Technical Memo

Date: 04/20/2011

To: Spruce Road Bulk Sample Site Project File - Minerals

From: Jason T. Butcher
Superior National Forest Aquatic Biologist

RE: Water quality/quantity evaluation on 10/29/2010

Summary:

In October 2010, surface water samples were collected at four sites in a single sampling event in the area adjacent to the Spruce Road Bulk Sampling location. Chemical constituents were compared to similar measurements taken before and after the closure of the site in the mid 1970's to evaluate changes and load contributions to surrounding streams. Ambient loadings for sulfate, copper, and nickel at Filson Creek (upstream) are two orders of magnitude (100 times) higher than loadings originating from the bulk sample site. Concentrations and loads of chemical constituents have not changed substantially since the mid 1970's. No further testing or management action is recommended.

Introduction:

The Spruce Road Bulk Sample Site is located in Lake County, Minnesota near the town of Ely (NW ¼ of the NW ¼ of Section 25, T62N, R11W). In January, 1974 the International Nickel Company (INCO) extracted a 10,000 ton surface sample for metallurgical testing adjacent to the Spruce Road on the Superior National Forest. The site was re-graded and seeded by INCO in the spring of 1974. In the summer of 1975, subsidence of the surface of the site occurred and seepage from the base of the site was noted. At the request of the MN PCA, water quality and quantity data were collected from the site during the summer of 1975 by INCO to characterize the waters leaving the site. Reclamation for the subsidence was completed in the fall of 1975; the site and adjacent waters were monitored during the summer of 1976 (USFS, 1977). The purpose of the current sampling effort (conducted on 10/29/2010) was to investigate the water quality/quantity of the area relative to the monitoring results from the data collected in 1975 (INCO) and 1976 (USFS).

Methods:

Samples were collected at five sites in the area on 10/29/2010 (Figure 1). This single sampling event was used as a simple status check on water quality and quantity compared to more extensive data sets and sampling regimes done in the mid 1970's. Sites corresponded to several of the sites sampled in 1975-76 (Appendix 1), including the Seep (A), Culvert (B) on the tributary receiving the seep, a downstream site on the tributary (C), and Filson Creek both upstream (Gage) and downstream (DS) from the confluence of the tributary. The current samples collected from Filson Creek upstream and downstream of the tributary confluence were closer to the confluence compared to the sites established in the1976; however, these sites are comparable in position and characteristics to the 1976 sites.

Due to the low volume of water at the seep, the 2010 samples were collected with a hand vacuum pump and hose. All other samples collected in 2010 were grab samples. Flow, Temperature, and Conductivity were taken in the field; all other parameters were stored on ice and analyzed in a certified lab using standard EPA methods. Three water samples were

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taken at each site; two samples analyzed unfiltered water (total) and one sample was filtered in the laboratory before analysis (dissolved).

Flow rates at each site were determined using various hydrologic methods including a direct volumetric sample at the seep, continuously recording flow gage at Filson Creek, and an estimate based on flow ratios for the tributary (Appendix 5).

Results:

It is important to note that results and discussions draw on a single sample event in the fall of 2010 and concentrations and flows can change through time (daily, seasonal, and yearly variability). Laboratory results are presented in this report in their raw form in Appendix 2. Summary graphs by site and chemical constituent are listed in Appendix 3a (all sites included) and Appendix 3b (seep site omitted for scale). The percent contribution for each site relative to the total (downstream most site) was calculated for flow and several chemical constituents (Figure 2, Table 1). Loadings were calculated for copper and nickel at two sites and compared to loadings from similar flows that occurred in 1976 (Figure 3); concentrations for each constituent were also compared with results from October, 1975 (INCO) samples (Appendix 4).

Discussion:

Downstream impacts are a function of both the concentration of the constituent and the amount of flow. The product of the estimated daily discharge rate and the concentration yields the daily load. Daily load helps to provide a better understanding of relative influence in space (between sites) and time (between years). Loads for total copper and total nickel at the seep are small compared to those found in Filson creek (Table 1); the seep contributes about 0.07% of copper, 1.11% of nickel, and 0.27% of sulfate to Filson Creek (Figure 2 and Figures 6-8). Mass for these constituents does not balance to the total output at the downstream site (Figures 6-8). This is due to substantial variability in inputs and outputs of flow and concentrations throughout the watershed. In addition, variability is introduced in the form of heterogeneous geology, landform, flow, and chemical interactions relative to the small number of sites and low sample size representing the area.

Compared to data in 1976 under similar flow conditions, loads in 2010 have not changed substantially for total copper and total nickel (Figure 3). Concentrations for chemical constituents in 2010 remain similar to levels found in 1975 when comparing sites during fall sample periods (Appendix 4). Although some constituents seem to show a trend in decreasing concentration through time, statistical significance cannot be determined due to low sample size.

Data indicate that both Filson Creek and the Tributary to Filson Creek have ambient (upstream) sources of copper that are independent of the seep's copper contribution. Copper levels exceed the applicable Class 2B chronic water quality standards (Table 2; Minn. Rule 7050.0222) at all sites sampled in 2010. This exceedance includes the site on Filson Creek that is upstream of the influence of the bulk sample site (Figure 4 and 5). Cobalt and nickel are below the chronic water quality standards for Class 2B Waters of the State at all sites except the outflow of the seep (A). Concentrations at similar sites in 1976 also exceed those standards; in addition, a sample site on the tributary above the influence of the bulk sample site also exceeded the standard (USFS, 1977).

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Conclusions/Recommendations:

- Concentrations and loads of chemical constituents have not changed substantially since the mid 1970's.
- Ambient loadings for total sulfate, copper, and nickel at Filson Creek (upstream) are two orders of magnitude (100 times) higher than loadings from the bulk sample site/seep (Figures 6, 7 and 8).
- No further testing is needed to characterize the water quality and quantity at the Spruce Road Bulk Sample Site; however, further testing would be appropriate if future management actions or mitigations occur.
- Provide Minnesota Department of Natural Resources, Division of Lands and Minerals and Minnesota Pollution Control Agency a copy of this document for their review and records.
- No management action is recommended at this time.

References:

Minnesota Rule 7050.0222. Specific Water Quality Standards For Class 2 Waters of the State; Aquatic Life and Recreation. https://www.revisor.mn.gov/rules/?id=7050.0222

USFS, 1977. Preliminary Report, Spruce Road Bulk Sample Site Monitoring Results. Superior National Forest. May 26, 1977. 81 pages.

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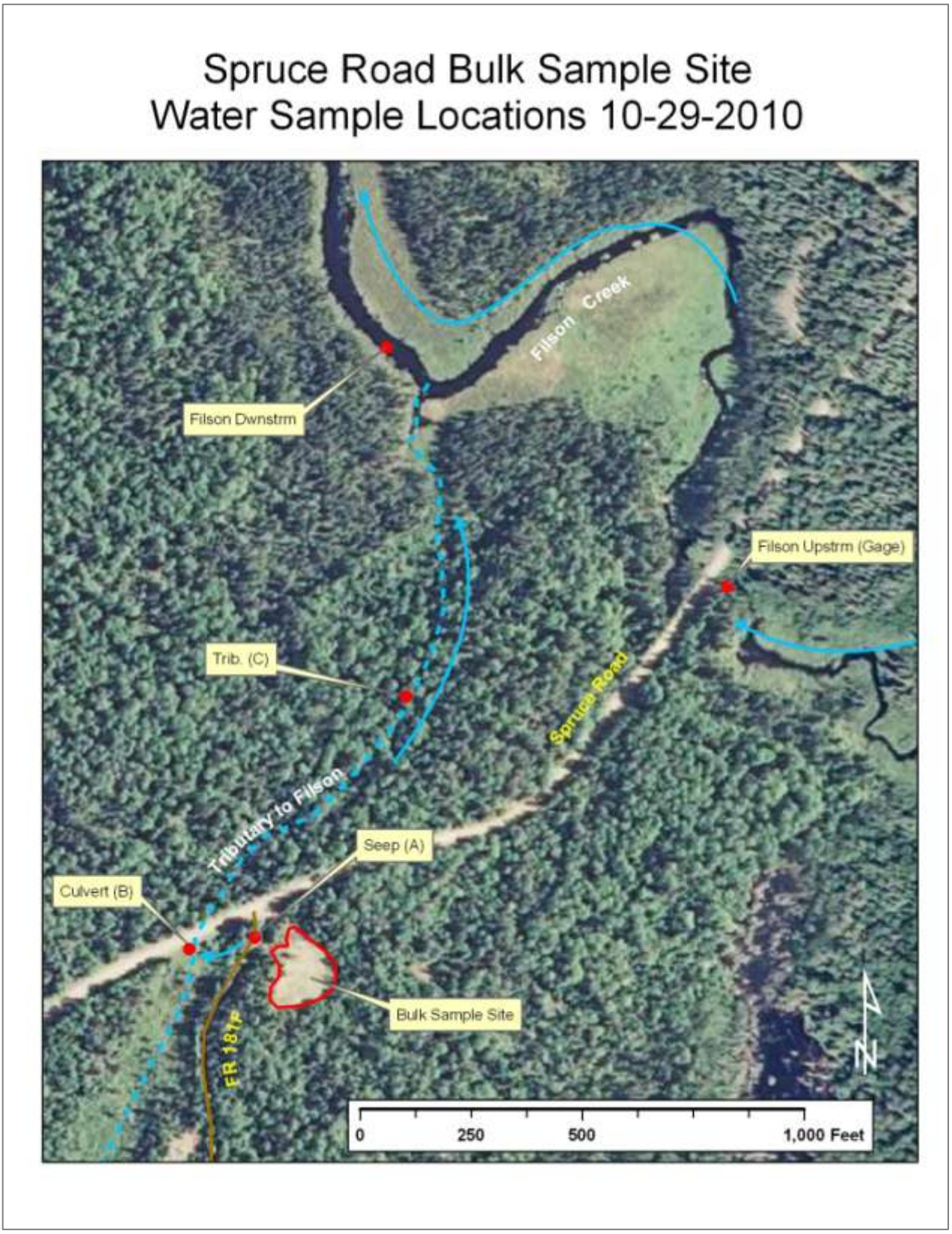


Figure 1. Map of the Spruce Road Bulk Sample Site area including water sample sites.

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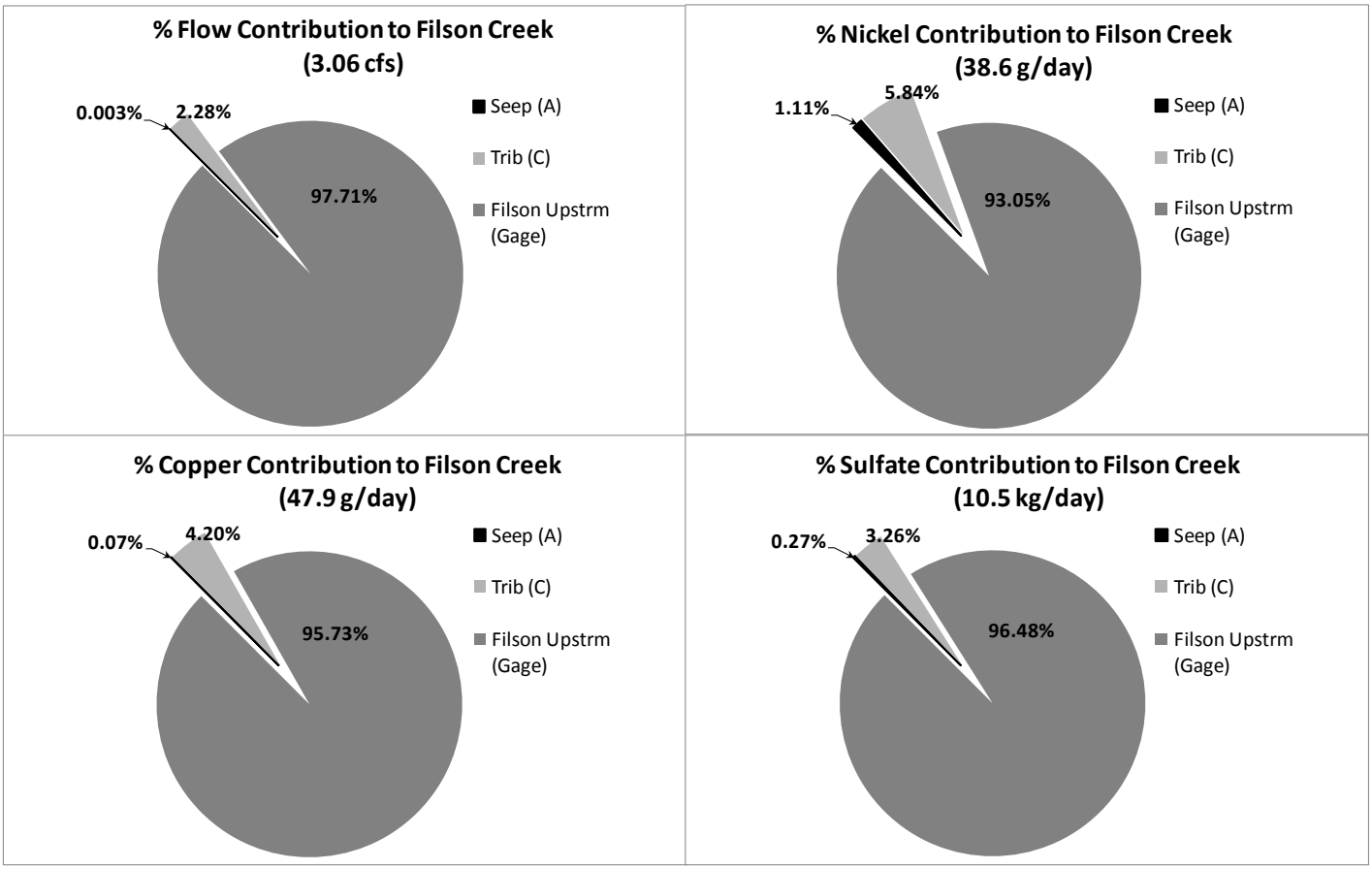
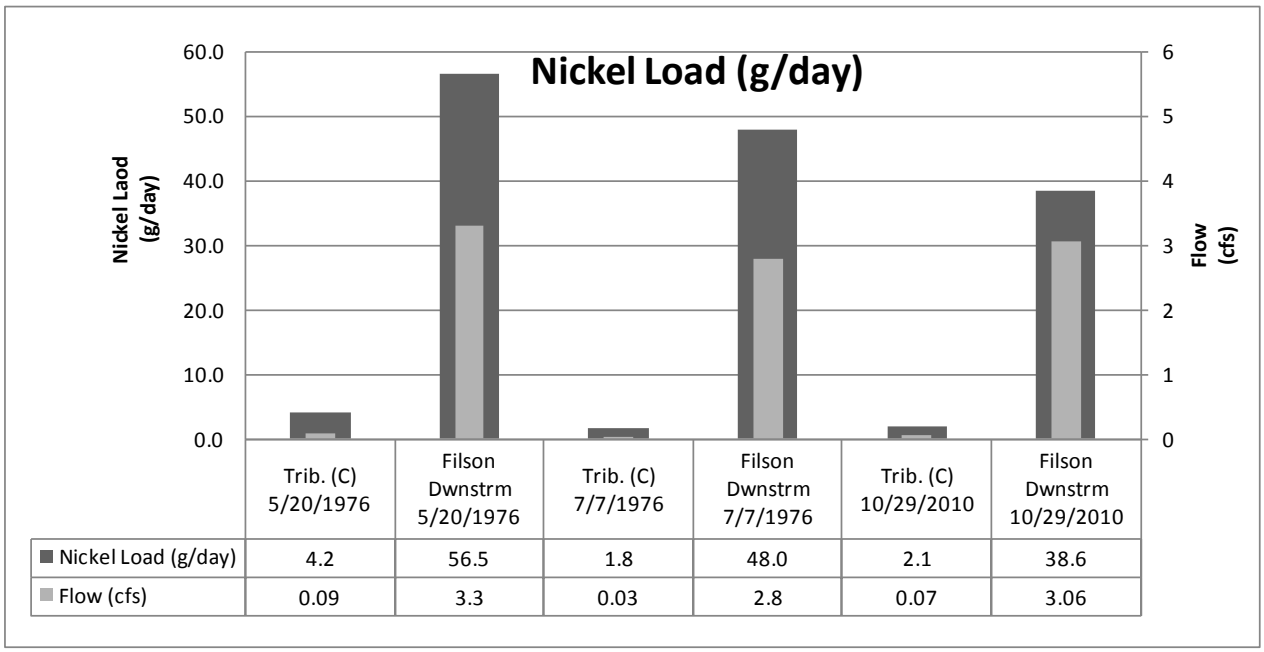


Figure 2. Percent contribution of each upstream site to Filson Creek for flow and total chemical loads. (flow and loads for Filson Creek Downstream of the Bulk Sample Site noted in parentheses)

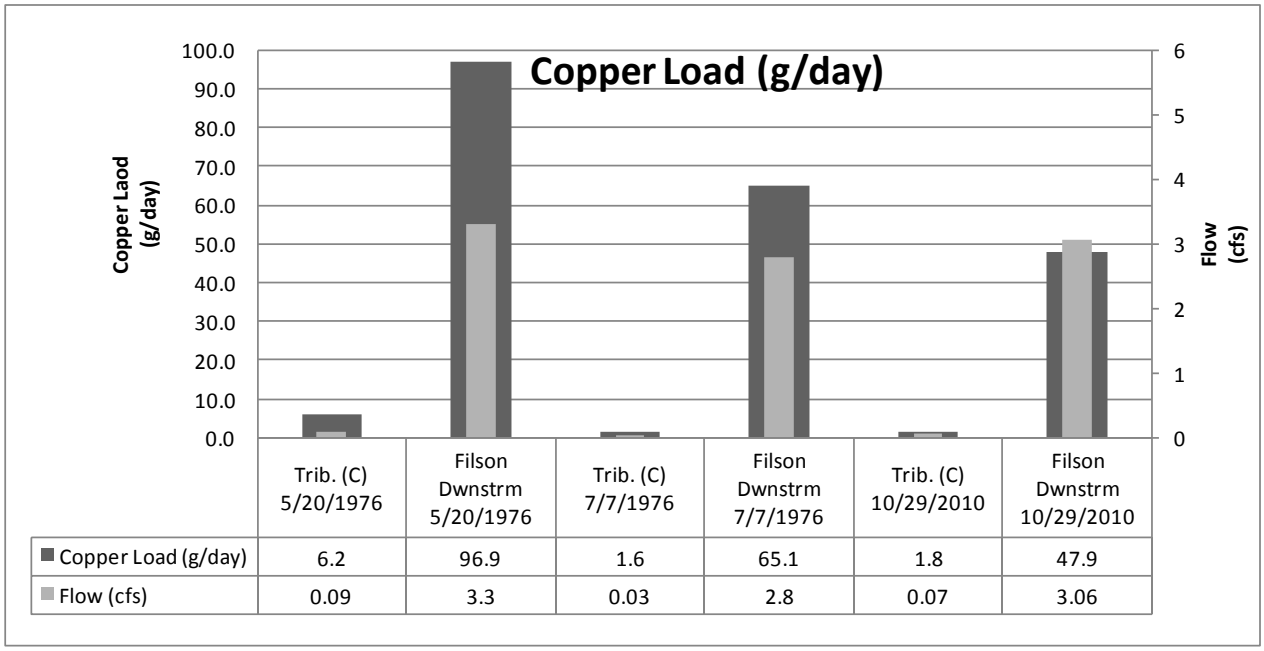
Table 1. Flow and Load (concentration times discharge) for sites sampled on 10/29/2010.

