

MEMORANDUM

Sampling Dates: January-December 2013
To: *Bear Creek Watershed Association*
From: Russell N. Clayshulte, Manager
Re: **Technical Memorandum 2013.02- Bear Creek
Kerr/Swede Gulch Summary Data**



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Segment 5 Bear Creek: Swede, Kerr, Sawmill, Troublesome, and Cold Springs Gulches, and mainstem of Cub Creek from the source to the confluence with Bear Creek.

Water Quality Standards

- Temperature =TVS(CS-II) °C;
 - April-October =18.2 (MWAT)/23.8 (DM) °C;
 - November-March =9.0 (MWAT)/13.0 (DM) °C
- D.O.=6.0 mg/l; D.O.(sp)=7.0 mg/l
- pH=6.5-9.0
- E. Coli=126/100ml (Measured as a geometric mean of data)



Figure 1 Sample Site at Kerr/Swede Confluence

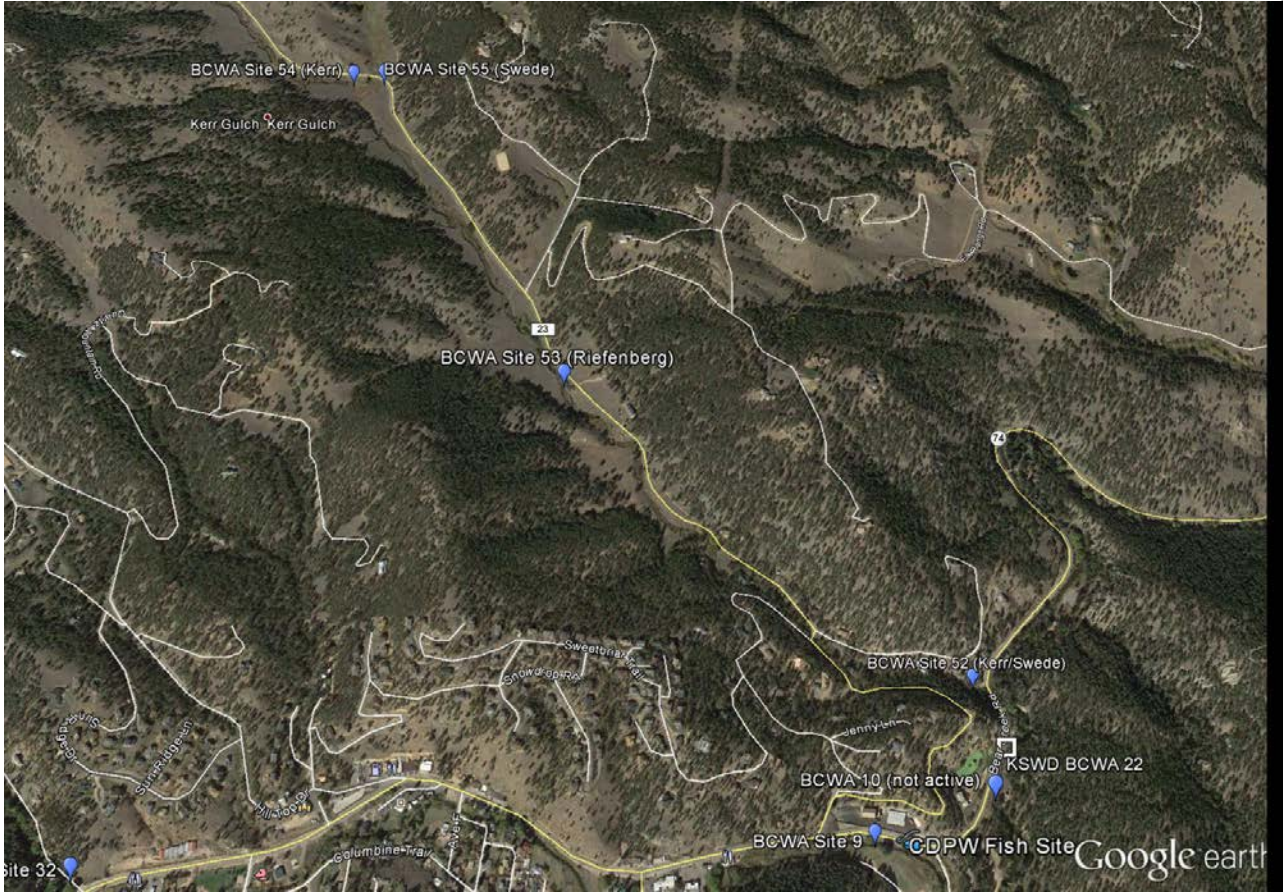


Figure 2 Kerr/Swede Gulch Sample Locations



Figure 3 Confluence of Kerr Gulch and Swede Gulch

Table 1 Kerr/Swede Gulch Sampling

BCWA Site	Time	Temp (C)	pH	SC (ms/cm)	DO (mg/l)	E. Coli (Cells/100ml)-Calc
1/22/2013						
Site 52 - Confluence	1:13	0	8.49	0.946	10.42	1
Site 53 - Riefenberg	1:26	0.5	7.95	0.98	10.31	1
Site 54 - Kerr	1:41	0	8.76	0.918	10.5	5
Site 55 - Swede	1:38	0	8.82	0.883	12	6
2/19/2013						
Site 52 - Confluence	1:36	0.2	8.66	0.862	12.3	1
Site 53 - Riefenberg	1:54	0.2	8.71	0.84	12.43	1
Site 54 - Kerr	2:09	0.1	8.34	0.812	11.21	1
Site 55 - Swede	2:06	0.08	8.27	0.672	11.77	4
3/25/2013						
