

# Technical Memorandum BCWA



**Date:** October 17, 2019  
**To:** Bear Creek Watershed Association  
**From:** Russell N. Clayshulte, Manager  
**Re:** BCWA TM 2019.01 Sediment Survey BCR

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## Water Column Probe and Field Data

A water column probe set taken at site 40a on 10-15-2018 (Dissolved Oxygen, Specific Conductance, Temperature, and pH) Table 1 and a total nitrogen and total phosphorus sample was obtained for surface (-1m) and bottom waters (+1m). The total depth was obtained for each sediment sample site.

**Table 1 Reservoir Field Profile Site 40a**

Reservoir Profile		date:	10/14/2019				
Site 40a	Time	SC	DO	Temp	pH	Secchi m	t depth
1/2m	10:25	350.5	10.72	12.6	8.36	0.9	9.4
1m		350.7	10.57	12.3	8.37		
1 1/2m		351.0	10.52	12.2	8.35	Air	16.6
2m		350.9	10.28	12.1	8.32	Baro	24.33
2 1/2m		351.0	10.16	12.1	8.29	Alt	5,764
3m		351.2	9.75	12.1	8.26		
3 1/2m		351.6	9.09	11.9	8.26		
4m		351.8	9.05	11.9	8.21		

Reservoir Profile		date:	10/14/2019				
Site 40a	Time	SC	DO	Temp	pH	Secchi m	t depth
5m		353.1	9.02	11.8	8.18		
6m		355.7	7.94	11.7	8.14		
7m		355.2	7.91	11.6	8.12		
8m		352.7	7.90	11.6	8.10		
9m		341.1	7.90	11.2	8.10		

### Sediment Analyses Methods and Results

Sediment samples were taken at six sites in BCR (Figure 1, Table 2) and two sites in Evergreen Lake (Figure 2, Table 2). Mud was bagged into one-quart baggies. Bottom samples obtained with a Petite Ponar sampler. This sampler takes a grab of the top 5-10 cm of the reservoir bottom sediments. One dredge free-drop results in about 1.5-2 liters of bottom sediment/mud. Sediment is dumped into cleaned bucket and excess water is decanted from sample prior to bagging (1-2 bags per site). GPS coordinates verified at each site. The locations in Figures 1 and 2 are at sample sites. The samples are processed as wet sediment/mud.



Figure 1 BCR Sample Sites

Table 2 BCR Samples Collected

BCWA Dredge Sample Program 10/15/2018 and EGL 10/24/2018				
Site	Sediment	Profile	Lat	Long
BC03	X	Site 40	39.651482	-105.145700
BC05a	X	Site 40	39.653061	-105.141098
PEL08a	X	Site 40	39.650141	-105.144222
PEL10a	X	Site 40	39.651351	-105.140487
TC14a	X	Site 40	39.648723	-105.144287
TC16a	X	Site 40	39.650405	-105.139538
EGL1	X	EGL4a	39.6314	-105.3231

