

TECHNICAL MEMORANDUM BCWA

Sampling Dates: January-December 2014
To: *Bear Creek Watershed Association*
From: Russell N. Clayshulte, Manager
Re: TM 2014.03- 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;
 - o April-October =18.2 (MWAT)/23.8 (DM) °C;
 - o 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**

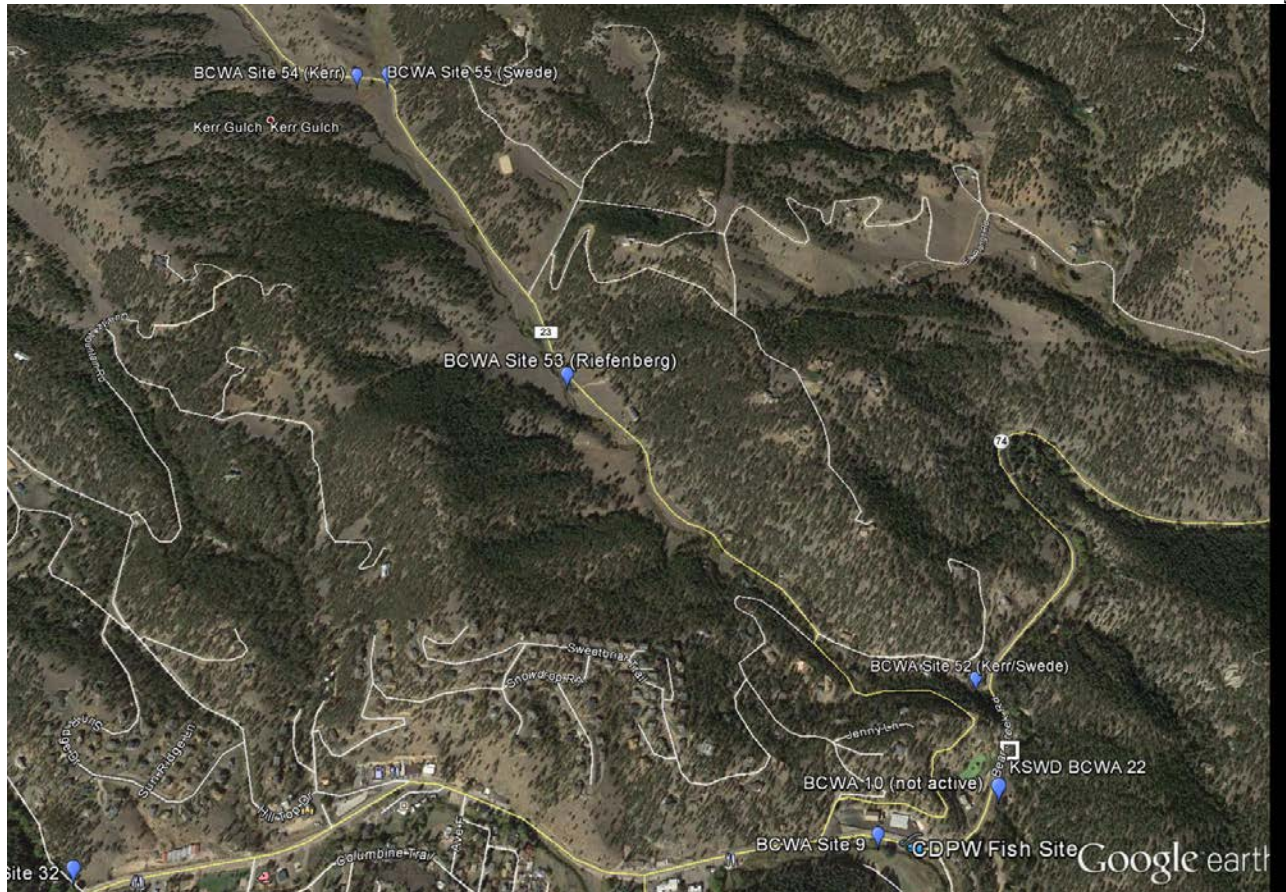


Figure 2 Kerr/Swede Gulch Sample Locations



Figure 3 Confluence of Kerr Gulch and Swede Gulch

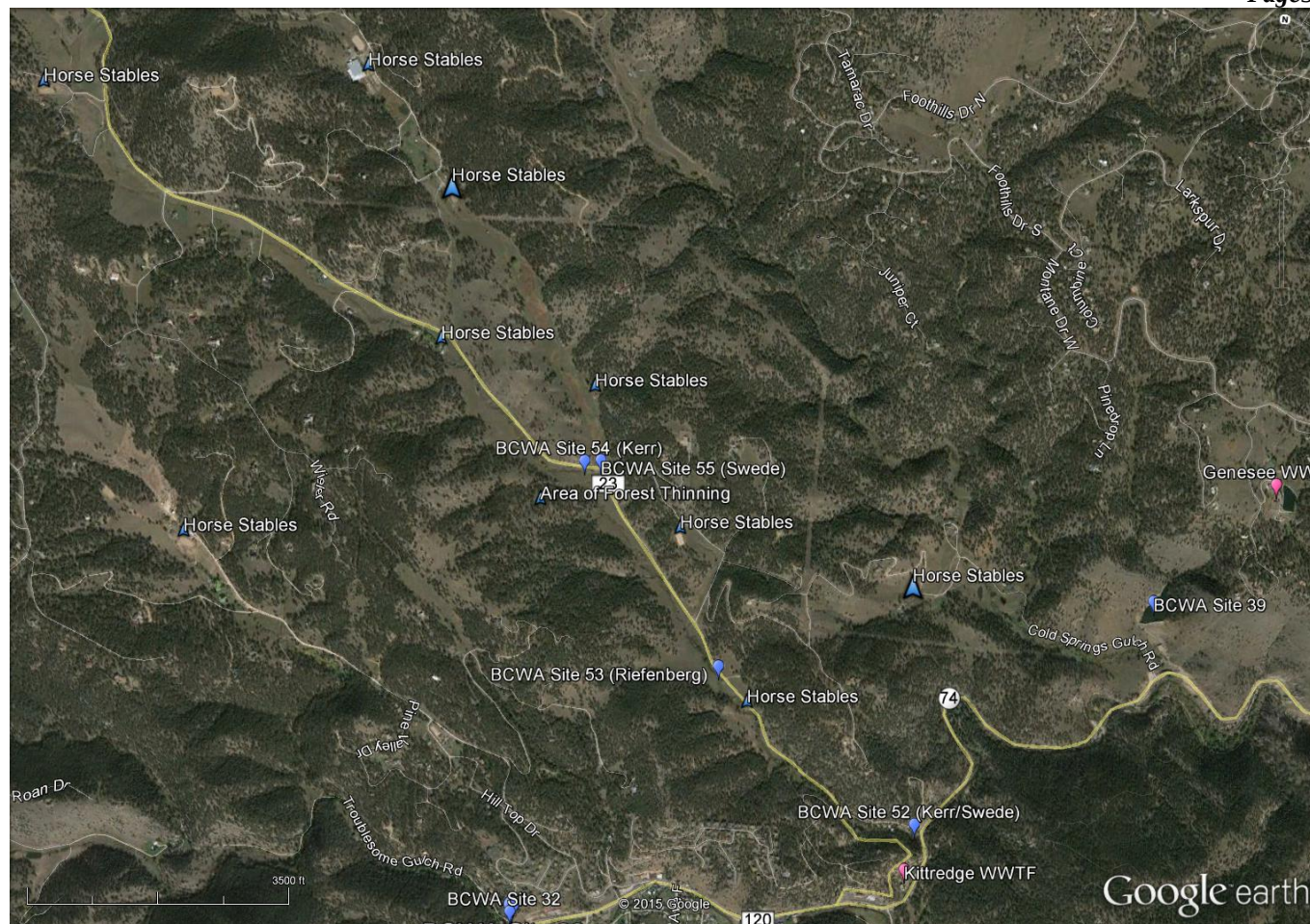


Figure 4 Horse Stable Operations in Kerr Gulch. There are at least 9 larger stable operations, with one facility on Swede Gulch that can house >45 horses.

