

Technical Memorandum BCWA

Approved: October 15, 2013

To: *Bear Creek Watershed Association*

From: Russell N. Clayshulte, Manager

Re: **TM2013.01 - Sampling Program Summit Lake/ Denver Mountain Parks and National Forest Service lands and 2013 BCWA Water Quality Data and Observations**



Sampling Program

Bear Creek Watershed Association established three sampling stations at Summit Lake and upper Bear Creek, Mt Evans Wilderness, Clear Creek County Colorado. The Association selected sampling Site 36 (Summit Lake near the outfall culverts), Upper Bear Creek Site 37 downstream of ponds #1 and #2 on the mainstem of Bear Creek, and a new 2013 site 65 between ponds #1 and #2.



Figure 1 BCW Site 65 between pond #1 and Pond #2

In June 2012, the Association began a special study effort to document the extent and magnitude of a potential pollution plume. The Association walked the area to identify potential problem areas. The Association concluded that the source area was in the vicinity of the parking lot. The Association originally assumed the problem was related to the past waste disposal practice of using pit privies. There are a large number of wetland or bog ponds that occur between the parking lot and upper Bear Creek. The Association noted that some of these ponds in a drainage fall-line had much more algal productivity than those ponds nearer Summit Lake and well downstream from the parking lot. This suggested that the pollution plume was surfacing in-part in some of the ponds.

The special sampling program at Summit Lake established four new BCWA sampling sites: Sites 60, 61, 62 and 63.

In 2013, the Denver Parks and Recreation District began their own investigation of the pollution plume. As such, the Association reduced their monitoring program to include only one plume site (63). The Association monitored four sites in 2013 - sites 36, 37, 63 and 65. There was a steady small flow at site 63, which was quantified for load estimates. Based on observations and measurements in September 2013, the site 63 is roughly the eastern edge of the plume with 6 measureable inflow points toward the west. Generally, the main inflow points cover a distance of 9.5 feet. The 2013 chemistry suggests the plume has made a western migration with increasing loading occurring near the outlet of Summit Lake.



Figure 2 Site 63 Lower Plume sample Site before entering Pond #1

Field Data and Chemistry

Table 1 Field Measurements and Observations

	19-Jun	24-Jul	28-Aug	26-Sep
	Site 36 Outlets			
Time	11:52	10:18	10:46	10:31
Temperature C	4.40	10.90	10.00	4.60
pH	6.82	8.95	7.77	7.24
Specific Conductance ms/cm	0.020	0.021	0.020	0.023
Dissolved Oxygen mg/l	10.61	7.54	7.75	9.65

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	19-Jun	24-Jul	28-Aug	26-Sep
	Site 37 Bear Creek			
Time	11:27	10:46	11:27	10:55
Temperature C	8.30	12.10	10.32	3.00
pH	6.87	7.44	6.48	7.00
Specific Conductance ms/cm	0.020	0.020	0.021	0.023
Dissolved Oxygen mg/l	9.55	8.06	7.32	10.30
	Site 63 Bottom Plume			
Time	10:45	10:27	10:48	10:40
Temperature C	7.70	10.90	9.52	4.10
pH	6.78	7.80	6.53	6.00
Specific Conductance ms/cm	0.035	0.031	0.034	0.030
Dissolved Oxygen mg/l	3.28	4.17	1.46	13.90
	65 - Between Ponds			
Time	11:10	10:35	11:15	10:45
Temperature C	5.80	12.00	10.27	2.8
pH	6.88	7.43	6.32	6.7
Specific Conductance ms/cm	0.017	0.019	0.021	0.023
Dissolved Oxygen mg/l	10.65	9.09	8.50	10.0
	Estimated Flow cfs			
site 36 through Culverts	1.06	0.92	1.80	0.98
site 37 - Bear Creek	0.96	2.12	3.97	2.12
site 63 - Bottom Plume @ flow site	0.010	0.015	0.029	0.008
site 65 - Between Pond #1 and #2	1.00	1.20	2.48	1.50
	Periphyton Coverage			
site 36 - within Summit lake	1%	1%	2%	1%
site 37 - Bear Creek	25%	20%	15%	15%
site 65 - Between Pond #1 and #2	5%	75%	15%	5%
End Pond #2, Bear Creek	40%	100%	75%	40%
	Fish Present			
site 36 - within Summit lake	1+	1+	2+	5+
site 37 - Bear Creek	no	no	no	no
site 65 - Between Pond #1 and #2	no	1+	no	1+
End Pond #2, Bear Creek	no	no	no	no
Channel from Culvert to Pond #1	no	no	no	no