sediments taken with Petite Ponar dredge, top 5-10 cm mud

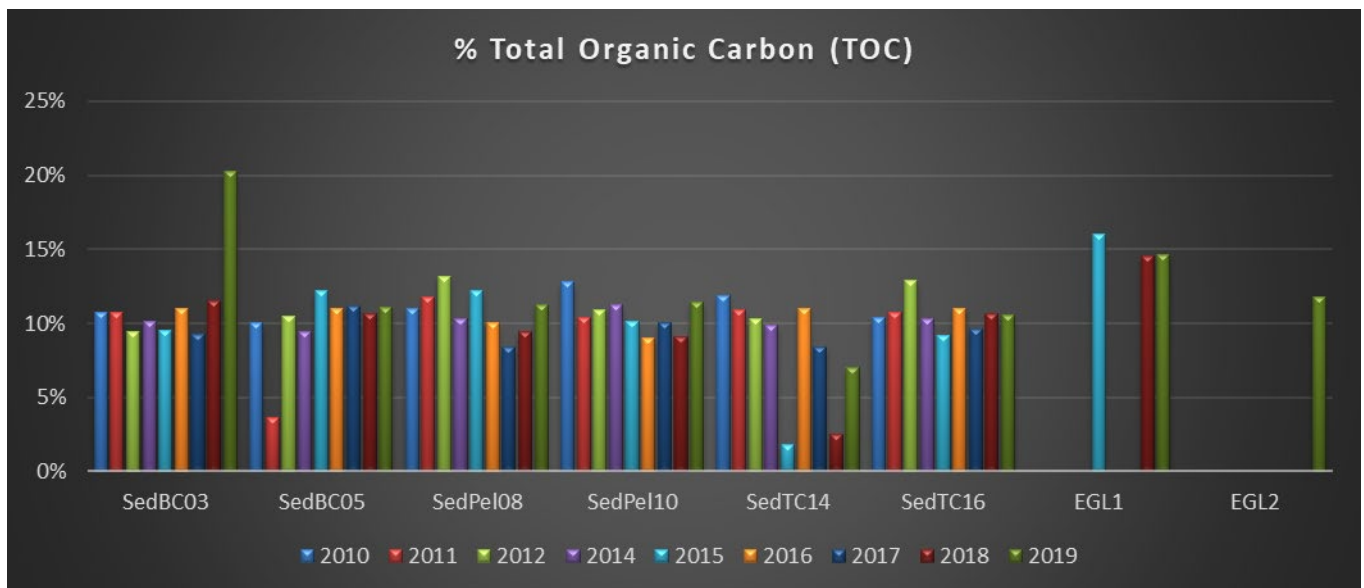
**Total Organic Matter**

About 5 grams of wet mud sample is weighed, dried for 1 hour at 103-105 degrees C, reweighed. This value is the total solids content of the sample. The dried sample is then ashed in a muffle furnace at 550 degrees C for 15 minutes and reweighed. This procedure provides a total solids percentage and a total organic carbon or volatile solid percentage. The total organic matter or total organic carbon (TOC) is volatilized and the percent difference is calculated to determine the estimated percentage of TOC contained in surface bottom muds (Table 3 and Figure 3). Table 4 compares the percentage TOC from 2010-2019, which remains very consistent at about 10% TOC.

**Table 3      2019 TOC Results**

	2019	
	% Solids	TOC %
<b>SedBC03</b>	42%	20.2%
<b>SedBC05</b>	24%	11.0%
<b>SedPel08</b>	34%	11.3%
<b>SedPel10</b>	22%	11.4%
<b>SedTC14</b>	40%	7.0%
<b>SedTC16</b>	25%	10.6%
<b>EGL1</b>	28%	14.7%
<b>EGL2</b>	28%	11.8%

**Table 4      2010-2019 TOC Comparison**



**Figure 2      2010- 2019 TOC Percentage**

**Grain Size Distribution**

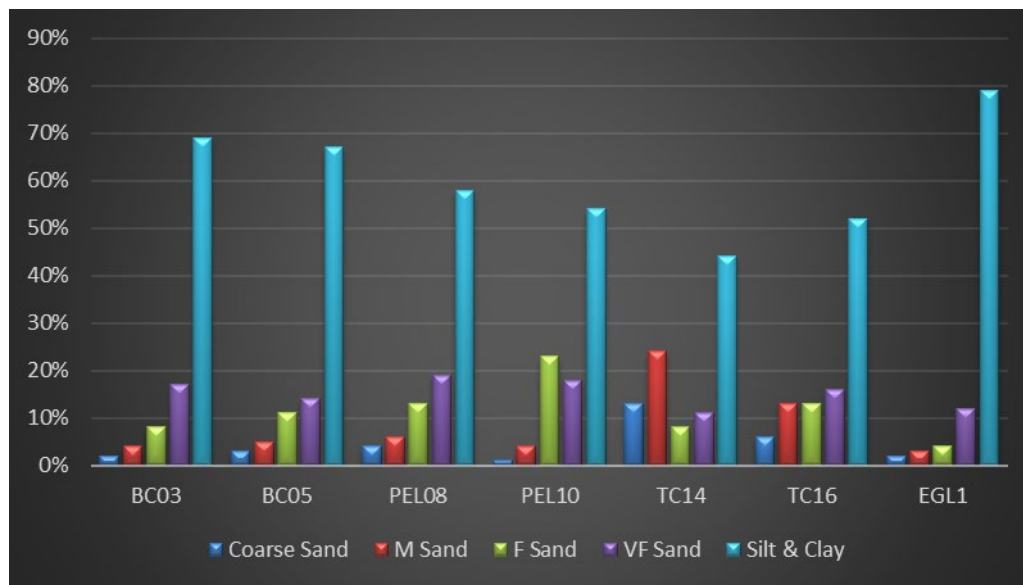
A mechanical sieve “sandshaker” is used to determine the percentage distribution of selected grain sizes in the bottom sediments. A wet sieve method is used to separate bottom sediments in a sieve pan set to obtain an estimated percentage accumulation on each pan. All bottom sediment material is less than U.S. Standard sieve 10 (0.08 inches) in diameter. As such, all reservoir sediment ranges from coarse sand to clay size. The sieve distribution used is shown in Table 5. The grain size distribution percentages are shown in Table 6 and Figure 4. The bottom muds are primarily a black/grey silt-clay.