Site	Flow (cfs)	Total Load (concentration x discharge) by Chemical Constituent			
		Copper (g/d)	Nickel (g/d)	Cobalt (g/d)	Sulfate (kg/d)
Seep (A)	0.00009	0.03	0.34	0.02	0.03
Culvert (B)	0.07	0.9	1.9	0.2	0.28
Trib (C)	0.07	1.8	2.1	0.2	0.33
Filson Upstrm (Gage)	2.99	39.5	28.5	6.6	9.14
Filson Dwnstrm	3.06	47.9	38.6	7.1	10.48

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	Trib. (C) 5/20/1976	Filson Dwnstrm 5/20/1976	Trib. (C) 7/7/1976	Filson Dwnstrm 7/7/1976	Trib. (C) 10/29/2010	Filson Dwnstrm 10/29/2010
Nickel Load (g/day)	4.2	56.5	1.8	48.0	2.1	38.6
Flow (cfs)	0.09	3.3	0.03	2.8	0.07	3.06



	Trib. (C) 5/20/1976	Filson Dwnstrm 5/20/1976	Trib. (C) 7/7/1976	Filson Dwnstrm 7/7/1976	Trib. (C) 10/29/2010	Filson Dwnstrm 10/29/2010
Copper Load (g/day)	6.2	96.9	1.6	65.1	1.8	47.9
Flow (cfs)	0.09	3.3	0.03	2.8	0.07	3.06

Figure 3. Total copper and total nickel loading for the Tributary to Filson Creek downstream of the Bulk Sample Site and Filson Creek downstream of the Bulk Sample Site for three time periods of similar flow.

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Table 2. Applicable Chronic Water Quality Standards for Class 2B waters; asterisk constituents have calculated value according to Minnesota Rule Equation using lowest (conservative) total Hardness value (Minn. Rule 7050.0222)

Constituent	Unit	Chronic Standard
Arsenic, total	ug/l	53
Cobalt, total	ug/l	5.0
*Copper, total	ug/l	3.1
Mercury, total	ng/l	6.9
*Nickel, total	ug/l	33.3

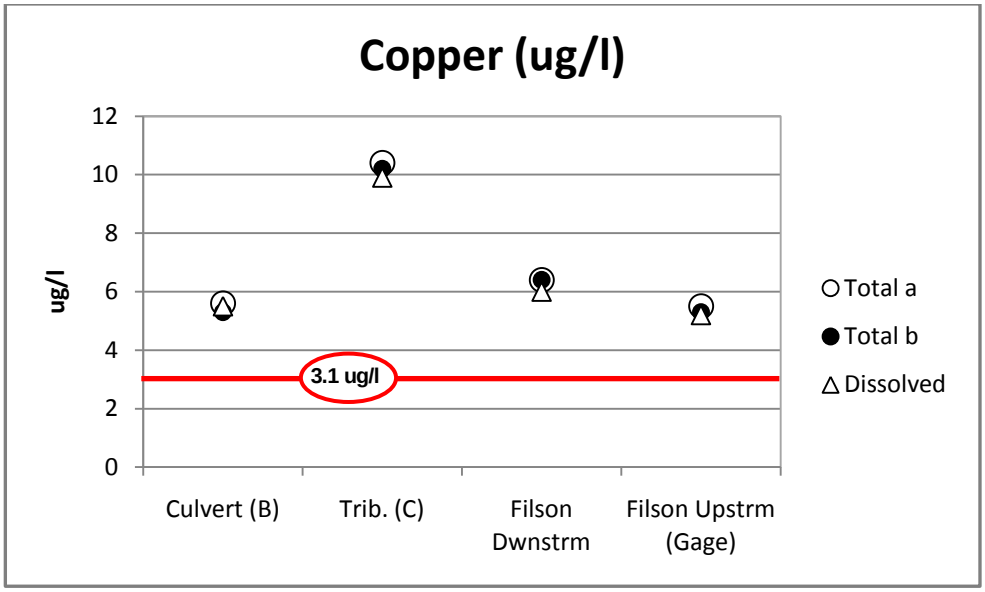


Figure 4. Copper concentrations (ug/l) at sites near the Spruce Road Bulk Sample Site on 10-29-2010. Each symbol represents a sample point; circles represent unfiltered (total) samples and triangles represent filtered (dissolved) samples. The red line denotes the water quality standard (chronic standard, Class 2B waters of the state, aquatic life and recreation). Seep data was not plotted for scale.

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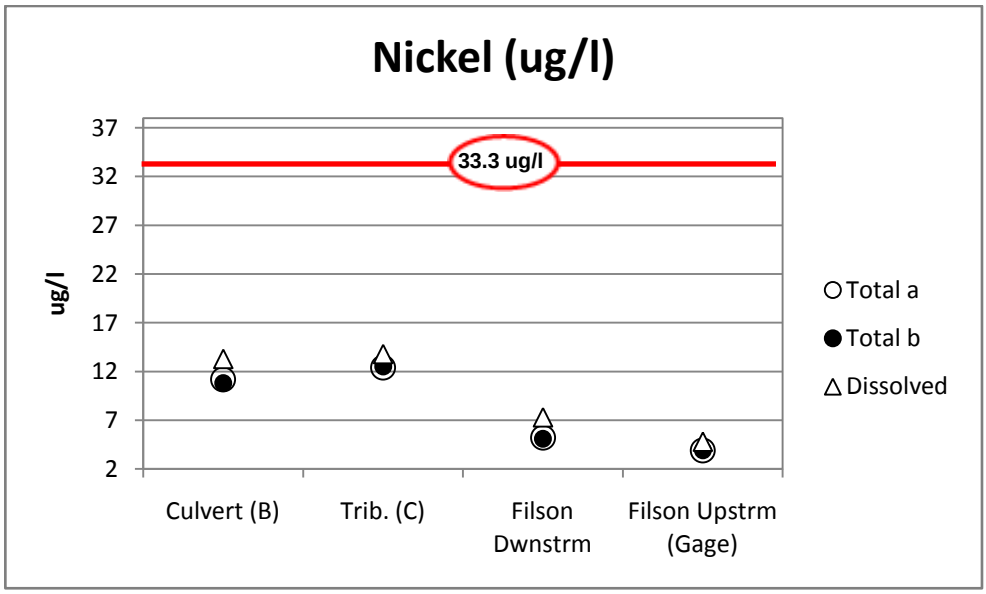


Figure 5. Nickel concentrations (ug/l) at sites near the Spruce Road Bulk Sample Site on 10-29-2010. Each symbol represents a sample point; circles represent unfiltered (total) samples and triangles represent filtered (dissolved) samples. The red line denotes the water quality standard (chronic standard, Class 2B waters of the state, aquatic life and recreation). Seep data was not plotted for scale.

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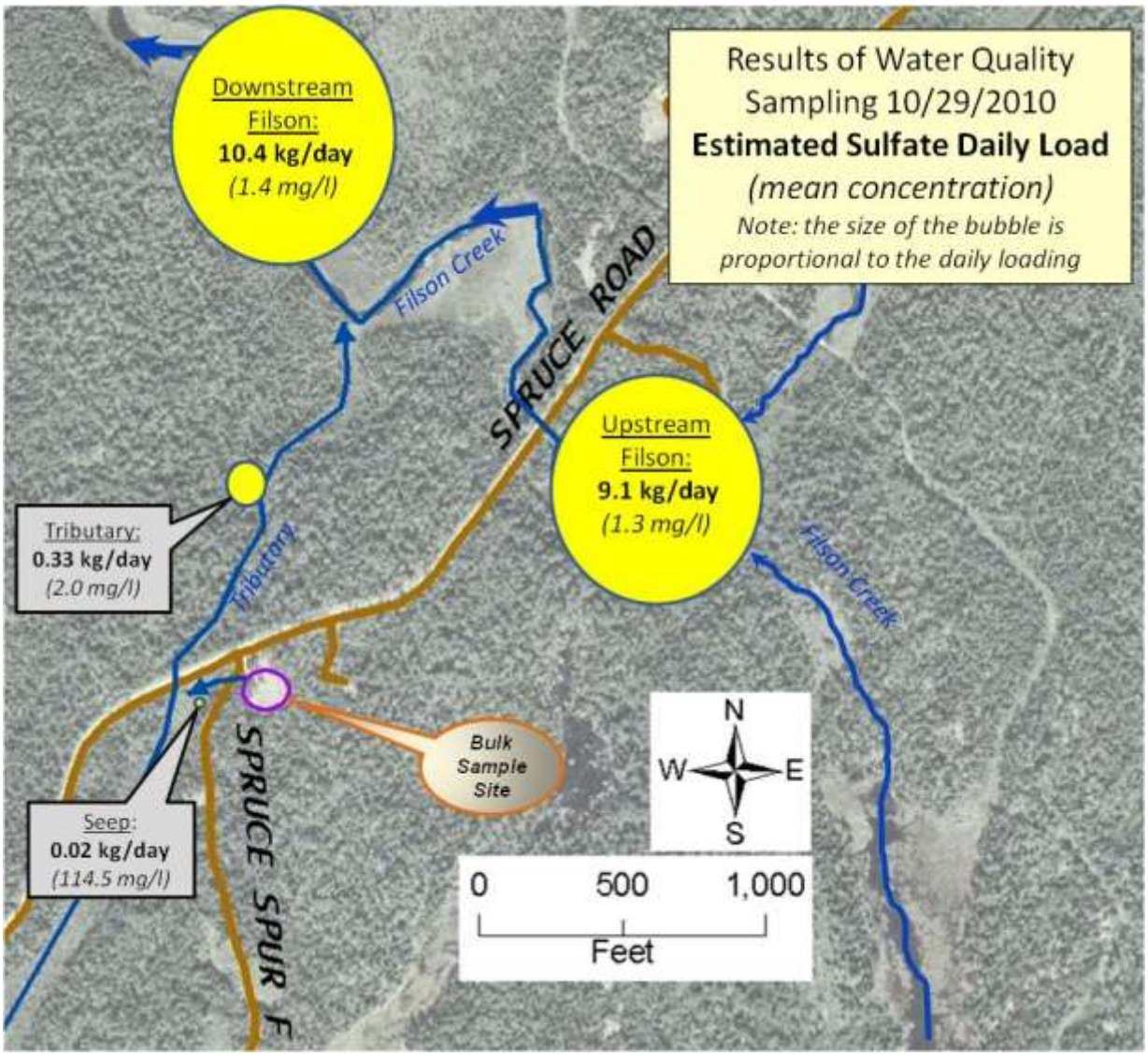


Figure 6. Bubble plot of sulfate daily load at four sites in the Filson Creek watershed. Size of the bubble is proportional to the daily load at each site (mean concentration in parentheses). Loads and concentrations were determined from field data collected on 10/29/2010.

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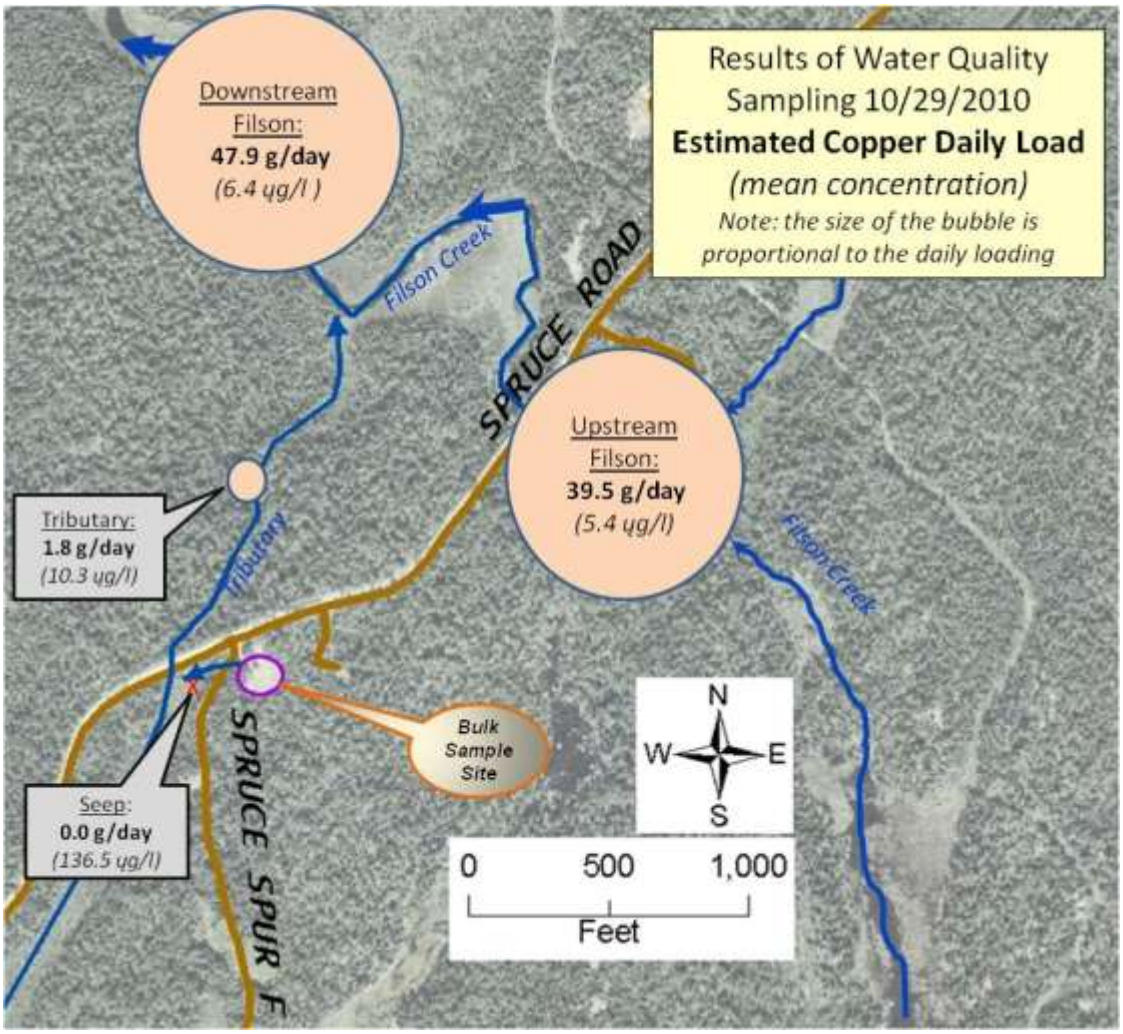


Figure 7. Bubble plot of copper daily load at four sites in the Filson Creek watershed. Size of the bubble is proportional to the daily load at each site (mean concentration in parentheses). Loads and concentrations were determined from field data collected on 10/29/2010.

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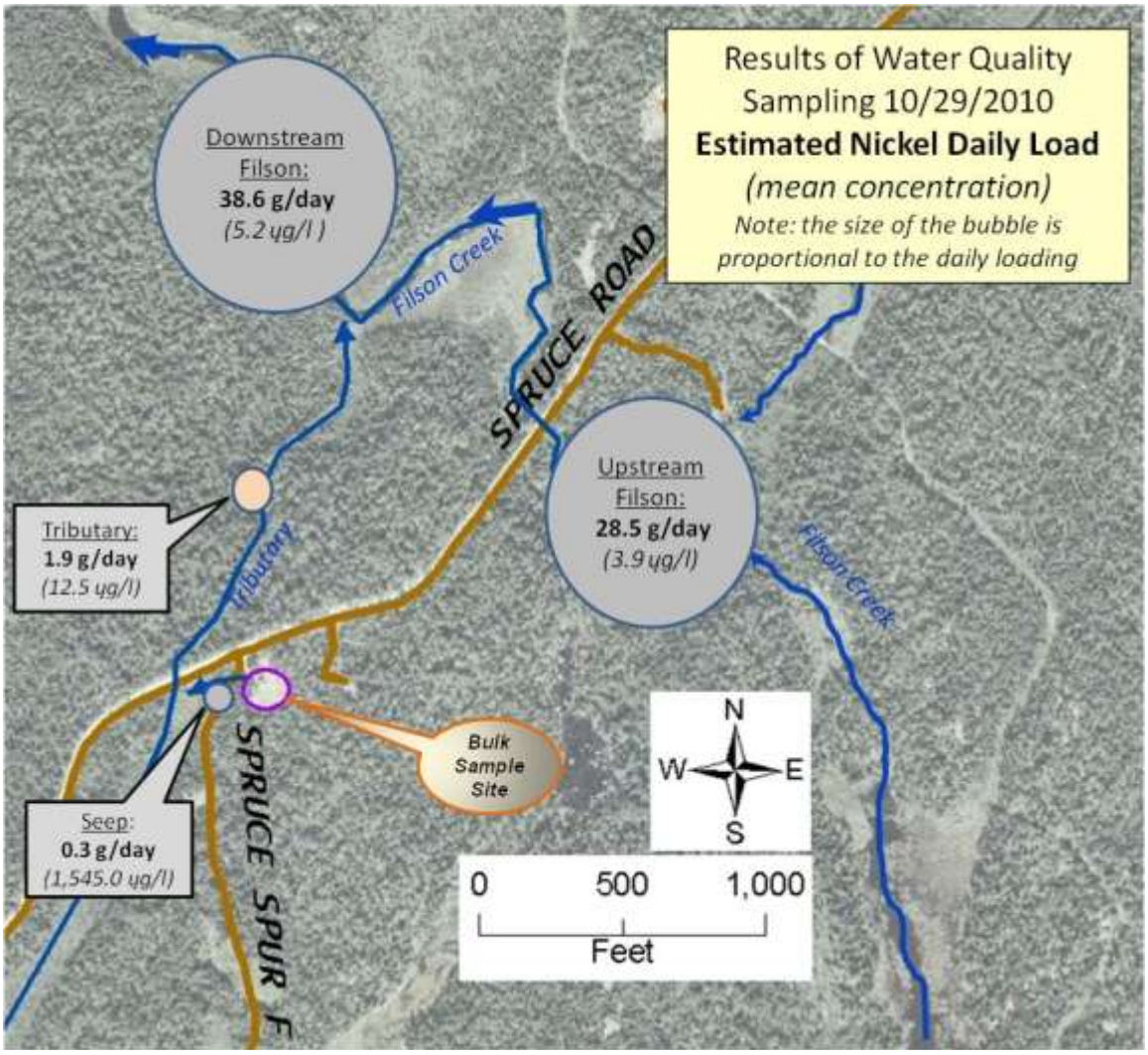


Figure 8. Bubble plot of nickel daily load at four sites in the Filson Creek watershed. Size of the bubble is proportional to the daily load at each site (mean concentration in parentheses). Loads and concentrations were determined from field data collected on 10/29/2010.