Table 1 Kerr/Swede Gulch Sampling

BCWA Site	Time	Temp (C)	pH	SC (ms/cm)	DO (mg/l)	E. Coli (CTS/100ml)
1/6/2014						
Site 52 - Confluence	12:40	0.6	8.15	1.00	12.2	1
Site 53 - Riefenberg	12:23	0.6	8.04	0.98	11.64	1
Site 54 - Kerr	12:10	0.6	7.82	0.944	11.26	1
Site 55 - Swede	12:05	0.3	7.68	1.08	11.74	5
2/10/2014						
Site 52 - Confluence	1:48	0.6	8.16	1.07	12.3	1
Site 53 - Riefenberg	2:02	0.5	8.1	1.08	12.02	1
Site 54 - Kerr	2:13	0.1	8.01	0.917	11.2	12
Site 55 - Swede	2:10	0.1	8.04	1.35	11.86	80
3/26/2014						
Site 52 - Confluence	1:20	4.5	8.11	0.94	11.23	1
Site 53 - Riefenberg	1:38	6.3	8.2	0.92	8.18	1
Site 54 - Kerr	1:55	7.7	8.06	0.9	9.57	4
Site 55 - Swede	1:50	6.7	8.02	1.001	9.62	2
4/21/2014						
Site 52 - Confluence	12:35	9.8	8.33	0.99	11.25	1
Site 53 - Riefenberg	12:45	10.6	8.25	1.02	10.5	1
Site 54 - Kerr	1:00	14.2	8.12	0.91	9.03	15

BCWA Site	Time	Temp (C)	pH	SC (ms/cm)	DO (mg/l)	E. Coli (CTS/100ml)
Site 55 - Swede	12:55	14.1	8.09	1.19	8.37	1
5/19/2014						
Site 52 - Confluence	12:20	13.1	8.26	1.00	9.4	1
Site 53 - Riefenberg	12:32	15	8.19	0.099	9.25	1
Site 54 - Kerr	12:43	17.1	8.06	0.92	7.86	3
Site 55 - Swede	12:40	16.9	7.26	1.12	7.12	3
6/16/2014						
Site 52 - Confluence	12:30	16.4	8.22	1.03	9.1	15
Site 53 - Riefenberg	12:40	17	8.08	1.02	8.67	7
Site 54 - Kerr	12:55	17.8	7.93	0.95	7.61	14
Site 55 - Swede	12:47	17.9	8.07	1.16	7.62	15
7/7/2014						
Site 52 - Confluence	12:10	17.8	8.06	1.01	7.89	25
Site 53 - Riefenberg	12:27	17.9	8.03	0.99	7.59	6
Site 54 - Kerr	12:43	18.6	7.99	0.97	7.17	21
Site 55 - Swede	12:37	17.9	8.07	1.16	7.14	30
8/18/2014						
Site 52 - Confluence	12:35	15.5	7.84	1.03	8.25	9
Site 53 - Riefenberg	12:51	14.6	8.13	1.03	7.29	3
Site 54 - Kerr	1:05	15.2	7.86	0.976	6.38	48
Site 55 - Swede	1:00	15.2	8.23	1.046	7.1	2
9/15/2014						
Site 52 - Confluence	12:17	12	8.14	1.021	10.12	1
Site 53 - Riefenberg	12:34	12.5	8.06	1.02	10.03	3
Site 54 - Kerr	12:50	13	7.87	0.985	8.72	1
Site 55 - Swede	12:43	14	7.98	1.117	8.72	10
10/20/2014						
Site 52 - Confluence	1:22	9	8.02	1.004	10.44	15
Site 53 - Riefenberg	1:34	10.6	8	1	9.8	3
Site 54 - Kerr	1:46	10.9	7.86	0.963	8.5	50
Site 55 - Swede	1:40	11.5	7.92	1.071	8.74	6
11/18/2014						
Site 52 - Confluence	1:25	0.6	8.04	1.016	12.39	1
Site 53 - Riefenberg	1:35	2.7	8.06	1.005	14.28	7
Site 54 - Kerr	1:52	0.3	8.05	0.0988	10.3	34
Site 55 - Swede	1:49	0.2	7.99	4.8	11.8	24
12/8/2014						
Site 52 - Confluence	1:10	1.1	8.13	1.014	12.66	12
Site 53 - Riefenberg	1:21	0.9	8.12	0.988	12.28	1
Site 54 - Kerr	1:35	0.3	8.1	0.93	12.19	1
Site 55 - Swede	1:30	1.6	8.01	1.073	11.89	1

