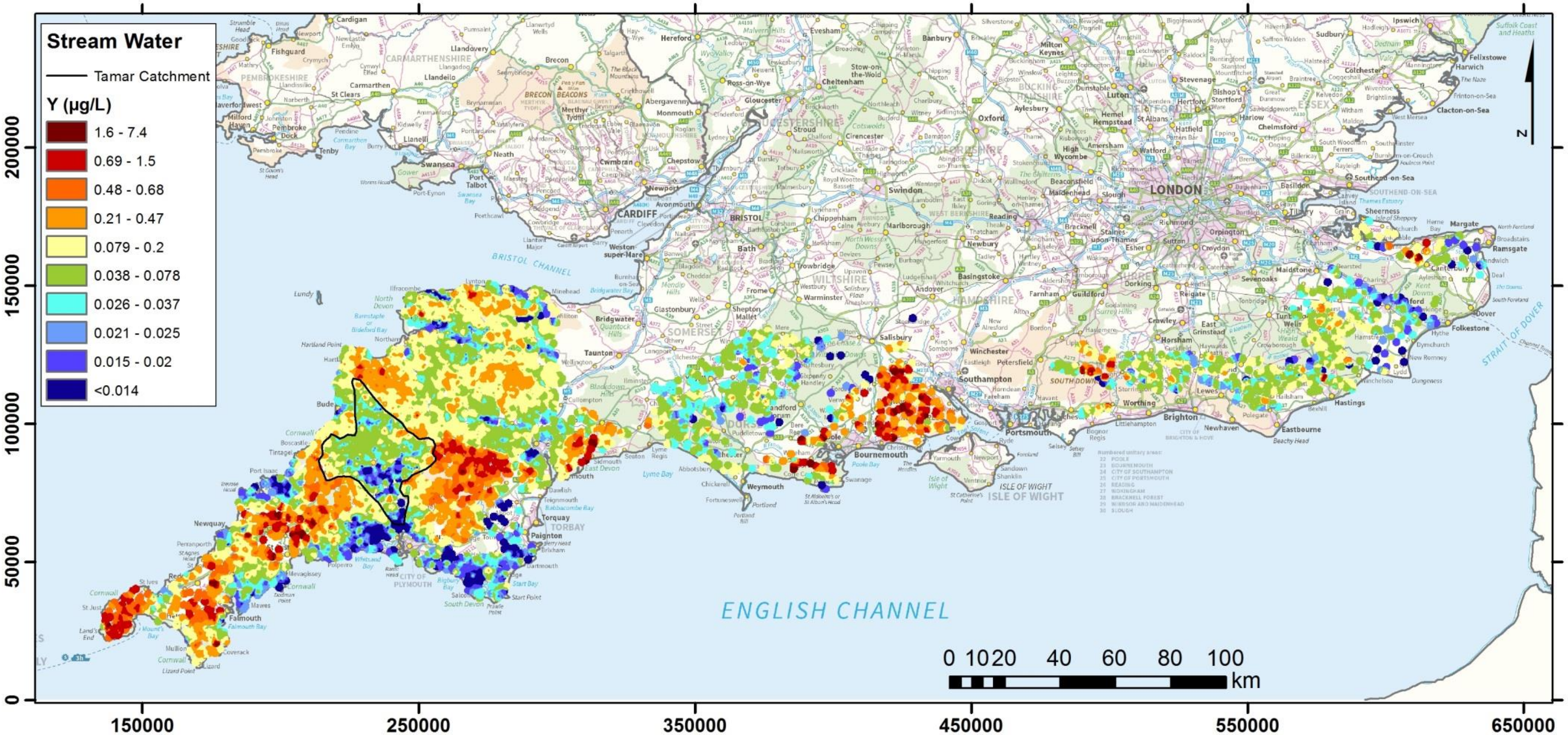
Provisional Geochemical Image



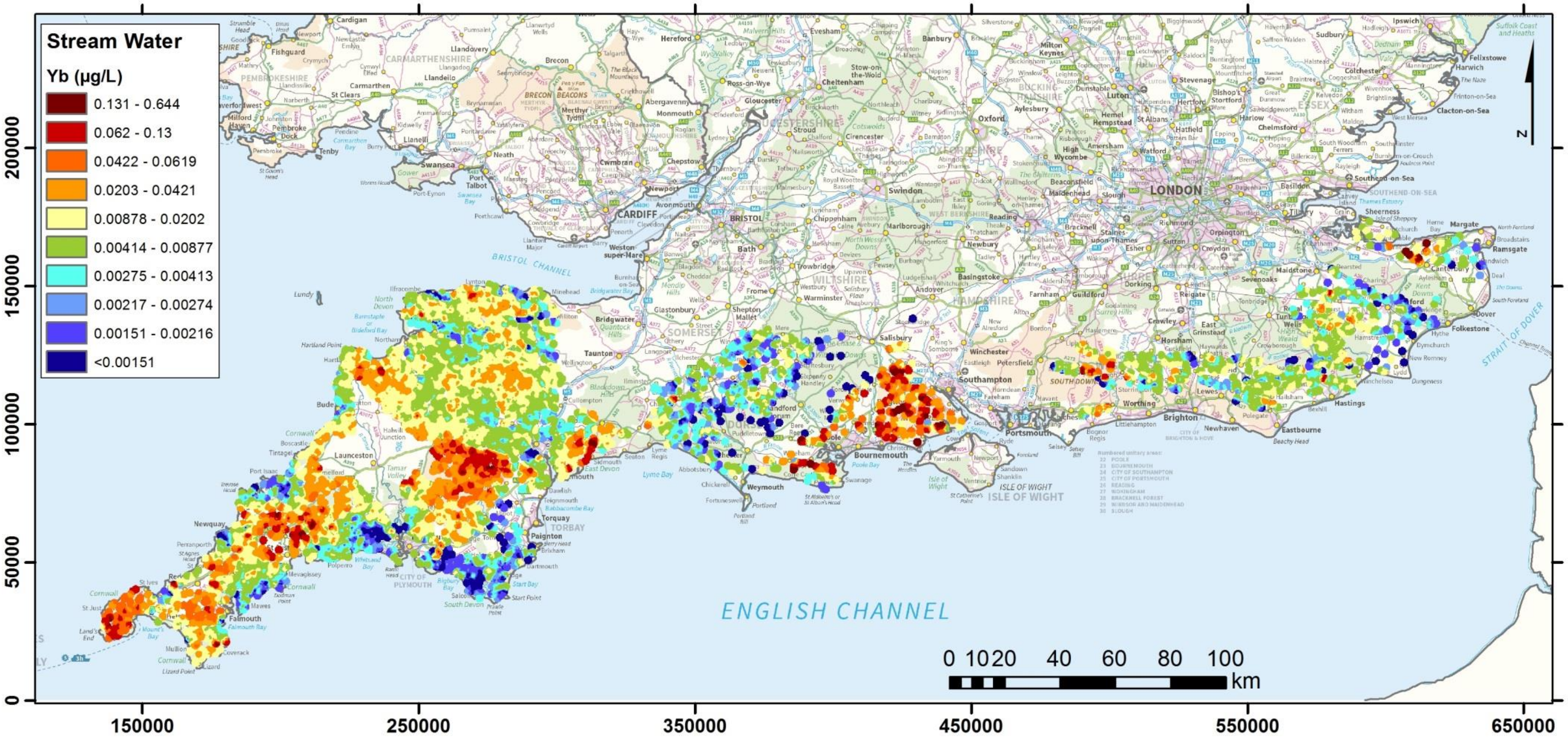