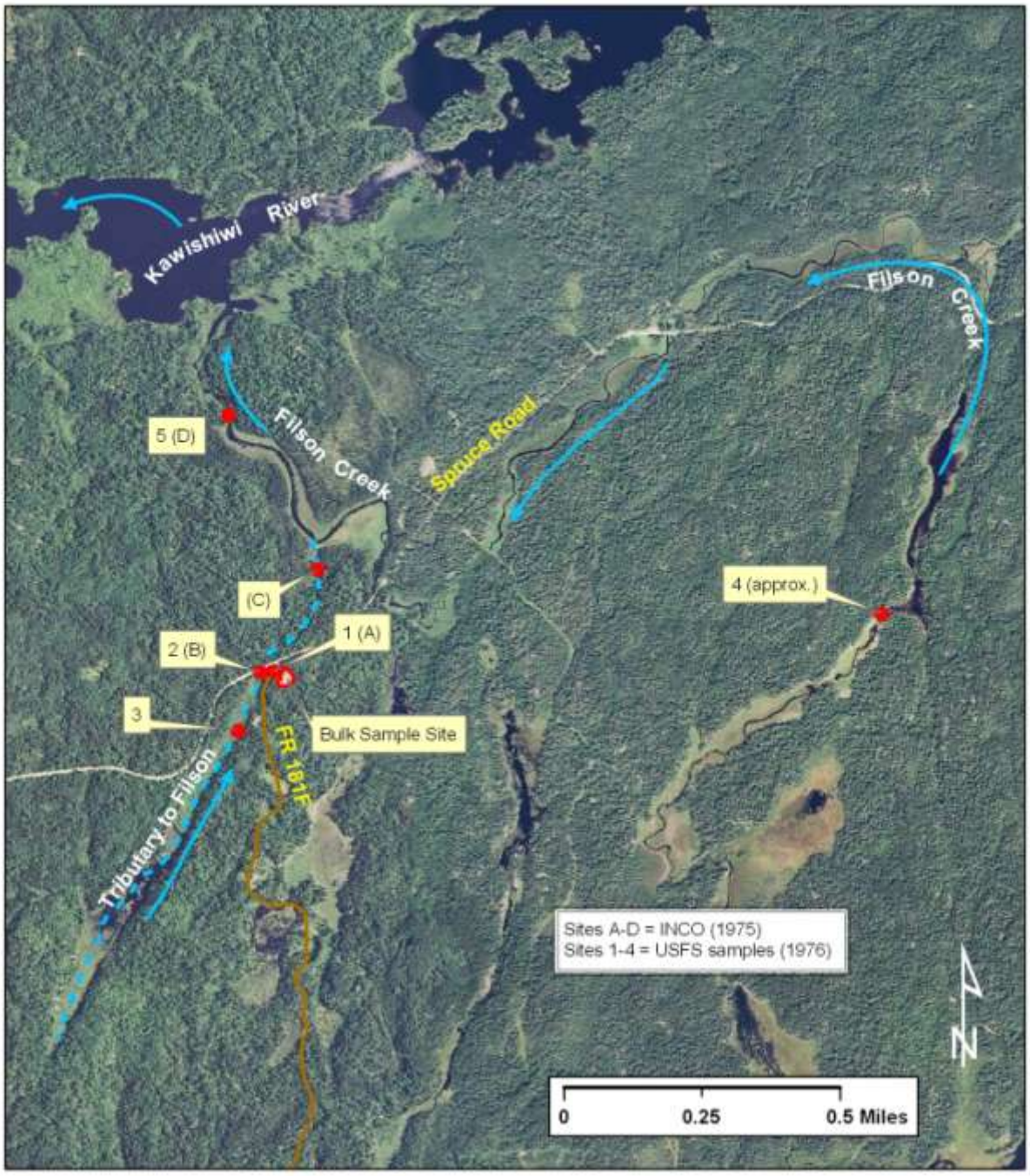
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Appendix 1:

Sample site locations for past monitoring efforts from INCO (lettered sites;1975) and the USFS (numbered sites; 1976). Site locations are approximations from previous reports.

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Spruce Road Bulk Sample Site
Past Sample Locations



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Appendix 2:

Laboratory Report for surface water samples taken at
Spruce Road Bulk Sample Site on 10-29-2010

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Era LABS
Era Laboratories, Inc.
4730 Oneota Street Duluth MN 55807 Telephone: (218)727-6380 Fax: (218)727-3049

Laboratory Report

Project Number:	059499
COC Number:	732742
Date Received:	11/4/2010
Report Date:	11/23/2010
ReportNumber:	103646

Client: JASON BUTCHER
SUPERIOR NAT'L FOREST/US FOREST SER
8901 GRAND AVENUE PLACE
DULUTH MN 55808

Sample ID: SEEP (A) **Sample Date:** 10/29/2010 **SampleTime:** 11:00 **Matrix:** Water
Era Project Number: 059499-1

Parameter:		Results:	Units:	Analysis Date/Time:		Method:	DF:	LOD:	LOQ:	QC Comments:
pH - Lab		6.4	SU	11/5/2010	16:45	SM 4500-H+B-00 OL	1			
Sulfate		113	mg/L	11/7/2010	23:26	EPA 300.0 Rev 2.1	10	5	15	
Arsenic, Total	<	0.4	µg/L	11/12/2010	11:25	EPA 200.8 Rev 5.4	1	0.4	1	
Calcium, Total		26.5	mg/L	11/17/2010	11:40	EPA 200.7 Rev 4.4	1	0.05	0.17	
Cobalt, Total		77.4	µg/L	11/12/2010	11:25	EPA 200.8 Rev 5.4	1	0.4	1	
Copper, Total		127	µg/L	11/12/2010	11:25	EPA 200.8 Rev 5.4	1	0.4	1	
Hardness, Total (as CaCO3)		171	mg/L	11/17/2010	10:49	EPA 200.7 Rev. 4.4	1	0.3	1	
Iron, Total		8.9	mg/L	11/17/2010	10:30	EPA 200.7 Rev 4.4	10	0.1	0.4	
Magnesium, Total		25.5	mg/L	11/17/2010	11:40	EPA 200.7 Rev 4.4	1	0.05	0.17	
Mercury, Total	<	0.04	µg/L	11/11/2010	15:13	EPA 245.2	1	0.04	0.05	
Nickel, Total		1580	µg/L	11/12/2010	12:43	EPA 200.8 Rev 5.4	5	2	5	

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Era Laboratories, Inc.
4730 Oneota Street Duluth MN 55807 Telephone: (218)727-6380 Fax: (218)727-3049

Laboratory Report

Project Number: 059499
COC Number: 732742
Date Received: 11/4/2010
Report Date: 11/23/2010
ReportNumber: 103846

Sample ID: SEEP (A) **Sample Date:** 10/29/2010 **SampleTime:** 11:00 **Matrix:** Water
Era Project Number: 059499-2

Parameter:		Results:	Units:	Analysis Date/Time:		Method:	DF:	LOD:	LOQ:	QC Comments:
pH - Lab		6.4	SU	11/5/2010	16:45	SM 4500-H+B-00 OL	1			
Sulfate		116	mg/L	11/8/2010	0:12	EPA 300.0 Rev 2.1	10	5	15	
Arsenic, Total	<	0.4	µg/L	11/12/2010	11:29	EPA 200.8 Rev 5.4	1	0.4	1	
Calcium, Total		25.7	mg/L	11/17/2010	11:42	EPA 200.7 Rev 4.4	1	0.05	0.17	
Cobalt, Total		76.9	µg/L	11/12/2010	11:29	EPA 200.8 Rev 5.4	1	0.4	1	
Copper, Total		146	µg/L	11/12/2010	11:29	EPA 200.8 Rev 5.4	1	0.4	1	
Hardness, Total (as CaCO3)		165	mg/L	11/17/2010	10:49	EPA 200.7 Rev. 4.4	1	0.3	1	
Iron, Total		10.6	mg/L	11/17/2010	10:32	EPA 200.7 Rev 4.4	10	0.1	0.4	
Magnesium, Total		24.6	mg/L	11/17/2010	11:42	EPA 200.7 Rev 4.4	1	0.05	0.17	
Mercury, Total	<	0.04	µg/L	11/11/2010	15:13	EPA 245.2	1	0.04	0.05	
Nickel, Total		1510	µg/L	11/12/2010	13:12	EPA 200.8 Rev 5.4	5	2	5	

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DOI-19-0291-K-000016

Era Laboratories, Inc.
4730 Oneota Street Duluth MN 55807 Telephone: (218)727-6380 Fax: (218)727-3049

Laboratory Report

Project Number:	059499
COC Number:	732742
Date Received:	11/4/2010
Report Date:	11/23/2010
ReportNumber:	103646

Sample ID: SEEP (A) **Sample Date:** 10/29/2010 **SampleTime:** 11:00 **Matrix:** Water
Era Project Number: 059499-3

Parameter:		Results:	Units:	Analysis Date/Time:		Method:	DF:	LOD:	LOQ:	QC Comments:
pH - Lab, Filtered		6.8	SU	11/5/2010	16:45	SM 4500-H+B-00 OL	1			
Sulfate, Dissolved		114	mg/L	11/8/2010	0:29	EPA 300.0 Rev 2.1	10	5	15	
Arsenic, Dissolved	<	0.4	µg/L	11/12/2010	11:47	EPA 200.8 Rev 5.4	1	0.4	1	
Calcium, Dissolved		25.6	mg/L	11/17/2010	11:44	EPA 200.7 Rev 4.4	1	0.05	0.17	
Cobalt, Dissolved		74.7	µg/L	11/12/2010	11:47	EPA 200.8 Rev 5.4	1	0.4	1	
Copper, Dissolved		17.5	µg/L	11/12/2010	11:47	EPA 200.8 Rev 5.4	1	0.4	1	
Hardness, Dissolved (as CaCO3)		166	mg/L	11/17/2010	10:49	EPA 200.7 Rev. 4.4	1	0.3	1	
Iron, Dissolved		0.03	mg/L	11/17/2010	9:55	EPA 200.7 Rev 4.4	1	0.01	0.04	J
Magnesium, Dissolved		24.8	mg/L	11/17/2010	11:44	EPA 200.7 Rev 4.4	1	0.05	0.17	
Mercury, Dissolved	<	0.04	µg/L	11/11/2010	15:13	EPA 245.2	1	0.04	0.05	
Nickel, Dissolved		1440	µg/L	11/12/2010	12:58	EPA 200.8 Rev 5.4	5	2	5	

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Era Laboratories, Inc.
4730 Oneota Street Duluth MN 55807 Telephone: (218)727-6380 Fax: (218)727-3049

Laboratory Report

Project Number:	059499
COC Number:	732742
Date Received:	11/4/2010
Report Date:	11/23/2010
ReportNumber:	103646

Sample ID: CULVERT (B) **Sample Date:** 10/29/2010 **SampleTime:** 11:45 **Matrix:** Water
Era Project Number: 059499-4

Parameter:		Results:	Units:	Analysis Date/Time:		Method:	DF:	LOD:	LOQ:	QC Comments:
pH - Lab		5.8	SU	11/5/2010	16:45	SM 4500-H+B-00 OL	1			
Sulfate		1.6	mg/L	11/12/2010	3:54	EPA 300.0 Rev 2.1	1	0.5	1.5	
Arsenic, Total	<	0.4	µg/L	11/12/2010	11:51	EPA 200.8 Rev 5.4	1	0.4	1	
Calcium, Total		2.58	mg/L	11/17/2010	11:47	EPA 200.7 Rev 4.4	1	0.05	0.17	
Cobalt, Total		1.5	µg/L	11/12/2010	11:51	EPA 200.8 Rev 5.4	1	0.4	1	
Copper, Total		5.6	µg/L	11/12/2010	11:51	EPA 200.8 Rev 5.4	1	0.4	1	
Hardness, Total (as CaCO3)		15.9	mg/L	11/17/2010	10:49	EPA 200.7 Rev. 4.4	1	0.3	1	
Iron, Total		0.53	mg/L	11/17/2010	9:57	EPA 200.7 Rev 4.4	1	0.01	0.04	
Magnesium, Total		2.3	mg/L	11/17/2010	11:47	EPA 200.7 Rev 4.4	1	0.05	0.17	
Mercury, Total	<	0.04	µg/L	11/11/2010	15:13	EPA 245.2	1	0.04	0.05	
Nickel, Total		11.2	µg/L	11/12/2010	11:51	EPA 200.8 Rev 5.4	1	0.4	1	

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Era Laboratories, Inc.
4730 Oneota Street Duluth MN 55807 Telephone: (218)727-6380 Fax: (218)727-3049

Laboratory Report

Project Number: 059499
COC Number: 732742
Date Received: 11/4/2010
Report Date: 11/23/2010
ReportNumber: 103646

Sample ID: CULVERT (B) **Sample Date:** 10/29/2010 **SampleTime:** 11:45 **Matrix:** Water
Era Project Number: 059499-5

Parameter:		Results:	Units:	Analysis Date/Time:		Method:	DF:	LOD:	LOQ:	QC Comments:
pH - Lab		5.8	SU	11/5/2010	16:45	SM 4500-H+B-00 OL	1			
Sulfate		1.7	mg/L	11/12/2010	4:09	EPA 300.0 Rev 2.1	1	0.5	1.5	
Arsenic, Total	<	0.4	µg/L	11/12/2010	11:54	EPA 200.8 Rev 5.4	1	0.4	1	
Calcium, Total		2.57	mg/L	11/17/2010	11:49	EPA 200.7 Rev 4.4	1	0.05	0.17	
Cobalt, Total		0.8	µg/L	11/12/2010	11:54	EPA 200.8 Rev 5.4	1	0.4	1	J
Copper, Total		5.3	µg/L	11/12/2010	11:54	EPA 200.8 Rev 5.4	1	0.4	1	
Hardness, Total (as CaCO3)		15.9	mg/L	11/17/2010	10:49	EPA 200.7 Rev. 4.4	1	0.3	1	
Iron, Total		0.59	mg/L	11/17/2010	9:59	EPA 200.7 Rev 4.4	1	0.01	0.04	
Magnesium, Total		2.3	mg/L	11/17/2010	11:49	EPA 200.7 Rev 4.4	1	0.05	0.17	
Mercury, Total	<	0.04	µg/L	11/11/2010	15:13	EPA 245.2	1	0.04	0.05	
Nickel, Total		10.8	µg/L	11/12/2010	11:54	EPA 200.8 Rev 5.4	1	0.4	1	

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Era Laboratories, Inc.
4730 Oneota Street Duluth MN 55807 Telephone: (218)727-6380 Fax: (218)727-3049

Laboratory Report

Project Number: 059499
COC Number: 732742
Date Received: 11/4/2010
Report Date: 11/23/2010
ReportNumber: 103646

Sample ID: CULVERT (B) **Sample Date:** 10/29/2010 **SampleTime:** 11:45 **Matrix:** Water
Era Project Number: 059499-6

Parameter:		Results:	Units:	Analysis Date/Time:		Method:	DF:	LOD:	LOQ:	QC Comments:
pH - Lab, Filtered		5.9	SU	11/5/2010	16:45	SM 4500-H+B-00 OL	1			
Sulfate, Dissolved		1.7	mg/L	11/12/2010	4:24	EPA 300.0 Rev 2.1	1	0.5	1.5	
Arsenic, Dissolved	<	0.4	µg/L	11/12/2010	11:58	EPA 200.8 Rev 5.4	1	0.4	1	
Calcium, Dissolved		2.51	mg/L	11/17/2010	11:58	EPA 200.7 Rev 4.4	1	0.05	0.17	
Cobalt, Dissolved		0.9	µg/L	11/12/2010	11:58	EPA 200.8 Rev 5.4	1	0.4	1	J
Copper, Dissolved		5.5	µg/L	11/12/2010	11:58	EPA 200.8 Rev 5.4	1	0.4	1	
Hardness, Dissolved (as CaCO3)		15.6	mg/L	11/17/2010	10:49	EPA 200.7 Rev. 4.4	1	0.3	1	
Iron, Dissolved		0.46	mg/L	11/17/2010	10:05	EPA 200.7 Rev 4.4	1	0.01	0.04	
Magnesium, Dissolved		2.27	mg/L	11/17/2010	11:58	EPA 200.7 Rev 4.4	1	0.05	0.17	
Mercury, Dissolved	<	0.04	µg/L	11/11/2010	15:13	EPA 245.2	1	0.04	0.05	
Nickel, Dissolved		13.3	µg/L	11/12/2010	11:58	EPA 200.8 Rev 5.4	1	0.4	1	

Receipt temperature within regulatory guidelines

MN Certification # 027-137-152

AMERICAN OVERSIGHT

DOI-19-0291-K-000020

Era Laboratories, Inc.
4730 Oneota Street Duluth MN 55807 Telephone: (218)727-6380 Fax: (218)727-3049

Laboratory Report

Project Number:	059499
COC Number:	732742
Date Received:	11/4/2010
Report Date:	11/23/2010
ReportNumber:	103646

Sample ID: TRIB (C **Sample Date:** 10/29/2010 **SampleTime:** 13:30 **Matrix:** Water
Era Project Number: 059499-7

Parameter:		Results:	Units:	Analysis Date/Time:		Method:	DF:	LOD:	LOQ:	QC Comments:
pH - Lab		6.3	SU	11/5/2010	16:45	SM 4500-H+B-00 OL	1			
Sulfate		2.1	mg/L	11/12/2010	4:39	EPA 300.0 Rev 2.1	1	0.5	1.5	
Arsenic, Total	<	0.4	µg/L	11/12/2010	12:02	EPA 200.8 Rev 5.4	1	0.4	1	
Calcium, Total		2.9	mg/L	11/17/2010	12:00	EPA 200.7 Rev 4.4	1	0.05	0.17	
Cobalt, Total		1.2	µg/L	11/12/2010	12:02	EPA 200.8 Rev 5.4	1	0.4	1	
Copper, Total		10.4	µg/L	11/12/2010	12:02	EPA 200.8 Rev 5.4	1	0.4	1	
Hardness, Total (as CaCO3)		18.3	mg/L	11/17/2010	10:49	EPA 200.7 Rev. 4.4	1	0.3	1	
Iron, Total		0.77	mg/L	11/17/2010	10:07	EPA 200.7 Rev 4.4	1	0.01	0.04	
Magnesium, Total		2.68	mg/L	11/17/2010	12:00	EPA 200.7 Rev 4.4	1	0.05	0.17	
Mercury, Total	<	0.04	µg/L	11/11/2010	15:13	EPA 245.2	1	0.04	0.05	
Nickel, Total		12.4	µg/L	11/12/2010	12:02	EPA 200.8 Rev 5.4	1	0.4	1	

Receipt temperature within regulatory guidelines

MN Certification # 027-137-152

AMERICAN OVERSIGHT

DOI-19-0291-K-000021

Era Laboratories, Inc.
4730 Oneota Street Duluth MN 55807 Telephone: (218)727-6380 Fax: (218)727-3049

Laboratory Report

Project Number:	059499
COC Number:	732742
Date Received:	11/4/2010
Report Date:	11/23/2010
ReportNumber:	103646

Sample ID: TRIB (C **Sample Date:** 10/29/2010 **SampleTime:** 13:30 **Matrix:** Water
Era Project Number: 059499-8

Parameter:		Results:	Units:	Analysis Date/Time:		Method:	DF:	LOD:	LOQ:	QC Comments:
pH - Lab		6.3	SU	11/5/2010	16:45	SM 4500-H+B-00 OL	1			
Sulfate		1.8	mg/L	11/12/2010	6:30	EPA 300.0 Rev 2.1	1	0.5	1.5	
Arsenic, Total	<	0.4	µg/L	11/12/2010	12:06	EPA 200.8 Rev 5.4	1	0.4	1	
Calcium, Total		2.97	mg/L	11/17/2010	12:03	EPA 200.7 Rev 4.4	1	0.05	0.17	
Cobalt, Total		1.1	µg/L	11/12/2010	12:06	EPA 200.8 Rev 5.4	1	0.4	1	
Copper, Total		10.2	µg/L	11/12/2010	12:06	EPA 200.8 Rev 5.4	1	0.4	1	
Hardness, Total (as CaCO3)		18.7	mg/L	11/17/2010	10:49	EPA 200.7 Rev. 4.4	1	0.3	1	
Iron, Total		0.79	mg/L	11/17/2010	10:08	EPA 200.7 Rev 4.4	1	0.01	0.04	
Magnesium, Total		2.73	mg/L	11/17/2010	12:03	EPA 200.7 Rev 4.4	1	0.05	0.17	
Mercury, Total	<	0.04	µg/L	11/11/2010	15:13	EPA 245.2	1	0.04	0.05	
Nickel, Total		12.5	µg/L	11/12/2010	12:06	EPA 200.8 Rev 5.4	1	0.4	1	

