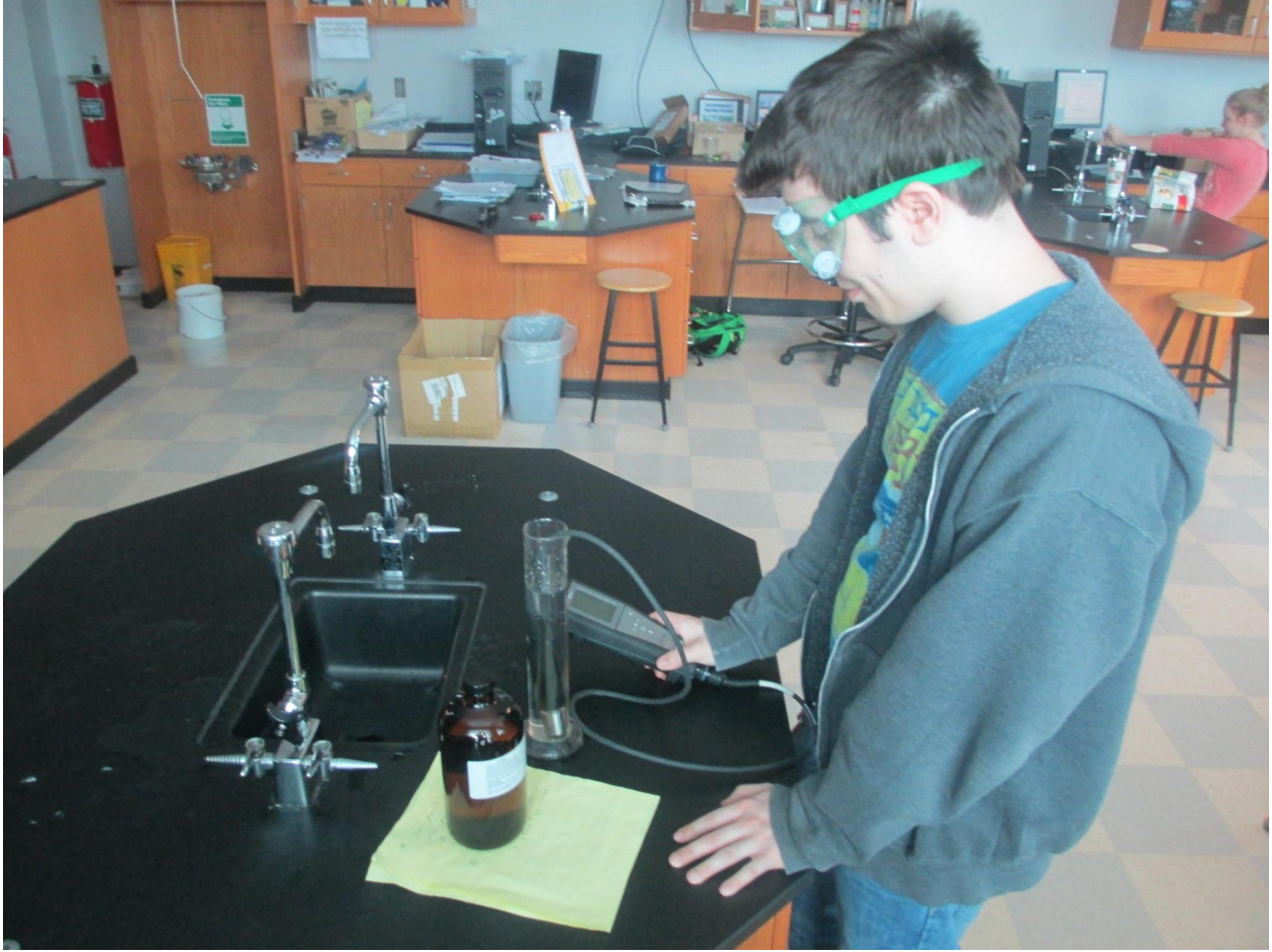
Fracking: Pros, Cons, Uncertainty, and Protecting the Safety of Frostburg's Drinking Water

Mountain Ridge Environmental Science Students

MOUNTAIN RIDGE MINERS

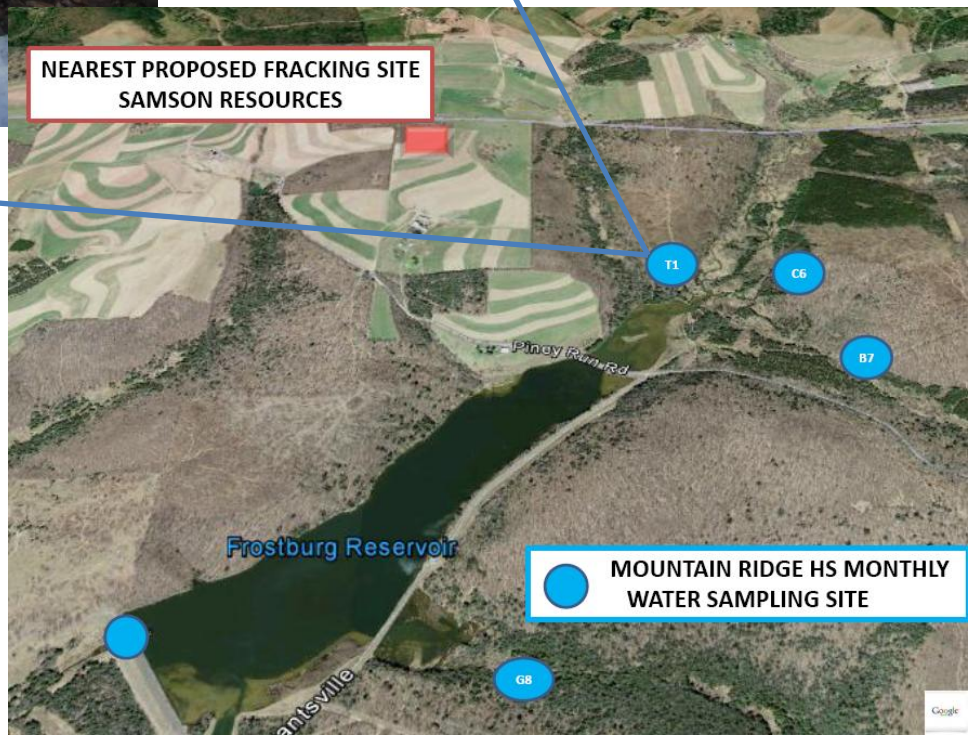
YAB | STATE FARM INSURANCE

STATE FARM® YOUTH ADVISORY BOARD



Student calibrating the YSI Pro30

Tributary T1



The tag line is installed

pH was measured using a YSI pH10 Meter

Student records data onto data sheet

YSI ProODO measures dissolved oxygen

YSI Pro30 measures the specific conductivity

Turbidity being measured using a Hach Turbidimeter

She fills up one bottle

She dumps the water out downstream

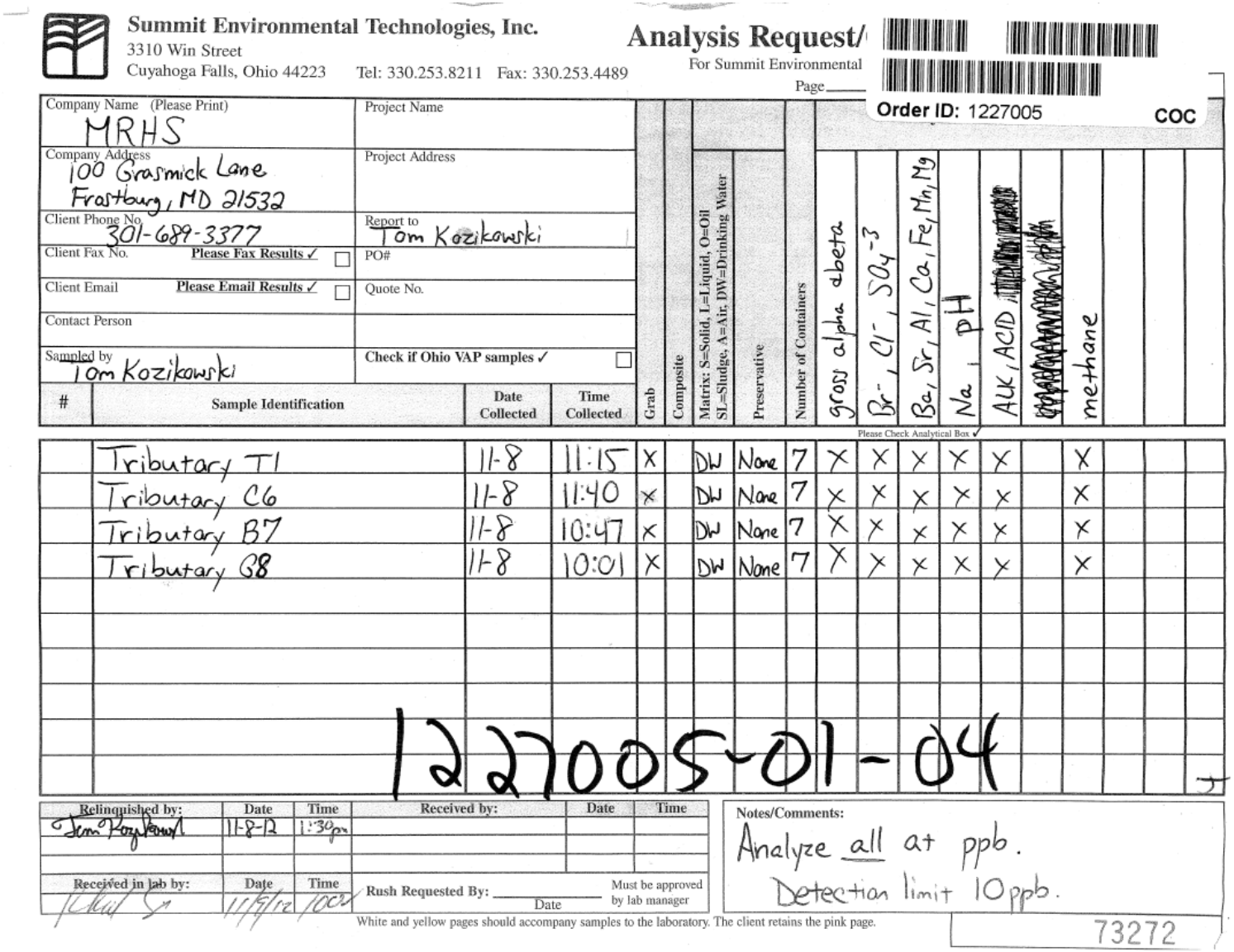
The water samples are put on ice

At the Aquifer and Frostburg Reservoir, the water must be pulled and tested from buckets

Frostburg's Water Treatment Plant

For treatment raw and treatment mixed, the water was pulled and tested from faucets

The bottle samples from the streams are shipped on ice with a chain of custody form via FedEx



Summit Environmental Technologies, Inc.
3310 Win Street
Cuyahoga Falls, Ohio 44223 Tel: 330.253.8211 Fax: 330.253.4489

Analysis Request/
For Summit Environmental
Page ____

Order ID: 1227005 COC

Company Name (Please Print)	Project Name
MRHS	
Company Address 100 Grasmick Lane Frostburg, MD 21532	Project Address
Client Phone No. 301-689-3377	Report to Tom Kozikowski
Client Fax No. **Please Fax Results ✓** ☐	PO#
Client Email **Please Email Results ✓** ☐	Quote No.
Contact Person	
Sampled by Tom Kozikowski	**Check if Ohio VAP samples ✓** ☐

Please Check Analytical Box ✓

#	Sample Identification	Date Collected	Time Collected	Grab	Composite	Matrix: S=Solid, L=Liquid, O=Oil SL=Sludge, A=Air, DW=Drinking Water	Preservative	Number of Containers	gross alpha dbeta	Br^-, Cl^-, SO_4^{-3}	Ba, Sr, Al, Ca, Fe, Mn, Mg	Na, pH	ALK, ACID	[illegible]	methane			
	Tributary T1	11-8	11:15	X		DW	None	7	X	X	X	X	X		X			
	Tributary C6	11-8	11:40	X		DW	None	7	X	X	X	X	X		X			
	Tributary B7	11-8	10:47	X		DW	None	7	X	X	X	X	X		X			
	Tributary G8	11-8	10:01	X		DW	None	7	X	X	X	X	X		X			

1227005-01-04

Relinquished by:	Date	Time	Received by:	Date	Time
Tom Kozikowski	11-8-12	1:30pm			
Received in lab by:	**Date**	**Time**	**Rush Requested By:** ____ Date	Must be approved by lab manager	
[illegible]	11/9/12	1005			

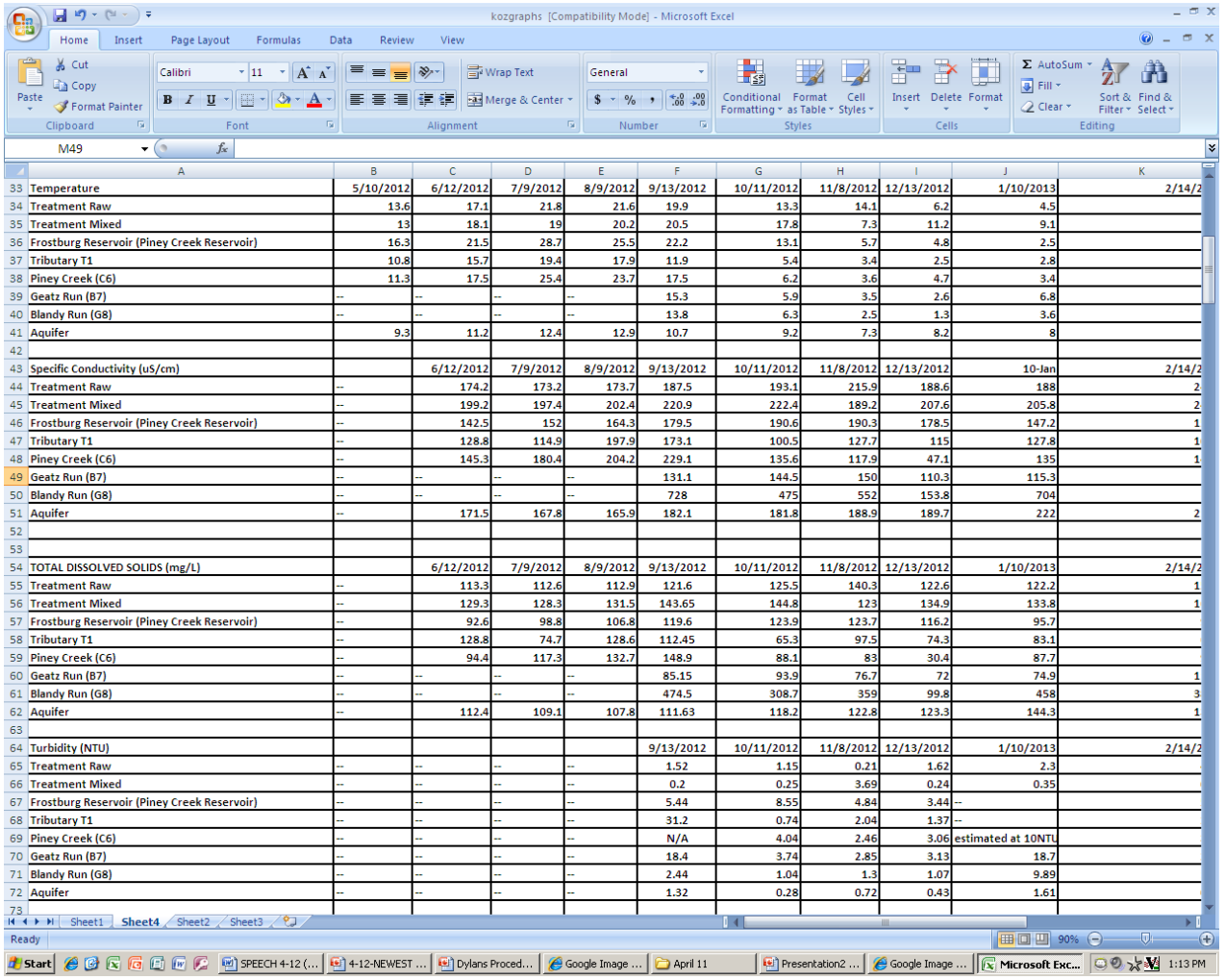
White and yellow pages should accompany samples to the laboratory. The client retains the pink page.

