



RIFFLES TO RIPPLES

MEMORANDUM

DATE: October 29, 2020

TO: Jacob James, P.E.; CCBWQA – TAC Chairman

CC: Chuck Reid, CCBWQA - Manager

FROM: Richard G. Borchardt PE, CFM

SUBJECT: Cattail Harvesting Pilot Project

Introduction:

The Cherry Creek Basin Water Quality Authority (CCBWQA) mission and vision include improving water quality and protecting the beneficial uses in Cherry Creek Reservoir (Reservoir). CCBWQA is working in the Cherry Creek Watershed to reduce nutrients (such as Phosphorus) through Pollution Abatement Projects (PAPs). In 2017, Tetra Tech proposed that one way to reduce nutrients and maintenance of existing PAPs was to consider a wetland harvesting program. CCBWQA formed a sub-committee¹ to evaluate the feasibility and determine the potential water quality benefits of wetland harvesting. Through the sub-committee’s work, a Cattail Harvesting Pilot Project was developed for CCBWQA’s consideration.

Background:

The Southeast Metro Stormwater Authority (SEMSWA) is studying a cattail harvesting and the associated benefits. CCBWQA partnered with SEMSWA and utilized their study to help shape and inform this work. The direct removal of nutrients from the harvesting were estimated. **Table 1** shows the nutrient benefits obtained from the SEMSWA study. The green highlighted values represent the lowest nutrients levels over all samples.

Sample	Total Mass (g)	Bag Mass (g)	Cattail Dry Mass (g)	Cattail Dry Mass per meter (g/m)	% N	g N/m ²	% P	gP/m ²
Piney Jon Inlet	350.4	55.4	295	2950	0.0409	120.7081	0.00749	22.09462
Piney Jon Outlet	390	59.7	330.3	3303	0.0205	67.61241	0.00266	8.772768
Cottonwood @ Peoria Inlet	214.8	54.5	160.3	1603	0.0136	21.738283	0.00199	3.193978
Cottonwood @ Peoria Outlet	259	53	206	2060	0.016	32.8982	0.00162	3.3269
Trib C Inlet	327.2	47.3	279.9	2799	0.0115	32.322852	0.00112	3.124244
Trib C Outlet	374.2	45.3	328.9	3289	0.0101	33.12023	0.00102	3.364647

Table 1 – Sample Results from SEMSWA Study

¹ Sub-committee members are Rick Goncalves – TAC Vice-Chairman; Bill Ruzzo- Board Member; Jon Erickson, Jason Trujillo, Lanae Raymond/ Ashley Byerley, and Casey Davenport – TAC Members; Dan Olsen – SEMSWA; Chuck Reid – Manager; Erin Stewart and Chris Holdren – Solitude; Carolyn Nobel – LRE, Rich Borchardt – R2R Engineers; Andy Herb – AlpineEco; and Jeremy Sueltenfuss – CSU Associate Professor.

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The SEMSWA data was compiled by site (see **Table 2**) and the yellow highlight shows the mean average nutrient values.

Site	Area (sq m)	AVG g N/m	AVG g P/m	TOTAL Site N (g)	TOTAL Site N (kg)	TOTAL Site P (g)	TOTAL Site P (kg)
Piney Jon	975	94.1603	15.4336915	91806	91.8	15048	15.0
Cottonwood @ Peoria	6719	27.3182	3.26043875	183551	183.6	21907	21.9
Trib C	3543	32.7215	3.2444454	115932	115.9	11495	11.5
	g/m ²	51.4	7.31285855				

Table 2 – Sample Results from SEMSWA Study

The SEMSWA data was converted imperial units of (see **Table 3**). The orange highlighted values represent the anticipated average and lowest nutrient removal per acre.

Nutrient lab results from 2020 SEMSWA Study of above Ground Biomass

	N Mass per Area		P Mass per Area	
	Average	Low	Average	Low
g/m ²	51.4	21.7	7.3	3.1
#/sf	0.010527547	0.004444509	0.001495158	0.00063493

Examples

Area	N Mass #		P Mass #	
	Average	Low	Average	Low
100	1.05	0.44	0.15	0.06
43560	458.58	193.60	65.13	27.66

Table 3 – Conversion to Imperial Units

These values of nutrient removal appeared promising, so the committed decided to look into possible locations for harvesting. The sub-committee looked at several potential sites for studying and selected the Cottonwood Creek within Cherry Creek State Park (see **Figure 1**) for several reasons:

1. Previous PAPs created an effective treatment train,
2. The stream has healthy and thriving wetland and riparian corridor,
3. The stream is stable, and
4. Upstream and downstream monitoring sites (CT-P2 and CT-1) are in place and history of water quality data.