Receipt temperature within regulatory guidelines

MN Certification # 027-137-152

AMERICAN OVERSIGHT
DOI-19-0291-K-000022

Era Laboratories, Inc.
4730 Oneota Street Duluth MN 55807 Telephone: (218)727-6380 Fax: (218)727-3049

Laboratory Report

Project Number: 059499
COC Number: 732742
Date Received: 11/4/2010
Report Date: 11/23/2010
ReportNumber: 103648

Sample ID: TRIB (C **Sample Date:** 10/29/2010 **SampleTime:** 13:30 **Matrix:** Water
Era Project Number: 059499-9

Parameter:		Results:	Units:	Analysis Date/Time:		Method:	DF:	LOD:	LOQ:	QC Comments:
pH - Lab, Filtered		6.6	SU	11/5/2010	16:45	SM 4500-H+B-00 OL	1			
Sulfate, Dissolved		2.2	mg/L	11/12/2010	6:45	EPA 300.0 Rev 2.1	1	0.5	1.5	
Arsenic, Dissolved	<	0.4	µg/L	11/12/2010	12:09	EPA 200.8 Rev 5.4	1	0.4	1	
Calcium, Dissolved		3	mg/L	11/17/2010	12:05	EPA 200.7 Rev 4.4	1	0.05	0.17	
Cobalt, Dissolved		1	µg/L	11/12/2010	12:09	EPA 200.8 Rev 5.4	1	0.4	1	
Copper, Dissolved		9.9	µg/L	11/12/2010	12:09	EPA 200.8 Rev 5.4	1	0.4	1	
Hardness, Dissolved (as CaCO3)		18.8	mg/L	11/17/2010	10:49	EPA 200.7 Rev. 4.4	1	0.3	1	
Iron, Dissolved		0.49	mg/L	11/17/2010	10:10	EPA 200.7 Rev 4.4	1	0.01	0.04	
Magnesium, Dissolved		2.74	mg/L	11/17/2010	12:05	EPA 200.7 Rev 4.4	1	0.05	0.17	
Mercury, Dissolved	<	0.04	µg/L	11/11/2010	15:13	EPA 245.2	1	0.04	0.05	
Nickel, Dissolved		13.8	µg/L	11/12/2010	12:09	EPA 200.8 Rev 5.4	1	0.4	1	

Receipt temperature within regulatory guidelines

MN Certification # 027-137-152

AMERICAN OVERSIGHT

DOI-19-0291-K-000023

Era Laboratories, Inc.
4730 Oneota Street Duluth MN 55807 Telephone: (218)727-6380 Fax: (218)727-3049

Laboratory Report

Project Number: 059499
COC Number: 732742
Date Received: 11/4/2010
Report Date: 11/23/2010
ReportNumber: 103646

Sample ID: FILSON DS **Sample Date:** 10/29/2010 **SampleTime:** 14:00 **Matrix:** Water
Era Project Number: 059499-10

Parameter:		Results:	Units:	Analysis Date/Time:		Method:	DF:	LOD:	LOQ:	QC Comments:
pH - Lab		6.2	SU	11/5/2010	16:45	SM 4500-H+B-00 OL	1			
Sulfate		1.4	mg/L	11/12/2010	7:00	EPA 300.0 Rev 2.1	1	0.5	1.5	J
Arsenic, Total		0.4	µg/L	11/12/2010	12:13	EPA 200.8 Rev 5.4	1	0.4	1	J
Calcium, Total		3.26	mg/L	11/17/2010	12:07	EPA 200.7 Rev 4.4	1	0.05	0.17	
Cobalt, Total		0.9	µg/L	11/12/2010	12:13	EPA 200.8 Rev 5.4	1	0.4	1	J
Copper, Total		6.4	µg/L	11/12/2010	12:13	EPA 200.8 Rev 5.4	1	0.4	1	
Hardness, Total (as CaCO3)		18.1	mg/L	11/17/2010	10:49	EPA 200.7 Rev. 4.4	1	0.3	1	
Iron, Total		1.06	mg/L	11/17/2010	10:12	EPA 200.7 Rev 4.4	1	0.01	0.04	
Magnesium, Total		2.41	mg/L	11/17/2010	12:07	EPA 200.7 Rev 4.4	1	0.05	0.17	
Mercury, Total	<	0.04	µg/L	11/11/2010	15:13	EPA 245.2	1	0.04	0.05	
Nickel, Total		5.2	µg/L	11/12/2010	12:13	EPA 200.8 Rev 5.4	1	0.4	1	

Receipt temperature within regulatory guidelines

MN Certification # 027-137-152

AMERICAN OVERSIGHT

DOI-19-0291-K-000024

Era LABS Era Laboratories, Inc.
4730 Oneota Street Duluth MN 55807 Telephone: (218)727-6380 Fax: (218)727-3049

Laboratory Report

Project Number:	059499
COC Number:	732742
Date Received:	11/4/2010
Report Date:	11/23/2010
ReportNumber:	103646

Sample ID: FILSON DS **Sample Date:** 10/29/2010 **SampleTime:** 14:00 **Matrix:** Water
Era Project Number: 059499-11

Parameter:		Results:	Units:	Analysis Date/Time:		Method:	DF:	LOD:	LOQ:	QC Comments:
pH - Lab		6.2	SU	11/5/2010	16:45	SM 4500-H+B-00 OL	1			
Sulfate		1.4	mg/L	11/12/2010	7:15	EPA 300.0 Rev 2.1	1	0.5	1.5	J
Arsenic, Total	<	0.4	µg/L	11/12/2010	12:17	EPA 200.8 Rev 5.4	1	0.4	1	
Calcium, Total		3.16	mg/L	11/17/2010	12:14	EPA 200.7 Rev 4.4	1	0.05	0.17	
Cobalt, Total		1	µg/L	11/12/2010	12:17	EPA 200.8 Rev 5.4	1	0.4	1	
Copper, Total		6.4	µg/L	11/12/2010	12:17	EPA 200.8 Rev 5.4	1	0.4	1	
Hardness, Total (as CaCO3)		17.7	mg/L	11/17/2010	10:49	EPA 200.7 Rev. 4.4	1	0.3	1	
Iron, Total		1.07	mg/L	11/17/2010	10:17	EPA 200.7 Rev 4.4	1	0.01	0.04	
Magnesium, Total		2.38	mg/L	11/17/2010	12:14	EPA 200.7 Rev 4.4	1	0.05	0.17	
Mercury, Total	<	0.04	µg/L	11/11/2010	15:13	EPA 245.2	1	0.04	0.05	
Nickel, Total		5.1	µg/L	11/12/2010	12:17	EPA 200.8 Rev 5.4	1	0.4	1	

Receipt temperature within regulatory guidelines

MN Certification # 027-137-152

AMERICAN OVERSIGHT

DOI-19-0291-K-000025

Era Laboratories, Inc.
4730 Oneota Street Duluth MN 55807 Telephone: (218)727-6380 Fax: (218)727-3049

Laboratory Report

Project Number:	059499
COC Number:	732742
Date Received:	11/4/2010
Report Date:	11/23/2010
ReportNumber:	103646

Sample ID: FILSON DS **Sample Date:** 10/29/2010 **SampleTime:** 14:00 **Matrix:** Water

Era Project Number: 059499-12

Parameter:		Results:	Units:	Analysis Date/Time:		Method:	DF:	LOD:	LOQ:	QC Comments:
pH - Lab, Filtered		6.4	SU	11/5/2010	16:45	SM 4500-H+B-00 OL	1			
Sulfate, Dissolved		1.4	mg/L	11/12/2010	7:30	EPA 300.0 Rev 2.1	1	0.5	1.5	J
Arsenic, Dissolved	<	0.4	µg/L	11/12/2010	12:20	EPA 200.8 Rev 5.4	1	0.4	1	
Calcium, Dissolved		3.2	mg/L	11/17/2010	12:16	EPA 200.7 Rev 4.4	1	0.05	0.17	
Cobalt, Dissolved		1	µg/L	11/12/2010	12:20	EPA 200.8 Rev 5.4	1	0.4	1	
Copper, Dissolved		6	µg/L	11/12/2010	12:20	EPA 200.8 Rev 5.4	1	0.4	1	
Hardness, Dissolved (as CaCO3)		17.9	mg/L	11/17/2010	10:49	EPA 200.7 Rev. 4.4	1	0.3	1	
Iron, Dissolved		0.51	mg/L	11/17/2010	10:19	EPA 200.7 Rev 4.4	1	0.01	0.04	
Magnesium, Dissolved		2.4	mg/L	11/17/2010	12:16	EPA 200.7 Rev 4.4	1	0.05	0.17	
Mercury, Dissolved	<	0.04	µg/L	11/11/2010	15:13	EPA 245.2	1	0.04	0.05	
Nickel, Dissolved		7.3	µg/L	11/12/2010	12:20	EPA 200.8 Rev 5.4	1	0.4	1	

Receipt temperature within regulatory guidelines

MN Certification # 027-137-152

AMERICAN OVERSIGHT

DOI-19-0291-K-000026

Era Laboratories, Inc.
4730 Oneota Street Duluth MN 55807 Telephone: (218)727-6380 Fax: (218)727-3049

Laboratory Report

Project Number:	059499
COC Number:	732742
Date Received:	11/4/2010
Report Date:	11/23/2010
ReportNumber:	103646

Sample ID: FILSON GAGE **Sample Date:** 10/29/2010 **SampleTime:** 14:30 **Matrix:** Water
Era Project Number: 059499-13

Parameter:		Results:	Units:	Analysis Date/Time:		Method:	DF:	LOD:	LOQ:	QC Comments:
pH - Lab		6.2	SU	11/5/2010	16:45	SM 4500-H+B-00 OL	1			
Sulfate		1.1	mg/L	11/12/2010	7:45	EPA 300.0 Rev 2.1	1	0.5	1.5	J
Arsenic, Total		0.4	µg/L	11/12/2010	12:32	EPA 200.8 Rev 5.4	1	0.4	1	J
Calcium, Total		3.18	mg/L	11/17/2010	12:18	EPA 200.7 Rev 4.4	1	0.05	0.17	
Cobalt, Total		0.9	µg/L	11/12/2010	12:32	EPA 200.8 Rev 5.4	1	0.4	1	J
Copper, Total		5.5	µg/L	11/12/2010	12:32	EPA 200.8 Rev 5.4	1	0.4	1	
Hardness, Total (as CaCO3)		17.7	mg/L	11/17/2010	10:49	EPA 200.7 Rev. 4.4	1	0.3	1	
Iron, Total		0.96	mg/L	11/17/2010	10:20	EPA 200.7 Rev 4.4	1	0.01	0.04	
Magnesium, Total		2.36	mg/L	11/17/2010	12:18	EPA 200.7 Rev 4.4	1	0.05	0.17	
Mercury, Total	<	0.04	µg/L	11/11/2010	15:13	EPA 245.2	1	0.04	0.05	
Nickel, Total		3.9	µg/L	11/12/2010	12:32	EPA 200.8 Rev 5.4	1	0.4	1	

Receipt temperature within regulatory guidelines

MN Certification # 027-137-152

AMERICAN OVERSIGHT
DOI-19-0291-K-000027

Era Laboratories, Inc.
4730 Oneota Street Duluth MN 55807 Telephone: (218)727-6360 Fax: (218)727-3049

Laboratory Report

Project Number:	059499
COC Number:	732742
Date Received:	11/4/2010
Report Date:	11/23/2010
ReportNumber:	103646

Sample ID: FILSON GAGE **Sample Date:** 10/29/2010 **SampleTime:** 14:30 **Matrix:** Water
Era Project Number: 059499-14

Parameter:		Results:	Units:	Analysis Date/Time:		Method:	DF:	LOD:	LOQ:	QC Comments:
pH - Lab		6.2	SU	11/5/2010	16:45	SM 4500-H+B-00 OL	1			
Sulfate		1.4	mg/L	11/12/2010	8:01	EPA 300.0 Rev 2.1	1	0.5	1.5	J
Arsenic, Total		0.4	µg/L	11/12/2010	12:36	EPA 200.8 Rev 5.4	1	0.4	1	J
Calcium, Total		3.22	mg/L	11/17/2010	12:20	EPA 200.7 Rev 4.4	1	0.05	0.17	
Cobalt, Total		0.9	µg/L	11/12/2010	12:36	EPA 200.8 Rev 5.4	1	0.4	1	J
Copper, Total		5.3	µg/L	11/12/2010	12:36	EPA 200.8 Rev 5.4	1	0.4	1	
Hardness, Total (as CaCO3)		17.9	mg/L	11/17/2010	10:49	EPA 200.7 Rev. 4.4	1	0.3	1	
Iron, Total		1.04	mg/L	11/17/2010	10:22	EPA 200.7 Rev 4.4	1	0.01	0.04	
Magnesium, Total		2.4	mg/L	11/17/2010	12:20	EPA 200.7 Rev 4.4	1	0.05	0.17	
Mercury, Total	<	0.04	µg/L	11/11/2010	15:13	EPA 245.2	1	0.04	0.05	
Nickel, Total		3.9	µg/L	11/12/2010	12:36	EPA 200.8 Rev 5.4	1	0.4	1	

Receipt temperature within regulatory guidelines

MN Certification # 027-137-152

AMERICAN OVERSIGHT

DOI-19-0291-K-000028

Era LABS
Era Laboratories, Inc.
4730 Oneota Street Duluth MN 55807 Telephone: (218)727-6380 Fax: (218)727-3049

Laboratory Report

Project Number: 059499
COC Number: 732742
Date Received: 11/4/2010
Report Date: 11/23/2010
ReportNumber: 103646

Sample ID: FILSON GAGE **Sample Date:** 10/29/2010 **SampleTime:** 14:30 **Matrix:** Water
Era Project Number: 059499-15

Parameter:		Results:	Units:	Analysis Date/Time:		Method:	DF:	LOD:	LOQ:	QC Comments:
pH - Lab, Filtered		6.4	SU	11/5/2010	16:45	SM 4500-H+B-00 OL	1			
Sulfate, Dissolved		1.3	mg/L	11/12/2010	8:16	EPA 300.0 Rev 2.1	1	0.5	1.5	J
Arsenic, Dissolved	<	0.4	µg/L	11/12/2010	12:40	EPA 200.8 Rev 5.4	1	0.4	1	
Calcium, Dissolved		3.11	mg/L	11/17/2010	12:23	EPA 200.7 Rev 4.4	1	0.05	0.17	
Cobalt, Dissolved		0.9	µg/L	11/12/2010	12:40	EPA 200.8 Rev 5.4	1	0.4	1	J
Copper, Dissolved		5.2	µg/L	11/12/2010	12:40	EPA 200.8 Rev 5.4	1	0.4	1	
Hardness, Dissolved (as CaCO3)		17.4	mg/L	11/17/2010	10:49	EPA 200.7 Rev. 4.4	1	0.3	1	
Iron, Dissolved		0.48	mg/L	11/17/2010	10:24	EPA 200.7 Rev 4.4	1	0.01	0.04	
Magnesium, Dissolved		2.33	mg/L	11/17/2010	12:23	EPA 200.7 Rev 4.4	1	0.05	0.17	
Mercury, Dissolved	<	0.04	µg/L	11/11/2010	15:13	EPA 245.2	1	0.04	0.05	
Nickel, Dissolved		4.8	µg/L	11/12/2010	12:40	EPA 200.8 Rev 5.4	1	0.4	1	

Results are reported on an as received basis.

< Not detected. Less than LOD.

J Estimate. Result between LOD and LOQ.

Report Approved By:
Robert D. Magnuson
Lab Director
MN Certification # 027-137-152

Temperature upon arrival (°C): 3.2
Receipt temperature within regulatory guidelines

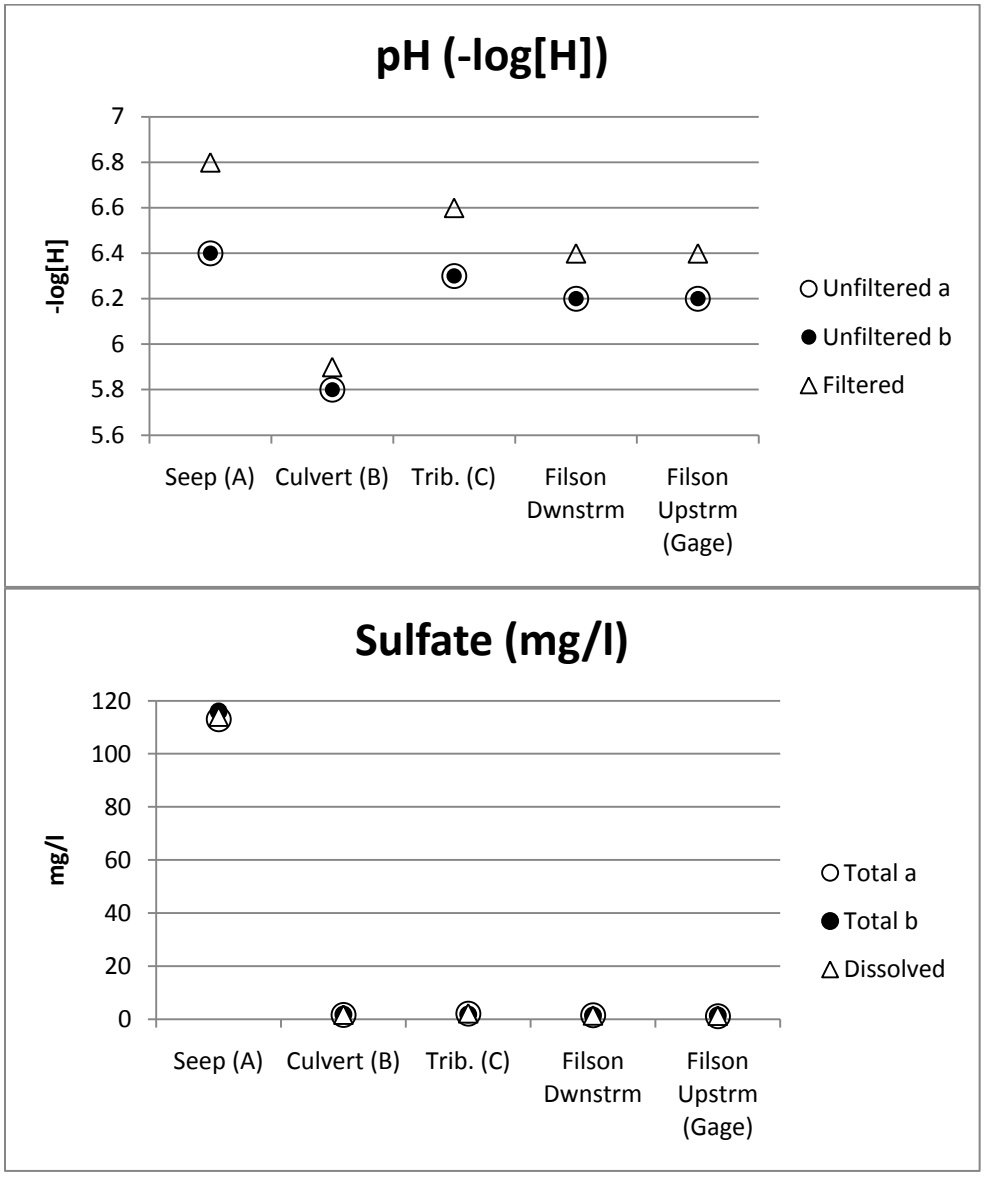
Test results in this report relate only to the samples received on the dates indicated. This report must not be reproduced, except in full, without the written approval from Era Laboratories, Inc. All tests were performed in-house by Era Labs.