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 2010-2014

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
			2014						
Sites 52-53		4	3	2	5	11	5	4	6
Site 52 - Confluence		3							6
Site 53 - Riefenberg		2							3
Site 54 - Kerr		8							11
Site 55 - Swede		6							7

Note -There is no exceedance of the E. coli standard from 2010-2014 within the drainage system

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

Acre-Feet/ month													
Site	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Site 52 - Confluence	49.5	29.9	62.3	119.6	71.4	90.7	41.8	14.4	11.7	17.0	17.5	37.5	563
Site 53 - Riefenberg	13.2	28.6	54.2	48.8	31.8	23.6	40.6	11.2	6.8	12.3	6.1	31.7	309
Site 54 - Kerr	6.4	6.7	11.6	12.0	4.7	8.2	1.8	2.0	1.2	8.5	3.7	19.3	86
Site 55 - Swede	1.6	19.7	26.0	23.2	27.4	8.0	9.8	9.2	2.9	4.4	2.4	3.2	138

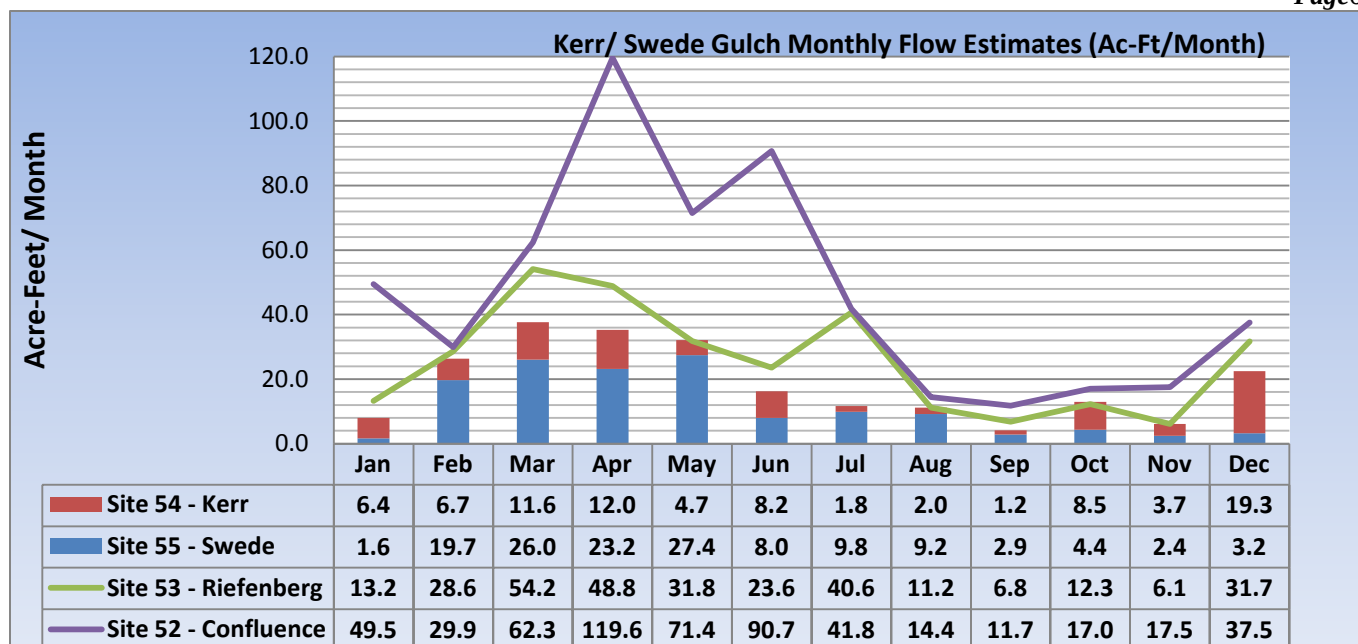


Figure 5 2014 Flow Estimates by Site

Table 4 2014 Chemistry Data and Loading Results

Site	Parameter (ug/l)	8-Jan	10-Feb	26-Mar	21-Apr	19-May	16-Jun	7-Jul	18-Aug	15-Sep	20-Oct	18-Nov	8-Dec	Avg
Site 52 - Confluence	Total Nitrogen	661	947	583	413	462	805	672	477	407	494	581	685	599
	Nitrate/Nitrite as N, dissolved	568	739	360	163	233	344	477	319	224	259	473	444	384
	Ammonia Nitrogen	7		101	17	16	21	6	17	8	5	14	16	21
	Phosphorus, total	13	27	23	9	12	10	8	11	2	23	7	10	13
Site 53 - Riefenberg	Total Nitrogen	495	787	277	207	254	394	473	247	230	331	301	452	371
	Nitrate/Nitrite as N, dissolved	371	552	131	38	53	132	183	88	61	53	212	224	175
	Ammonia Nitrogen	7	5	82	27	21	25	7	9	5	5	15	16	19
	Phosphorus, total	7	25	10	12	19	28	39	8	16	7	5	5	15
Site 54 - Kerr	Total Nitrogen	656	640	459	295	321	575	398	252	340	309	734	489	456
	Nitrate/Nitrite as N, dissolved	422	451	226	65	94	177	154	47	95	78	304	342	205