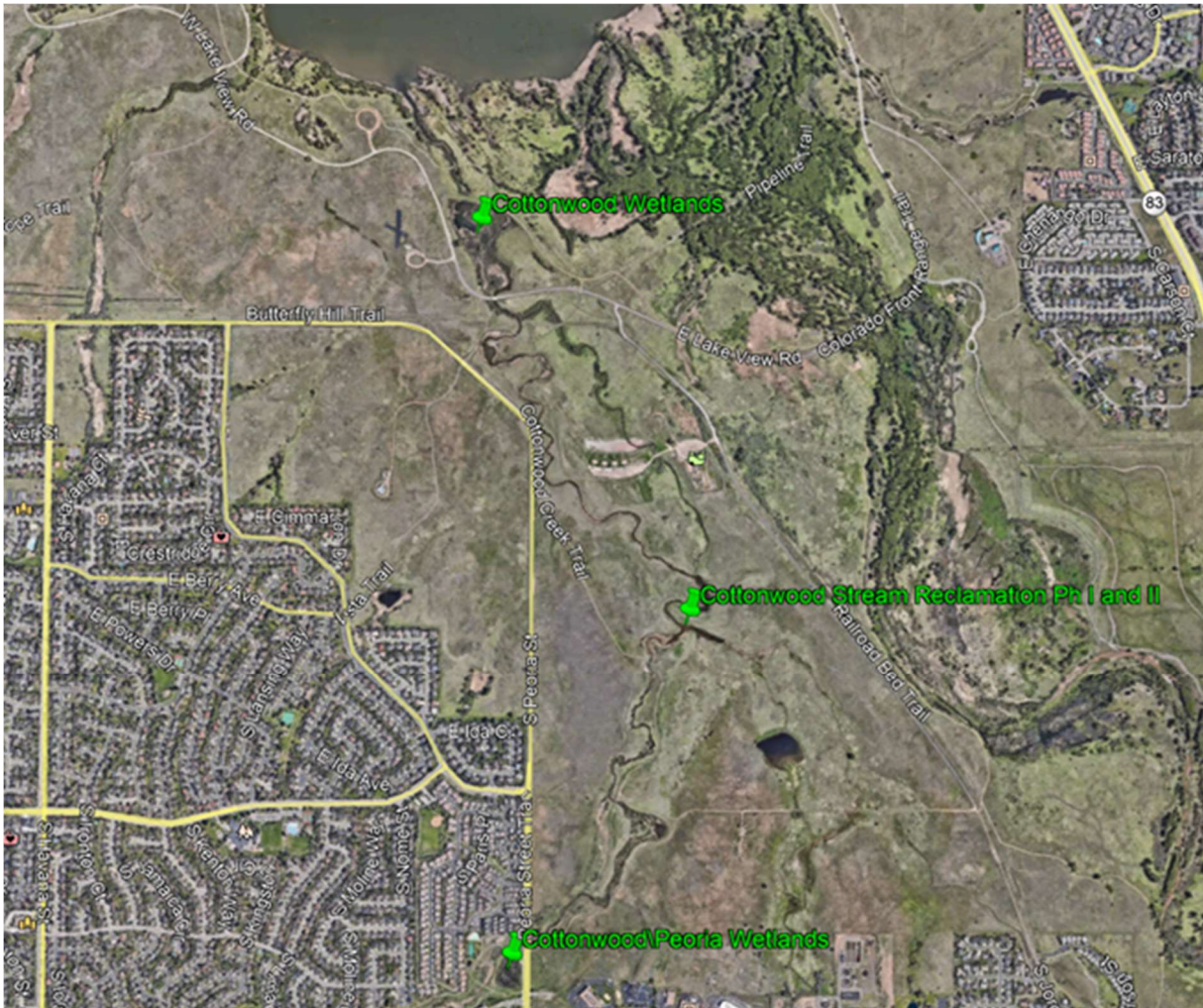


Figure 1 – Cottonwood Creek within Cherry Creek State Park (downstream of Cottonwood Peoria Wetlands Pond to Reservoir)

Harvesting is defined as cutting the above ground bio-mass of cattails at 6 inches above soil, gathering and removing cuttings, and hauling of cuttings to recycling/compost facility or disposing of them in a landfill.

Three scenarios were evaluated to determine feasibility and benefits of cattail harvesting.

1. 3 feet either side of stream (desktop analysis from Google Earth)
2. Full wetland and riparian corridor (desktop analysis from Google Earth)
3. Opportunistic areas of cattails that have large areas over short distances and easy access is available for contractor (determined by field visit)

Pilot Project:

The opportunistic scenario was selected based on the ability to get the biggest benefit at the smallest cost and that large-dense cattail communities with heights up to 8 feet tall could be targeted. Three harvest areas were identified in a field visit to identify large areas of cattails over short distances with access available. These areas are described and shown here.

1. Around the Perimeter Road Pond/Wetlands PRF



2. Upstream of the Cottonwood Trail Crossing (just south of the Lake View Drive)



3. At the confluence of Cottonwood Creek and Lone Tree Creek.



The pilot project harvests the left banks (facing downstream) in odd years and right banks (facing downstream) in even years. This allows for one side of the creek to remain for habitat, minimizes visual impact of harvesting, while improving visibility to the creek during regrowth (an observation/concern noted from birding community). Harvesting (as defined previously) leaves root structure in place to provide for regrowth and stream stability. Ideally the harvest would be done in Fall (late September/October) after cattails have absorbed as much nutrients as possible during the growing season and are still standing up to facilitate cutting. Harvest areas utilize existing trails where available or provide a 10' wide mowed path for truck/trailer access to minimize fire risk (hot vehicle parts in contact with dry grass) while performing this work. During the site visit, upland vegetation was 1 to 2 feet tall.