Notes/Comments:
Analyze all at ppb.
Detection limit 10ppb.

73272


SUMMIT
ENVIRONMENTAL TECHNOLOGIES

The information is inputted into our baseline water quality excel data files and then proofread independently three times.



kozgraphs [Compatibility Mode] - Microsoft Excel

	A	B	C	D	E	F	G	H	I	J	K
33	Temperature	5/10/2012	6/12/2012	7/9/2012	8/9/2012	9/13/2012	10/11/2012	11/8/2012	12/13/2012	1/10/2013	2/14/2
34	Treatment Raw	13.6	17.1	21.8	21.6	19.9	13.3	14.1	6.2	4.5	
35	Treatment Mixed	13	18.1	19	20.2	20.5	17.8	7.3	11.2	9.1	
36	Frostburg Reservoir (Piney Creek Reservoir)	16.3	21.5	28.7	25.5	22.2	13.1	5.7	4.8	2.5	
37	Tributary T1	10.8	15.7	19.4	17.9	11.9	5.4	3.4	2.5	2.8	
38	Piney Creek (C6)	11.3	17.5	25.4	23.7	17.5	6.2	3.6	4.7	3.4	
39	Geatz Run (B7)	--	--	--	--	15.3	5.9	3.5	2.6	6.8	
40	Blandy Run (G8)	--	--	--	--	13.8	6.3	2.5	1.3	3.6	
41	Aquifer	9.3	11.2	12.4	12.9	10.7	9.2	7.3	8.2	8	
42											
43	Specific Conductivity (uS/cm)		6/12/2012	7/9/2012	8/9/2012	9/13/2012	10/11/2012	11/8/2012	12/13/2012	10-Jan	2/14/2
44	Treatment Raw	--	174.2	173.2	173.7	187.5	193.1	215.9	188.6	188	2
45	Treatment Mixed	--	199.2	197.4	202.4	220.9	222.4	189.2	207.6	205.8	2
46	Frostburg Reservoir (Piney Creek Reservoir)	--	142.5	152	164.3	179.5	190.6	190.3	178.5	147.2	1
47	Tributary T1	--	128.8	114.9	197.9	173.1	100.5	127.7	115	127.8	1
48	Piney Creek (C6)	--	145.3	180.4	204.2	229.1	135.6	117.9	47.1	135	1
49	Geatz Run (B7)	--	--	--	--	131.1	144.5	150	110.3	115.3	
50	Blandy Run (G8)	--	--	--	--	728	475	552	153.8	704	
51	Aquifer	--	171.5	167.8	165.9	182.1	181.8	188.9	189.7	222	2
52											
53											
54	TOTAL DISSOLVED SOLIDS (mg/L)		6/12/2012	7/9/2012	8/9/2012	9/13/2012	10/11/2012	11/8/2012	12/13/2012	1/10/2013	2/14/2
55	Treatment Raw	--	113.3	112.6	112.9	121.6	125.5	140.3	122.6	122.2	1
56	Treatment Mixed	--	129.3	128.3	131.5	143.65	144.8	123	134.9	133.8	1
57	Frostburg Reservoir (Piney Creek Reservoir)	--	92.6	98.8	106.8	119.6	123.9	123.7	116.2	95.7	
58	Tributary T1	--	128.8	74.7	128.6	112.45	65.3	97.5	74.3	83.1	
59	Piney Creek (C6)	--	94.4	117.3	132.7	148.9	88.1	83	30.4	87.7	
60	Geatz Run (B7)	--	--	--	--	85.15	93.9	76.7	72	74.9	1
61	Blandy Run (G8)	--	--	--	--	474.5	308.7	359	99.8	458	3
62	Aquifer	--	112.4	109.1	107.8	111.63	118.2	122.8	123.3	144.3	1
63											
64	Turbidity (NTU)					9/13/2012	10/11/2012	11/8/2012	12/13/2012	1/10/2013	2/14/2
65	Treatment Raw	--	--	--	--	1.52	1.15	0.21	1.62	2.3	
66	Treatment Mixed	--	--	--	--	0.2	0.25	3.69	0.24	0.35	
67	Frostburg Reservoir (Piney Creek Reservoir)	--	--	--	--	5.44	8.55	4.84	3.44	--	
68	Tributary T1	--	--	--	--	31.2	0.74	2.04	1.37	--	
69	Piney Creek (C6)	--	--	--	--	N/A	4.04	2.46	3.06	estimated at 10NTU	
70	Geatz Run (B7)	--	--	--	--	18.4	3.74	2.85	3.13	18.7	
71	Blandy Run (G8)	--	--	--	--	2.44	1.04	1.3	1.07	9.89	
72	Aquifer	--	--	--	--	1.32	0.28	0.72	0.43	1.61	
73											

Sheet1 Sheet4 Sheet2 Sheet3

Ready 90%

Start SPEECH 4-12 (... 4-12-NEWEST ... Dylans Proced... Google Image ... April 11 Presentation2 ... Google Image ... Microsoft Exc... 1:13 PM

Rock with HOBO monitor is pulled from stream

Data is collected off of the HOBO monitors

The information…is transferred to the computer via USB cord
The newly obtained data is then plotted and analyzed

Our Data

Barium and Strontium Levels in Tributary T1 February 2012-February 2013 Plotted with the Depth on a Staff Plate

Barium (ppb) Schijf
Strontium (ppb) Schijf
Depth at Staff Plate (cm)

Strontium
Average: 42ppb

Barium
Average: 33ppb

Concentration (ppb) or Depth in Centimeters

80
70
60
50
40
30
20

Feb 2012 March April May June July Aug Sept Oct Nov Dec Jan Feb 2013

Sampling Month

Barium and Strontium Levels in Tributary T1 February 2012-February 2013 Plotted with the Depth on a Staff Plate

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Feb 2012 March April May June July Aug Sept Oct Nov Dec Jan Feb 2013

Sampling Month

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Strontium (ppb) Schijf
Depth at Staff Plate (cm)

Strontium
Average: 42ppb

Barium
Average: 33ppb

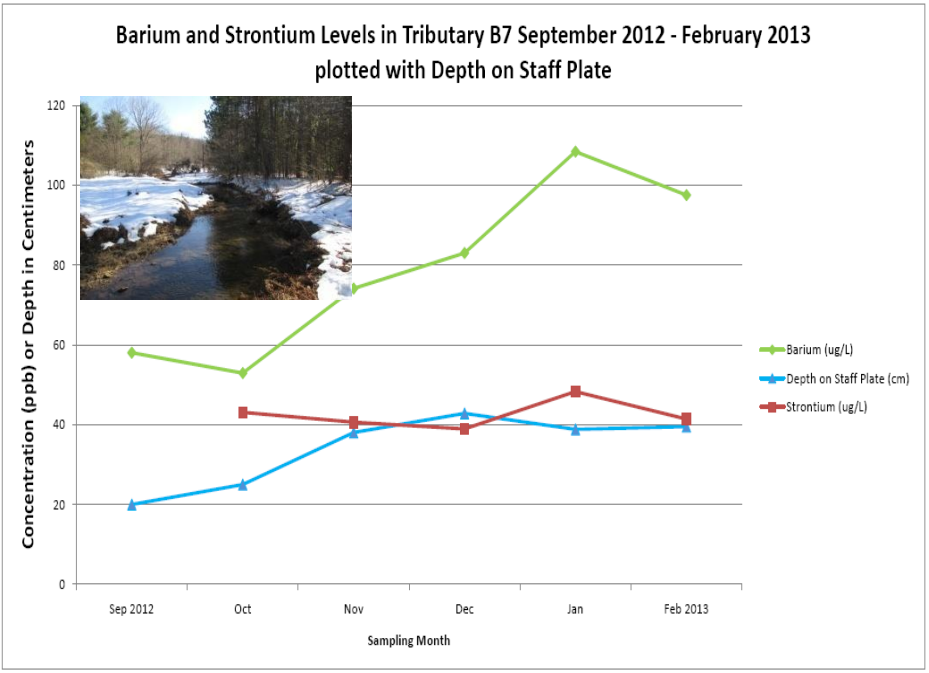
Concentration (ppb) or Depth in Centimeters

80
70
60
50
40
30
20

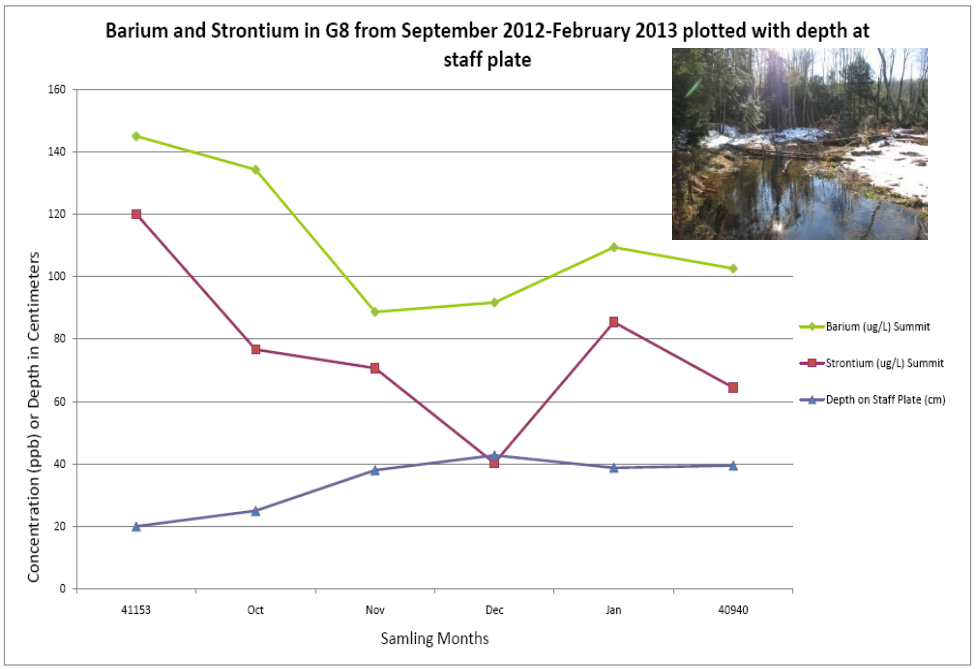
Feb 2012 March April May June July Aug Sept Oct Nov Dec Jan Feb 2013

Sampling Month

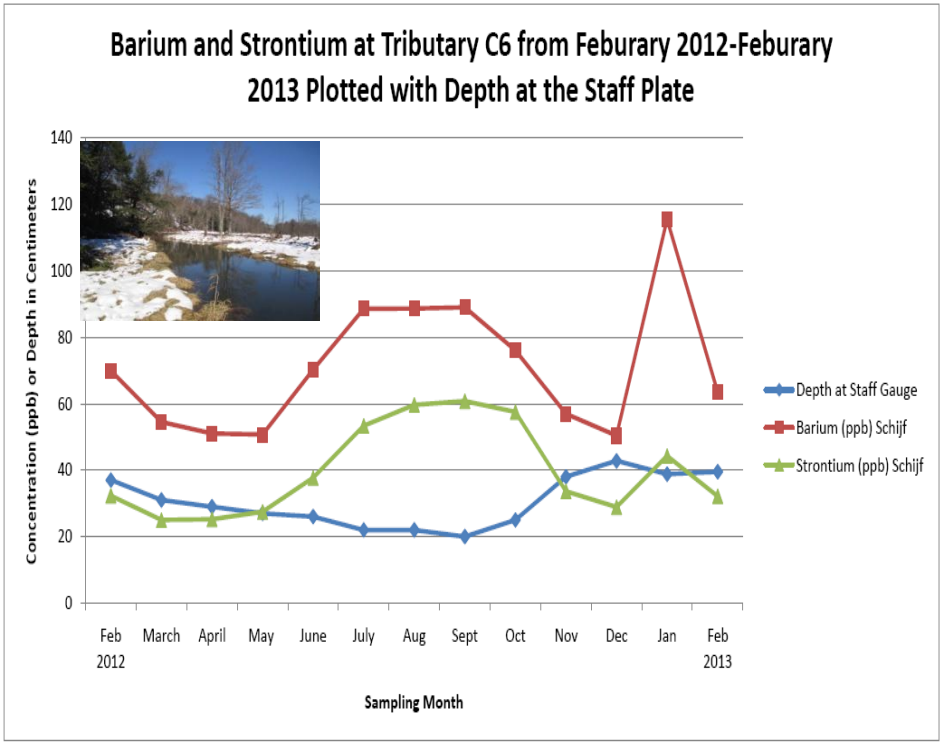
Barium and Strontium Levels in Tributary B7 September 2012 - February 2013 plotted with Depth on Staff Plate