	Ammonia Nitrogen	21	5	90	26	16	39	11	17	14	9	27	15	24
	Phosphorus, total	26	39	91	49	61	47	62	103	69	69	312	36	80
Site 55 - Swede	Total Nitrogen	394	1216	219	197	266	485	268	270	317	306	147	379	372
	Nitrate/Nitrite as N, dissolved	263	712	10	8	4	6	12	3	6	6	17	40	91
	Ammonia Nitrogen	8	47	73	23	11	20	6	15	5	9	16	13	21
	Phosphorus, total	33	73	15	19	19	70	27	27	2	46	58	28	35

Load Pounds/ Month														
Site	Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Site 52 - Confluence	Total Nitrogen	89.1	77.0	99.0	134.5	89.9	198.9	76.5	18.7	13.0	22.8	27.8	69.9	916.9
	Nitrate/Nitrite as N, dissolved	76.5	60.1	61.1	53.1	45.3	85.0	54.3	12.5	7.1	12.0	22.6	45.3	535.0
	Ammonia Nitrogen	0.9	0.0	17.1	5.5	3.1	5.2	0.7	0.7	0.3	0.2	0.7	1.6	36.1
	Phosphorus, total	1.8	2.2	3.9	2.9	2.3	2.5	0.9	0.4	0.1	1.1	0.3	1.0	19.4
Site 53 -	Total Nitrogen	17.8	61.3	40.8	27.5	22.0	25.3	52.3	7.5	4.3	11.1	5.0	39.0	313.9

Riefenberg	Nitrate/Nitrite as N, dissolved	13.4	43.0	19.3	5.1	4.6	8.5	20.2	2.7	1.1	1.8	3.5	19.3	142.4
	Ammonia Nitrogen	0.3	0.4	12.1	3.6	1.8	1.6	0.8	0.3	0.1	0.2	0.3	1.4	22.7
	Phosphorus, total	0.3	1.9	1.5	1.6	1.6	1.8	4.3	0.2	0.3	0.2	0.1	0.4	14.3
Site 54 - Kerr	Total Nitrogen	11.4	11.6	14.5	9.7	4.1	12.8	2.0	1.3	1.2	7.2	7.4	25.7	108.8
	Nitrate/Nitrite as N, dissolved	7.3	8.2	7.1	2.1	1.2	3.9	0.8	0.3	0.3	1.8	3.1	18.0	54.1
	Ammonia Nitrogen	0.4	0.1	2.8	0.9	0.2	0.9	0.1	0.1	0.0	0.2	0.3	0.8	6.7
	Phosphorus, total	0.5	0.7	2.9	1.6	0.8	1.0	0.3	0.6	0.2	1.6	3.1	1.9	15.2
Site 55 - Swede	Total Nitrogen	1.7	65.3	15.5	12.4	19.9	10.6	7.2	6.7	2.5	3.6	1.0	3.3	149.7
	Nitrate/Nitrite as N, dissolved	1.1	38.2	0.7	0.5	0.3	0.1	0.3	0.1	0.0	0.1	0.1	0.3	42.0
	Ammonia Nitrogen	0.0	2.5	5.2	1.5	0.8	0.4	0.2	0.4	0.0	0.1	0.1	0.1	11.3
	Phosphorus, total	0.1	3.9	1.1	1.2	1.4	1.5	0.7	0.7	0.0	0.5	0.4	0.2	11.9