**Table 5 Grain-size distributions used to analyze Bear Creek & Evergreen bottom sediments.**

Grain-Size Term	ASTM No.	Mesh Opening (in)	Sieve
Very Coarse & Coarse Sand	25	0.026	26 OPN
Medium Sand	60	0.009	9 OPN
Fine Sand	120	0.0046	46 OPN
Very Fine Sand	200	0.0029	29 OPN
Silt and Clay	<200		

**Table 6 Grain Size Distribution**

Site	Grain Size % retained				
	Coarse Sand	M Sand	F Sand	VF Sand	Silt & Clay
BC03	2%	4%	8%	17%	69%
BC05	3%	5%	11%	14%	67%
PEL08	4%	6%	13%	19%	58%
PEL10	1%	4%	23%	18%	54%
TC14	13%	24%	8%	11%	44%
TC16	6%	13%	13%	16%	52%
EGL1	2%	3%	4%	12%	79%



**Figure 3 Grain Size Distributions**

**Total Phosphorus Analysis Method**

**Extraction Procedure - Distilled Water**

- Weigh about 4-5 g of wet mud into 125 ml bottle with lid
- Add 25 mL of distilled water and shake manually over a minimum one-hour period or leave samples sitting with agitation for up to 4 days
- Centrifuge at 3,100 rpm for 15 minutes
- Filter the solution through a 0.47 µm membrane filter
- Use 5 ml for analysis; retain remainder for dilution. Dilution is 1:5 or, as appropriate

**Total Phosphorus in Wet Mud Test**

Determine the readily available total phosphorus as water extractable P (no strong digestion) in wet mud using HACH method 8190 PhosVer 3 with acid persulfate digestion Test “N Tube method measured with a Hach DR3900 spectrophotometer at 890 nm (Table 7 and Figure 5). Table 8 compares the BCWA sampled sediments for readily available total phosphorus data at six sites from 2010-2019.

A special sediment analyses was done by SePro Company in 2012 using a method (EPA 365.3, Modified) to evaluate the total amount of available phosphorus in bottom sediments (BCWA TM 2012.12 BCR Sediment Study & SePro). The SePro method measured all phosphorus in a sample as measured by persulfate strong digestion and includes inorganic, oxidizable organic and polyphosphates. This includes what is readily available, potential to become available and stable forms (Table 9).

**Table 7 2019 Total Phosphorus Data mgP/kg Mud**

		mgP/kg Mud
Bear Creek Transect	SedBC03	8.71
	SedBC05	4.41
Pelican Point Transect	SedPel08	3.52
	SedPel10	6.65
Turkey Creek Transect	SedTC14	4.46
	SedTC16	5.52
Evergreen Lake	EGL1	4.37
	EGL2	2.73

