



R I F F L E S T O R I P P L E S

MEMORANDUM

DATE: September 14, 2020 (Updated with TAC Comments on 10/8/20)

TO: Jacob James, P.E.; Cherry Creek Basin Water Quality Authority (CCBWQA) – Technical Advisory Committee (TAC) Chairman
Chuck Reid, CCBWQA Manager

CC: Jason Trujillo, Cherry Creek State Park (CCSP) Park Manager

FROM: Richard G. Borchardt PE, CFM

SUBJECT: 2020 Annual Field Observation of Pollution Reduction Facilities (PRFs) at CCSP

Introduction

Annually, the CCBWQA performs Field Observation (FO) of the PRFs constructed by the CCBWQA at CCSP. The annual FO is a requirement of the Operations and Maintenance Agreement between the CCBWQA and CCSP dated January 14, 2006 (Agreement). The West Boat Ramp PRF was excluded from the Agreement by the First Amendment dated April 18, 2013 (Amendment).

The purpose of the FO is to assess whether the PRF's are functioning as designed and to identify routine, restorative, and rehabilitative maintenance requirements. The TAC of the CCBWQA will use this report to provide recommendations to the Board for the following fiscal year budgeting of maintenance activities. Restorative and rehabilitative maintenance requirements are the responsibility of the CCBWQA. Routine maintenance is the responsibility of CCSP. Other items, such as educational/interpretive sign replacement and weed control, as outlined in the Agreement, is shared 50% CCSP and the 50% CCBWQA. The West Boat Ramp PRF routine, restorative, and rehabilitative maintenance is 100% CCSP and/or the Marina.

As defined in the Agreement, the term "Restorative and Rehabilitative Maintenance" shall mean all maintenance and repair reasonably necessary to keep the structural and other essential components or portions of a PRF in good working order and functioning as designed, including but not limited to the repair of walls, embankments, pipes, gates, monitoring facilities, erosion and riprap, the removal of sediment, and the replacement of vegetation within the disturbed area of a PRF as needed to maintain or restore the PRFs function. "Routine Maintenance" shall mean any and all maintenance that is necessary (other than Restorative and Rehabilitative Maintenance) to keep a PRF in a clean, visually appealing and safe condition, free from debris and rubbish, and protected from vandalism and malicious mischief to the same extent as any other public facility located within the CCSP.

The PRFs that are part of the Stream and Drainage System are observed at least annually and after storm events since they are more likely have changes in their condition. The PRFs that are Shoreline Stabilization are observed on an as needed basis or as the CCBWQA, CCSP and/or USACE personnel identify issues or concerns during the year. The FO frequency by PRF are shown in **Table 1**.

PRFs Field Observation Annually and After Significant Storm Events (Part of Stream and Drainage System)	PRFs Field Observation As-Needed (Part of Shoreline Stabilization)
Shop Creek Cherry Creek at 12-Mile Park (Phases I and II) Cottonwood Creek Stream Reclamation Cottonwood Wetlands Quincy Drainage West Boat Ramp	Tower Loop East Shade Shelters East Boat Ramp Dixon Grove Mountain and Lake Loop

Table 1 – Frequency of Field Observation by PRF

The PRFs were broken into groups to minimize trips and coordinate with schedules of attendees.

- **Group 1:** Cottonwood Wetlands and Cottonwood Creek Stream Reclamation was observed on May 22, 2020 by R2R Engineers on behalf of CCBWQA.
- **Group 2:** Shop Creek, Quincy Drainage, Tower Loop, Dixon Grove, and Mountain and Lake Loop was observed by R2R Engineers on May 29, 2020 on behalf of CCBWQA. The Dixon Grove repair was observed on July 17, 2020.
- **Group 3:** Highlights from previous observations done by R2R Engineers of Dixon Grove, Tower Loop, and Mountain and Lake Loop and new observations of Cherry Creek 12-mile Park (Phases I and II) and West Boat Ramp were made on July 30, 2020 by R2R Engineers, Larry Butterfield and Steven Stanton with CCSP, and Chuck Reid with CCBWQA.
- **Group 4:** East Shade Shelters and East Boat Ramp PRFs were not observed in 2020. Pictures from 2019 FO and repair status updates were included.

General Assessments

The 2020 annual FO general assessments and photos are provided on the following pages.