Site 52 - Confluence	12:48	0	8.3	0.809	13.15	1
Site 53 - Riefenberg	1:01	0.2	7.97	0.793	12.16	1
Site 54 - Kerr	1:21	0.1	7.75	0.813	8.66	1
Site 55 - Swede	1:16	0.1	7.96	0.759	8.93	1
4/25/2013						
Site 52 - Confluence	10:45	2.9	7.89	0.93	11.48	1
Site 53 - Riefenberg	10:16	1.7	8.4	0.97	13.12	1
Site 54 - Kerr	10:30	3.6	7.94	0.803	11.2	1
Site 55 - Swede	10:26	2.9	7.74	1.13	10.87	4
5/20/2013						
Site 52 - Confluence	10:35	9.2	7.93	0.572	11.42	1
Site 53 - Riefenberg	10:47	10.3	7.91	0.83	9.8	1
Site 54 - Kerr	11:01	12.1	7.43	0.79	9.06	12
Site 55 - Swede	10:58	12	7.82	0.65	9.2	4
6/17/2013						
Site 52 - Confluence	10:48	11.4	7.87	0.128	12.07	21
Site 53 - Riefenberg	11:01	12.4	8.16	0.86	10.91	27
Site 54 - Kerr	11:15	13.6	8.17	0.83	10.1	66
Site 55 - Swede	11:11	13.2	8.16	0.94	10.7	17
7/22/2013						
Site 52 - Confluence	11:14	14.5	8.01	0.88	8.63	11
Site 53 - Riefenberg	11:26	15.3	8.26	0.91	8.24	37
Site 54 - Kerr	11:40	17.4	8.13	0.67	6.67	60
Site 55 - Swede	11:36	16.6	8.26	1	7.88	6
8/26/2013						
Site 52 - Confluence	11:17	14.65	8.47	0.914	8.17	10
Site 53 - Riefenberg	11:36	15.48	8.29	0.919	7.27	9
Site 54 - Kerr	11:51	16.52	8.17	0.917	6.25	10
Site 55 - Swede	11:46	17.28	8.32	0.871	7.21	2
9/24/2013						
Site 52 - Confluence	9:45	8.9	8.62	1.02	10.54	1
Site 53 - Riefenberg	10:05	8.3	8.46	1.01	10.38	1
Site 54 - Kerr	10:22	9	8.36	1	9.95	1
Site 55 - Swede	10:20	9.5	8.36	1.02	9.42	1