AMERICAN OVERSIGHT
DOI-19-0291-K-000029

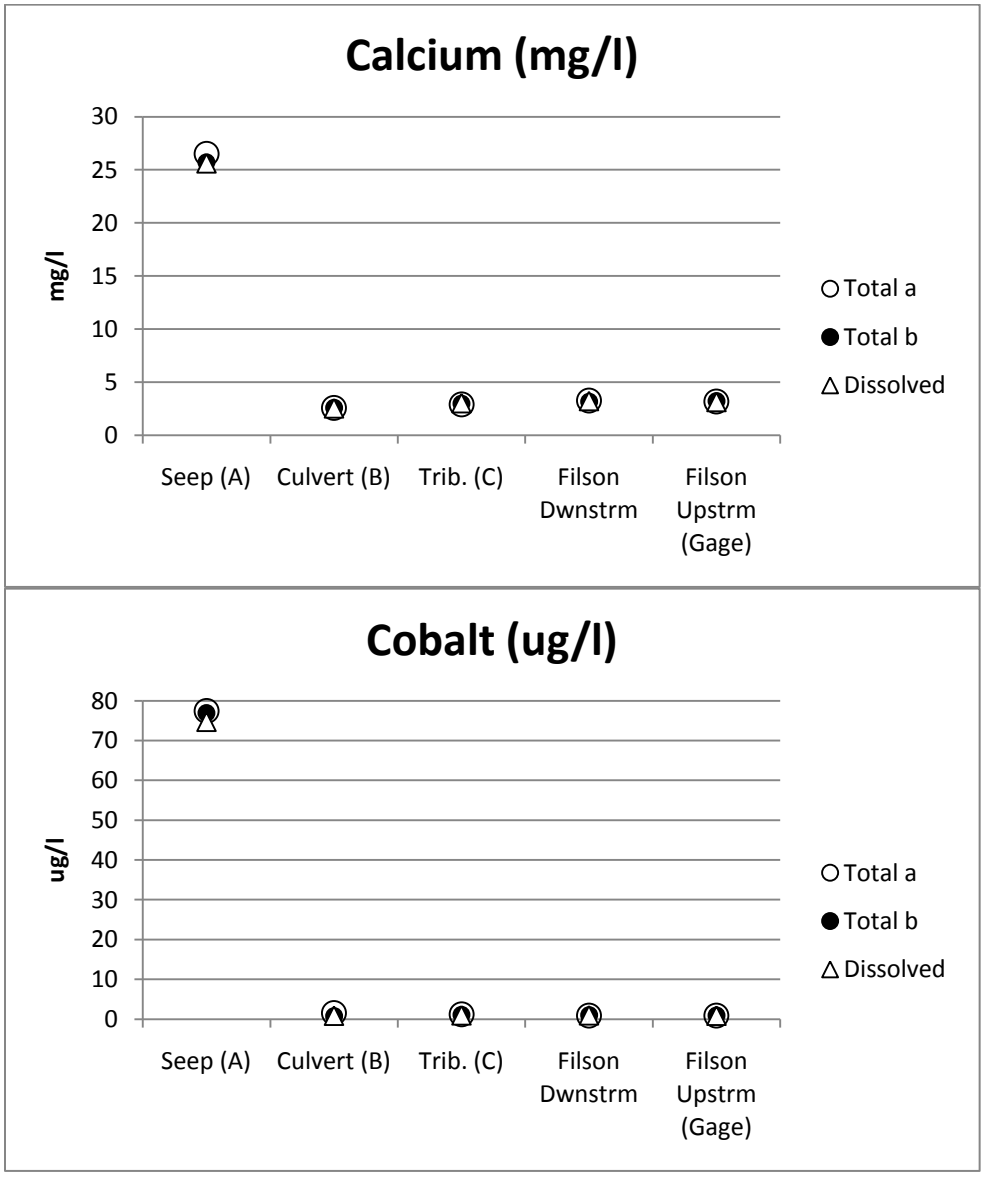
Appendix 3a:

Graphs for surface water samples taken at
Spruce Road Bulk Sample Sites on 10-29-2010. Each symbol represents a sample point; circles represent unfiltered (total) samples and triangles represent filtered (dissolved) samples.

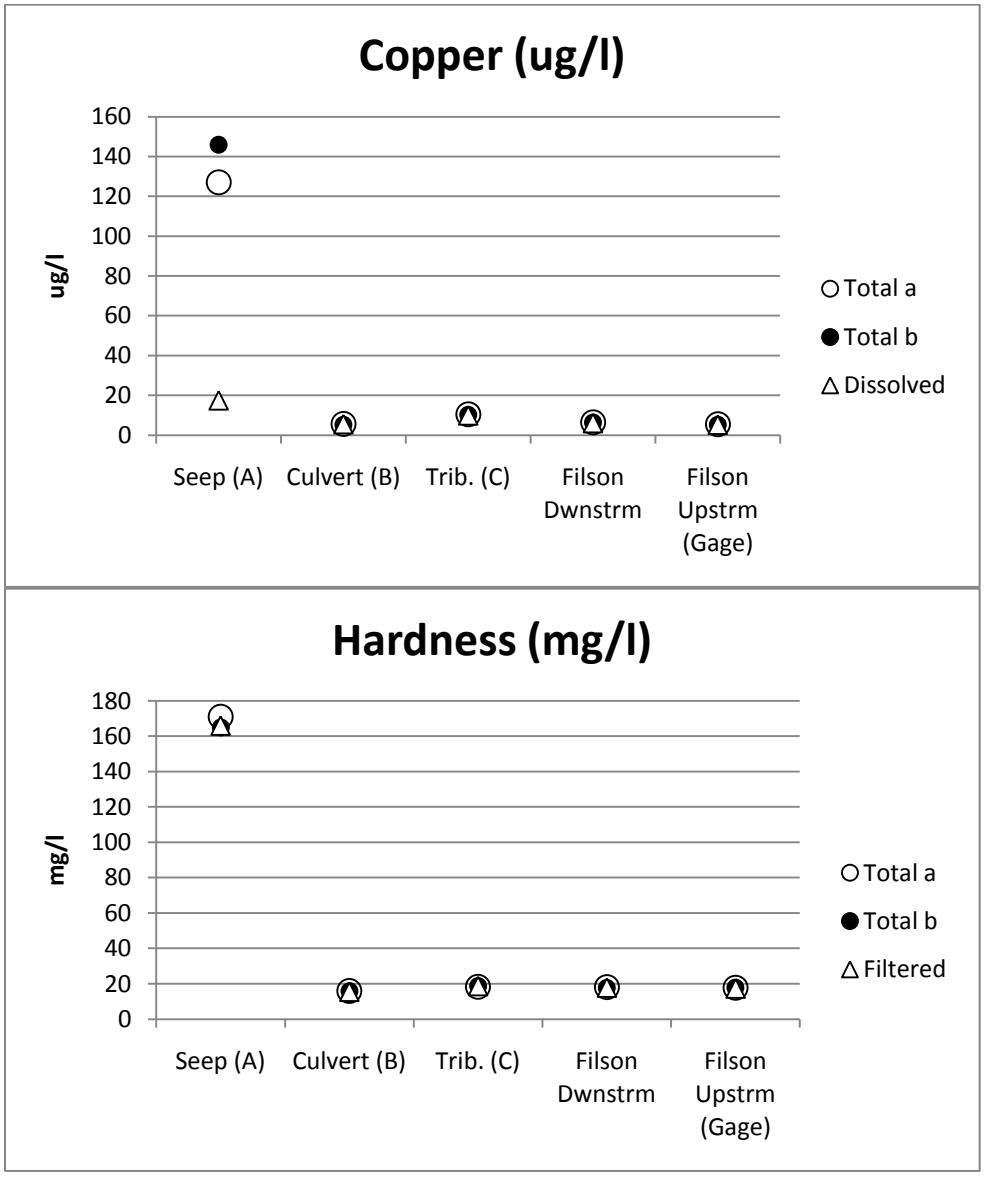
AMERICAN OVERSIGHT



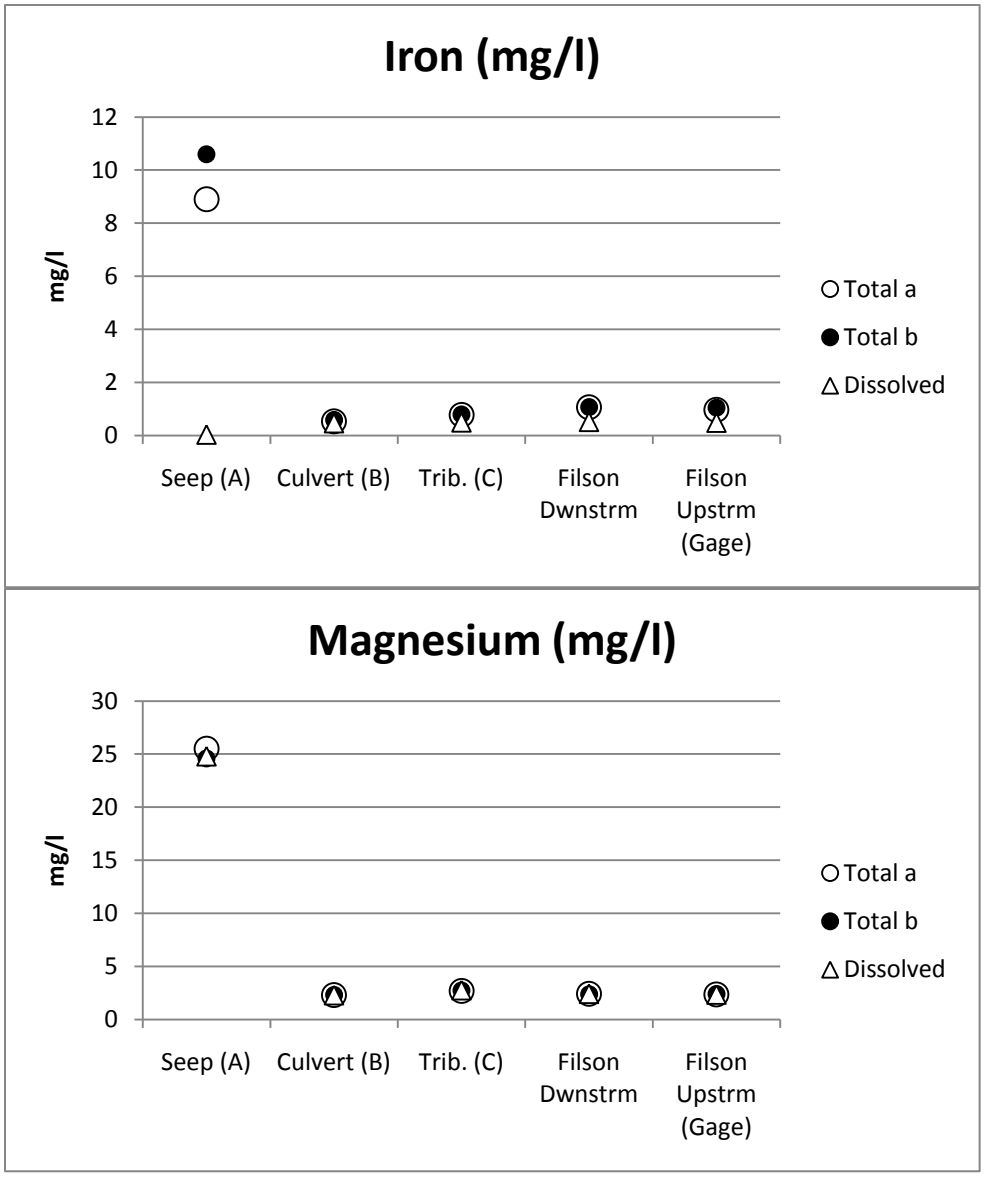
AMERICAN OVERSIGHT



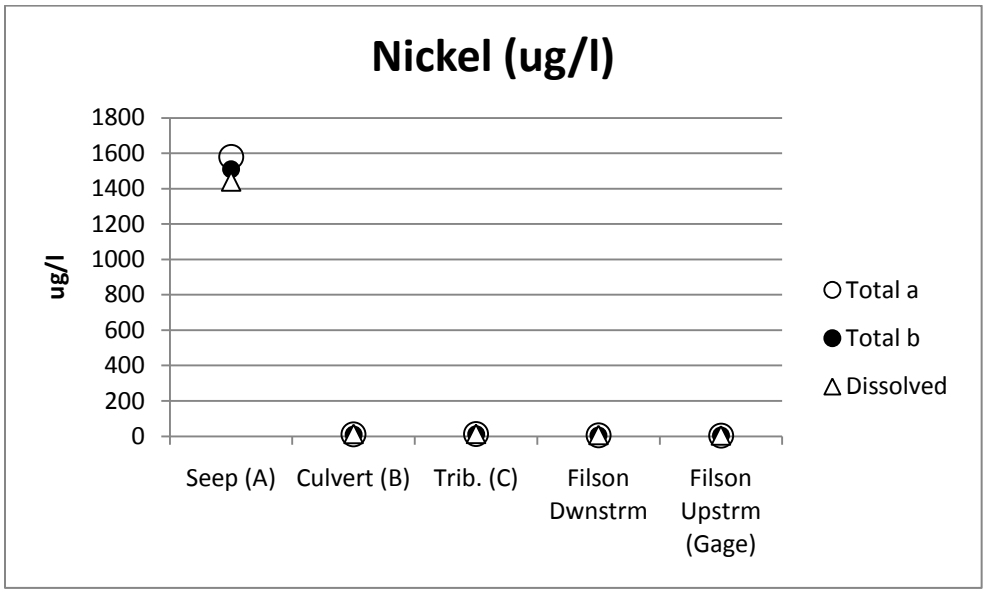
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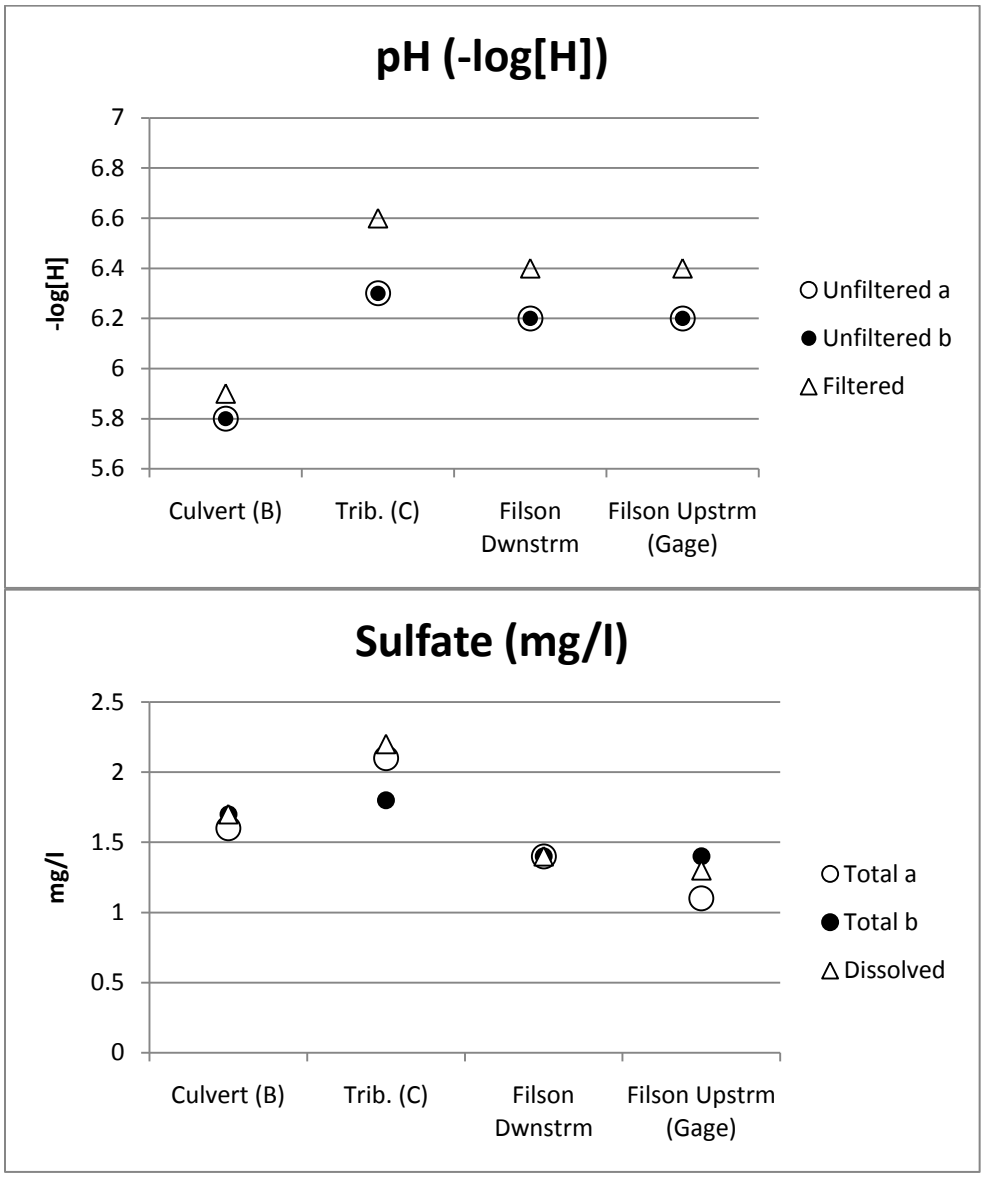