Mountain and Lake Loop (Reservoir Water Surface Elevation = 5550.2): Construction of this PRF was completed in 2013. Additional shoreline stabilization and restoration work was performed following the 2015 flooding. This project appears to be functioning effectively as shoreline stabilization (**Photos 1 and 2**). There is some erosion near a trail access (**Photo 3**) and a maintenance project is included in this report for TAC and Board consideration. This PRF provides a BioRetention Area that treats access road and parking (**Photo 4**); this area is well vegetated and appears stable.



Photo 1



Photo 2



Photo 3



Photo 4

Tower Loop (Reservoir Water Surface Elevation = 5550.2): Repairs from 2018 Annual FO (**Photos 5**) were completed on April 20, 2020. New for 2020, the crusher fines behind grouted boulders are lower than top edge of grout (**Photo 6**); maintenance of crusher fines will be brought to attention of CCSP. There is erosion occurring where the existing shoreline protection stops (**Photo 7**); a second phase of shoreline protection is planned in the current Capital Improvement Program. Ducks are monitoring the water quality and the effectiveness of an existing boulder Jetty (**Photo 8**).



Photo 5



Photo 6



Photo 7

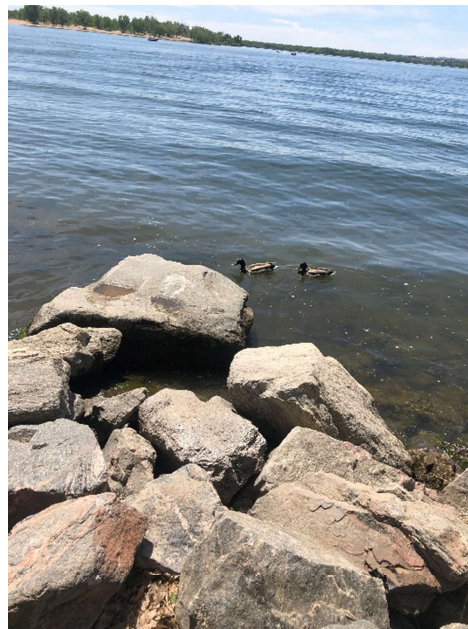


Photo 8

East Shade Shelters: Erosion was noted in the 2018 FO (**Photo 9**) resulted in shoreline protection being scheduled for 2020. Shifting riprap shown near steps in 2018 observation (**Photo 10**) was monitored in 2019. The 2020 repair has been submitted for review and approval by the United States Army Corps of Engineers (USACOE) and CCSP; repair will be scheduled for construction after approval is received. Additional shoreline erosion was noted in 2019 (**Photos 11-12**) continued monitoring of this area is suggested.



Photo 9



Photo 10



Photo 11



Photo 12

East Boat Ramp: Maintenance identified in 2018 FO (**Photos 13-15**) resulted shoreline protection being scheduled for 2020. The 2020 repair has been submitted for review and approval by the United States Army Corps of Engineers (USACOE) and CCSP; repair will be scheduled for construction after approval is received. First observed in 2019, additional shoreline erosion was noted (**Photo 16**) to south of previous shoreline stabilization projects; continued monitoring of this area is suggested.