BCWA Site	Time	Temp (C)	pH	SC (ms/cm)	DO (mg/l)	E. Coli (Cells/100ml)-Calc
10/21/2013						
Site 52 - Confluence	10:15	3.3	8.23	1.02	12.79	1
Site 53 - Riefenberg	10:28	2.8	8.06	1.01	12.77	1
Site 54 - Kerr	10:45	2.8	8	0.97	11.78	15
Site 55 - Swede	10:40	3.6	8.02	1.02	11.93	1
11/18/2013						
Site 52 - Confluence	1:10	2.9	8.21	1.01	11.6	1
Site 53 - Riefenberg	1:31	3.2	8.1	0.97	11.65	1
Site 54 - Kerr	1:48	4.1	7.95	0.95	11.74	5
Site 55 - Swede	1:43	5.7	7.99	0.99	10.08	2
12/16/2013						
Site 52 - Confluence	12:52	1	8.14	1.01	10.28	1
Site 53 - Riefenberg	1:05	1.4	8.1	0.93	11.23	9
Site 54 - Kerr	1:18	0.1	8.07	0.902	11.33	9
Site 55 - Swede	1:13	0.4	7.92	0.93	12.1	15

Note: There are no Temperature (based on single sample measurement), pH or Dissolved Oxygen exceedances of the standards.

Table 2 E. coli Geometric Mean Summary

E. coli Summary, Geometric Mean									
BCWA Site	2010		2011						
	May-Dec	J-D (Annual)	Jan-Feb	Mar-Apr	May-Jun	Jul-Aug	Sep-Oct	Nov-Dec	May-Oct
	n=36	n=48	n=8	n=8	n=8	n=8	n=8	n=8	n=24/6
Sites 52-53			14	2	6	5	6	2	6
Site 52 - Confluence	10	6							15
Site 53 - Riefenberg	13	4							9
Site 54 - Kerr	16	5							3
Site 55 - Swede	11	3							2
2012									
Sites 52-53		5	3	1	11	26	10	3	13
Site 52 - Confluence		3							6
Site 53 - Riefenberg		4							9
Site 54 - Kerr		10							32
Site 55 - Swede		3							13
2013									
Sites 52-53		3	2	1	9	14	1	3	5
Site 52 - Confluence		2							4
Site 53 - Riefenberg		2							5
Site 54 - Kerr		6							14
Site 55 - Swede		3							3

Note -There is no exceedance of the E. coli standard from 2010-2013 within the drainage system

Table 3 Kerr/Swede Gulch Flow Estimates (Acre-Feet/ Month)

	31	28	31	30	31	30	31	31	30	31	30	31	Total
Site	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Site 52 - Confluence	6.9	14.9	18.6	90.1	19.3	28.7	9.3	21.2	121.9	47.3	17.1	22.2	417
Site 53 - Riefenberg	4.1	5.1	11.1	43.0	10.7	17.8	0.9	3.1	106.8	12.3	13.3	11.2	239
Site 54 - Kerr	1.9	3.7	3.3	1.1	4.5	3.2	0.2	0.8	53.5	2.2	9.8	10.7	95
Site 55 - Swede	1.6	0.8	1.2	9.4	3.8	3.7	0.3	1.7	36.2	9.3	2.6	3.0	74

