

Technical Memorandum BCWA



Date: February 12, 2019
To: Bear Creek Watershed Association
From: Russell N. Clayshulte, Manager

Re: BCWA TM 2018.03 Coyote Gulch

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The Association coordinates with the City of Lakewood a sampling program on Coyote Gulch in the Bear Creek Park (Figure 1). The monitoring is done at two sampling sites: above the restoration project (Upper Coyote), and at the discharge into the reservoir (Lower Coyote). Beginning in 2013, the Association incorporated the nutrient sampling into the Association monitoring program as part of the P2 Supplemental Monitoring Program. The Association reduced the monitoring frequency to bi-monthly. Nutrient analyses are done at the Association's contract laboratory GEI Consultants Inc. The Association collects the chemistry data for total phosphorus and total nitrogen (Table 1). The Association takes bi-monthly flow measurements to determine nutrient loading. The Association also collects data for temperature, pH, specific conductance and Dissolved Oxygen. Data results are incorporated into the Association annual data summaries. The Association has pre-construction and post-construction loading data. This monitoring project has established a total phosphorus trade credit for use of the Association membership. Data maintained in the BCWA *MSD11 Coyote Gulch Data Master spreadsheet*.



Figure 1 Coyote Gulch Project and Sample Sites

Table 1 Field Data

Location	Date	Time	pH	Water Temp °C	Air Temp °C	DO(mg/l)	SC (us/cm)	Flow (cfs)	Periphyton Coverage %	Periphyton Thickness	Water Clarity
Upper Coyote	2/12/2018	11:40	7.77	0.00	3.6	4.63	769	0.74	8%	2	c
	4/9/2018	12:10	7.99	6.50	14.0	11.11	1210	0.47	20%	3	c
	6/11/2018	11:30	7.83	15.20	27.4	6.37	1251	0.55	30%	3	c
	8/7/2018	11:55	7.99	17.70	31.4	6.57	1227	0.41	15%	3	c
	10/15/2018	1:00	8.26	2.10	12.7	11.71	1197	0.49	15%	3	c
	11/5/2018	10:50	8.19	4.40	12.4	11.12	1343	0.79	8%	2	c
	12/19/2018	10:45	7.98	0.00	12.0	10.80	1617	0.19	30%	3	c
Lower Coyote	2/12/2018	11:55	8.02	0.00	3.6	4.63	901	0.72	3%	2	c
	4/9/2018	12:20	8.25	7.80	14.7	12.30	1192	0.43	60%	4	c
	6/11/2018	11:45	8.06	18.10	28.0	8.20	1251	0.54	40%	3	c
	8/7/2018	12:10	8.09	18.70	31.4	8.90	1176	0.35	75%	5	c
	10/15/2018	1:10	8.40	3.10	12.7	11.83	1188	0.48	100%	5	c
	11/5/2018	11:00	8.37	5.60	12.4	12.09	1320	0.77	100%	5	c
	12/19/2018	11:00	8.12	0.00	12.2	14.22	1590	0.16	70%	5	c

Table 2 Nutrient Data

Location	Date	Total Nitrogen	Total Phosphorus
Upper Coyote	2/12/2018	2403	22
	4/9/2018	1237	50
	6/11/2018	974	149
	8/7/2018	911	136
	10/15/2018	1304	43
	11/5/2018	1041	29
	12/19/2018	3213	22
Lower Coyote	2/12/2018	2409	22
	4/9/2018	998	27
	6/11/2018	851	122
	8/7/2018	717	120
	10/15/2018	1239	31
	11/5/2018	877	24
	12/19/2018	3110	21

Table 3 Flow Data

	60	61	61	62	61	61	
	Jan-Feb	Mar-Apr	May-Jun	Jul-Aug	Sep-Oct	Nov-Dec	
	cfs						
Upper Coyote	0.74	0.47	0.55	0.41	0.49	0.19	
Lower Coyote	0.72	0.43	0.54	0.35	0.48	0.16	
	Ac-Ft/day						
Upper Coyote	1.467	0.932	1.091	0.813	0.972	0.377	
Lower Coyote	1.428	0.853	1.063	0.694	0.950	0.307	
	Ac-ft/month						Annual ac-ft
Upper Coyote	88.0	55.9	65.4	48.8	58.3	23.0	339.5
Lower Coyote	85.7	52.0	64.8	43.0	57.9	18.7	322.2