Harvest Benefits:

The harvesting benefits are the direct removal of nutrients from the system and any reduction of nutrients observed water samples.

The anticipated nutrient removal are estimated in the **Table 4a** for the Left Bank and **Table 4b** for Right Bank.

Reach	Area (SF)	N (#/sf)	p (#/ sf)	N # / Area	P #/ Area
Area 1 Left Mowed Access	18593	0.00445	0.000640	82.78	11.90
Area 2 Left Mowed Access	23285	0.00445	0.000640	103.67	14.90
Area 2 Left Existing Trail	19086	0.00445	0.000640	84.98	12.21
Area 3 Mowed Access	30930	0.00445	0.000640	137.71	19.79
	91894			409.14	58.80

2.11

Table 4a

Reach	Area (SF)	N (#/sf)	p (#/ sf)	N # / Area	P #/ Area
Area 1 Right Mowed Access	8693	0.00445	0.000640	38.70	5.56
Area 1 Right Existing Trail	7592	0.00445	0.000640	33.80	4.86
Area 2 Right Mowed Access	35842	0.00445	0.000640	159.58	22.94
Area 3 Right Mowed Access	41712	0.00445	0.000640	185.72	26.69
	93839			417.80	60.05

2.15

Table 4b

It is anticipated that it will take awhile for the nutrient removed from the system to be detectable in the nutrient concentration in the water quality sampling.

Harvest Costs:

Table 5 shows opinion of probable cost and estimated cost per pound of Phosphorus removed.

Left Bank

Item	Description	Quantity	Unit	Unit Cost	Item Cost
1	Wetland Harvesting off Mowed Access - Left Bank	1.67	Acres	\$ 20,000.00	\$ 33,428.83
2	Wetland Harvesting - Left Bank off of Existing Trail (longer hand transport)	0.44	Acres	\$ 25,000.00	\$ 10,953.86
3	Access Route Mowing - Left Bank	0.76	Acres	\$ 10,000.00	\$ 7,617.08

SubTotal = \$ 51,999.77

Contingency = \$ 7,799.97

Total = \$ 59,799.74

Cost per Pound

of P = \$ 1,016.96

Right Bank

Item	Description	Quantity	Unit	Unit Cost	Item Cost
1	Wetland Harvesting off Mowed Access - Right Bank	1.98	Acres	\$ 20,000.00	\$ 39,599.17
2	Wetland Harvesting - Right Bank off of Existing Trail (longer hand transport)	0.17	Acres	\$ 25,000.00	\$ 4,357.21
3	Access Route Mowing -Right Bank	0.81	Acres	\$ 10,000.00	\$ 8,112.95

SubTotal = \$ 52,069.33

Contingency = \$ 7,810.40

Total = \$ 59,879.73

Cost per Pound

of P = \$ 997.21

Table 5 – Cost Estimates of Pilot Project

Evaluation and Optimization of Pilot Project:

It is expected that the pilot project will be evaluated every year. The evaluation process will include sampling and testing of harvest areas to determine nutrient levels, estimation of nutrients removed with harvest, and determination and evaluation of unit cost for pound of Phosphorus removed with harvest.

At 2-year milestones, evaluation of the nutrient concentrations at the monitoring sites (for similar time periods before and after harvest) will be compared to see whether a reduction in nutrient concentrations in the stream can be

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detected. It is anticipated that it will take several years before significant reduction can be detected. A 6-year period for the pilot project is proposed to allow for decay and possible detection of a reduction.

Optimization of harvesting is included around the Perimeter Pond to see whether additional areas are feasible to harvest. The initial harvest areas around the pond were limited to widths that I could walk into with waterproof boots and not get stuck or fill the boots with water.

Optimization through comparison of total biomass weights and estimated nutrients removed per harvest will be compared to evaluate the 2-year regrowth period.

Conclusion:

The Pilot Project harvests about 2.1 Acres of Cattails Annually at an estimated cost of \$60,000 per year, removing an estimated 59-60 pounds of Phosphorus from the Cottonwood Creek system per year. The unit cost is around \$1000 per pound of Phosphorus removed. This unit cost is comparable to other PAP that CCBWQA participates in. The correlation between Phosphorus removed from the system and reduction in nutrient concentration in the water samples is not known at this time; a comparison of nutrient concentrations for 2-year periods before and after harvesting will be used to see whether a correlation can be made.

Evaluation of Pilot Project annually allows for verification of benefits and costs of Cattail Harvest. It provides decisions point each year on whether continuing the pilot makes sense for CCBWQA.

At 2-year milestones and at the end of the 6-year pilot project, reports summarizing results and findings of the pilot project are anticipated.