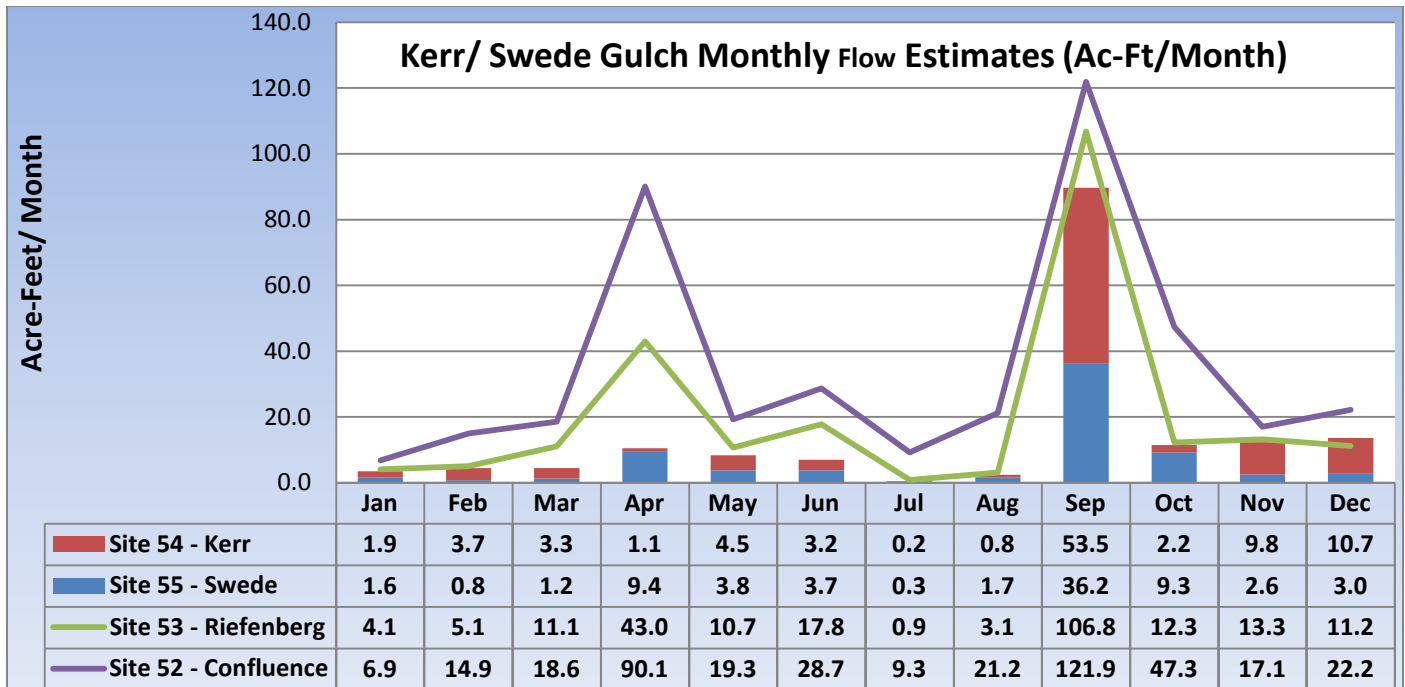


Figure 4 2013 Flow Estimates by Site

Table 4 2013 Chemistry Data and Loading Results

Site	Parameter (ug/l)	22-Jan	19-Feb	25-Mar	25-Apr	20-May	17-Jun	22-Jul	26-Aug	24-Sep	21-Oct	18-Nov	16-Dec	Avg
Site 52 - Confluence	Total Nitrogen	1717	514	651	419	516	338	360	841	696	358	516	633	630
	Nitrate/Nitrite as N, dissolved	810	507	425	224	84	122	257	250	319	202	309	483	333
	Ammonia Nitrogen	76	16	39	25	31	35	24	42	8	2	30	5	27.8
	Phosphorus, total	105	9	51	19	9	35	6	28	26	2	19	16	27.1
Site 53 - Riefenberg	Total Nitrogen	403	202	291	407	278	187	277	612	349	244	238	437	327
	Nitrate/Nitrite as N, dissolved	158	126	139	162	30	35	83	41	57	73	99	219	102
	Ammonia Nitrogen	23	20	33	25	34	28	25	37	18	10	43	5	25.1
	Phosphorus, total	49	13	9	30	24	10	2	19	16	2	15	16	17.1
Site 54 - Kerr	Total Nitrogen	481	391	319	209	230	341	199	540	391	307	280	469	346
	Nitrate/Nitrite as N, dissolved	253	217	149	90	39	109	41	9	125	46	117	285	123
	Ammonia Nitrogen	26	17	27	12	28	35	29	45	14	7	45	5	24.2
	Phosphorus, total	69	90	122	26	30	32	45	36	46	31	22	25	47.8
Site 55 - Swede	Total Nitrogen	1530	301	318	387	296	217	149	615	287	268	199	262	402
	Nitrate/Nitrite as N, dissolved	310	8	133	223	3	2	6	2	35	69	7	78	73
	Ammonia Nitrogen	148	18	46	18	24	28	21	44	12	6	48	14	35.6
	Phosphorus, total	262	41	47	15	13	8	2	18	11	2	23	58	41.7

Site	Parameter (ug/l)	22-Jan	19-Feb	25-Mar	25-Apr	20-May	17-Jun	22-Jul	26-Aug	24-Sep	21-Oct	18-Nov	16-Dec	Avg