Figure 3 Clean Substrate (Trace Periphyton) Site 36 Summit Lake

Table 2 Chemistry

Site	Parameter	19-Jun	24-Jul	28-Aug	26-Sep	Average
BCWA Segment Sample Sites						
36 - Outlet Summit Lake	Total Nitrogen, ug/l	289	260	351	345	311
36 - Outlet Summit Lake	Nitrate/Nitrite as N, dissolved, ug/l	52	75	127	165	105
36 - Outlet Summit Lake	Nitrogen, ammonia, ug/l	46	9	63	16	34
36 - Outlet Summit Lake	Phosphorus, total, ug/l	16	2	40	6	16
65 - Between Pond #1 & #2	Total Nitrogen, ug/l	229	517	458	283	372
66 - Between Pond #1 & #2	Nitrate/Nitrite as N, dissolved, ug/l	74	76	251	167	142
67 - Between Pond #1 & #2	Nitrogen, ammonia, ug/l	43	25	9	14	23
68 - Between Pond #1 & #2	Phosphorus, total, ug/l	16	2	63	8	22
37 - Upper Bear Creek	Total Nitrogen, ug/l	219	327	421	338	326
37 - Upper Bear Creek	Nitrogen, ammonia, ug/l	32	32	51	15	33
37 - Upper Bear Creek	Nitrate/Nitrite as N, dissolved, ug/l	86	101	228	169	146
37 - Upper Bear Creek	Phosphorus, total, ug/l	7	2	12	6	7
Summit Plume Discharge						
63- Est Bottom Plume	Phosphorus, total, ug/l	4112	1798	208	1087	1801
63- Est Bottom Plume	Total Dissolved Phosphorus, ug/l			39		
63- Est Bottom Plume	Ortho-Phosphorus, ug/l			22		
63- Est Bottom Plume	Total Nitrogen, ug/l	1722	3108	121	925	1469
63- Est Bottom Plume	Nitrogen, ammonia, ug/l	49	42	83	32	52
63- Est Bottom Plume	Nitrate/Nitrite as N, dissolved, ug/l	4	3	2	2	3



Figure 4 Periphyton Growth (Red Algae) and Sheen below Plume in Pond #1



Figure 5 Site 37 Bear Creek with about 20% Periphyton Growth on Substrate

Table 3 Load Estimates

Flow acre-feet/month					
	June	July	August	Sep	Season Totals
site 36 through Culverts	63.1	56.6	110.7	58.3	288.6
site 37 - Bear Creek	57.1	130.3	244.0	126.1	557.6
site 63 - Bottom Plume @ flow site	0.6	0.9	1.8	0.5	3.8
Site 63 - Bottom Plume Adjusted	5.7	8.8	16.9	4.5	35.9
Site 65 - Between Pond #1 and #2	59.5	73.8	152.1	89.2	374.6
Total Phosphorus, Pounds/month					
site 36 through Culverts	2.7	0.3	12.1	1.0	16.1
site 37 - Bear Creek	2.5	0.7	41.9	2.7	47.8
Site 63 - Bottom Plume Adjusted	63.3	42.9	9.6	13.4	129.1
site 65 - Between Pond #1 and #2	2.6	0.4	26.1	1.9	31.0
Total Nitrogen, Pounds/month					
site 36 through Culverts	49.6	40.0	105.8	54.8	250.2
site 37 - Bear Creek	34.1	116.0	279.8	116.1	545.9
Site 63 - Bottom Plume Adjusted	26.5	74.1	5.6	11.4	117.6
site 65 - Between Pond #1 and #2	37.1	103.8	189.7	68.8	399.5
Nitrate/Nitrite as N, dissolved, Pounds/month					
site 36 through Culverts	8.9	11.5	38.3	26.2	84.9
site 37 - Bear Creek	13.4	35.8	151.5	58.0	258.8
Site 63 - Bottom Plume Adjusted	0.1	0.1	0.1	0.0	0.2
site 65 - Between Pond #1 and #2	12.0	15.3	104.0	40.6	171.8
Ammonia Nitrogen, Pounds/month					
site 36 through Culverts	7.9	1.4	19.0	2.5	30.8
site 37 - Bear Creek	5.0	11.4	33.9	5.2	55.4
Site 63 - Bottom Plume Adjusted	0.8	1.0	3.8	0.4	6.0
site 65 - Between Pond #1 and #2	7.0	5.0	3.7	3.4	19.1