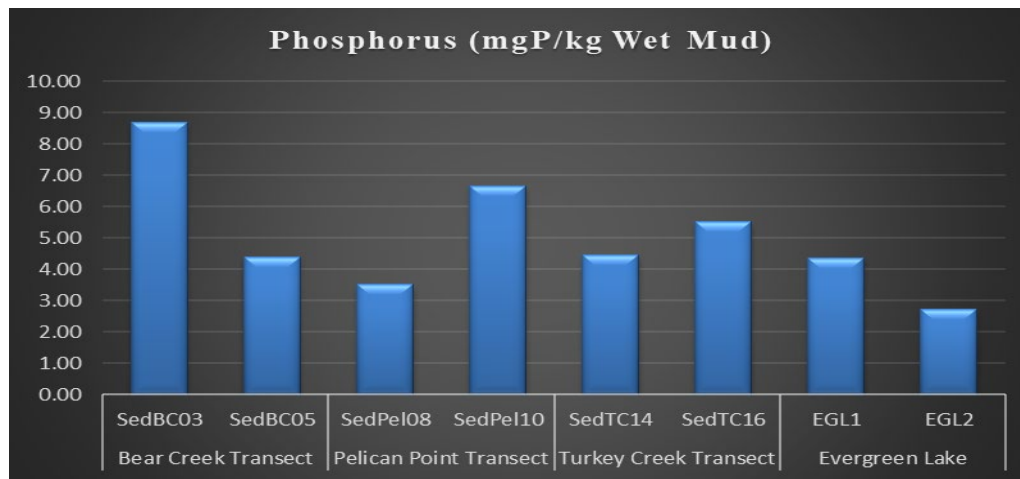


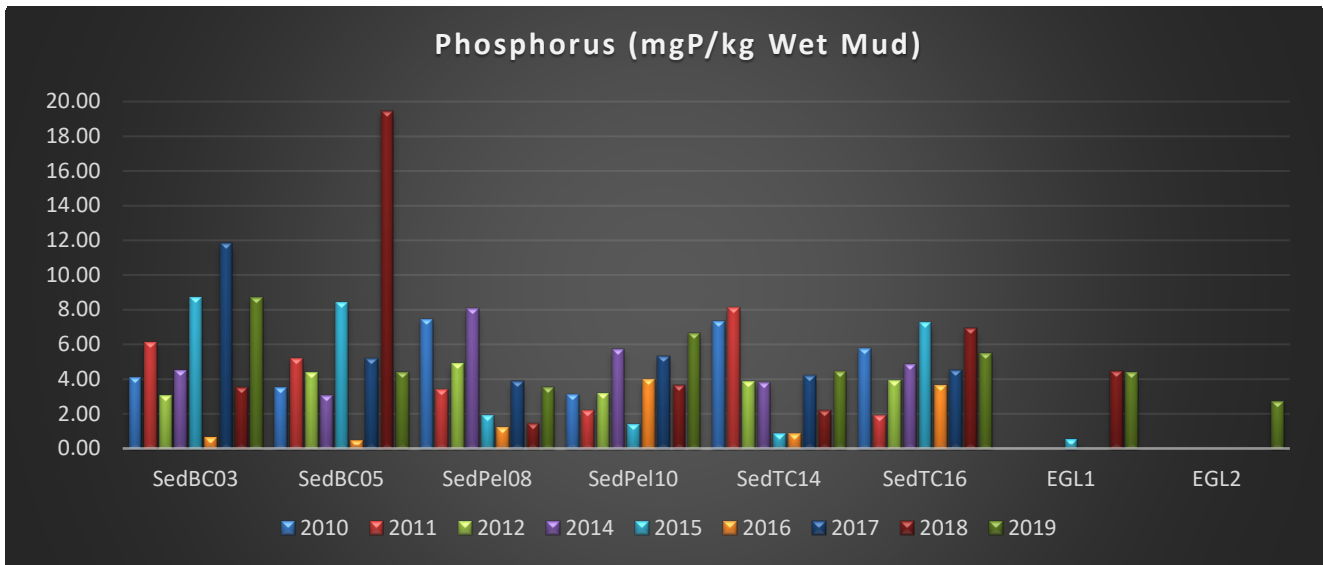
Figure 4 Phosphorus Distribution Along Transects BCR

**Table 8 Comparison Phosphorus Content of Bottom Muds from 2010-2019**

	Sediment Phosphorus (mgP/kg Wet Mud)									
	2010	2011	2012	2014	2015	2016	2017	2018	2019	
SedBC03	4.12	6.11	3.06	4.48	8.73	0.65	11.82	3.54	8.71	
SedBC05	3.50	5.21	4.38	3.06	8.43	0.47	5.21	19.47	4.41	
SedPel08	7.47	3.39	4.89	8.07	1.89	1.20	3.86	1.47	3.52	
SedPel10	3.13	2.20	3.19	5.69	1.42	3.97	5.33	3.63	6.65	
SedTC14	7.32	8.11	3.88	3.79	0.88	0.85	4.20	2.22	4.46	
SedTC16	5.76	1.91	3.90	4.85	7.25	3.64	4.51	6.92	5.52	
EGL1					0.54			4.44	4.37	

EGL2

2.73



**Figure 5 Comparison Phosphorus Content of Bottom Muds from 2010-2019**

**Table 9 2012 SePro P Data**

	P (mg/kg)
	2012 SePRO
SedBC03	844.92
SedBC05	1129.92
SedPel08	1100.76
SedPel10	1052.08
SedTC14	632.82
SedTC16	831.88