AMERICAN OVERSIGHT

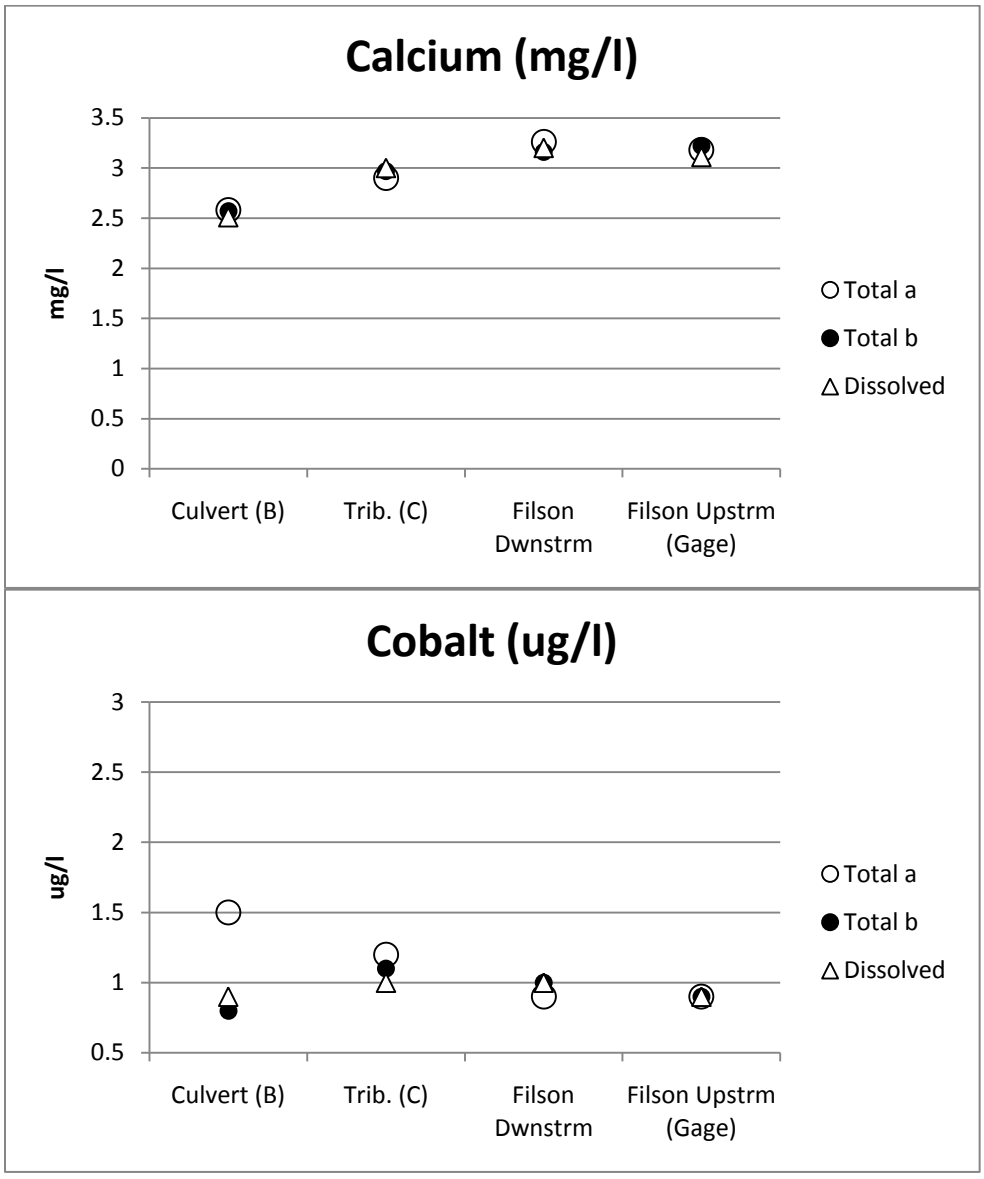
Appendix 3b:

Graphs for surface water samples taken at the Spruce Road Bulk Sample Site on 10-29-2010. Each symbol represents a sample point; circles represent unfiltered (total) samples and triangles represent filtered (dissolved) samples. Seep data was not plotted for scale. When present, a red line denotes the water quality standard for a chemical constituent (Class 2B waters of the state; aquatic life and recreation).

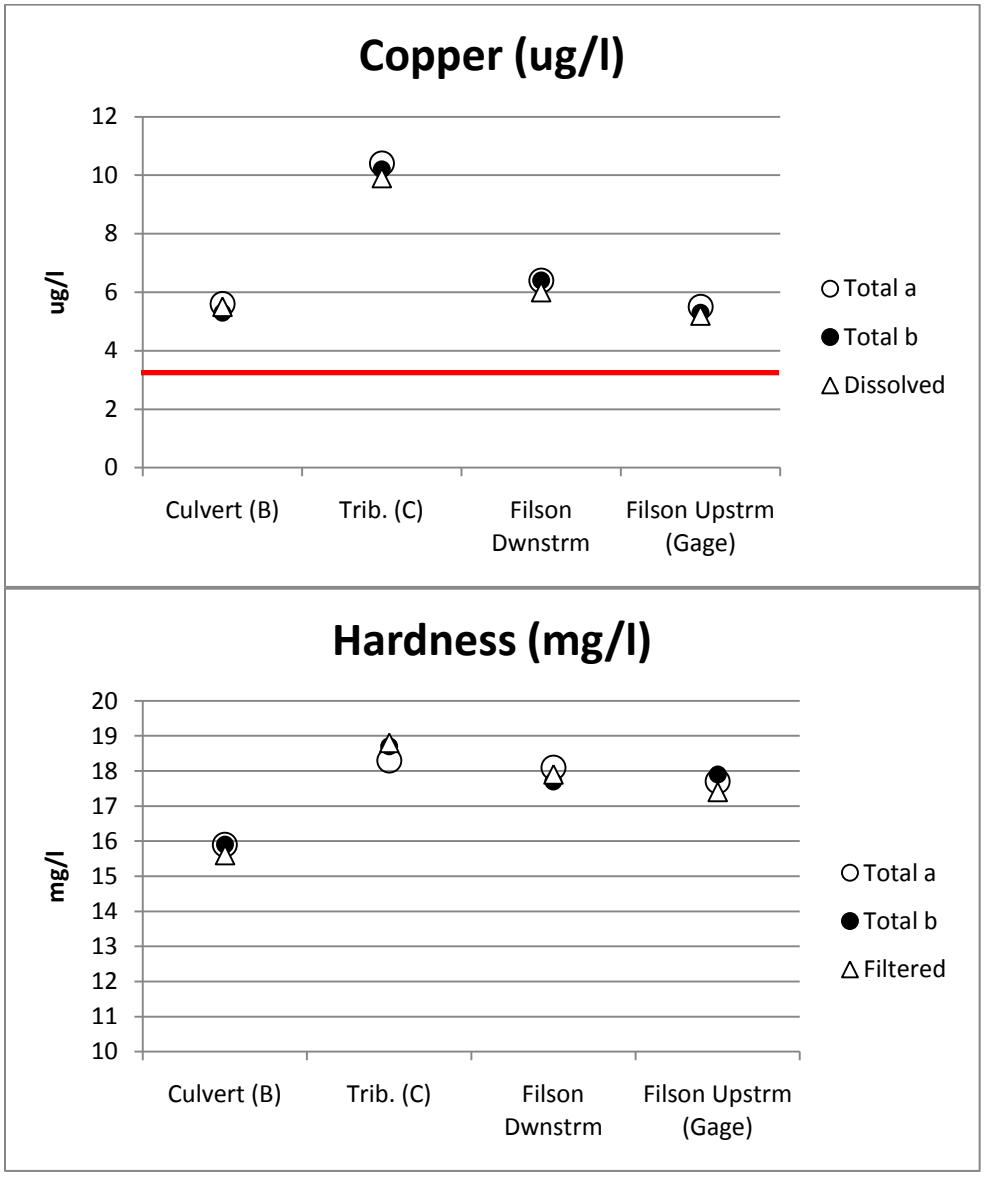
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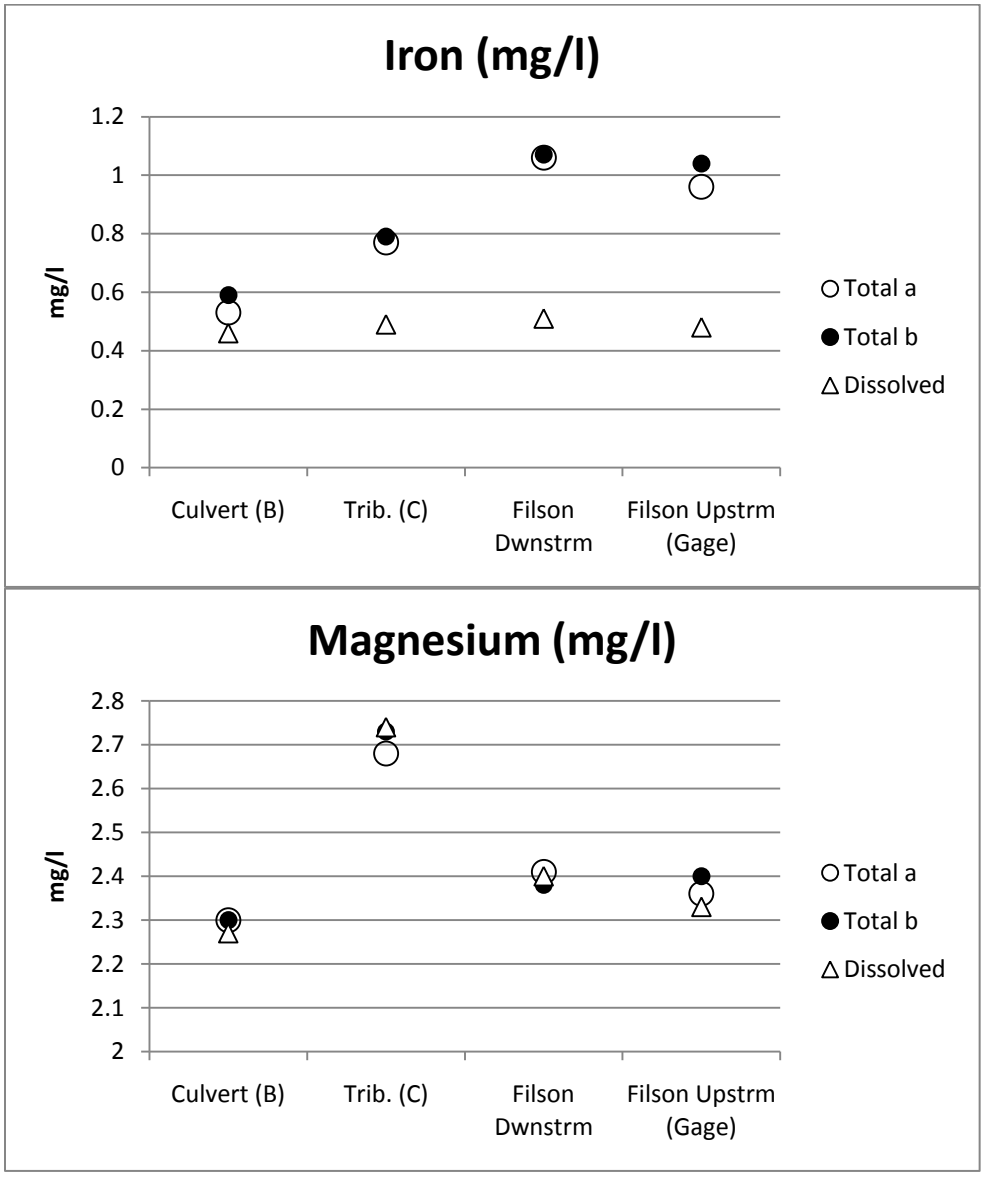
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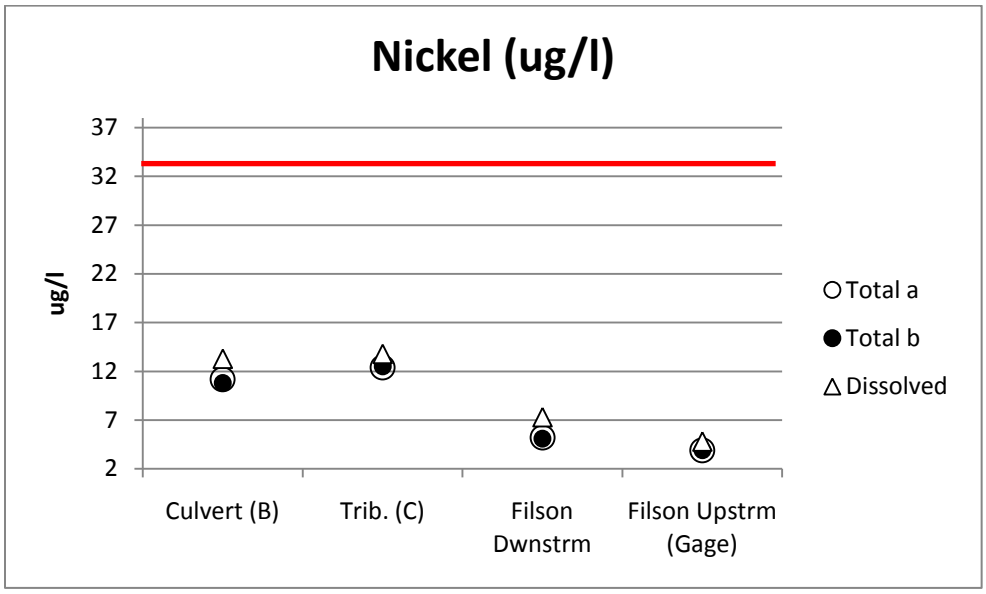
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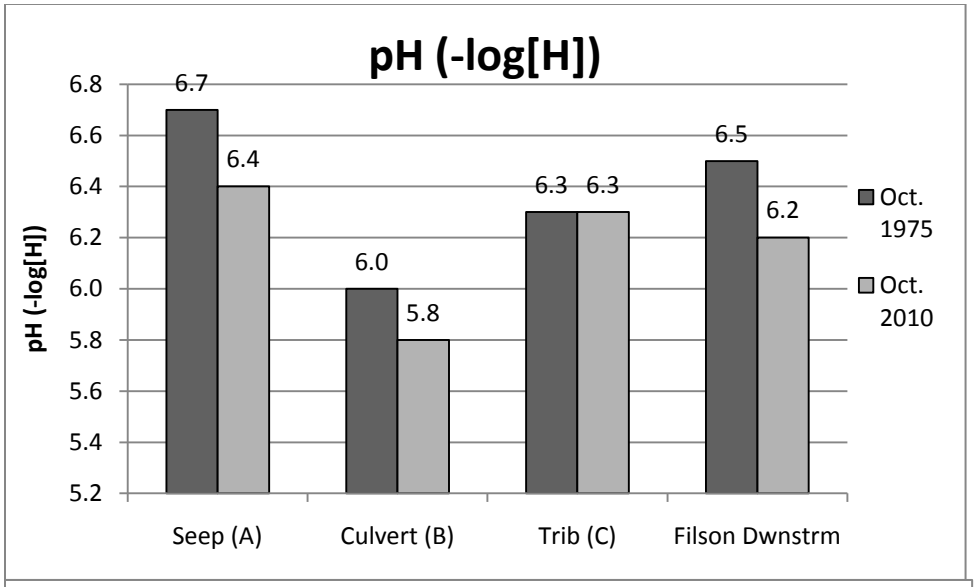
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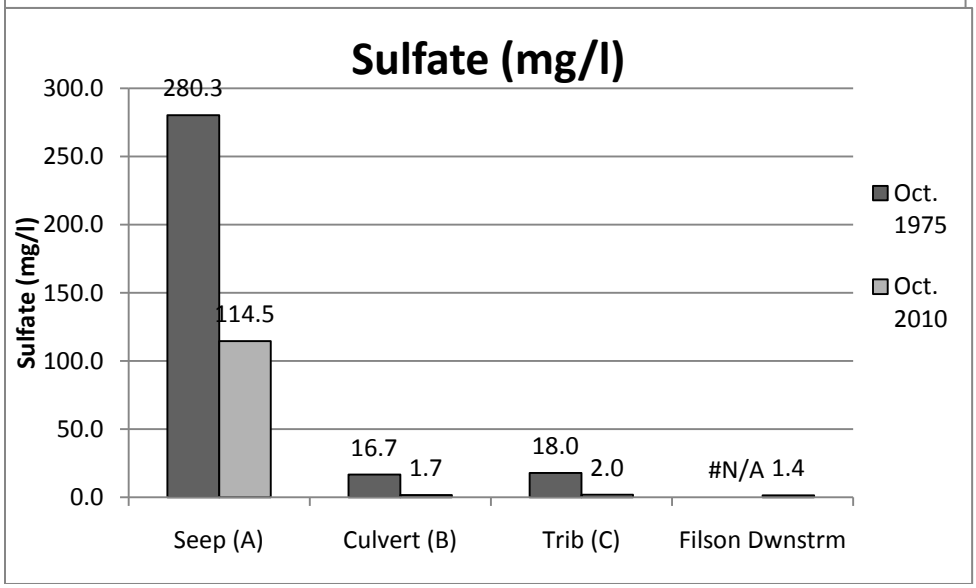
Appendix 4:

Graphs for surface water samples taken at
Spruce Road Bulk Sample Sites comparing chemical constituents during
October, 1975 (n=3) and October, 2010 (n=2).

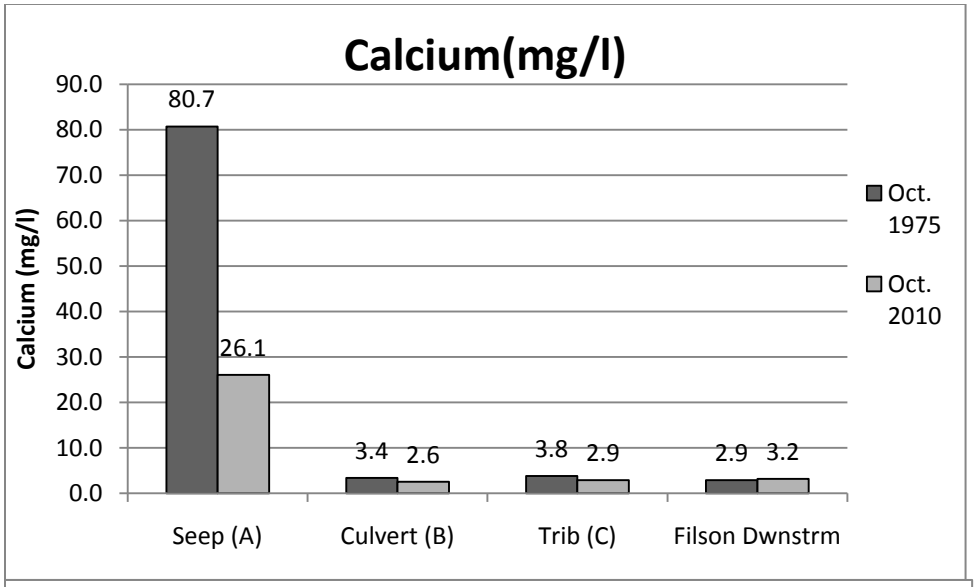
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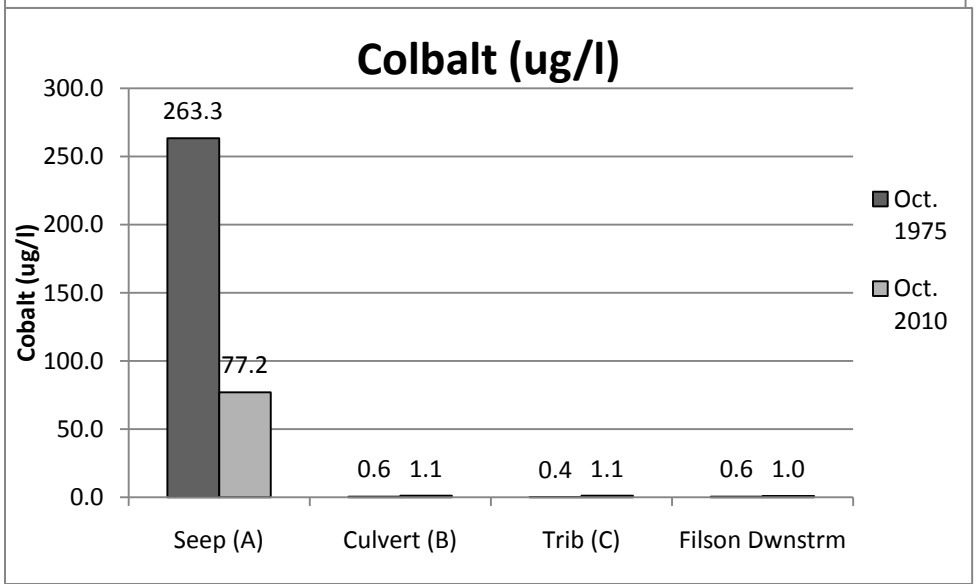
DOI-19-0291-K-000042