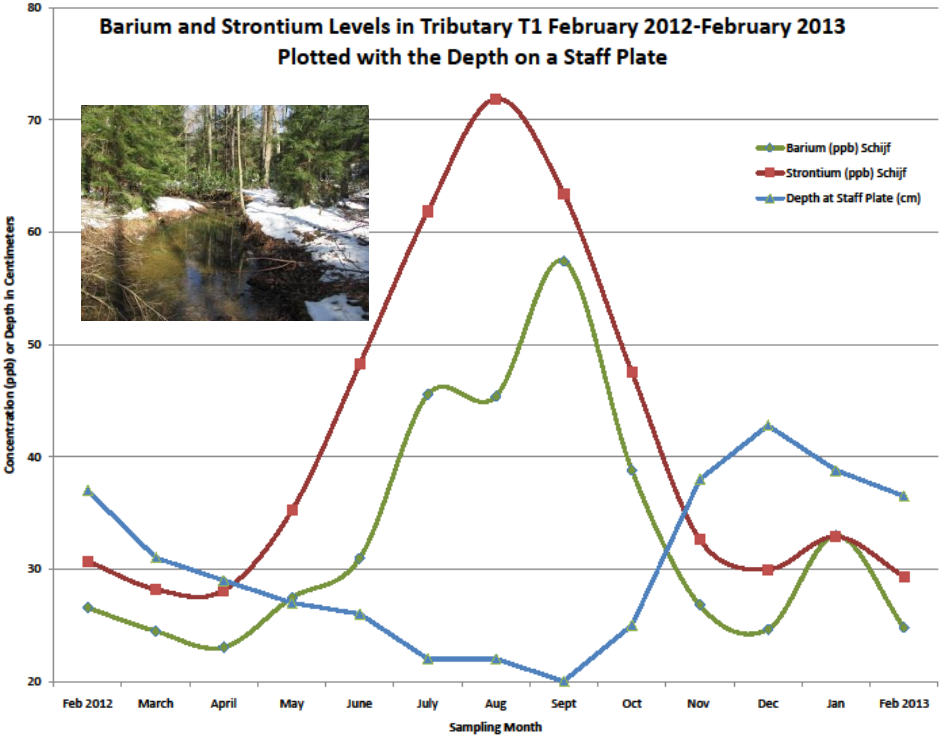
Barium and Strontium in G8 from September 2012-February 2013 plotted with depth at staff plate



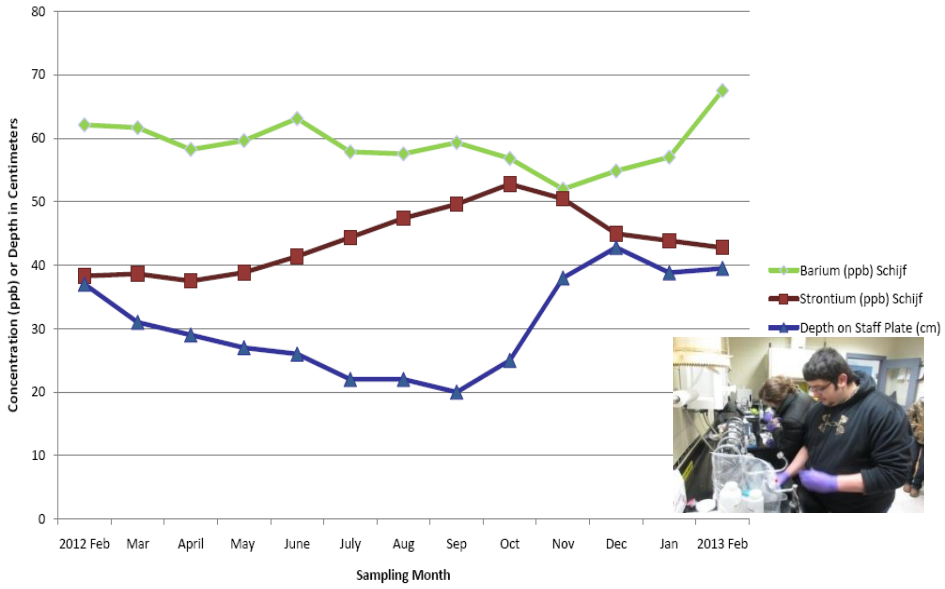
Barium and Strontium at Tributary C6 from Feburary 2012-Feburary 2013 Plotted with Depth at the Staff Plate



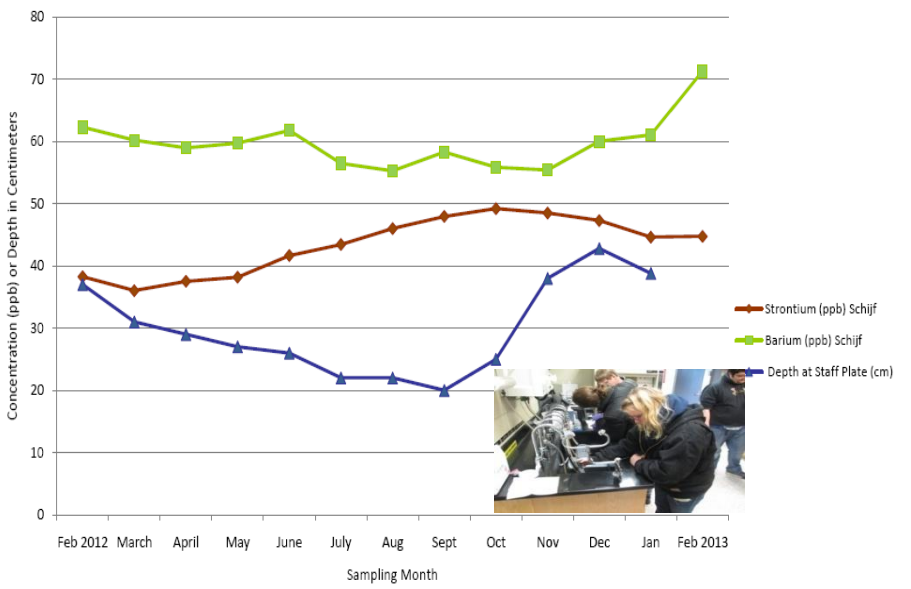
Barium and Strontium Levels in Tributary T1 February 2012-February 2013 Plotted with the Depth on a Staff Plate



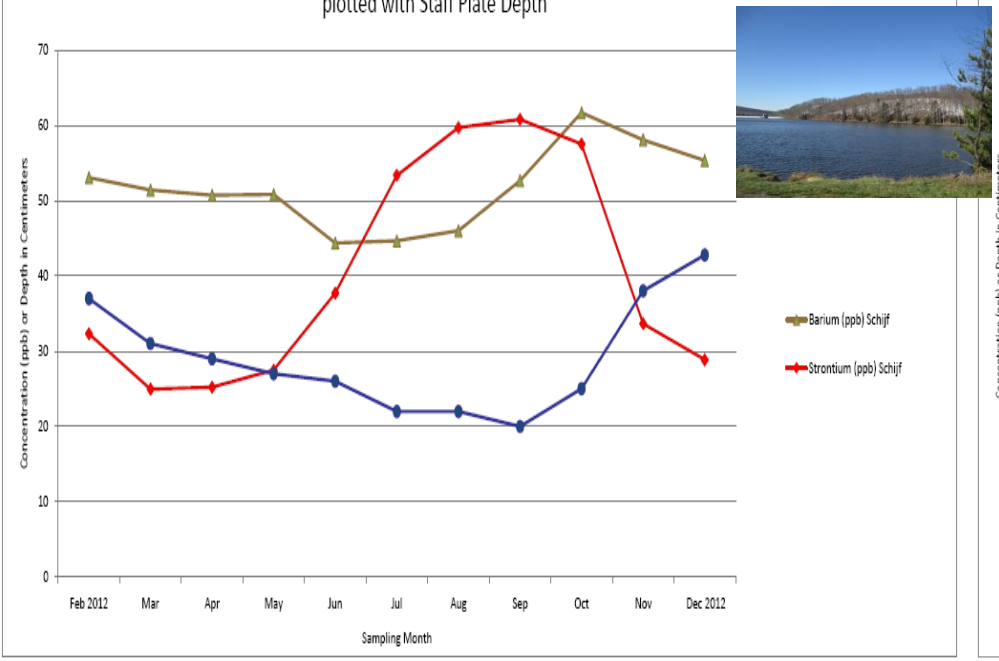
Barium and Strontium Levels in Treatment Mixed Feburary 2012-Feburary 2013 Plotted with the Depth on a Staff Plate



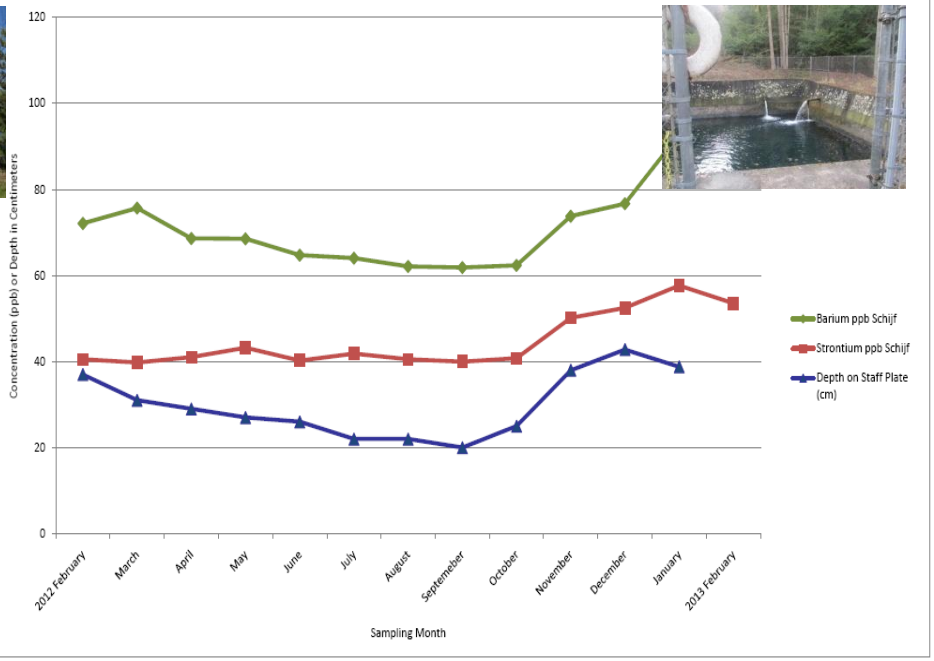
Barium and Strontium Levels in Treatment Raw February 2012-Februrary 2013 Plotted with Depth on Staff Plate



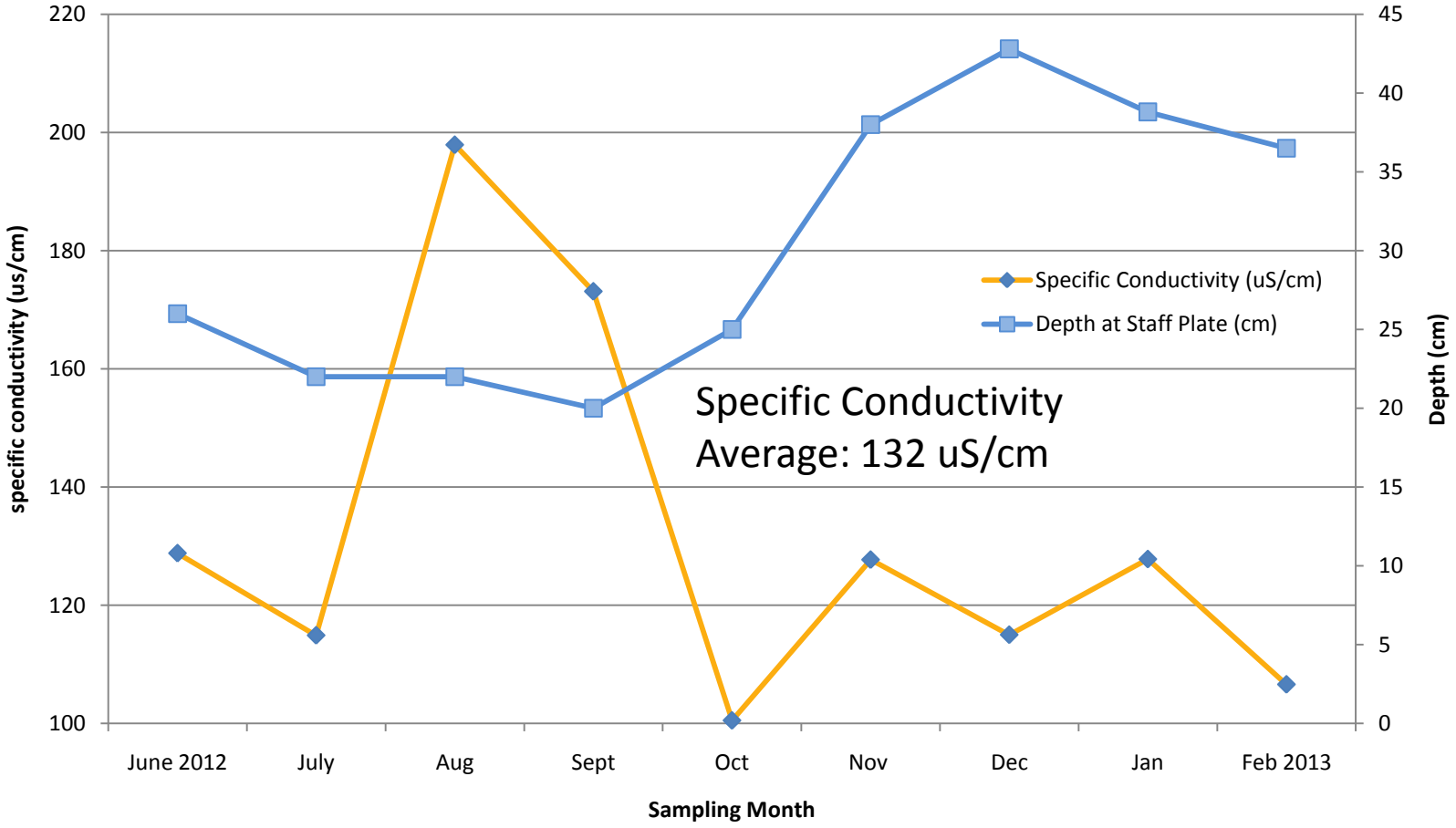
Barium and Strontium at the Frostburg Reservoir from February 2012 to December 2012 plotted with Staff Plate Depth