Photo 13



Photo 14



Photo 15

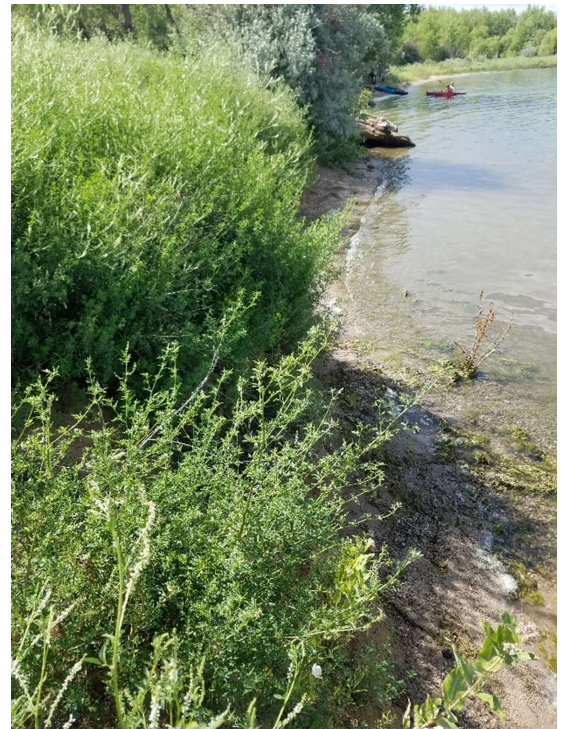


Photo 16

Shop Creek: Minor deterioration of the top of the roller compacted concrete drop structures #2 and #3 (**Photo 17**); continued monitoring of this issue is suggested. CCSP performs regular maintenance by cleaning the trash racks and mowing and removing vegetation around inlets. Vegetation intrusion in inlets was noted drop structures #1 and #2 (**Photo 18**); maintenance of these inlets will be brought to the attention of CCSP. The Mile High Flood District has completed a sediment removal for upstream pond outside of state park (**Photo 19**)¹. Weed control (**Photo 20**) started in 2020 and the continuation of this program is included in this report for consideration by the TAC and Board.



Photo 17



Photo 18



Photo 19



Photo 20

¹ 1 The upstream drop structure is outside the park and is the responsibility of Aurora, but is included in the annual assessment since proper function of all drops is important to the overall performance of the Shop Creek system. Parks Structures are numbered 1 through 5 from upstream to downstream.

Cherry Creek 12-mile Park Phase I: Phase I was completed in 2012. It did experience significant sediment aggradation from the 2014 and 2015 storm events which appears to have resolved with the breach. Maintenance identified in 2018 FO (**Photo 21**); resulted in budgeting for fencing and revegetation which was completed on August 24, 2020 (**Photo 22**). Bank erosion and social trails were noted in 2019 FO (**Photo 23-24**); planning and permitting have started for this repair. Noxious weed control and mowing was done by CCSP in 2020 and should be continued by CCSP.



Photo 21



Photo 22



Photo 23



Photo 24

Cherry Creek 12-mile Park Phase II: Phase II was completed in 2014 and is experiencing high pedestrian and dog activity. It did experience significant sediment aggradation from the 2014 and 2015 storm events which appears to have resolved itself in 2020. Noted in 2019 FO, traffic into along the banks of the Creek has denuded the vegetation and continued in 2020 (**Photos 25-26**). Area behind Boulder Edging is eroding, the Boulders have tipped, and a maintenance effort for this repair (**Photo 27**) is included in this report for consideration by CCBWQA’s TAC and Board. Noxious weed control and mowing was done by CCSP in 2020 and should be continued by CCSP.



Photo 25



Photo 26



Photo 27

Cottonwood Creek Stream Reclamation: Noxious weed control was performed by the CCSP and the CCBWQA (**Photos 28-29**) in 2020. The east bank of a riffle structure is experiencing some erosion of topsoil over the riprap (**Photo 30**), and continued monitoring of this issue is suggested. The main channel area and structures appear to be functioning (**Photos 31**). Additional weed control for noxious weeds is included in this report for consideration by the TAC and Board.



Photo 28

Photo 29



Photo 30

Photo 31

West Boat Ramp (Reservoir Water Surface Elevation = 5549.4): Construction of this PRF was completed in 2014. All maintenance for this PRF is the responsibility of CCSP. Routine maintenance that was noted in 2019 FO and has been completed: cleaning of the outlet structure box and screen and clearing of woody vegetation (**Photo 31**) and removal of tree over pipe outfall is needed (**Photos 32**). Weed control is still needed (**Photo 33**) and should be continued by CCSP. Marina continues to store equipment and materials in spillway area (**Photo 34**); CCSP staff will continue to work with the Marina to relocate these items.



Photo 31



Photo 32



Photo 33



Photo 34

Dixon Grove (Reservoir Water Surface Elevation = 5550.2): A hole developed near the edge on the Shoreline (**Photo 35**); CCSP staff were notified and repair was made (**Photo 36**). A gap between a boulder and the grout has formed (**Photo 37**), continued monitoring of this issue is suggested. Starting with the 2019 FO, an area to the south of the existing shoreline protection shows some erosion (**Photo 38**), a second phase of shoreline protection will be included in the upcoming Capital Improvement Program for consideration by TAC and Board. The riprap installed along the shoreline appears to be working (**Photo 39**).



Photo 35



Photo 36



Photo 37



Photo 38



Photo 39

Quincy Drainage: No erosion or revegetation concerns were observed around the detention basin (**Photos 41-42**). CCSP is doing routine maintenance on dead and downed trees (**Photo 43**). Erosion was observed on Quincy Drainage upstream of the detention basin to the Perimeter Road (**Photo 44-45**).



