Technical Memorandum BCWA

Date: February 5, 2020
To: Bear Creek Watershed Association
From: Russell N. Clayshulte, Manager

Re: BCWA TM 2019.03 Coyote Gulch

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

Segment	Site	Location	Date	Time	pH	Water Temp °C	Air Temp °C	DO(mg/l)	SC (us/cm)	Flow (cfs)	Periphyton Coverage %	Periphyton Thickness	Water Clarity
Segment 4a	Site 47a	Upper Coyote	2/11/2019	12:05	7.81	0.10	8.3	10.16	2360	0.73	8%	2	c
			4/8/2019	10:55	8.25	9.20	22.6	11.74	1439	0.45	10%	2	c
			6/10/2019	12:10	7.80	15.10	35.2	9.60	1256	0.62	40%	4	c
			8/5/2019	11:05	7.49	18.50	35.2	7.85	1109	0.54	20%	3	c
			10/14/2019	12:15	7.60	7.60	27.6	12.29	1401	0.21	20%	3	c
			12/9/2019	10:50	7.61	3.40	8.2	12.95	1250	0.18	8%	2	c
	Site 47b	Lower Coyote	2/11/2019	12:15	7.95	0.10	8.5	13.54	2360	0.36	40%	3	c
			4/8/2019	11:03	8.23	10.40	22.8	11.70	1427	0.41	90%	5	c
			6/10/2019	12:20	8.07	15.30	35.3	10.34	1196	0.27	60%	5	c
			8/5/2019	11:15	7.56	19.40	34.9	8.20	1101	0.52	75%	5	c
			10/14/2019	12:27	7.66	7.80	27.3	12.75	1396	0.25	100%	5	c
			12/9/2019	11:00	7.65	3.40	8.0	12.98	1259	0.15	30%	5	c

Table 2 Nutrient Data

Segment	Site	Location	Date	Total Nitrogen	Total Phosphorus
Segment 4a	Site 47a	Upper Coyote	2/11/2019	2562	24
			4/8/2019	1052	28
			6/10/2019	957	77
			8/5/2019	802	172
			10/14/2019	1707	23
			12/9/2019	498	34
	Site 47b	Lower Coyote	2/11/2019	2424	23
			4/8/2019	860	27
			6/10/2019	885	74
			8/5/2019	701	105
			10/14/2019	1592	18
			12/9/2019	734	97

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	0.73	0.45	0.62	0.54	0.21	0.18	
Lower Coyote	0.36	0.41	0.27	0.52	0.25	0.15	
	Ac-Ft/day						
Upper Coyote	1.442	0.888	1.237	1.071	0.416	0.357	
Lower Coyote	0.714	0.813	0.535	1.031	0.496	0.297	
	Ac-ft/month						Annual ac-ft
Upper Coyote	86.5	53.3	74.2	64.2	25.0	21.8	325.1
Lower Coyote	42.8	49.6	32.7	63.9	30.2	18.1	237.4

Table 4 Nutrient Loads

			Loading Pounds/Period	
Location	Date	Flow Estimate	Total Nitrogen	Total Phosphorus
Upper Coyote	Jan-Feb	86.5	603.4	5.7
	Mar-Apr	53.3	152.7	4.1
	May-Jun	74.2	193.5	15.6
	Jul-Aug	64.2	140.3	30.1

			Loading Pounds/Period	
Location	Date	Flow Estimate	Total Nitrogen	Total Phosphorus
	Sep-Oct	25.0	116.1	1.6
	Nov-Dec	21.8	143.7	1.4
Lower Coyote	Jan-Feb	42.8	282.7	2.7
	Mar-Apr	49.6	116.1	3.6
	May-Jun	32.7	78.7	6.6
	Jul-Aug	63.9	122.0	18.3
	Sep-Oct	30.2	131.1	1.5
	Nov-Dec	18.1	36.3	4.8