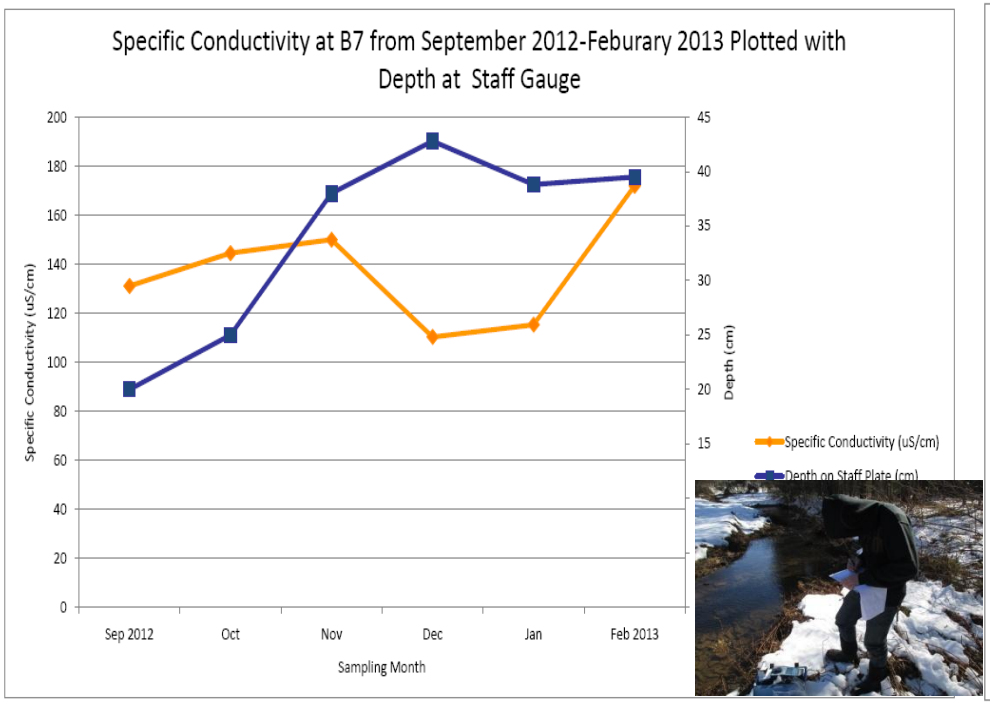


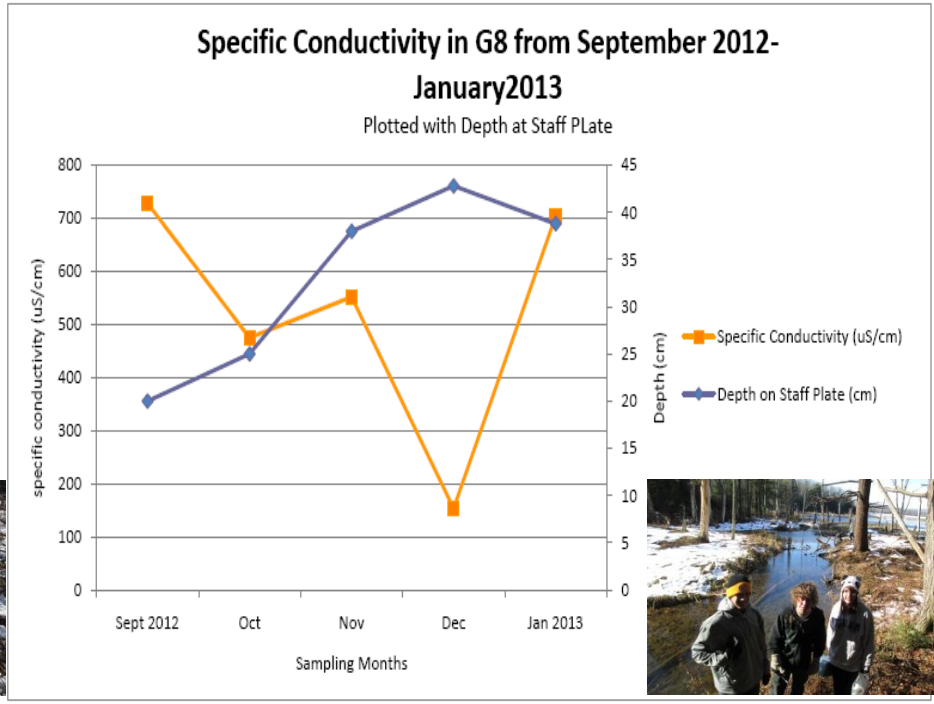
Barium and Strontium Levels in Aquifer February 2012-February 2013 Plotted with Depth on a Staff Plate

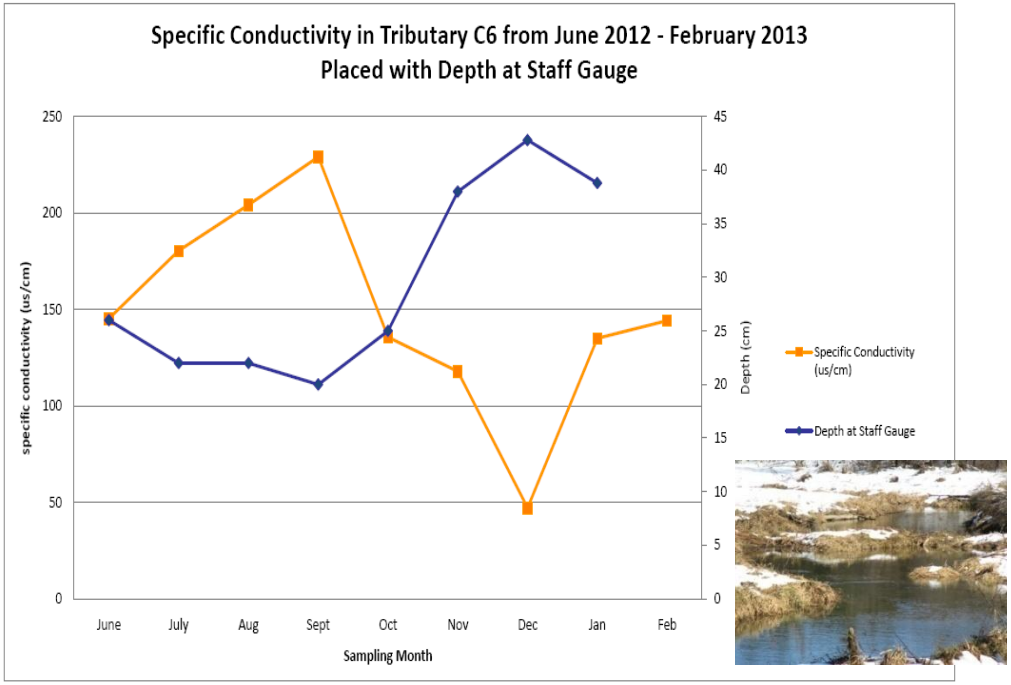


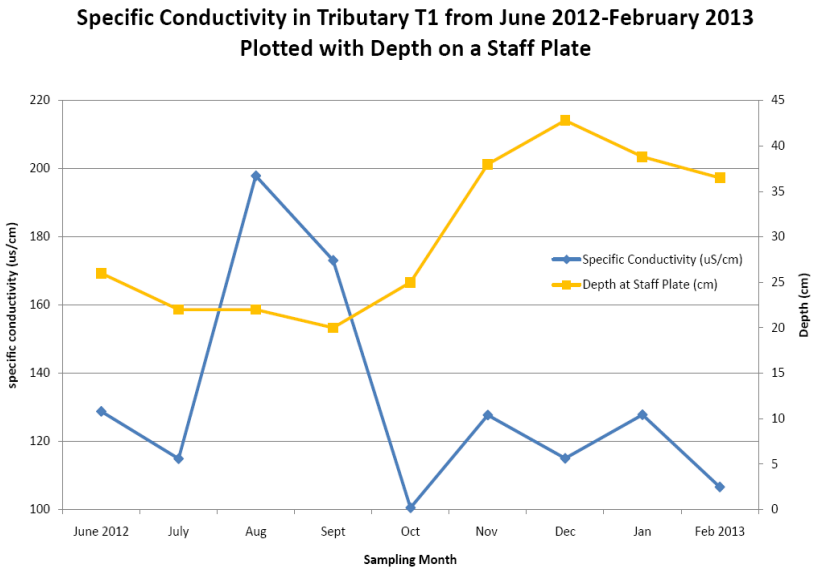
Specific Conductivity in Tributary T1 from June 2012-February 2013 Plotted with Depth on a Staff Plate

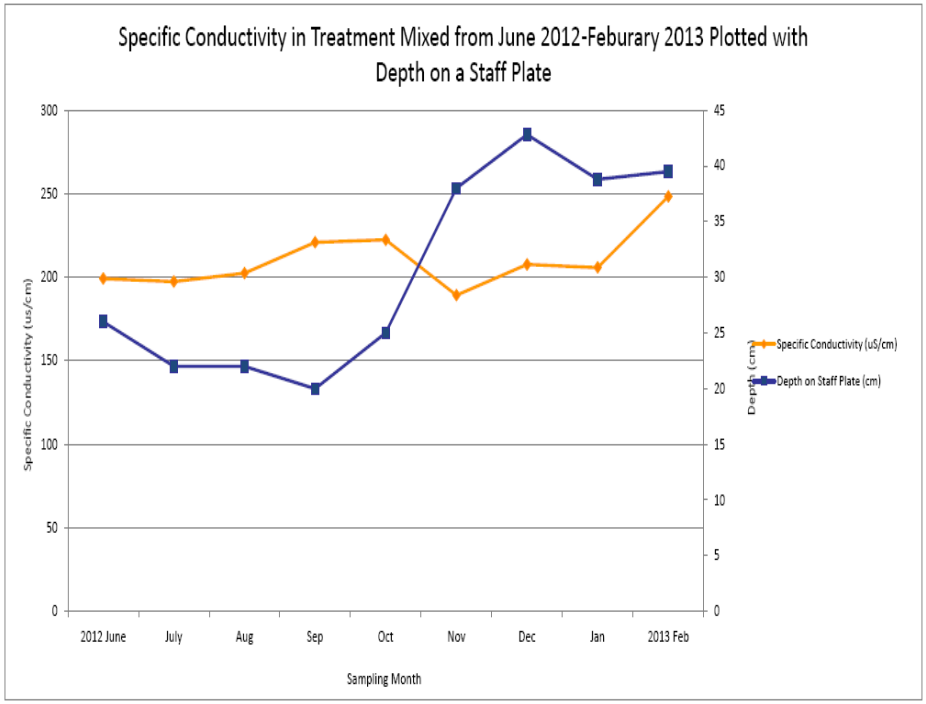


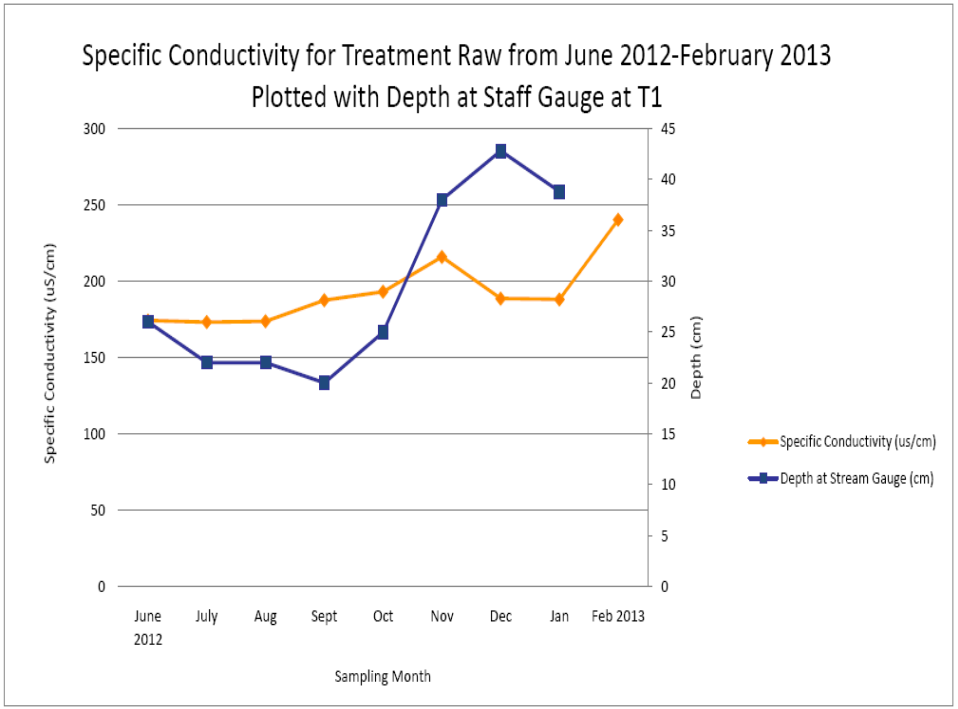

Specific Conductivity at B7 from September 2012-Feburary 2013 Plotted with Depth at Staff Gauge
Specific Conductivity (uS/cm)
Depth (cm)
Sampling Month
Sep 2012
Oct
Nov
Dec
Jan
Feb 2013
Specific Conductivity (uS/cm)
Depth on Staff Plate (cm)

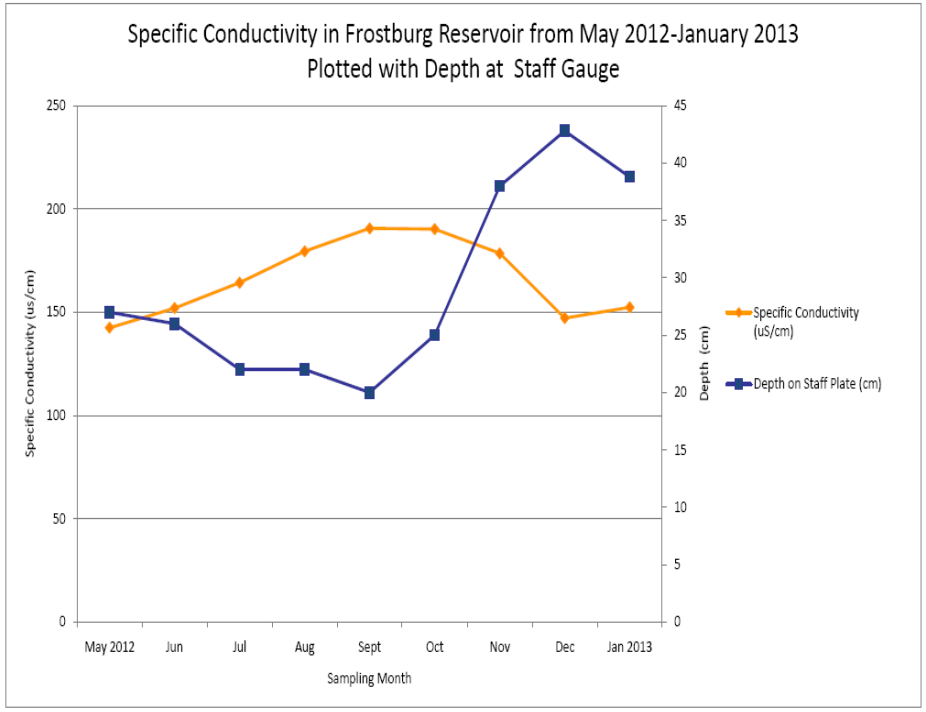

Specific Conductivity in G8 from September 2012-January2013
Plotted with Depth at Staff PLate
specific conductivity (uS/cm)
Depth (cm)
Sampling Months
Sept 2012
Oct
Nov
Dec
Jan 2013
Specific Conductivity (uS/cm)
Depth on Staff Plate (cm)