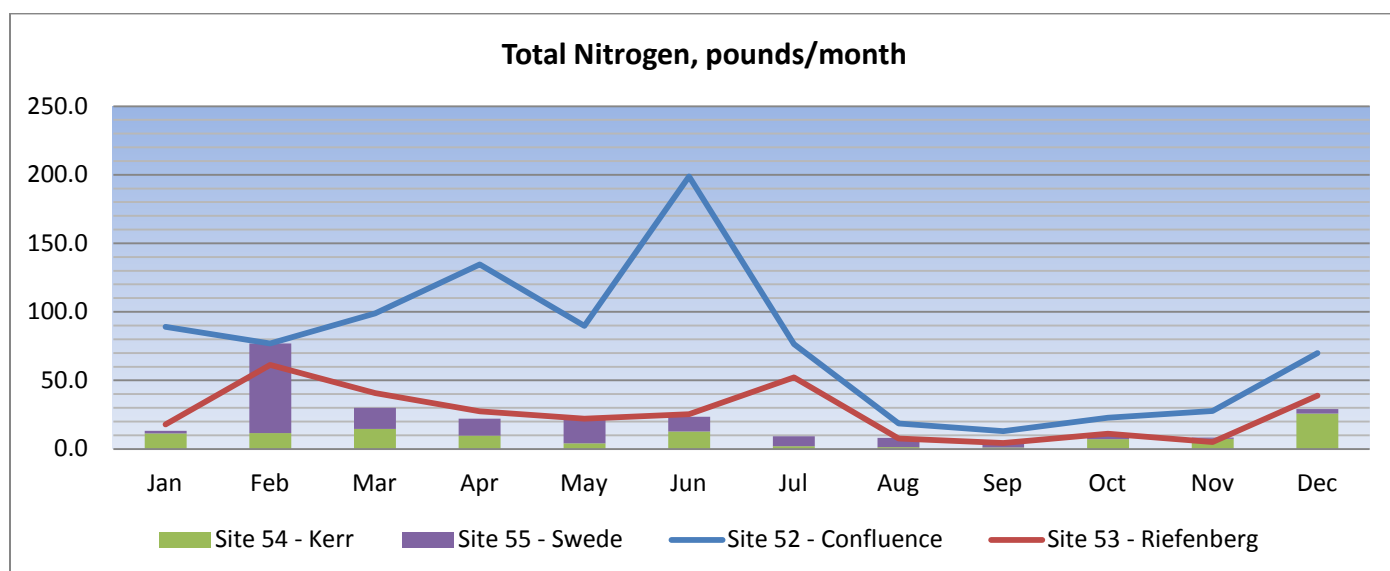


Figure 6 Total Nitrogen Loading in Kerr/Swede System

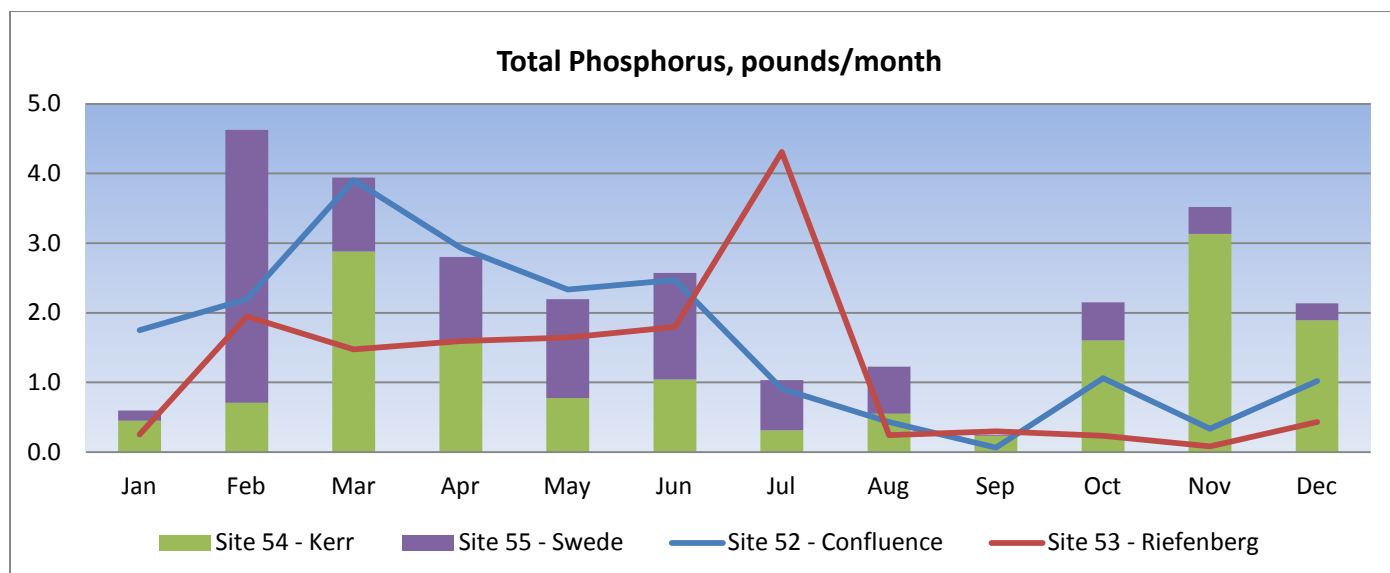


Figure 7 Total Phosphorus Loading in Kerr/ Swede System