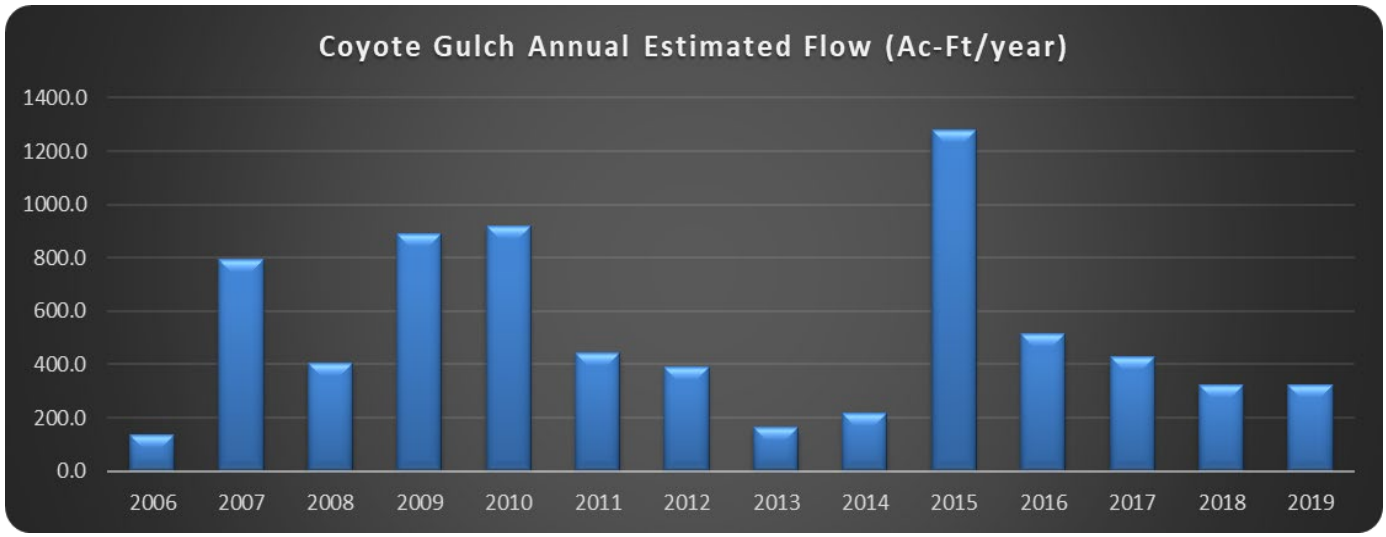

Figure 2 Estimated Annual Flows

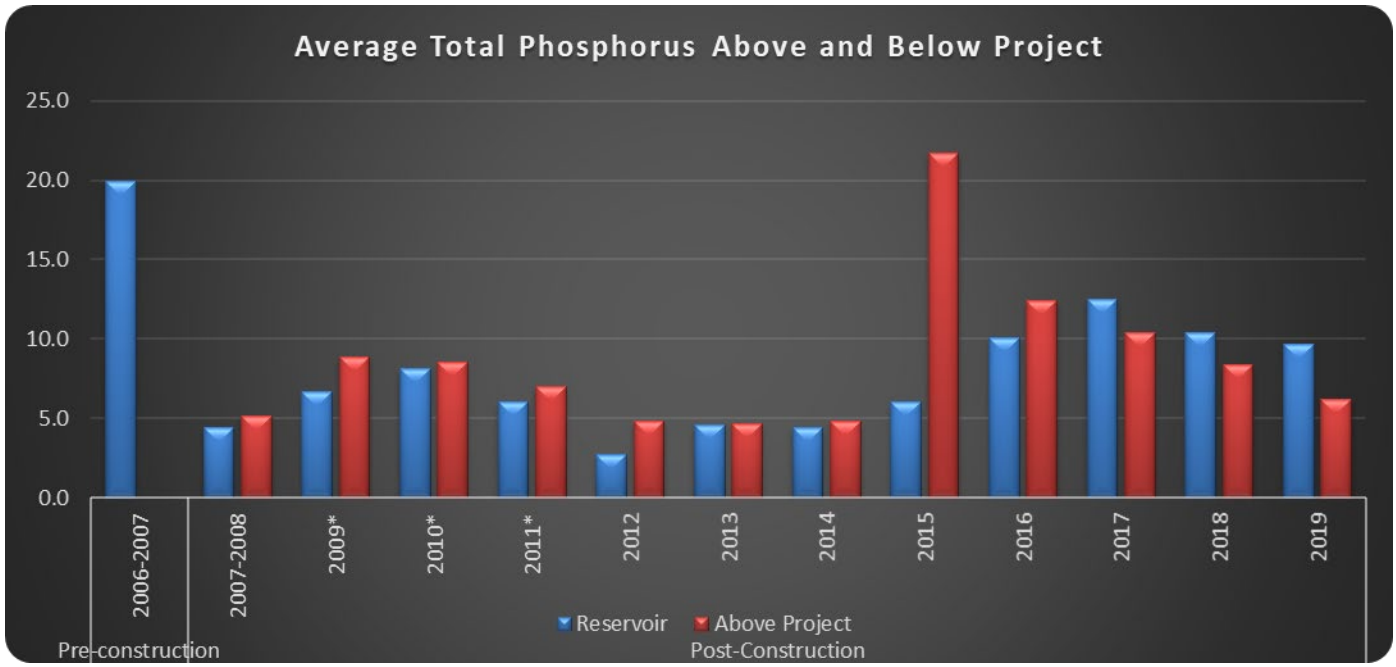

Figure 3 Total Phosphorus Removal by Project

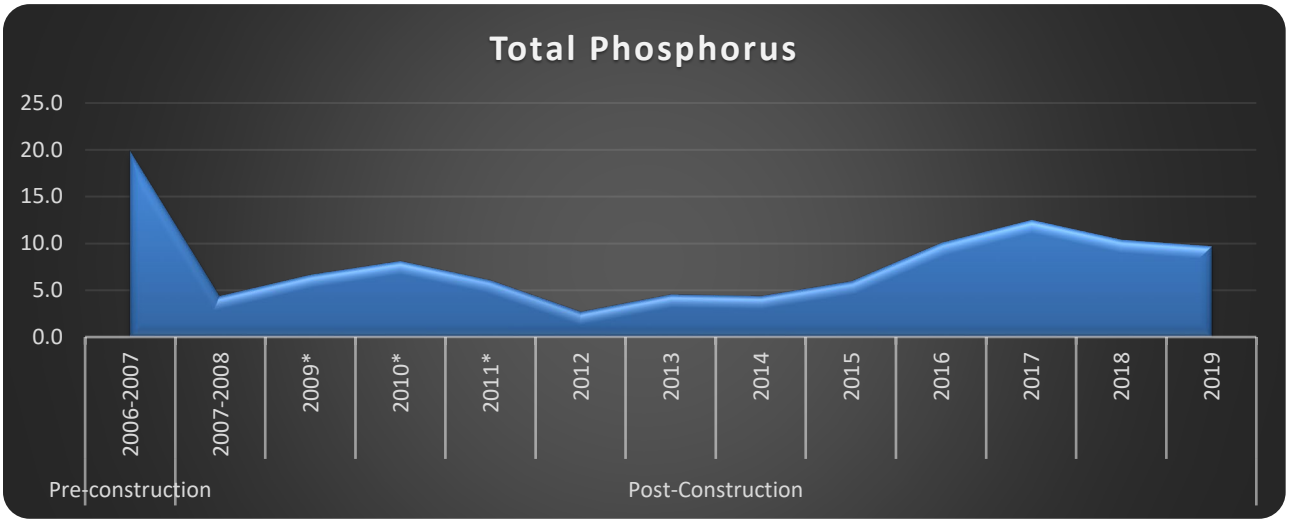

Figure 4 Total Phosphorus Baseload Estimates

Table 5 2019 Annual Nutrient Loads

	Annual Pounds		
	Flow Estimate ac-yr	Total Nitrogen	Total Phosphorus
Upper Coyote	325.1	1349.8	58.3
Lower Coyote	237.4	767.0	37.5
	Average Loading		
Upper Coyote		225.0	9.7
Lower Coyote		127.8	6.2

Table 6 2019 Trade Pound Estimates

Total Phosphorus Trade Pounds				
	Total Base Flow		Trade Ration Pounds	
	Monthly	Annual	Monthly	Annual
Average	7.1	85.7	6.4	**76.9**
Median	6.4	76.5	6.8	**81.5**
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 = 77 pounds Total Phosphorus				