Load Pounds/ Month														
Site	Parameter (ug/l)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Site 52 - Confluence	Total Nitrogen	32.0	20.9	32.9	102.8	27.1	26.4	9.1	48.6	231.0	46.1	24.0	38.3	639.3
	Nitrate/Nitrite as N, dissolved	15.1	20.6	21.5	54.9	4.4	9.5	6.5	14.4	105.9	26.0	14.4	29.2	322.5
	Ammonia Nitrogen	1.4	0.7	2.0	6.1	1.6	2.7	0.6	2.4	2.7	0.3	1.4	0.3	22.2
	Phosphorus, total	2.0	0.4	2.6	4.7	0.5	2.7	0.2	1.6	8.6	0.3	0.9	1.0	25.3
Site 53 - Riefenberg	Total Nitrogen	7.5	8.2	14.7	99.8	14.6	14.6	7.0	35.3	115.8	31.4	11.1	26.4	386.6
	Nitrate/Nitrite as N, dissolved	2.9	5.1	7.0	39.7	1.6	2.7	2.1	2.4	18.9	9.4	4.6	13.2	109.8
	Ammonia Nitrogen	0.4	0.8	1.7	6.1	1.8	2.2	0.6	2.1	6.0	1.3	2.0	0.3	25.4
	Phosphorus, total	0.9	0.5	0.5	7.4	1.3	0.8	0.1	1.1	5.3	0.3	0.7	1.0	19.7
Site 54 - Kerr	Total Nitrogen	9.0	15.9	16.1	51.3	12.1	26.7	5.0	31.2	129.8	39.6	13.0	28.3	378.0
	Nitrate/Nitrite as N, dissolved	4.7	8.8	7.5	22.1	2.0	8.5	1.0	0.5	41.5	5.9	5.4	17.2	125.4
	Ammonia Nitrogen	0.5	0.7	1.4	2.9	1.5	2.7	0.7	2.6	4.6	0.9	2.1	0.3	21.0
	Phosphorus, total	1.3	3.7	6.2	6.4	1.6	2.5	1.1	2.1	15.3	4.0	1.0	1.5	46.6
Site 55 - Swede	Total Nitrogen	28.6	12.2	16.1	94.9	15.6	17.0	3.8	35.5	95.3	34.5	9.3	15.8	378.5
	Nitrate/Nitrite as N, dissolved	5.8	0.3	6.7	54.7	0.2	0.2	0.2	0.1	11.6	8.9	0.3	4.7	93.7
	Ammonia Nitrogen	2.8	0.7	2.3	4.4	1.3	2.2	0.5	2.5	4.0	0.8	2.2	0.8	24.6
	Phosphorus, total	4.9	1.7	2.4	3.7	0.7	0.6	0.1	1.0	3.7	0.3	1.1	3.5	23.5