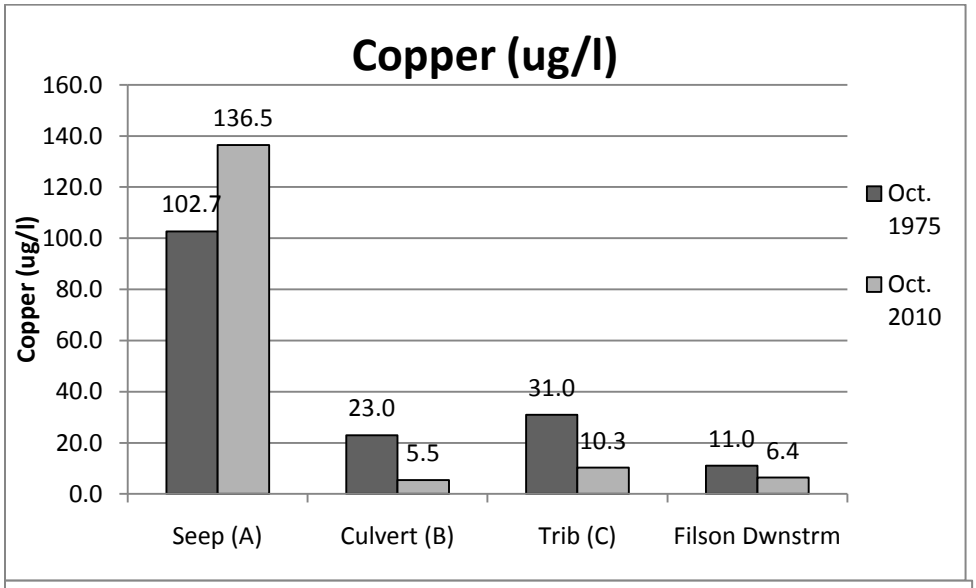


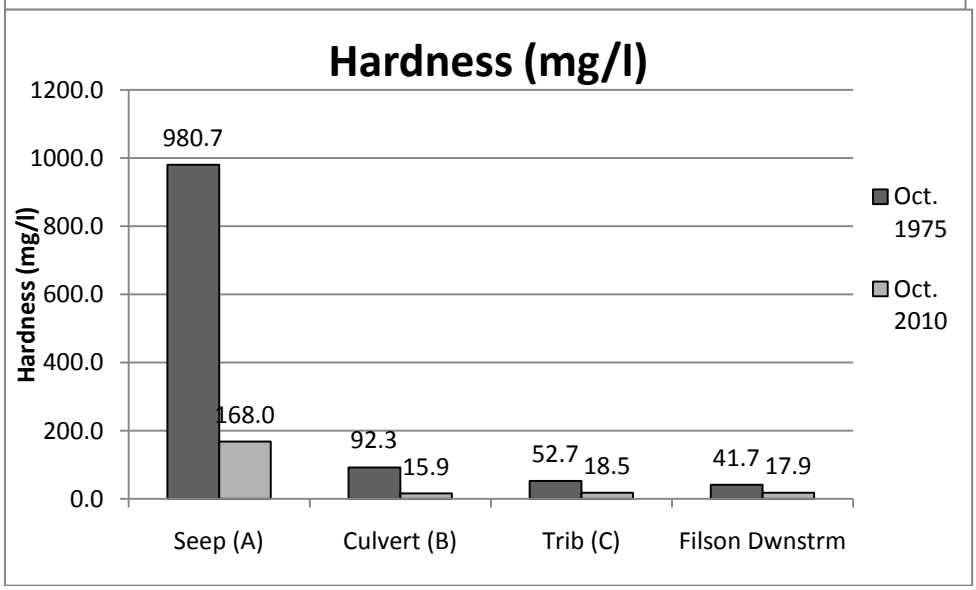
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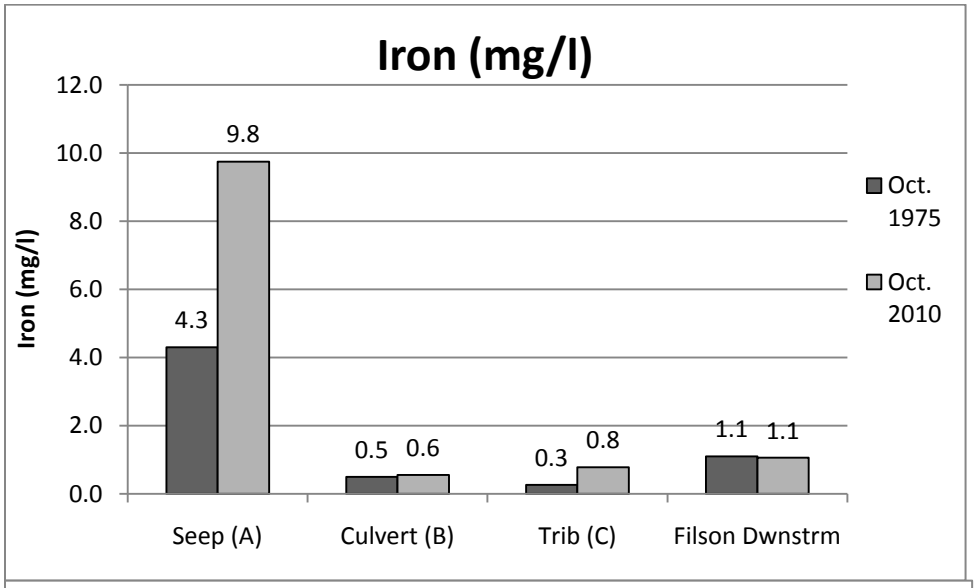


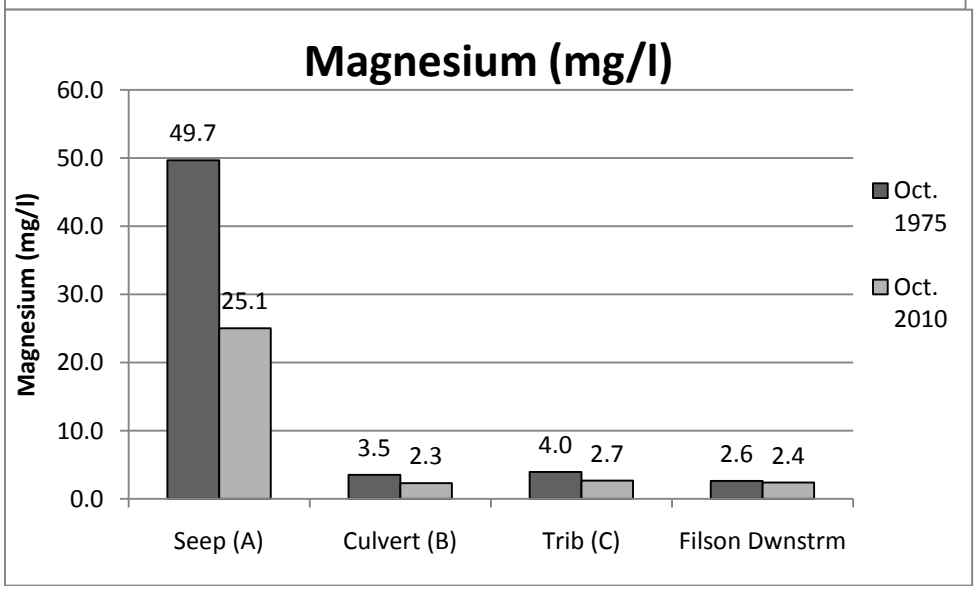
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Appendix 5:

Flow Rates of Spruce Road Bulk Sample Seep, Tributary to Filson Creek at Spruce Road, and Filson Creek at Spruce Road on 10/29/2010.

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Interoffice Memo

Date: 2/2/2011

To: Jason Butcher, SNF Aquatic Ecologist

From: Marty E. Rye, P.E.
Superior National Forest Hydrologist

RE: Flow Rates of Spruce Road Bulk Sample Seep, Tributary to Filson Creek at Spruce Road, and Filson Creek at Spruce Road on 10/29/2010

Summary

Water quality samples were collected from the Spruce Road Bulk Sample Seep, the Tributary to Filson Creek at Spruce Road, and Filson Creek at Spruce Road on 10/29/2010. In order to convert concentrations to loading rates the flow or discharge is needed. The discharge rate at the seep was directly measured and there is a continuously recording flow gage at Filson Creek at Spruce Road that is maintained by the Minnesota Department of Natural Resources (MnDNR). Flow within the Tributary to Filson Creek at Spruce Road was estimated based upon observed conditions and a flow ratio with Filson Creek established by previous flow measurements. The flow rates at these locations are summarized below in Table 1.

Table 1. Comparison of Discharge Rates on 10/29/2010

	Spruce Road Bulk Sample Seep	**Tributary to Filson Creek at Spruce Road**	**Filson Creek at Spruce Road**
Discharge Rate [1,2]	**0.00009 cfs** *(.04 gpm)*	**0.07 cfs** *(31 gpm)*	**2.99 cfs** *(1,342 gpm)*
Computed Ratio to Tributary to *Filson Creek* Discharge	-----	1 :1	43 :1
Computed Ratio to *Seep* Discharge	1 :1	778 :1	33,222 : 1
% of Filson Creek Flow Downstream of Confluence with Tributary ***(assuming total = 2.99+0.07 = 3.06 cfs)***	0.003%	2.3%	97.7%

(1) cfs = cubic feet per second (2) gpm = gallons per minute

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Methods and Results

Seep

The discharge at the seep was directly measured as 160ml in a minute. Only one measurement was taken using a graduated bottle. This translates to:

(160~~ml~~/~~minute~~) * (1 ~~minute~~ / 60 sec) * (1 cubic ft / 28,317 ~~ml~~) = 0.00009 cfs, *or*

(160~~ml~~/minute) * (1 gallon / 3,785 ~~ml~~) = 0.04 gpm

As a comparison a typical bathroom faucet will run at 2 gallons per minute. *So, it is approximately 1/50th or 2% of a running bathroom faucet*. Alternatively, at this rate it would take about 24 minutes to fill up a gallon bucket.

Tributary to Filson Creek

A water quality sample was collected from the Tributary to Filson Creek upstream of the Spruce Road Crossing. The A direct measurement of discharge was not made during the 10/29/2010 field visit. However, the discharge was indirectly estimated based upon four different methods:

1. Measurement of the headwater and tailwater at the culverts beneath Spruce Road
2. Mass balance of constituencies within Filson Creek
3. Comparison to historic measured flows and flow ratio with Filson Creek, and
4. Personal observation

The headwater and tailwater was measured at the culverts beneath Spruce Road. The crossing consists of twin 15-inch corrugated metal pipes (cmp's) beneath the roadway. A survey of these pipes was completed on 1/31/2011. The tailwater was observed to be below the inverts of the culverts on 10/29/2010 and was therefore considered a free discharge. Photos of the upstream and downstream ends of culverts are shown below in Figures 1 and 2.



Figure 1 – Upstream End
Unnamed Trib to Filson at Spruce Rd
HW ~ 0.7 ft, but likely clogged



Figure 2 – Downstream End
Unnamed Trib to Filson at Spruce Rd
Note: free discharge and magnitude of discharge << 1 cfs

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The headwater was measured to be 0.7 ft at the culverts (see Attachment A). The *computed* discharge rate for this condition is 1.7 cfs (see Attachment B). However, as shown in Figure 3 the observed flow is much less than 1.7 cfs. Some flow could be undermining the culvert outlet if the culvert has failed under the embankment. However, there was no observed failure and the observed flow downstream of the crossing remained much less than 1.7 cfs. Observation of flow conditions on 10/29/2010 at the confluence between the Tributary and Filson Creek confirms that the flow in the Tributary was not close to half of the flow in Filson Creek (estimated to be 2.99 cfs – see below). As a matter of comparison, the contributing watershed area for Fison Creek is approximately 35 times larger than the contributing drainage area for the Tributary. Hence, it is considered that there was internal blockage of the culvert that raised the headwater of the culvert. Observation of the upstream end of the culverts (see Figure 1) confirm the potential for blockage within the culvert. Thus, based upon these considerations the *computed* discharge rate based upon the measured culvert headwater is *rejected*.



Figure 3. Exploded view of downstream end of Spruce Road culverts

In addition, the flow was estimated using a mass balance within Filson Creek downstream of the mouth of the Tributary (see Appendix B). The results of this analysis did not compare well with the observed flow conditions as described above and shown in Figure 3. Coincidentally, the estimated flow using the mass balance is similar to the calculated flow using the culvert headwater. As described above, this is considered to be inconsistent with observed conditions and is rejected. If the estimated flow of 0.07 cfs (as estimated below using historic flow ratios – described below) is used in the mass balance analysis, the concentration constituents

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downstream of the mouth of the Tributary in Filson Creek would be less than the observed values. This discrepancy between the observed values and the computed values can be attributed to a combination of natural variability and uncertainty. There is some variability in the discharge rate, mixing zones, and local fluxes. In addition, there is some uncertainty because there is some additional flow that enters the system between the water quality sample locations and additional contact with surface material.

The fourth method used to estimate the flow in the Tributary is to compare the flow in Filson Creek based upon collected data in 1976. The flow in Filson Creek at the gage site upstream of Spruce Road for 10/29/2010 is reported as 2.99 cfs during the day by the MnDNR (see below). As shown in Attachment C the computed flow in the Tributary based upon comparison of values collected in 1976 range from 0.05 to 0.07 cfs. This is consistent with the observed magnitude of flow on 10/29/2010.

Based upon the analysis described above and field observations, it is estimated that the Tributary to Filson Creek at Spruce Road had a discharge of 0.07 cfs during the mid day of 10/29/2010. As a matter of comparison this correlates to:

(0.07 cubic feet / sec) * (448.8 gpm / cfs) = 31 gpm

It is estimated that the accuracy of this estimate is likely within 20% based upon other available measurements.

Filson Creek

As mentioned above there is a continuous recording gage at the sample site that is maintained by the Minnesota Department of Natural Resources (MnDNR). The flow was reported by the MnDNR as 2.99 cfs (see Attachment C).

As a matter of comparison this correlates to:

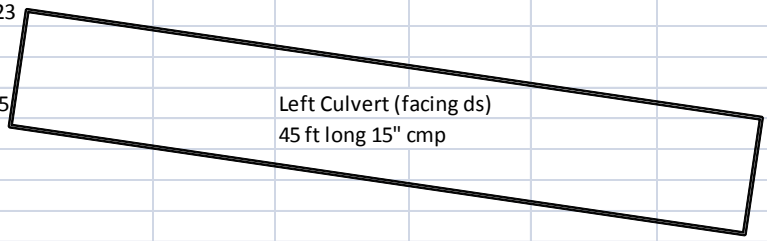
(2.99 cubic feet / sec) * (448.8 gpm / cfs) = 1,342 gpm

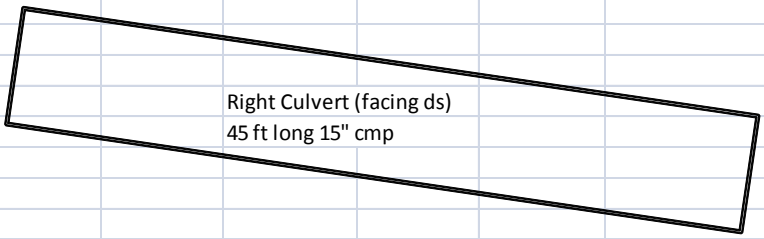
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Attachment A

Results of 1/31/2011 Survey of Spruce Road Culverts at Tributary to Filson Creek

Title of Survey:	Survey of culverts on Spruce Road at Unnamed Tributary to Filson Creek near Bulk Sample				
Date of Survey:	1/31/2011				
Personnel:	Notes: J. Garcia / Instrument: J. Garcia				
Instrument:	Laser level, stadia with mirror, and cloth tape				
Conditons:	Clear ~ 10°F				
Shot Description	**Backsight (BS)**	**Height of Instrument (HI)**	**Foresight (FS)**	**Elevation**	**Notes**
TBM1		108.21	8.21	100.00	Temporary Benchmark, downstream top of left 15-inch cmp culvert (facing downstream) - Assumed Benchmark
Upstream Top of Left Culvert	7.98			100.23	15- inch cmp measured 45 ft long
Invert Upstream Left Culvert	9.36			98.85	
Upstream Top of Right Culvert	8.02			100.19	15- inch cmp measured 45 ft long
Invert Upstream Right Culvert	9.39			98.82	
Downstream Top of Left Culvert	8.21			100.00	
Invert Downstream Left Culvert	9.46			98.75	
Downstream Top of Right Culvert	8.40			99.81	
Invert Downstream Right Culvert	9.55			98.66	
Top Centerline of Road	5.23			102.98	
Closure			8.21	108.21	check
		Centerline Road =	102.98		





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Attachment B - *Computed* Culvert Discharge at Tributary to Filson Creek

(1) Culvert Headwater Assuming No Blockage, and

(2) Mass Balance of Constituents in Filson Creek Downstream of Tributary

Flow Conditions on 10/29/2010 on Tributary to Filson Creek at Spruce Road

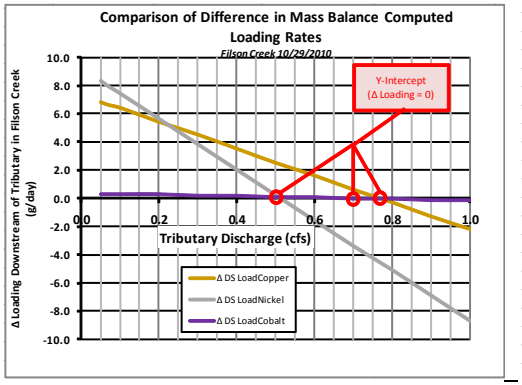
Measured by: M.Rye / E. Wirz using staff gage ("pocket rod")

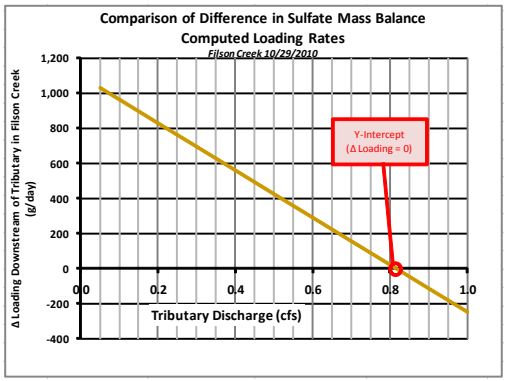
	HW Depth *10/29/2010* (ft)	HW Elevation *(based upon 1/31/2011 survey)*	TW Depth *10/29/2010* (ft)
Left Culvert	0.69	99.54	Free Discharge
Right Culvert	0.71	99.53	Free Discharge

Note: orientation of culverts is facing downstream

From Rating Curve:		
Q Left =	0.79	cfs
Q Right =	0.92	cfs
Total Computed =	1.70	cfs

*However, observations (see photo below) indicate the headwater elevation on the Q Left was due to blockage and there was very little flow in the left culvert. In addition, the discharge in the right culvert appears to be **much** less than the computed value of 0.9 cfs - likely also some blockage.*