Table 4 Nutrient Loads

Location	Date	Flow Estimate	Loading Pounds/Period	
			Total Nitrogen	Total Phosphorus
Upper Coyote	Jan-Feb	88.0	576.1	5.3
	Mar-Apr	55.9	188.4	7.6
	May-Jun	65.4	173.6	26.6
	Jul-Aug	48.8	121.0	18.1
	Sep-Oct	58.3	510.1	3.5
	Nov-Dec	23.0	150.8	1.4
Lower Coyote	Jan-Feb	85.7	561.9	5.1
	Mar-Apr	52.0	141.4	3.8
	May-Jun	64.8	150.2	21.5
	Jul-Aug	43.0	84.0	14.1
	Sep-Oct	57.9	195.5	4.9
	Nov-Dec	18.7	44.8	1.2

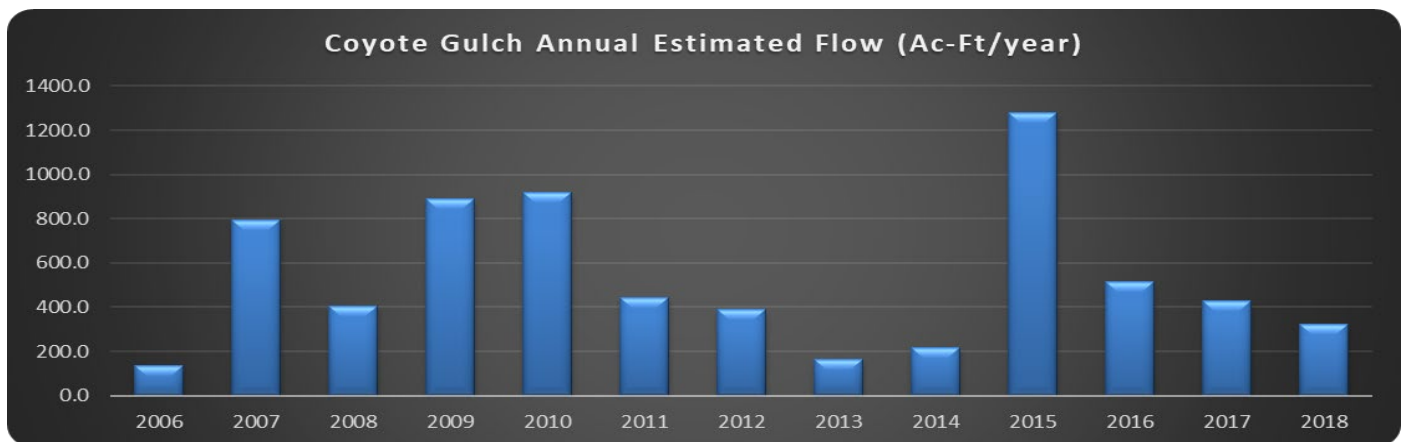


Figure 2 Estimated Annual Flows

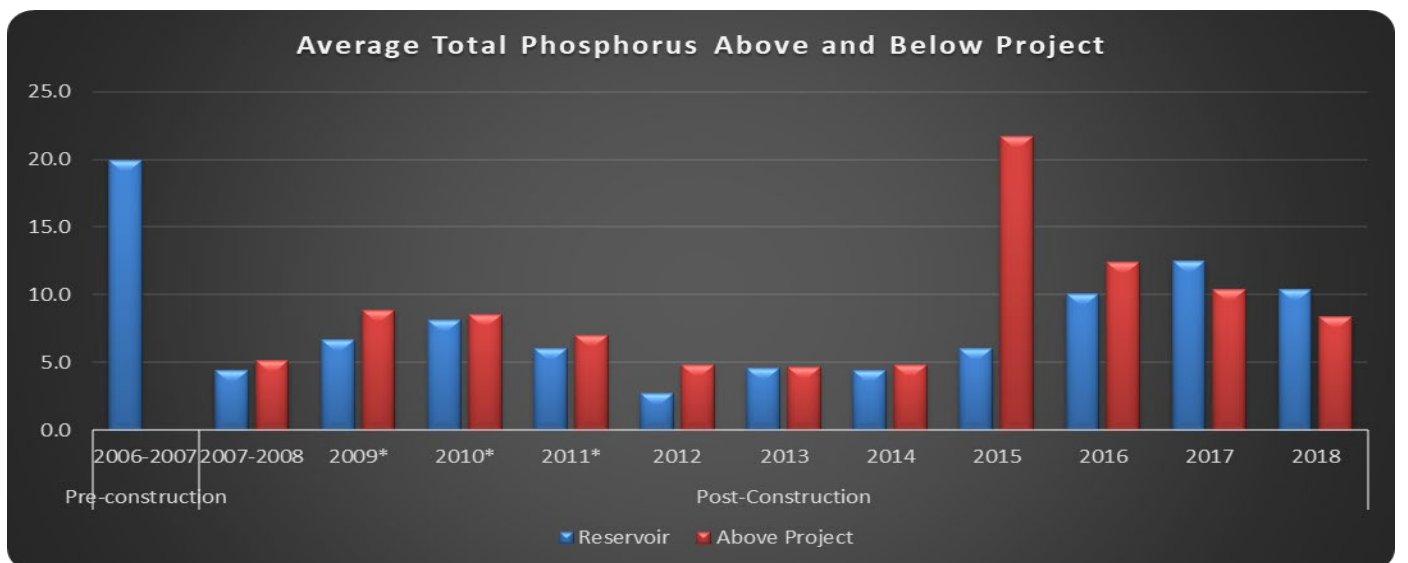


Figure 3 Total Phosphorus Removal by Project

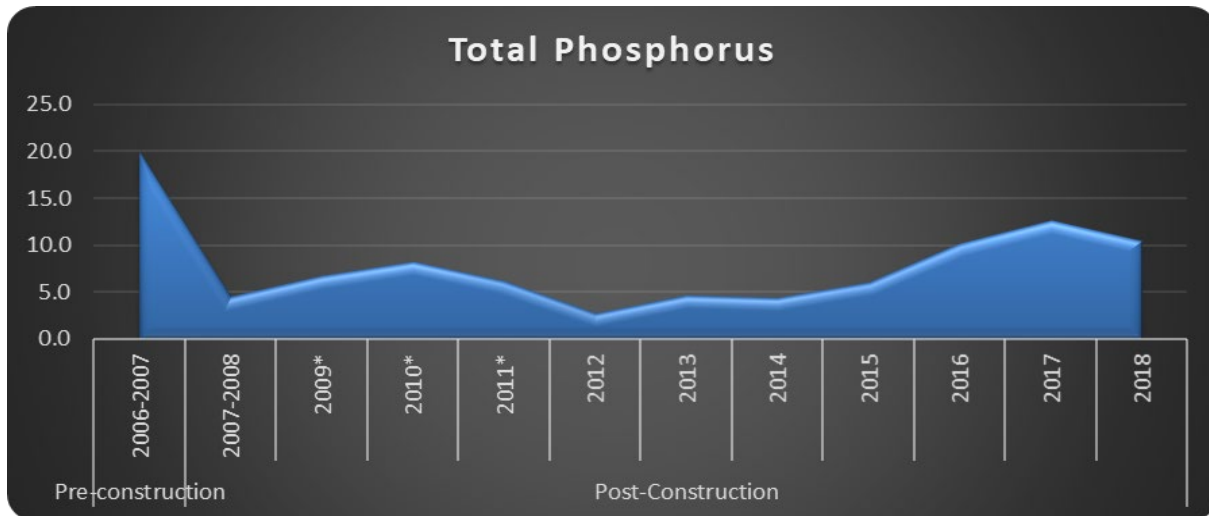


Figure 4 Total Phosphorus Baseload Estimates

Table 5 2018 Annual Nutrient Loads

	Annual Pounds		
	Flow Estimate ac-yr	Total Nitrogen	Total Phosphorus
Upper Coyote	339.5	1719.9	62.4
Lower Coyote	322.2	1177.8	50.7
	Average Loading		
Upper Coyote		286.6	10.4
Lower Coyote		196.3	8.4

Table 6 2018 Trade Pound Estimates

Total Phosphorus Trade Pounds				
	Total Base Flow		Trade Ration Pounds	
	Monthly	Annual	Monthly	Annual
Average	6.9	83.0	6.5	78.3
Median	6.1	72.9	6.9	83.3
Monthly TRP=PC Base Load-TBF Monthly Pounds/2				
The base trade ratio is 2:1 for Association Trade Projects				
Base Flows Exclude April Storm Loadings				
Annual Trade Pounds Available = 78 pounds Total Phosphorus				