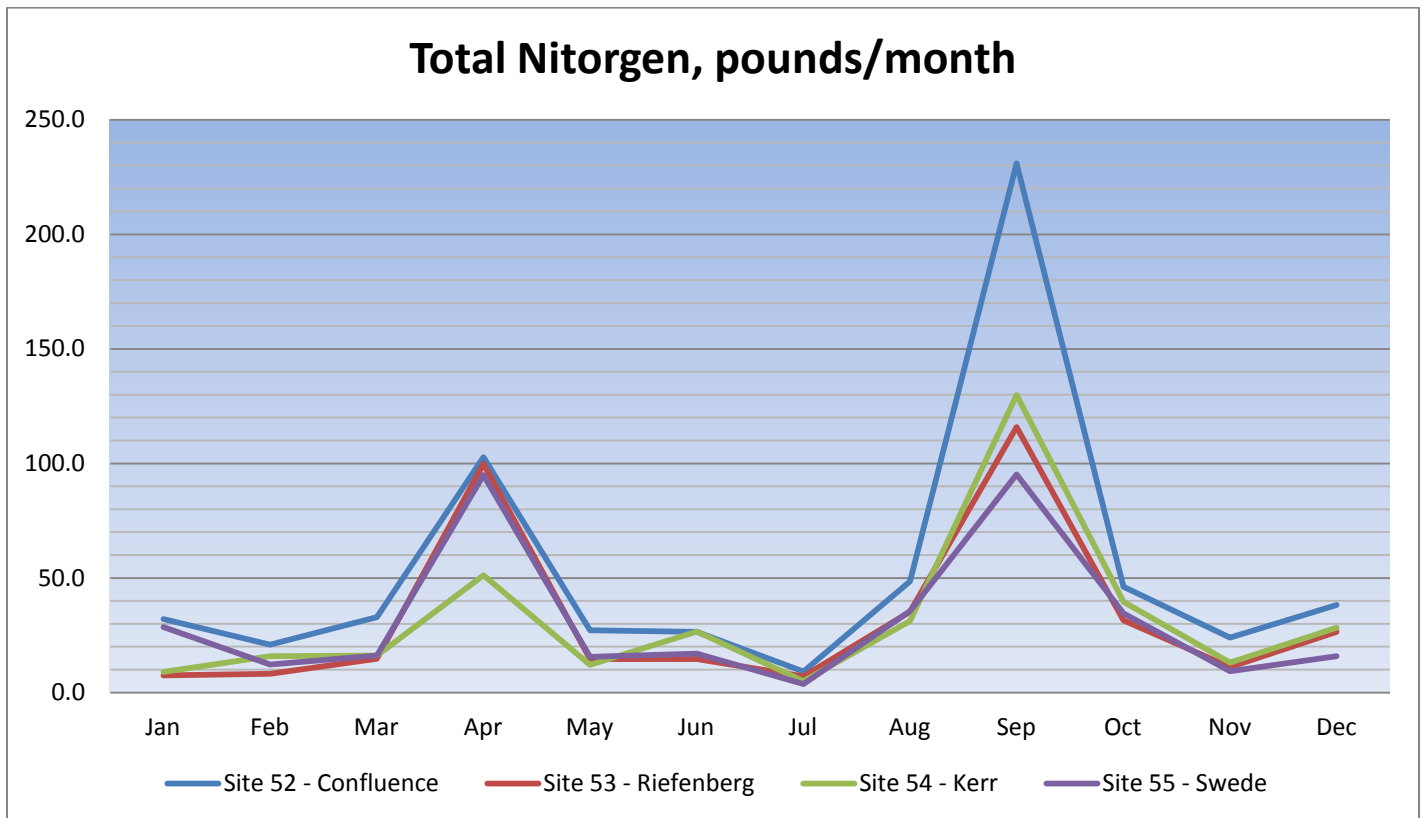


Figure 5 Total Nitrogen Loading in Kerr/Swede System