Photo 41



Photo 42



Photo 43



Photo 44



Photo 45

Cottonwood Wetlands: Noted Leafy spurge on the west bank (**Photo 45**). The stakes and wires that were supporting the trees when planted are now constricting them; it is suggested that these stakes and wire be removed since they are no longer needed (**Photo 46**). No concerns were observed with pond and outlet structure (**Photos 47-48**). A maintenance effort for control of noxious weeds is included in this report for TAC and Board consideration.



Photo 45



Photo 46



Photo 47



Photo 48

Conclusions

The conclusions and suggestions from the 2020 Annual FO of PRFs are:

1. All PRFs appear to be performing their function. Some maintenance needs are recommended, and continued monitoring of developing concerns/issues are suggested.
2. This 2020 Report has identified several maintenance efforts and projects for consideration by the the TAC and Board are summarized as follows (**See Appendix A**).
 - a. The projected total O&M cost as the result of this FO for 2021 is \$213,570 as compared to the 2020 budget of \$124,200.
 - b. The CCBWQA's noxious weed control (herbicide application) can be more readily accomplished by using the CCSP vendor for weed control (i.e.: Vegetation Management Inc, aka. VMI). The CCBWQA purchased a seed drill for CCSP. Seeding areas are identified and a quantity of seed is estimated herein for budgeting purposes. CCSP will perform the reseeding and over-seeding on behalf of the CCBWQA.

Appendix A

Cherry Creek Basin Water Quality Authority
 Summary of Operation & Maintenance (O&M) Costs
 Prepared / Updated: October 8, 2020

Project	Quantity			Mowing	Herbicide Application	Reseeding	Tree Planting	Shrub Planting	Misc.	Restorative / Rehabilitation project	Comments	Total Cost
	Each	Hours	Acres									
Shop Creek ^{1,2}			8		\$ 1,120						50/50 split w/CCSP	\$ 4,120
			0			\$ -					Seed only	
	1									\$ 3,000	Assumes MHFD has budgeted for remainder of sediment removal of pond downstream of Parker Road in 2020, \$3k included for Authority to fund WQ and Sediment Sampling	
Cottonwood Creek Ph I & Ph II ^{1,2}			15		\$ 2,100						50/50 split w/CCSP	\$ 24,300
		9		\$ 1,800							50/50 split w/CCSP	
	1		3.75			\$ 3,000					CCBWQA provides seed, CCSP provides install Fencing, Erosion Control, Soil Amendment, and Seeding	
Cottonwood Wetlands ⁴			8		\$ 1,120						50/50 split w/CCSP	\$ 1,120
CC @ 12-Mile Park Ph I ^{1,2}		3		\$ 600	\$ -						50/50 split w/CCSP	\$ 600
CC @ 12-Mile Park Ph II ³		12		\$ 2,400	\$ -						50/50 split w/CCSP	\$ 59,500
	1									\$ 57,100	Repair Boulder Edging, Remove Dead Tree, Soil Amendment, Seed Bed Prep, Drill Seed, Blanket, and Fencing	
Mountain/Lake Loop Shoreline ^{2,3}			2		\$ 280						50/50 split w/CCSP	\$ 23,930
	1									\$ 23,650	Shoreline Erosion	
East Boat Ramp	1									\$ 90,400	Restore shoreline area	\$ 90,400
East Shade Shelters	1									\$ 9,600	Restore shoreline area	\$ 9,600
West Boat Ramp											WBR is CCSP Maintenance Responsibility	

Subtotal \$ 4,800 \$ 4,620 \$ 3,000 \$ - \$ - \$ - \$ 201,150

TOTAL \$ 213,570

Areas in Acres
 33
 3.75

Note 1. Mowing Rate = \$400/hr; Participation @50/50 w/Parks=\$200/hr. Herbicide Application Rate =\$140/acre per time for 2 treatments (1 Summer and 1 Fall) =\$280 per Acre; Participation @ 50/50 w/Parks=\$140 per Acre.
 Note 2. Reseeding Rate = \$800/acre. Seed purchase only.
 Note 3. Mowing Rate = \$200/hr. Herbicide Application Rate =\$100/acre. Participation @ 100%.
 Note 4. Tree Replacement = \$1,000/ea. Shrub Replacement =\$50/ea.. Participation @ 100%.
 Note 5. PRF Function Repair/Maintenance. Project Specific Estimate. Participation @ 100%.