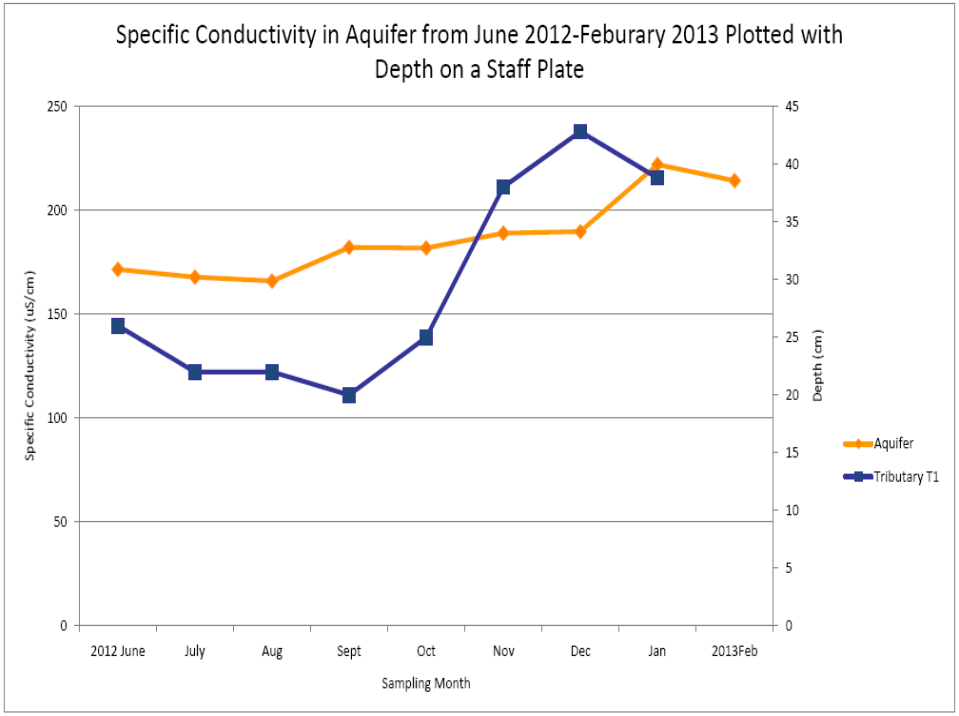

Specific Conductivity in Tributary C6 from June 2012 - February 2013 Placed with Depth at Staff Gauge
specific conductivity (us/cm)
Depth (cm)
Sampling Month
June
July
Aug
Sept
Oct
Nov
Dec
Jan
Feb
Specific Conductivity (us/cm)
Depth at Staff Gauge


Specific Conductivity in Tributary T1 from June 2012-February 2013 Plotted with Depth on a Staff Plate
specific conductivity (us/cm)
Depth (cm)
Sampling Month
June 2012
July
Aug
Sept
Oct
Nov
Dec
Jan
Feb 2013
Specific Conductivity (uS/cm)
Depth at Staff Plate (cm)

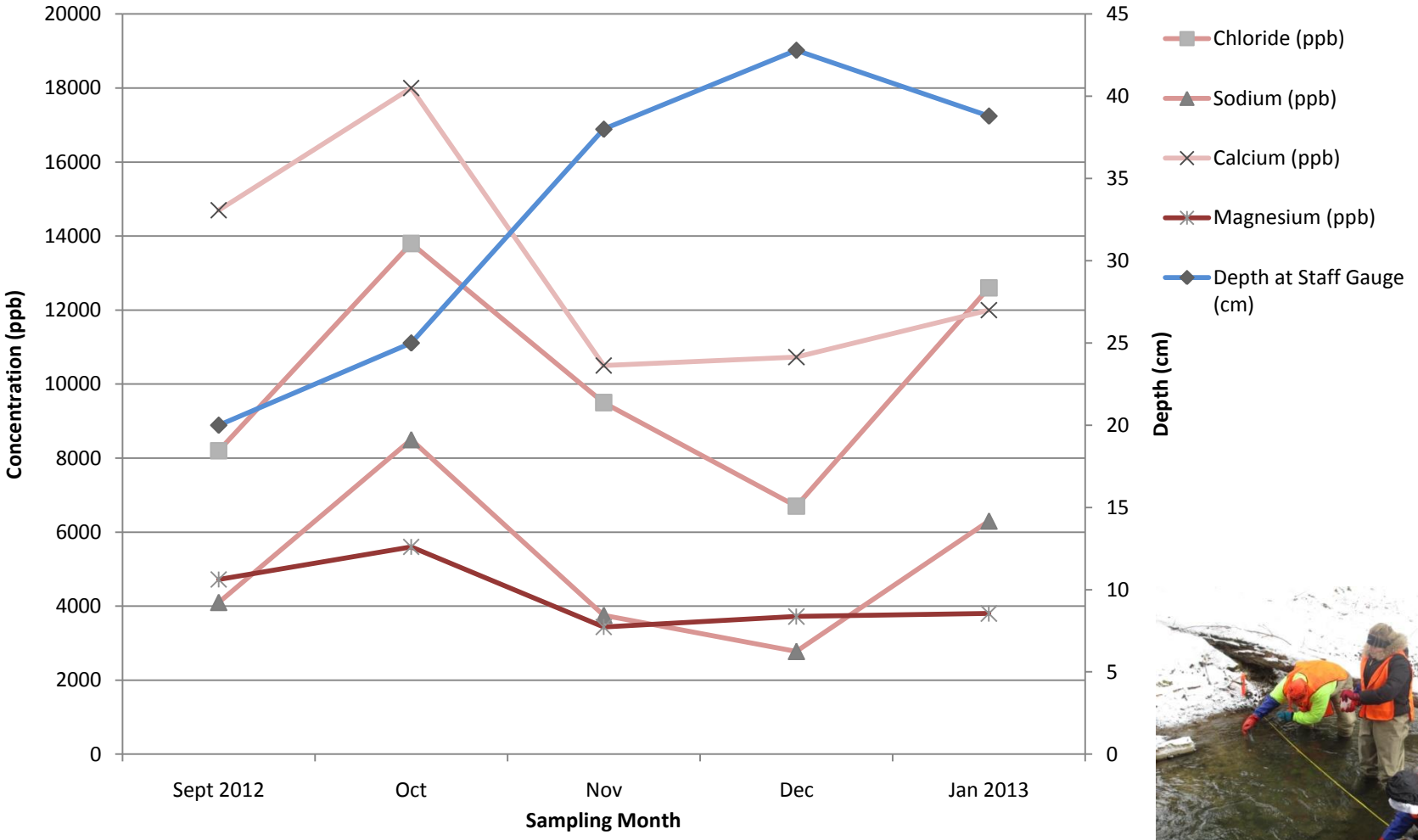

Specific Conductivity in Treatment Mixed from June 2012-Feburary 2013 Plotted with Depth on a Staff Plate
Specific Conductivity (us/cm)
Depth (cm)
Specific Conductivity (uS/cm)
Depth on Staff Plate (cm)
2012 June
July
Aug
Sep
Oct
Nov
Dec
Jan
2013 Feb
Sampling Month

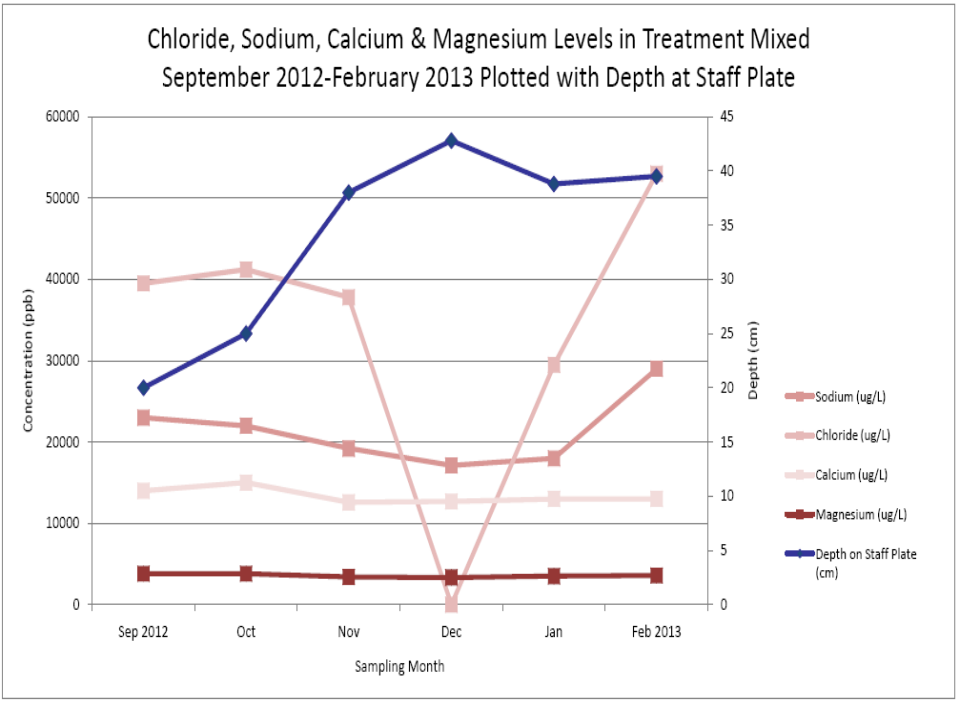

Specific Conductivity for Treatment Raw from June 2012-February 2013 Plotted with Depth at Staff Gauge at T1
Specific Conductivity (uS/cm)
Depth (cm)
Specific Conductivity (us/cm)
Depth at Stream Gauge (cm)
June 2012
July
Aug
Sept
Oct
Nov
Dec
Jan
Feb 2013
Sampling Month

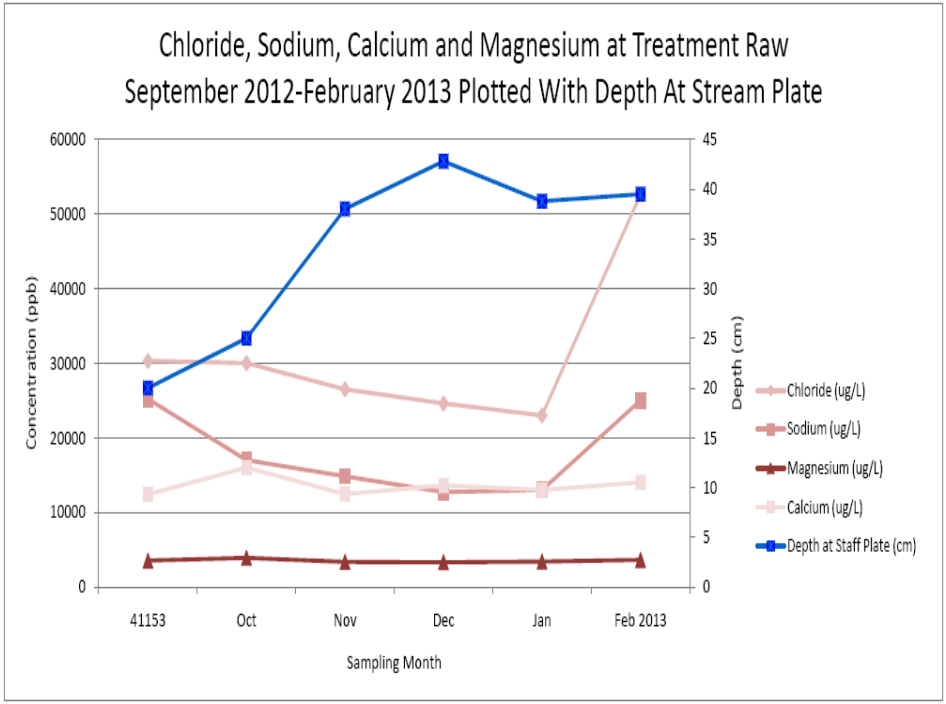

Specific Conductivity in Frostburg Reservoir from May 2012-January 2013 Plotted with Depth at Staff Gauge
Specific Conductivity (us/cm)
Depth (cm)
Specific Conductivity (uS/cm)
Depth on Staff Plate (cm)
May 2012
Jun
Jul
Aug
Sept
Oct
Nov
Dec
Jan 2013
Sampling Month

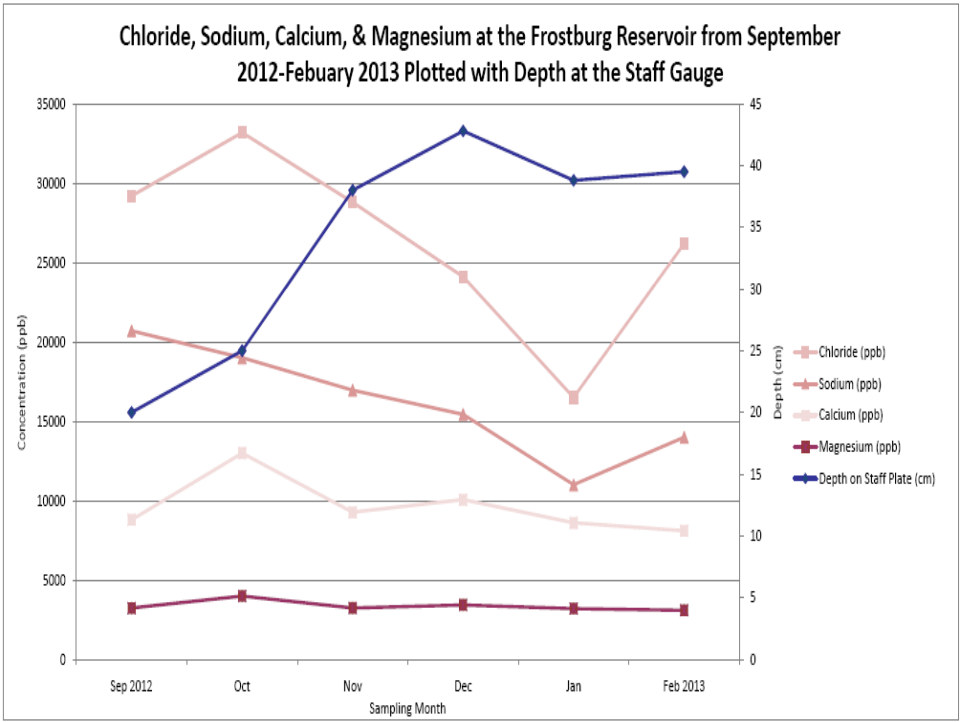

Specific Conductivity in Aquifer from June 2012-Feburary 2013 Plotted with Depth on a Staff Plate
Specific Conductivity (uS/cm)
Depth (cm)
Aquifer
Tributary T1
2012 June
July
Aug
Sept
Oct
Nov
Dec
Jan
2013Feb
Sampling Month

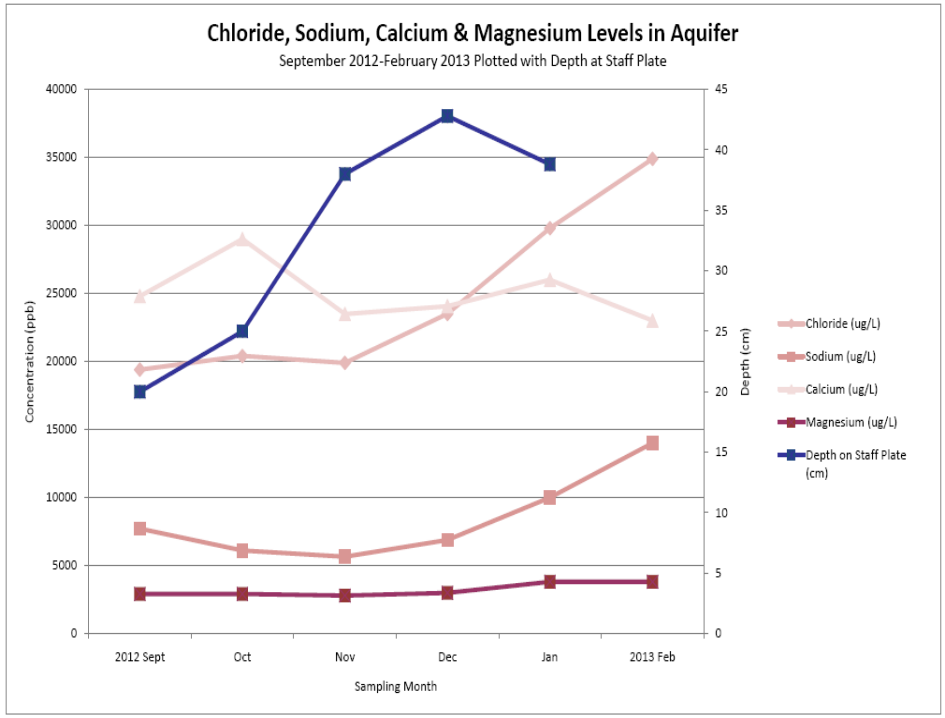
Chloride, Sodium, Calcium, & Magnesium Levels in Tributary T1 September 2012-February 2013 Plotted with Depth at the Staff Plate