Provisional Geochemical Image



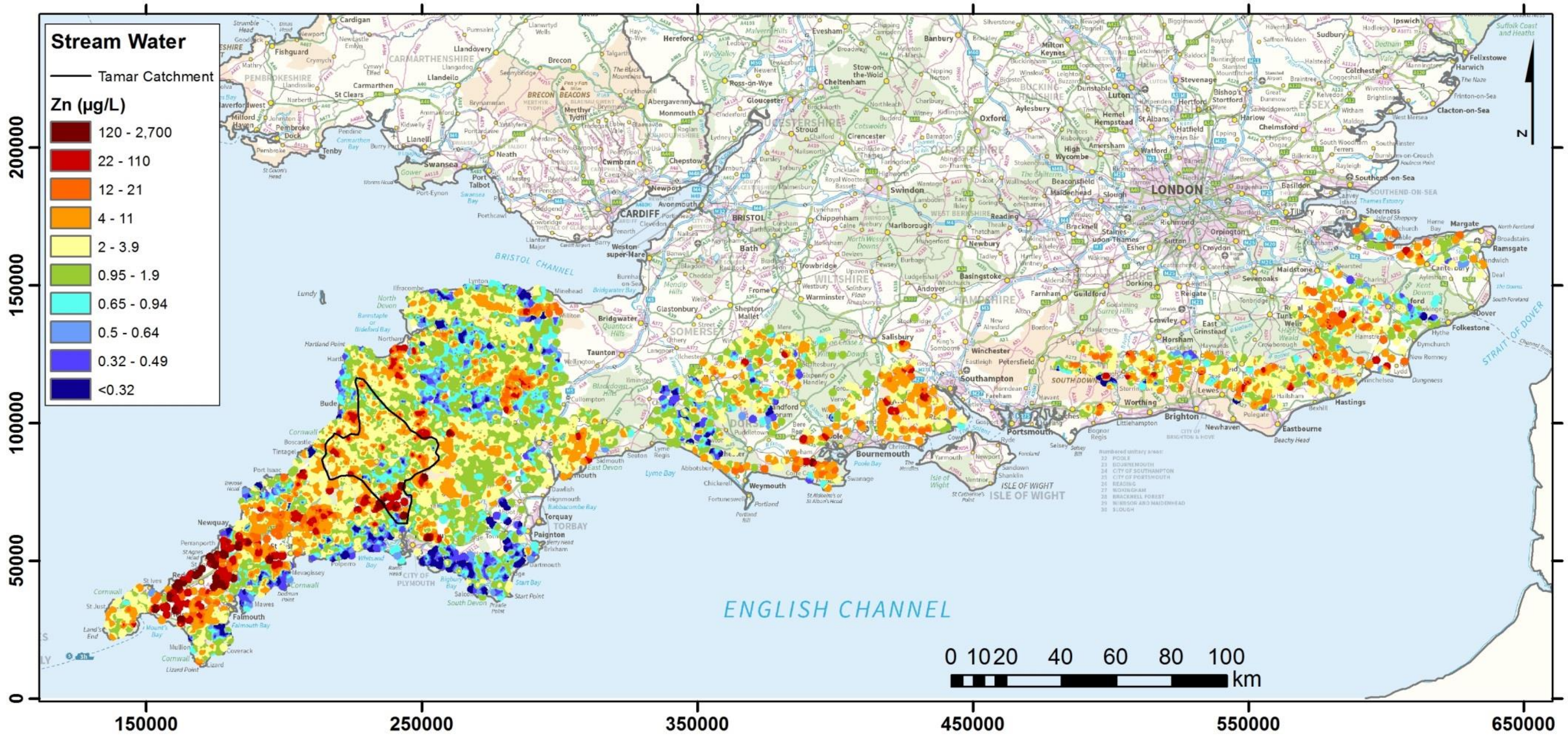
Provisional Geochemical Image



Provisional Geochemical Image



Provisional Geochemical Image



Provisional Geochemical Image