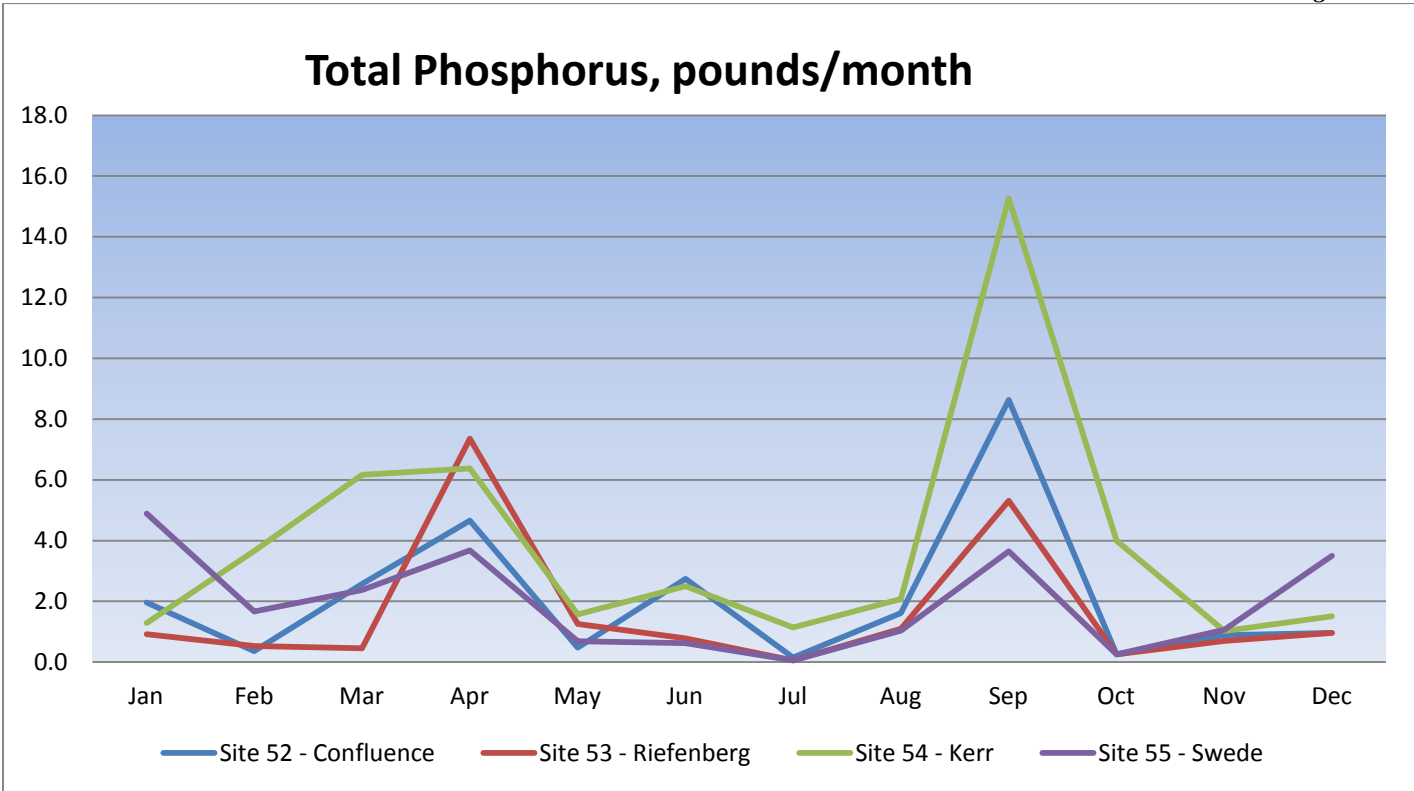


Figure 6 Total Phosphorus Loading in Kerr/ Swede System