Chloride, Sodium, Calcium & Magnesium Levels in Treatment Mixed
September 2012-February 2013 Plotted with Depth at Staff Plate
Concentration (ppb)
Depth (cm)
Sampling Month
Sep 2012
Oct
Nov
Dec
Jan
Feb 2013
Sodium (ug/L)
Chloride (ug/L)
Calcium (ug/L)
Magnesium (ug/L)
Depth on Staff Plate (cm)

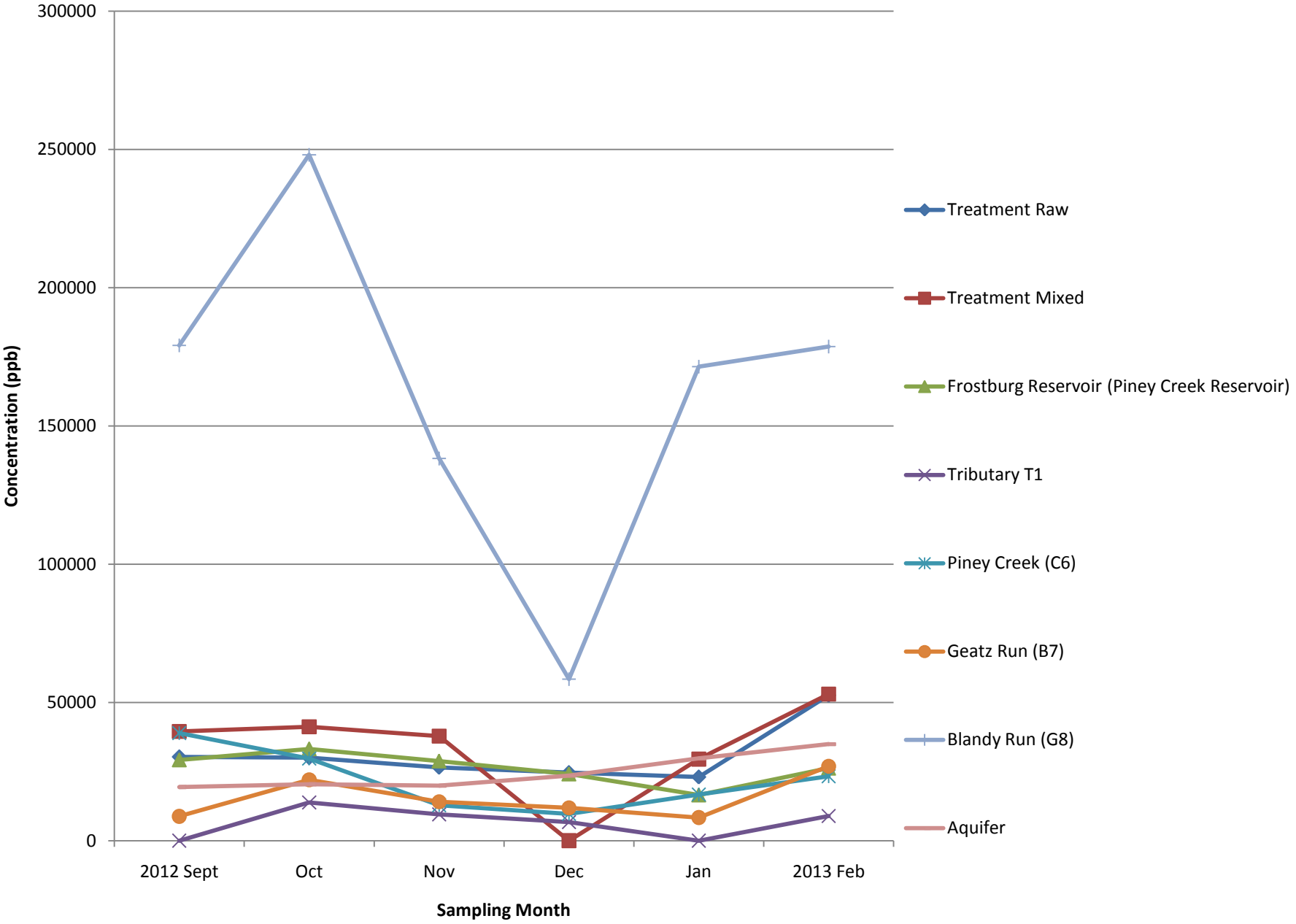

Chloride, Sodium, Calcium and Magnesium at Treatment Raw
September 2012-February 2013 Plotted With Depth At Stream Plate
Concentration (ppb)
Depth (cm)
Sampling Month
41153
Oct
Nov
Dec
Jan
Feb 2013
Chloride (ug/L)
Sodium (ug/L)
Magnesium (ug/L)
Calcium (ug/L)
Depth at Staff Plate (cm)


Chloride, Sodium, Calcium, & Magnesium at the Frostburg Reservoir from September
2012-Febuary 2013 Plotted with Depth at the Staff Gauge
Concentration (ppb)
Depth (cm)
Sampling Month
Sep 2012
Oct
Nov
Dec
Jan
Feb 2013
Chloride (ppb)
Sodium (ppb)
Calcium (ppb)
Magnesium (ppb)
Depth on Staff Plate (cm)

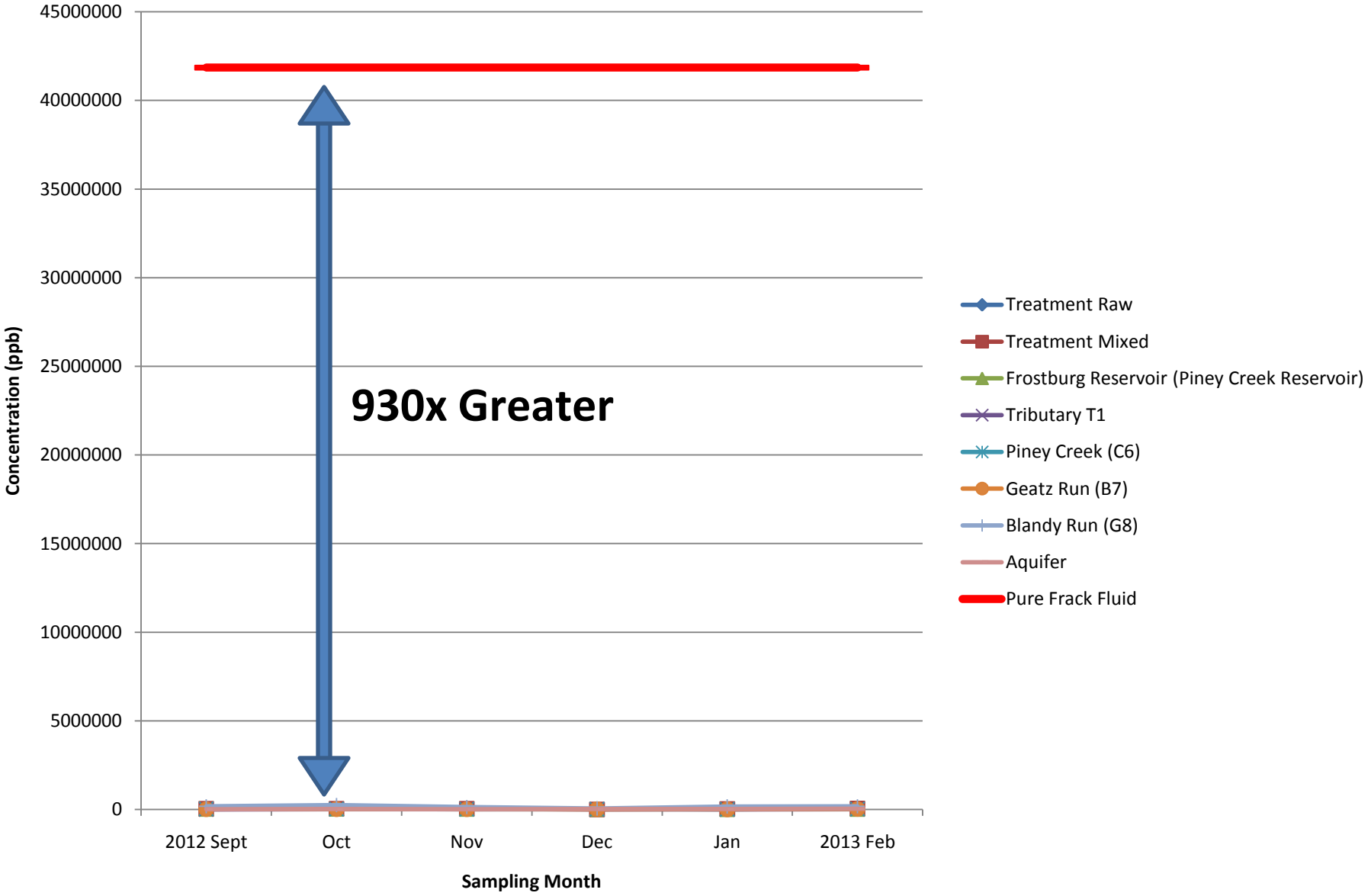

Chloride, Sodium, Calcium & Magnesium Levels in Aquifer
September 2012-February 2013 Plotted with Depth at Staff Plate
Concentration (ppb)
Depth (cm)
Sampling Month
2012 Sept
Oct
Nov
Dec
Jan
2013 Feb
Chloride (ug/L)
Sodium (ug/L)
Calcium (ug/L)
Magnesium (ug/L)
Depth on Staff Plate (cm)

COMPARING OUR BASELINE DATA TO FRACKING FLUID

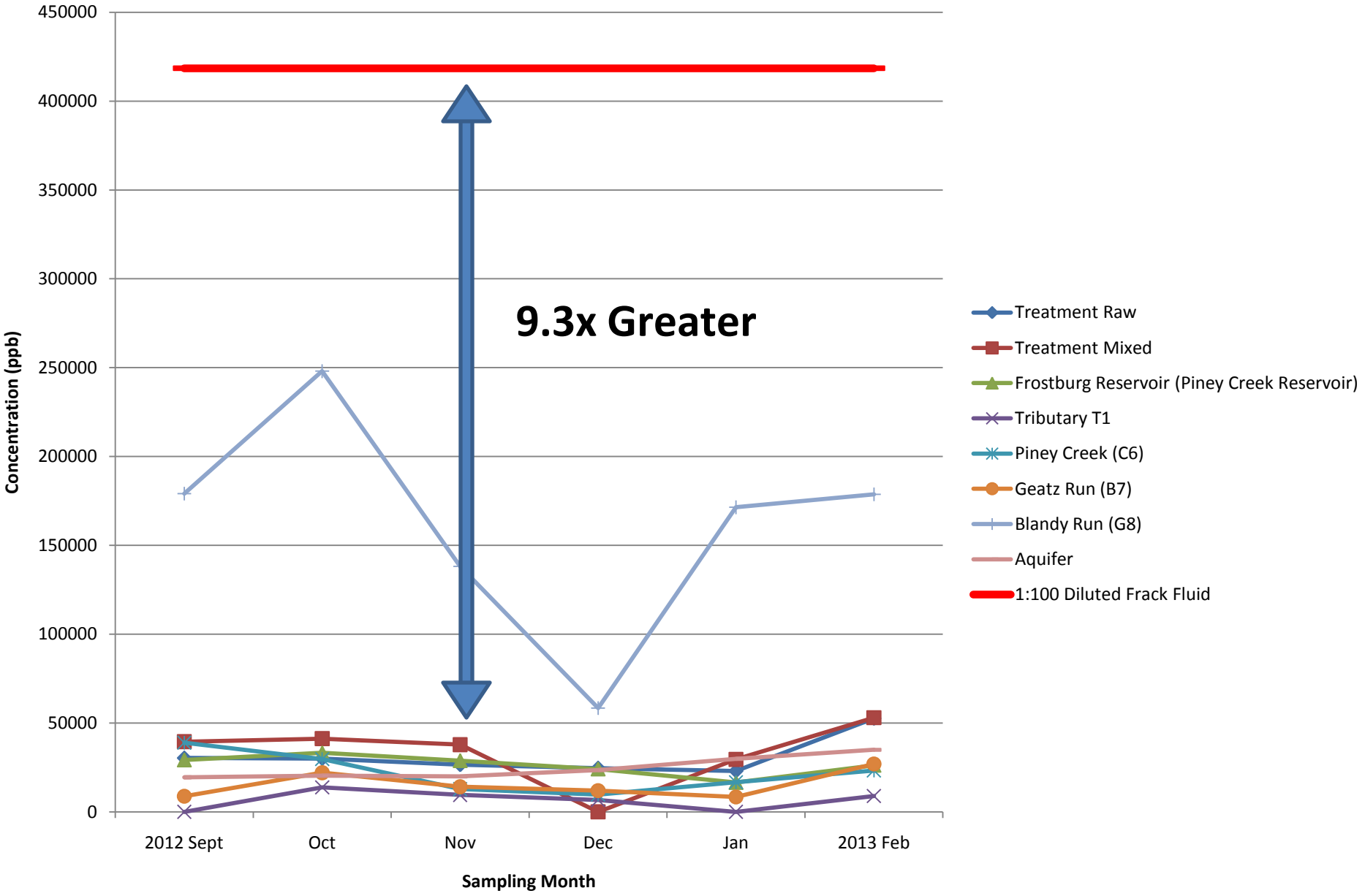
Chloride Concentrations at all 8 testing sites Sept 2012-Feb 2013