East Boat Ramp - Shoreline Stabilization

Engineer's Opinion of Probable Construction Cost

Date: 6/12/2020



No.	Item	Bid Quantity	Unit	Unit Price	Extension
General					
1	Mobilization	1	EA	\$ 7,000.00	\$ 7,000.00
2	Clear and Grub	1	LS	\$ 500.00	\$ 500.00
3	Provide Traffic Control#	1	LS	\$ 2,500.00	\$ 2,500.00
4	Provide Water Control	1	LS	\$ 15,000.00	\$ 15,000.00
GESC					
5	Furnish, Install, and Remove Construction Fence	170	LF	\$ 4.00	\$ 680.00
6	Furnish, Install, and Remove Vehicle Tracking Control*	1	EA	\$ 500.00	\$ 500.00
7	Furnish, Install, and Remove Stabilized Staging Area*	1	EA	\$ 500.00	\$ 500.00
8	Furnish, Install, and Remove Sediment Control Log	140	LF	\$ 5.00	\$ 700.00
9	Furnish and Install Seed/Erosion Control Blanket (SC-150 W/ Biodegradable Netting and 12" Eco Stakes)	35	SY	\$ 4.00	\$ 140.00
10	Furnish and Install Seed/Mulch Area	60	SY	\$ 3.25	\$ 195.00
11	Furnish and Install Seed/Mulch/Coir Mat over Type M Void Filled Riprap	135	SY	\$ 8.00	\$ 1,080.00
12	Furnish, Install, and Remove Curb Socks	2	EA	\$ 150.00	\$ 300.00
13	Furnish, Install, and Remove Silt Curtain	150	LF	\$ 100.00	\$ 15,000.00
Demo					
14	Remove and Dispose of Concrete Peers	4	EA	\$ 300.00	\$ 1,200.00
15	Remove and Reset Signs	3	EA	\$ 750.00	\$ 2,250.00
16	Remove and Dispose of Trees	5	EA	\$ 1,200.00	\$ 6,000.00
Construction					
17	Prep Seed Bed and Amend Soils	95	SY	\$ 2.00	\$ 190.00
18	Furnish and Install Topsoil	25	CY	\$ 60.00	\$ 1,500.00
19	Furnish and Install Type M Void Filled Riprap	90	CY	\$ 120.00	\$ 10,800.00
20	Furnish and Install Type M Riprap	65	CY	\$ 100.00	\$ 6,500.00
21	Earthwork - Excavation to Haul Off-Site	170	CY	\$ 55.00	\$ 9,350.00
22	Earthwork - Excavation Complete in Place	12	CY	\$ 20.00	\$ 240.00

Sub-Total = \$ 82,125.00
 10% Contingency = \$ 8,212.50
Total = \$ 90,337.50

Includes signage and cones to close off existing paved area for access, vehicle tracking, and staging

* Uses existing pavement, cost to clean up only.

East Shade Shelters - Shoreline Stabilization

Engineer's Opinion of Probable Construction Cost

Date: 6/18/2020



No.	Item	Bid Quantity	Unit	Unit Price	Extension
General					
1	Mobilization	1	EA	\$ 1,500.00	\$ 1,500.00
2	Clear and Grub	1	LS	\$ 500.00	\$ 500.00
3	Provide Traffic Control#	1	LS	\$ 750.00	\$ 750.00
GESC					
4	Furnish, Install, and Remove Construction Fence	60	LF	\$ 4.00	\$ 240.00
5	Furnish, Install, and Remove Vehicle Tracking Control*	1	EA	\$ 500.00	\$ 500.00
6	Furnish, Install, and Remove Stabilized Staging Area*	1	EA	\$ 500.00	\$ 500.00
7	Furnish, Install, and Remove Sediment Control Log	35	LF	\$ 5.00	\$ 175.00
Construction					
8	Furnish and Install Type M Riprap	17	CY	\$ 150.00	\$ 2,550.00
9	Furnish and Install Type II Bedding (6" width along cub)	1	CY	\$ 125.00	\$ 125.00
10	Earthwork - Excavation (Haul Off-Site from Project Area)	2	CY	\$ 100.00	\$ 200.00
11	Earthwork - Excavation (Haul Off-Site from Borrow Area)	16	CY	\$ 100.00	\$ 1,600.00

Sub-Total = \$ 8,640.00
 10% Contingency = \$ 864.00
Total = \$ 9,504.00

Includes signage and cones to close off existing paved area for access, vehicle tracking, and staging

* Uses existing pavement, cost to clean up only.