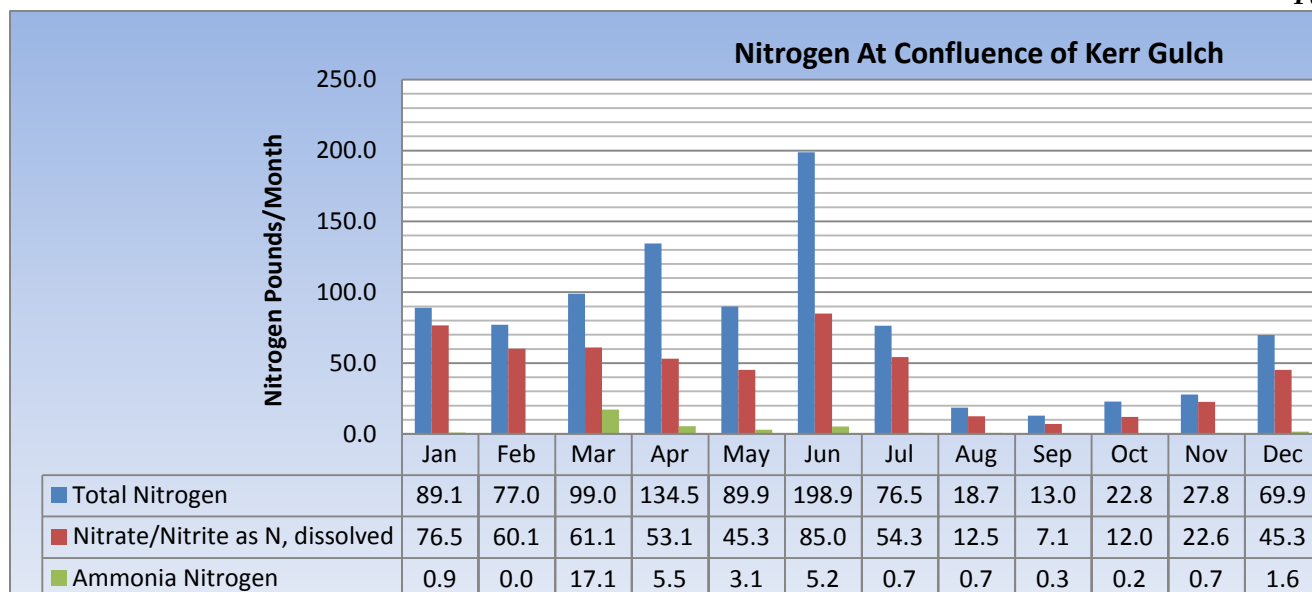


Figure 8 Nitrogen Loading at Kerr Gulch Discharge into Bear Creek



Figure 9 Several of the Horse Stable Operations Straddle Kerr and Swede Gulches with Resultant Direct Manure Loading.