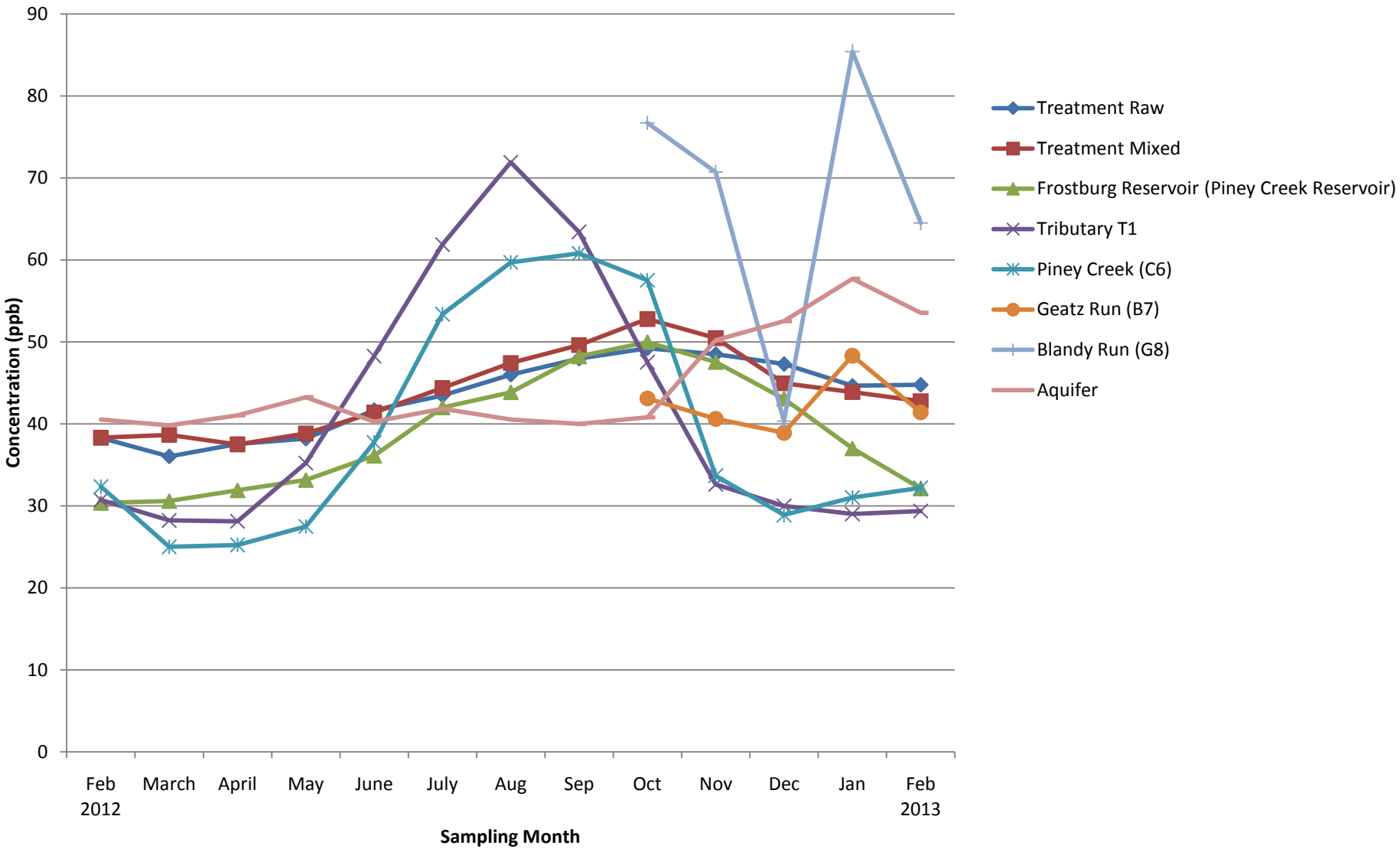
Chloride Concentrations at all 8 testing sites Sept 2012-Feb 2013
Pure Frack Fluid also shown



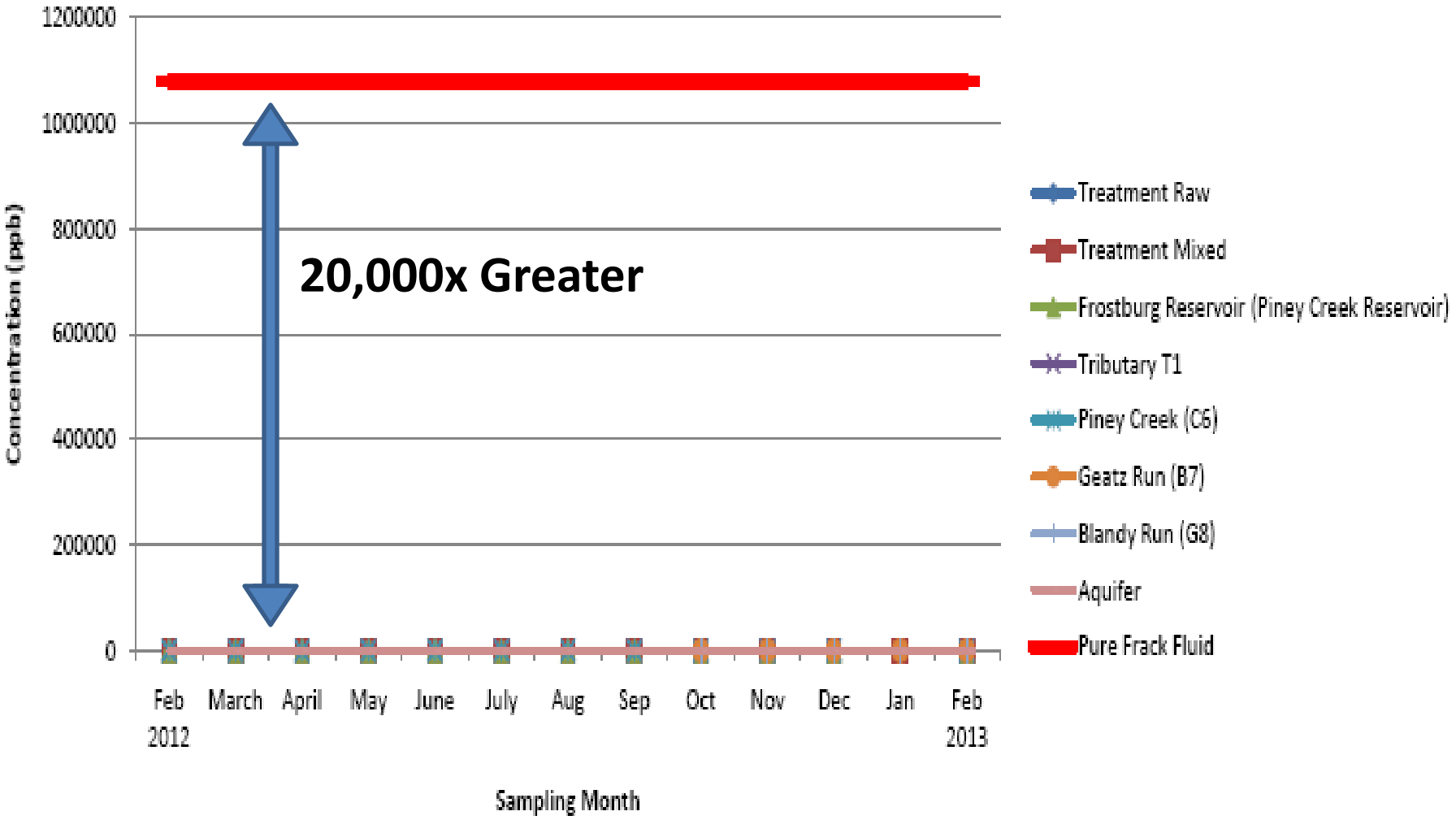
Chloride Concentrations at all 8 testing sites Sept 2012-Feb 2013
1:100 Diluted Frack Fluid also shown



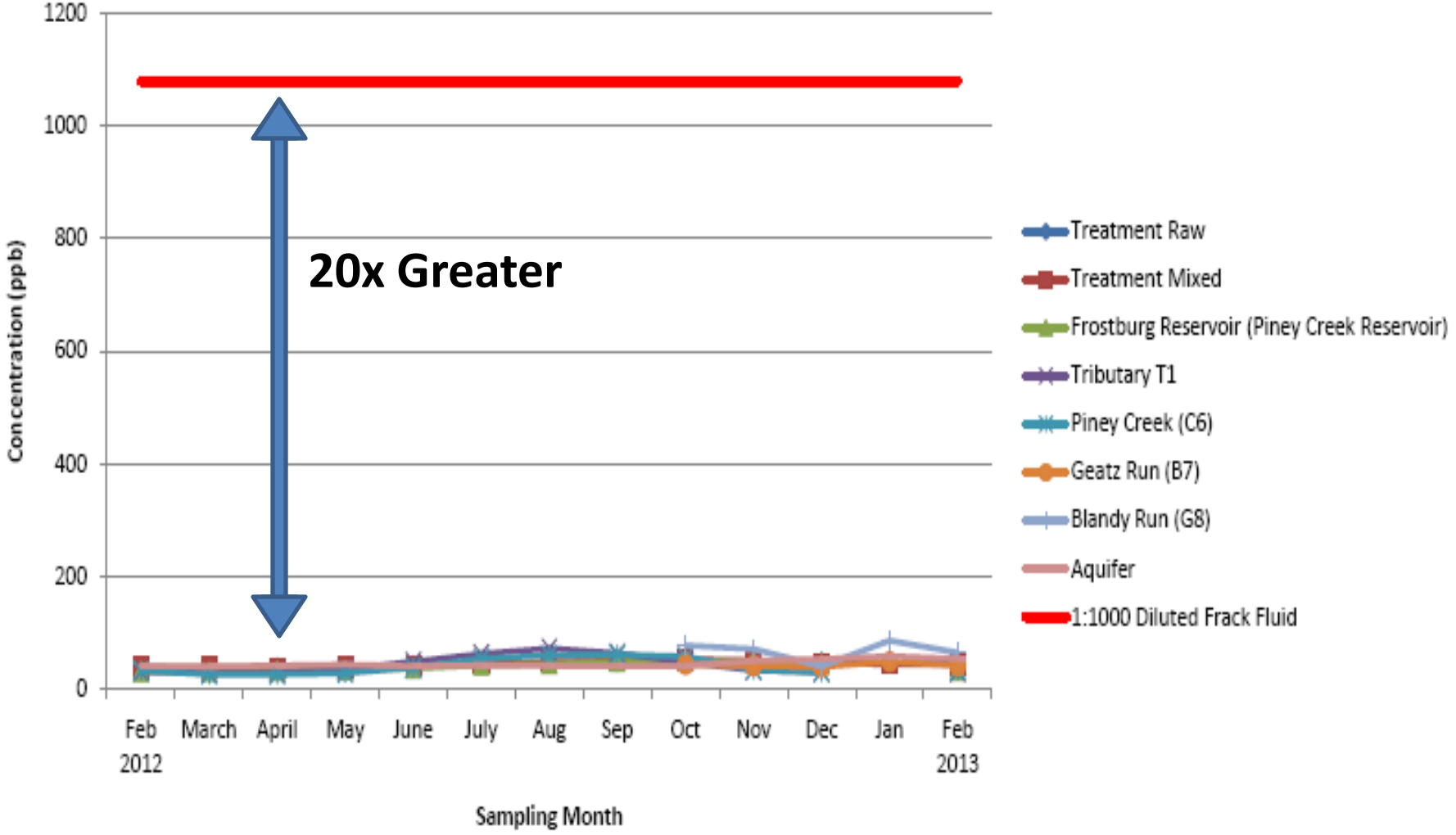
Strontium Concentrations at all 8 Testing Sites Feb 2012-Feb 2013



Strontium Concentrations at all 8 Testing Sites Feb 2012-Feb 2013 with Pure Frack Fluid



Strontium Concentrations at all 8 Testing Sites Sept 2012-Feb 2013 with 1:1000 Diluted Frack Fluid

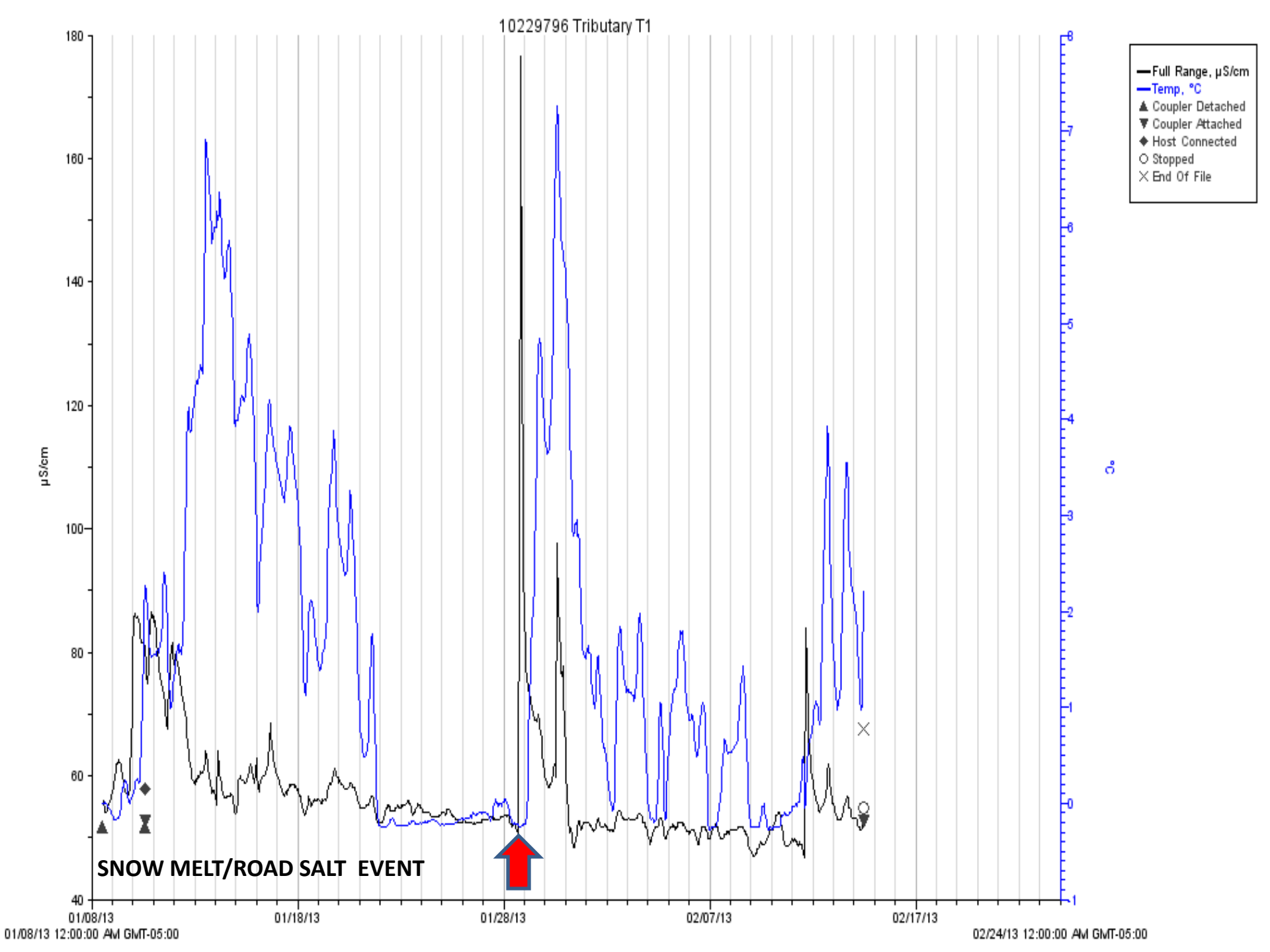


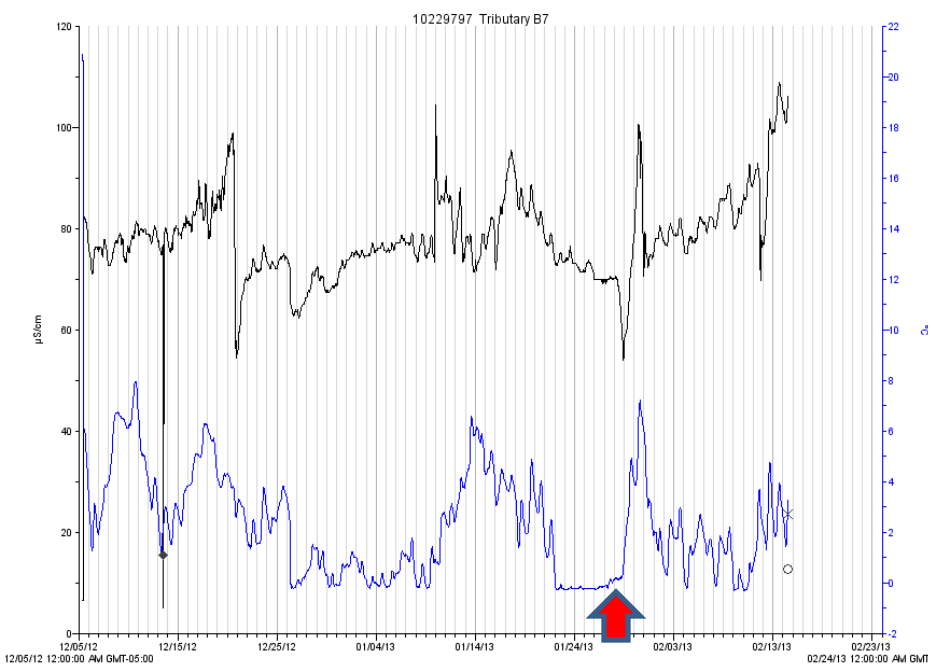
Other Key Fracking Indicators that We Are Monitoring…