NOTE: COMPUTED VALUES DID NOT CORRESPOND TO OBSERVED CONDITIONS AND WERE NOT USED FOR LOADING ANALYSIS

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Attachment C
Comparison of Measured Flows in 1976

TABLE II

Flow Ratios: Filson/Tributary

Date	Filson CFS	Tributary CFS	Ratio
4/13/76	74	1.76	42
5/5/76	17	.34	50
5/20/76	3.3	.09	37
6/22/76	14	.35	40
7/7/76	2.8	.03	93
7/20/76	.94	.02	47
8/5/76	.18	--	--

Figure C-1: Filson / Tributary Flow Values and Ratios from:
May 26, 1977 Spruce Road Bulk Sample Site Monitoring Results

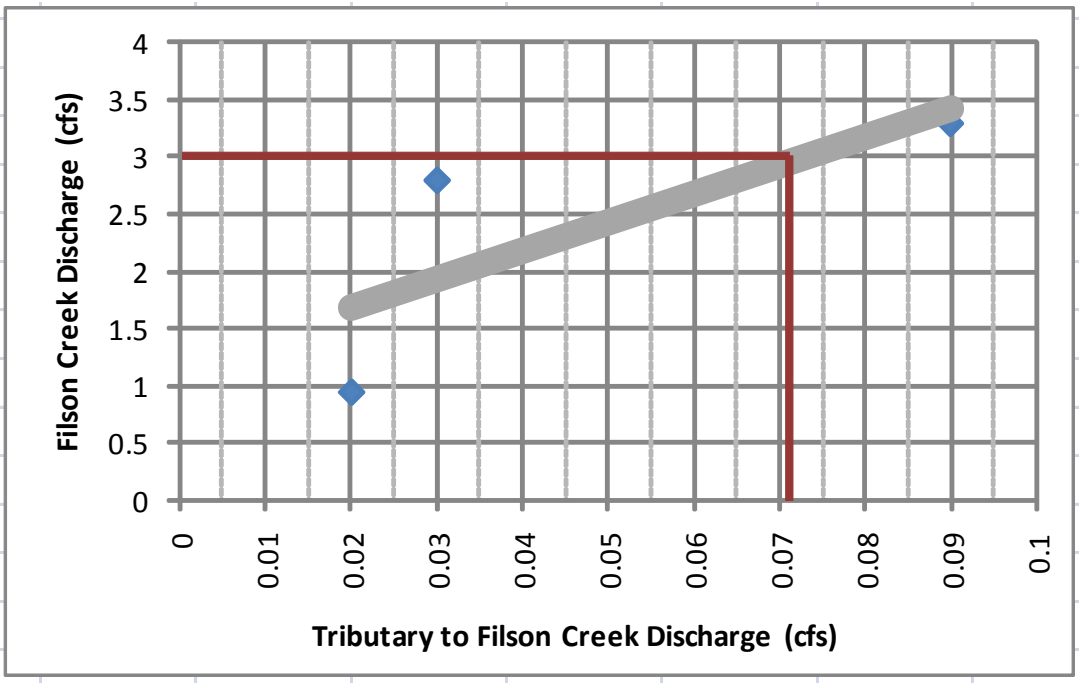


Figure C-2: Filson / Tributary Flow Ratios
Linear Trend Line developed using only Q_{Filson} <= 3.3 cfs
Based upon this analysis $Q_{Tributary}$ = 0.07cfs at Q_{Filson} = 2.99 cfs

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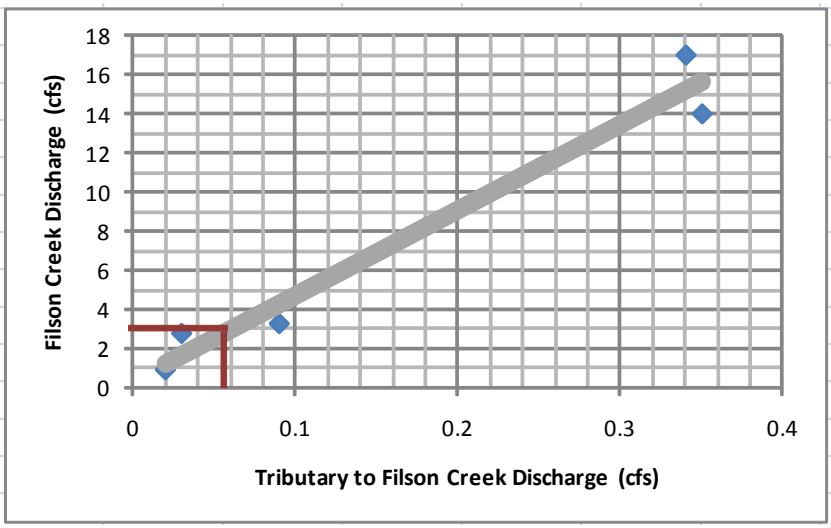


Figure C-3: Filson / Tributary Flow Ratios
Linear Trend Line developed using only Q_{Filson} <= 17 cfs
Based upon this analysis $Q_{Tributary}$ = 0.06 cfs at Q_{Filson} = 2.99 cfs

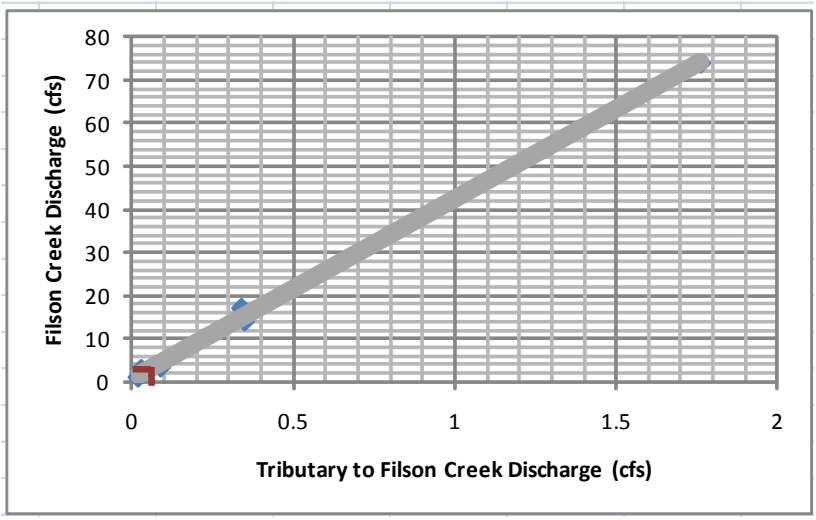


Figure C-4: Filson / Tributary Flow Ratios
Linear Trend Line developed using all 1976 data
Based upon this analysis $Q_{Tributary}$ = 0.05 cfs at Q_{Filson} =2.99 cfs

Alternatively, if simple linear interpolation is used between the two data points collected in 1976:

Q_{Filson} = 2.8 cfs $Q_{Tributary}$ = 0.03 cfs
Q_{Filson} = 3.3 cfs $Q_{Tributary}$ = 0.09 cfs

Then, $Q_{Tributary}$ at Q_{Filson} = 3.0 cfs is:

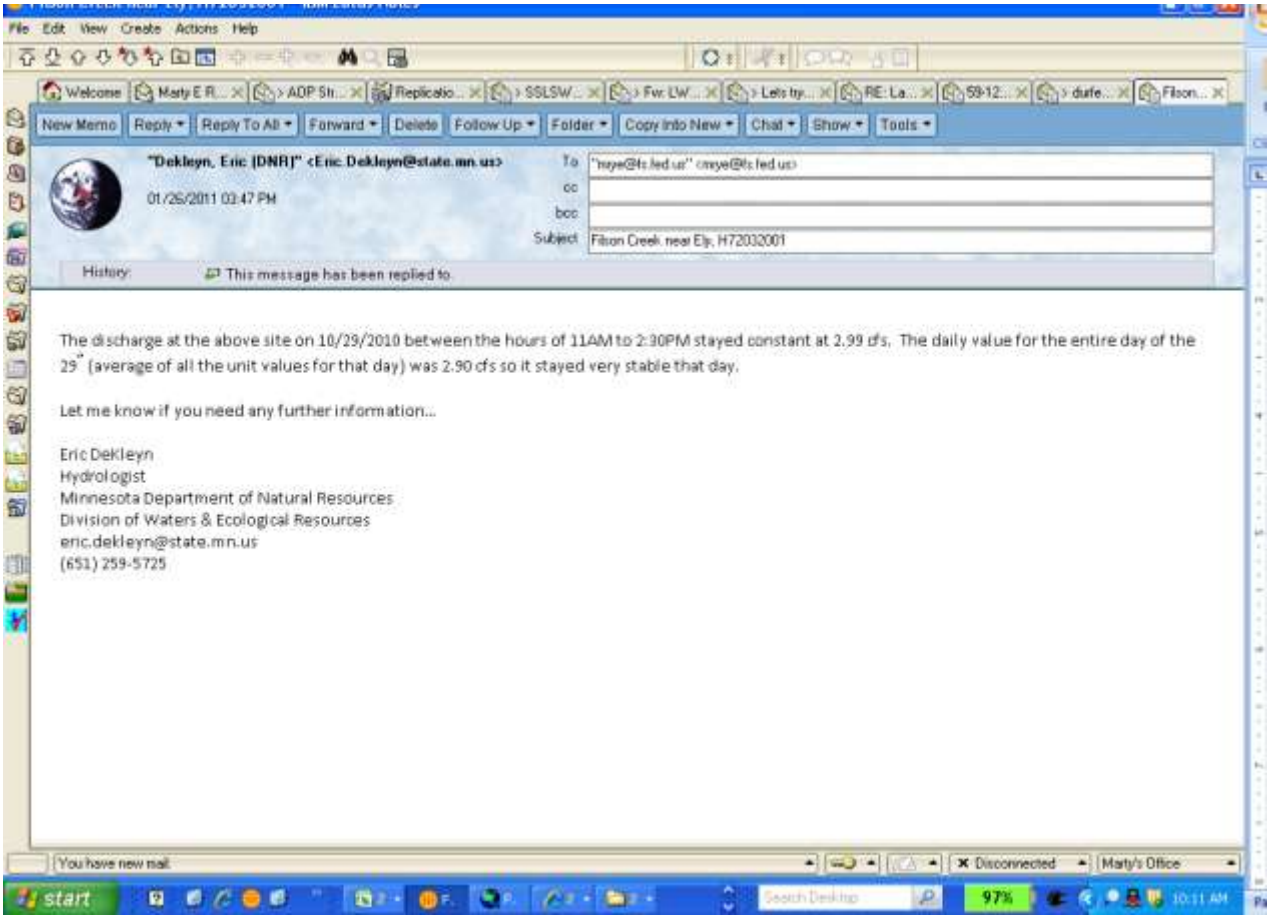
(3.0-2.8) / (3.3-2.8) * (0.09 – 0.03) +0.03 = 0.05 cfs

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DOI-19-0291-K-000055

Attachment D

Recorded Flow at Filson Creek on 10/29/2010

Recorded Flow at MnDNR Gage on Filson Creek on 10/29/2010:



"Dekleyn, Eric [DNR]" <Eric.Dekleyn@state.mn.us>

01/26/2011 03:47 PM

To: "meye@fs.fed.us" <meye@fs.fed.us>

cc:

bcc:

Subject: Filson Creek near Ely, H72032001

History: This message has been replied to.

The discharge at the above site on 10/29/2010 between the hours of 11AM to 2:30PM stayed constant at 2.99 cfs. The daily value for the entire day of the 29th (average of all the unit values for that day) was 2.90 cfs so it stayed very stable that day.

Let me know if you need any further information...

Eric Dekleyn
Hydrologist
Minnesota Department of Natural Resources
Division of Waters & Ecological Resources
eric.dekleyn@state.mn.us
(651) 259-5725

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Appendix 6:

Photos taken on 10/29/2010 at
Spruce Road Bulk Sample Sites.

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Above: Top of Bulk Sample Site;

Below: Collecting water samples at the seep outlet with a hand pump (Left) and sample bottles (Rigth).





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Above, Left: Upstream of Culvert crossing on tributary to Filson Creek below the seep;
Above, Right; Downstream of crossing on tributary to Filson Creek below the seep

Below, Left; Filson Creek upstream of Spruce Road at Gage site.
Below, Right; Filson Creek downstream of Spruce Road at Gage site.





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TWIN METALS MINNESOTA

June 2, 2017

Dean Gettinger
District Manager
Northeastern States District
626 E. Wisconsin Avenue, Suite 200
Milwaukee, WI 53202

Re: Provisional Reclamation Plan For MNES 1352 and 1353

Dear Dean:

On December 15, 2016, BLM issued a decision rejecting Twin Metals' application for the renewal of hard rock mineral preference right leases MNES 01352 and MNES 01353. As you know, Twin Metals' position is that this decision by BLM was unlawful and is of no force and effect. However, per your request, and in connection with your consideration of the attached proposal, I can confirm that Twin Metals is conducting and will continue to conduct—as it has conducted throughout its time as lessee—appropriate reclamation measures on the subject lands.

TMM will continue to develop and plan for appropriate future reclamation measures to occur on the lease property, in accordance with its lease obligations. I ask that you approve the attached provisional reclamation plan for the interim period relating to the ongoing litigation with the understanding that the proposal, adoption and implementation of this plan will not constitute an admission or waiver of any claim, issue, or defense by any party to the pending litigation in Minnesota concerning the termination of the leases.

Do not hesitate to contact me if I can provide any more information.

Sincerely,

Ian Duckworth
Chief Operating Officer

Cc: Karen Mouritsen

380 St. Peter St, Suite 705
St. Paul, MN 55102 USA

Tel: +1 651 842 6800
Fax: +1 651 842 6801

www.twin-metals.com

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June 2, 2017

Plaintiffs' Provisional Reclamation Plan Pertaining to
***Franconia Minerals (US) LLC v. United States*, No. 16-cv-3042 (D. Minn.)**

Plaintiffs (hereafter TMM) believe that while the litigation challenging the termination of the MNES 1352 and 1353 leases is ongoing, reclamation activities other than those that would occur independent of the termination are premature. This is particularly true given that the activities performed under the leases also contribute to the development of other mineral rights. Additionally, TMM believes that maintaining the current status quo during this interim period is in both parties' interests as premature reclamation may lead to greater surface impacts in the future. TMM offers the following proposal as a provisional reclamation plan and for ongoing and future reclamation planning pending the outcome of the litigation.

Background

1. The existing boreholes, well pads, roads, and other structures that exist on the lease property are as follows:

   - Approximately 170 boreholes currently exist that require sealing and abandonment. Over 60 of these boreholes originate on state or private land.
   - Approximately 30 drill pads and other sites exist.
   - Approximately 3 miles of roads exist.
   - Approximately 11 hydrologic well pads exist; 7 well pads contain hand driven piezometers and 1 well pad contains a 1000 foot hydrologic well.
   - An approximately 1000-foot mine shaft exists on MNES 1352.

2. TMM's ongoing activities on the lease land are as follows:

   - TMM currently has USFS permits for the use of roads in the entire project area. Existing roads may pass through the lease property. TMM maintains these roads by clearing snow and ensuring they are kept in their required status. TMM uses these roads to access and maintain lease sites as well as other surface and mineral rights not on the two leases.
   - TMM performs monthly water level measurements at each of the existing hydrologic sites. This activity has no or minimal disturbance to the site.
   - TMM performs annual legacy checks of each site. Legacy checks ensure compliance with Minnesota Department of Health standards and ensure temporary abandonment casings have not been tampered with or suffered environmental disturbance due to extreme temperature conditions.

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- TMM performs annual non-native invasive species (NNIS) spraying of the areas in order to ensure compliance with Federal Hard Rock Minerals Prospecting Permit requirements and to discourage the inadvertent spread of NNIS within the Superior National Forest.

- TMM halted an ongoing geotechnical drilling program. Two of the drill holes originated on MNES 1352, however, intersected state subsurface.

Proposal

- The time to complete final reclamation activities will not commence until the resolution of the litigation (including any appeal). If the termination for the leases is upheld, TMM will continue to work with the BLM on an appropriate reclamation schedule.

- TMM will continue annual reclamation activities and future reclamation planning including legacy checks, NNIS spraying and borehole sealing.

- TMM will be allowed to undertake non-invasive testing for existing drill holes on the leases such as ATV logging and hydro testing in accordance with approved plans and Minnesota state regulations.

- TMM proposes to maintain the access (ingress and egress) rights under the two leases. TMM will continue to undertake all maintenance of roads, well pads, and drilling sites in accordance with previous and approved practices.

- TMM will be allowed to collect the hydrologic data from the existing well sites. TMM will not undertake the installation of any future wells on the leases prior to resolution of the litigation.

- TMM will not undertake any future drilling for geotechnical or exploration purposes on the leases prior to resolution of the litigation.

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DOI-19-0291-K-000062

United States Department of Agriculture
Forest Service
Superior National Forest
8901 Grand Ave. Place
Duluth, MN 55808-1122
Phone: (218) 626-4300
Fax: (218) 626-4398

File Code: 1500
Date: April 28, 2011

Frank Ongaro
Mining Minnesota
P.O. Box 16666
Duluth, MN 55816

Dear Mr. Ongaro:

In response to public concern raised during the summer of 2010 about water quality, Forest Service personnel sampled a water seep at the Spruce Road mineral exploration Bulk Sample site located on the Kawishiwi Ranger District of the Superior National Forest. Because of your previous interest in this issue, we are sending a copy of the technical memo outlining the details of our findings. These findings are summarized below.

In January 1974, the International Nickel Company (INCO) extracted a 10,000 ton surface sample for metallurgical testing adjacent to the Spruce Road on the Superior National Forest. The site was rehabilitated (graded and seeded) by INCO in the spring of 1974. In the summer of 1975, subsidence of the surface of the site occurred and seepage from the base of the site was noted. At the request of the Minnesota Pollution Control Agency, INCO collected water quality and quantity data from the site during the summer of 1975 to characterize the waters leaving the site. Reclamation for the subsidence was completed in the fall of 1975; the site and adjacent waters were monitored during the summer of 1976 by the U.S. Forest Service.

The purpose of the current sampling effort, conducted on October 29, 2010, was to investigate the water quality/quantity of the area relative to the monitoring results from the data collected in 1975 (INCO) and 1976 (USFS). Surface water samples were collected at four sites in a single sampling event in the area adjacent to the Spruce Road Bulk Sampling location. Chemical constituents were compared to similar measurements taken in the mid 1970's to evaluate changes and load contributions to surrounding streams.

Results indicate that concentrations and loads of chemical constituents from the site have not changed substantially since the mid 1970s. Additionally, background loadings for sulfate, copper, and nickel at Filson Creek, upstream of the bulk sample site, are two orders of magnitude (100 times) higher than loadings originating from the bulk sample site. This indicates that contributions from the seep are insignificant relative to the ambient or naturally occurring loadings in Filson Creek and the seep is not having any measurable negative impact to the watershed. Therefore, based on these data and recommendations from Forest aquatic specialists, I conclude that no management action or further testing is needed at this time. We will continue to periodically monitor the site to see if any changes take place.

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DOI-19-0291-K-000063

A copy of the results has also been submitted to the Minnesota Pollution Control Agency and Minnesota Department of Natural Resources.

If you have any questions regarding the enclosed document, please contact Jason Butcher at (218) 626-4307 or jtbutcher@fs.fed.us.

Sincerely,

/s/ Mary L. Shedd (for)
JAMES W. SANDERS
Forest Supervisor

Enclosure

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