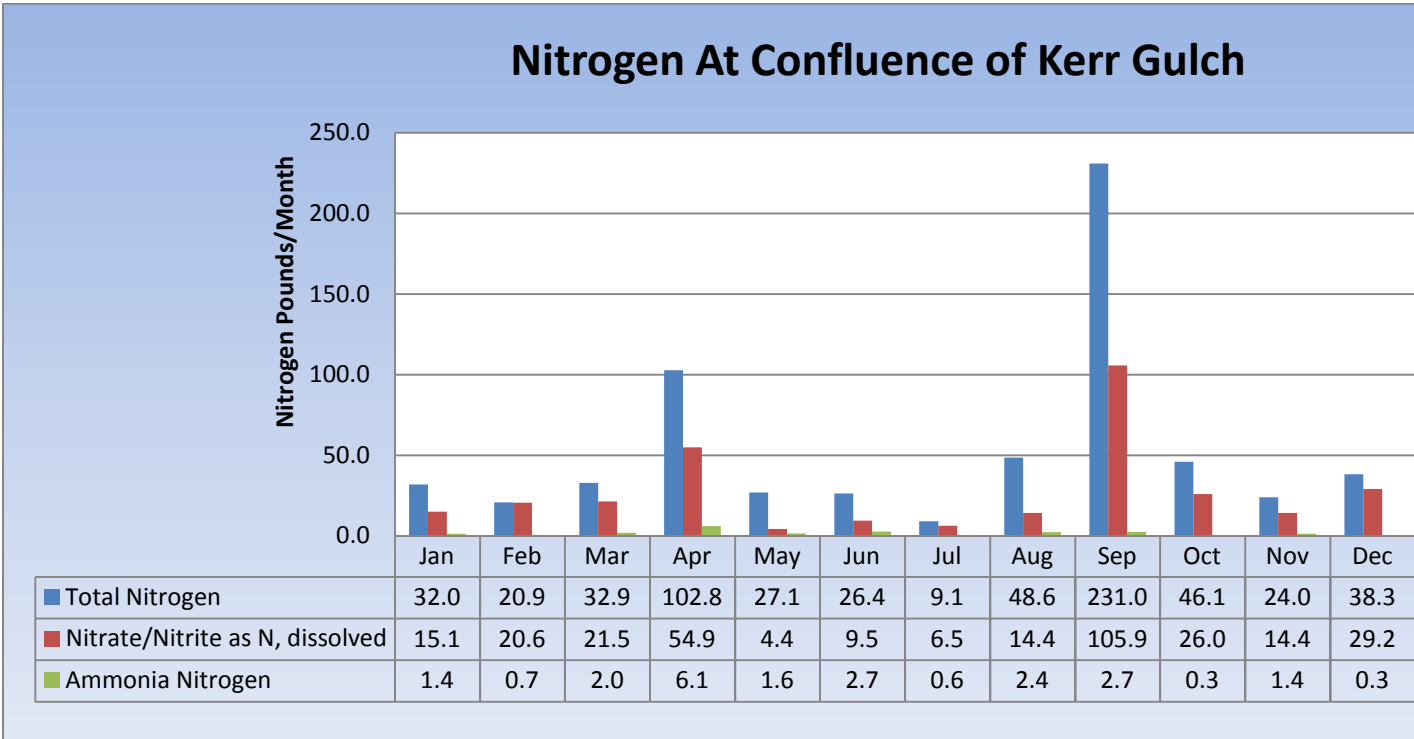


Figure 7 Nitrogen Loading at Kerr Gulch Discharge into Bear Creek