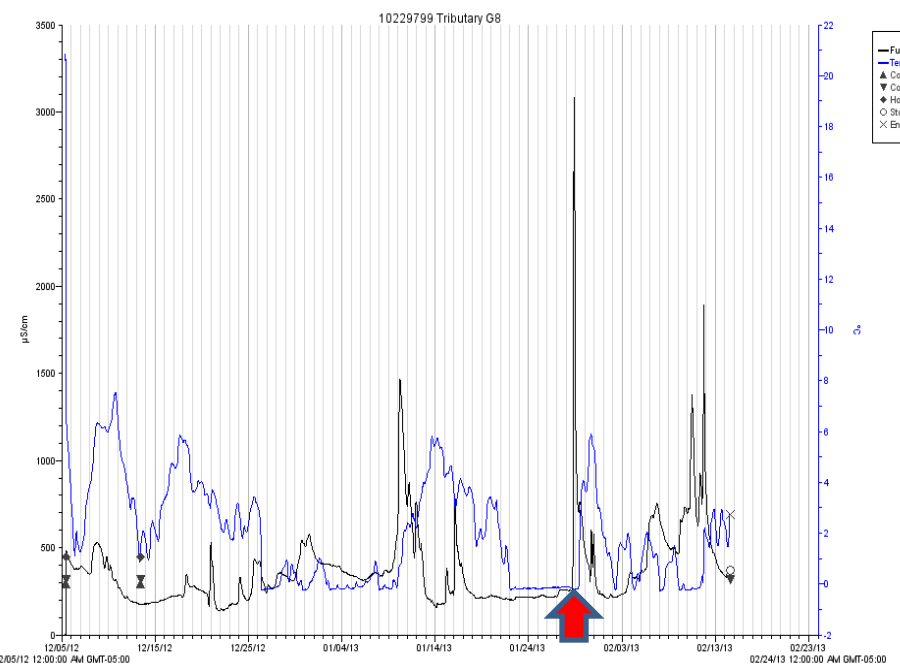
Analyte	Average Concentration in Tributary T1	Concentration in Frack Fluid	Multiple of Natural Level to Frack Fluid
Bromide	**Below 10 ppb**	**445,000 ppb[1]**	**45,000 times**
Barium	**33ppb**	**686,000ppb[1]**	**21,000 times**
Strontium	**45ppb**	**1,000,000ppb[1]**	**20,000 times**
Sp. Conductivity	**125 uS/cm**	**700,000 uS/cm**	**5600 times**
Gross-Alpha	3.92 pCi/L	1750 pCi/L [2]	450 times
Gross-Beta	5.34 pCi/L	760 pCi/L [2]	140 times
Iron	942 ppb	39000ppb[1]	40 times
Aluminum	4707 ppb	39,000 ppb[1]	8 times
Manganese	672 ppb	2630ppb[1]	4 times

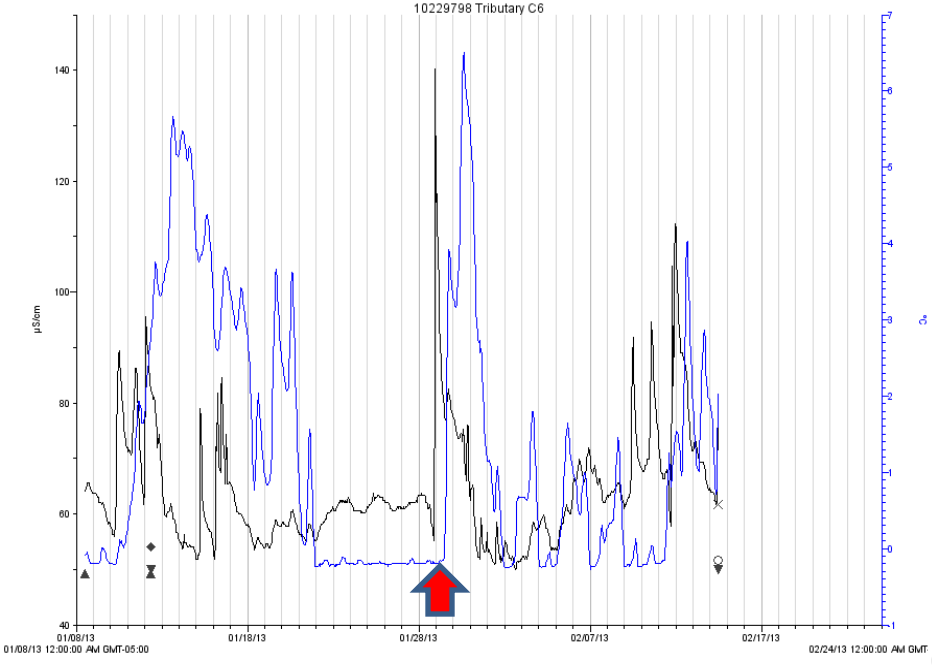
[1-] The Center for Rural Pennsylvania, The Impact of Marcellus, 2011

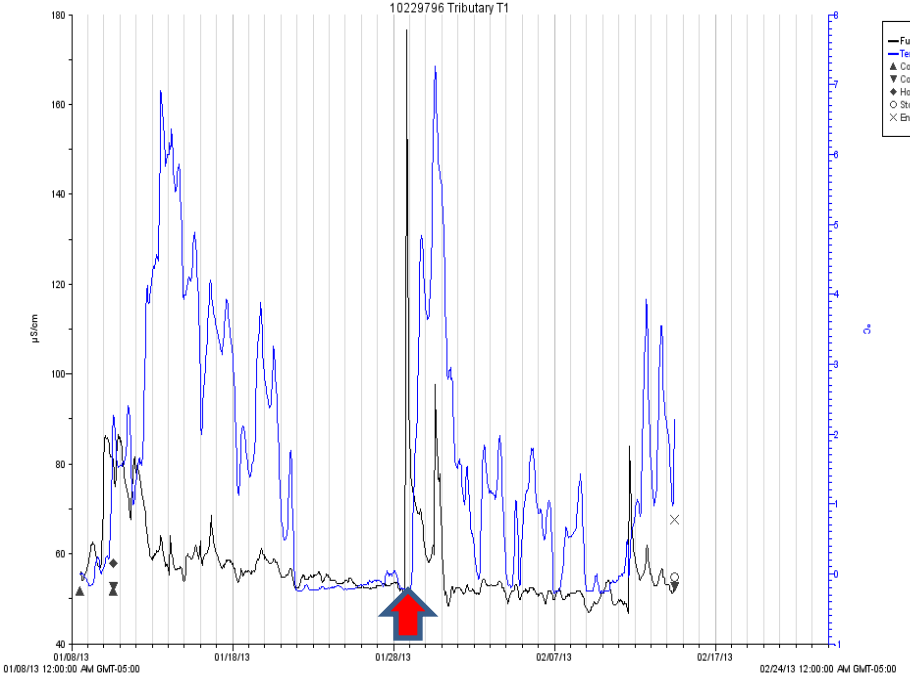
2- EPA- http://www.epa.gov/hfstudy/comparisonofhffluidscompositionwithproducedformationwater.pdf


10229796 Tributary T1
Full Range, µS/cm
Temp, °C
Coupler Detached
Coupler Attached
Host Connected
Stopped
End Of File
µS/cm
°C
180
160
140
120
100
80
60
40
8
7
6
5
4
3
2
1
0
-1
01/08/13
01/18/13
01/28/13
02/07/13
02/17/13
01/08/13 12:00:00 AM GMT-05:00
02/24/13 12:00:00 AM GMT-05:00
SNOW MELT/ROAD SALT EVENT


10229797 Tributary B7
µS/cm
°C
12/05/12 12:00:00 AM GMT-05:00
02/24/13 12:00:00 AM GMT-05:00


10229799 Tributary G8
Full Range, µS/cm
Temp, °C
Coupler Detached
Coupler Attached
Host Connected
Stopped
End Of File
µS/cm
°C
12/05/12 12:00:00 AM GMT-05:00
02/24/13 12:00:00 AM GMT-05:00

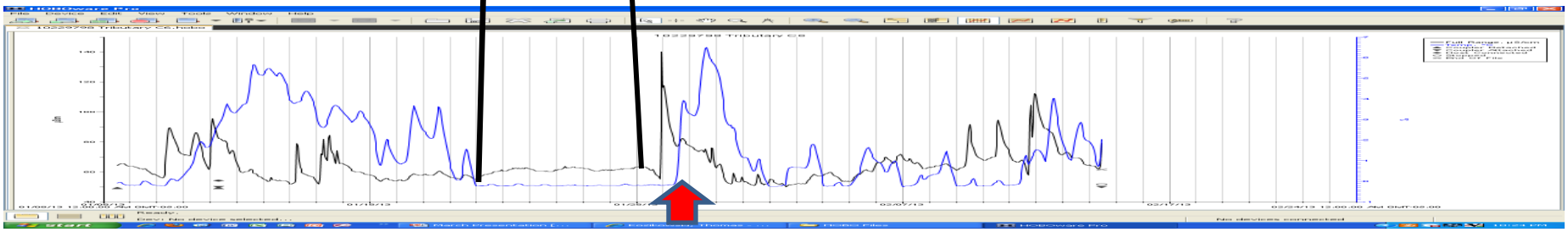

10229798 Tributary C6
µS/cm
°C
01/08/13 12:00:00 AM GMT-05:00
02/24/13 12:00:00 AM GMT-05:00

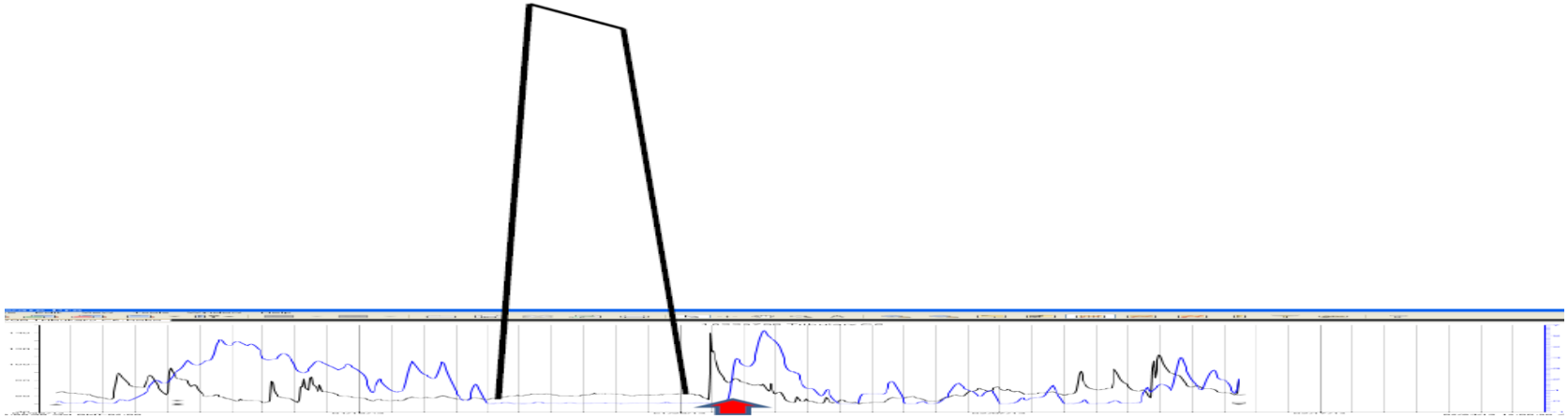

10229796 Tributary T1
Full Range, µS/cm
Temp, °C
Coupler Detached
Coupler Attached
Host Connected
Stopped
End Of File
µS/cm
°C
01/08/13 12:00:00 AM GMT-05:00
02/24/13 12:00:00 AM GMT-05:00

What might a contamination event look like if frack fluid is diluted 1:1000? (peak is 700 us/cm)(made to scale)

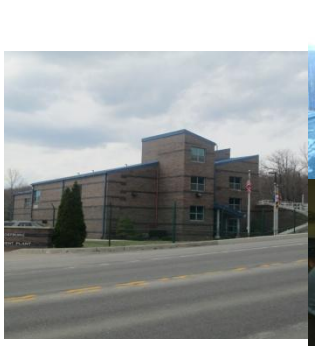
Pure Frack Fluid = 700,000 us/cm

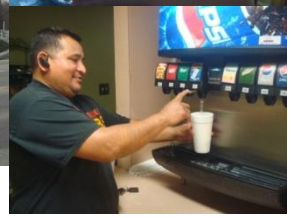
Hopefully, a contamination event like this is never observed and citizens can continue to confidently drink from the municipal water supply.





It is our hope to provide quarterly notifications indicating that the water is “still safe” to drink.





Inform the Frostburg Water Treatment Plant.

Proceed to take more detailed samples with our 20 other analytes to verify whether or not fracking was in fact the cause of the event.

We would request that a government agency would assist in further analysis, monitoring, and resolution of the issue.

MARYLAND
DEPARTMENT OF
NATURAL RESOURCES