Technical

Memo

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To: Shingle Creek/West Mississippi WMO TAC

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Date: December 7, 2018

Subject: Potential Crystal Lake Management Plan Scope and Budget

Recommended Commission Action	Review and discuss and provide direction.

Background

The Crystal Lake Nutrient Total Maximum Daily Load (TMDL) addressed a nutrient impairment in Crystal Lake in the City of Robbinsdale (Wenck 2008). The TMDL and associated Implementation Plan (Wenck 2009) were approved in 2009 and implementation actions have been underway since that time. Per the TMDL, the total phosphorus (TP) load reductions were set at 256 lbs/yr from the Crystal Lake watershed, and 255 lbs/yr from internal loading.

Actions identified in the TMDL Implementation Plan included continued monitoring, the implementation of internal load reduction project(s), including benthic aluminum sulfate treatment and fisheries management, and the completion of a lake vegetation management plan. Additionally, several measures were identified to address the load reduction across the watershed (external loading).

The Crystal Lake Nutrient TMDL Five Year Review was completed to provide a review of progress toward meeting the load reductions identified in the TMDL. The Shingle Creek Watershed Management Commission (Commission) and stakeholders (Hennepin County, Cities of Robbinsdale and Minneapolis, property owners) have implemented several actions in general coordination, education and ongoing monitoring (Commission), as well as internal and external load reduction efforts. The report confirms that the efforts to improve biological integrity in the lake – aquatic vegetation management and fish community management – have not yet been completed.

Whereas all the load reduction efforts described in the TMDL Implementation Plan are important initiatives, the Crystal Lake Nutrient TMDL Five Year Review (Wenck 2016) suggests that an approach to lake management that addresses the previously identified aquatic vegetation and fish community management as well as an enhancement of the internal load reduction is warranted. A determination of feasibility for aquatic vegetation management and fish community management – listed as actions in the TMDL Implementation Plan – have not yet been carried out, and new data are required to enhance the internal load reduction project.

The City of Robbinsdale is interested in pursuing a wholistic lake management approach that would provide both ongoing internal P removal and management of invasive fish and aquatic vegetation species. This approach would include a whole-lake alum treatment to seal the sediments and reduce release into the hypolimnion while continuing the withdrawal and treatment of water from both the bottom and surface layers to maximize the efficiency of the P removal and extend the life of the alum treatment. A recent fish survey found carp levels approaching the nuisance threshold; the proposed lake management plan would also include rough fish management. At present there is limited aquatic vegetation present in the lake, but there is the potential for a bloom of invasive species as water clarity improves. Aquatic vegetation management should also be considered in such a plan.

This scope and budget document describes the details and estimated costs of feasibility studies for the aquatic vegetation management and fish community management as well as the collection of new data for enhancing the internal load reduction project. Whereas the cost of execution of these components will depend on the results of the information gathered, an estimated range for execution is also provided.

Internal Loading (Sediment release)

The current internal load reduction project was designed as a flocculation treatment facility that withdraws and treats nutrient-rich hypolimnetic (deep-lake) water from Crystal Lake; after being withdrawn from the lake, water is treated using aluminum sulfate (alum) to remove phosphorus (P), and the treated water is discharged back to the lake. The hypolimnetic water treatment facility removed approximately 208 pounds of total TP in 2013, 148 pounds of TP in 2015 (Wenck 2016), and 84 pounds of TP in 2017 (Gagliano 2018). While treating water from the hypolimnion has shown effectiveness (70 percent of required load reductions achieved [Wenck 2016]), the treatment facility tends to produce unpleasant odors that have prompted complaints from residents that use the park where the facility is located, which limits the amount of time the facility can withdraw water from the hypolimnion.

An investigation to determine the rates of P release from sediments of Crystal Lake was carried out in 2008 (Wenck 2016). Sediment core samples were collected from one deep location and one shallow location in the lake. The samples were then analyzed in a laboratory, indicating relatively high sediment P release rates. The field of sediment chemistry has evolved over the past 10 years in that in 2008 cores were sectioned at a 10 cm depth and preliminary alum doses were prescribed based on the analysis of the full 10 cm. The current practice is to section the cores into 2 cm sections from 0-10 cm and then into 5 cm sections 10-20 cm. Sediment P release rates are determined for each 2 cm or 5 cm section, and more refined alum doses are prescribed. The more refined approach holds the potential to reduce treatment costs by thousands of dollars.

To calculate the most effective alum dosing for Crystal Lake, Wenck will collect intact sediment cores at two locations (one deep and one shallow). The cores will be analyzed at the University of Wisconsin-Stout (UW-Stout) for sediment chemistry, anoxic sediment P release, and maximum allowable alum dosage. Core sectioning will be as described above, allowing for determination of vertical profiles of P fractionation, organic matter content, bulk density, and total metal concentration (iron, manganese, and aluminum). Wenck recommends sampling for anoxic sediment P release to have sampling events that can be paired with the 2008 data. If anoxic sediment P release would be sampled, two replicate cores from each sampling site will be used for measurement of soluble reactive P flux from the sediment. For analysis of the maximum allowable alum dosage, one core from each sampling site will be used to determine how much alum can be added to a given area of

sediment before pH drops below 6.0. A total of 5 cores will be collected at each site. Using the laboratory results, Wenck will develop the internal P budget report, monitoring recommendations, and alum doses; a P-fractionation profile, P release rate, and internal P budget for the lake will be included in the report. Table 1 provides an estimate of the cost of data collection for the internal loading (sediment release) program, and Table 2 provides an estimated range of estimated potential implementation/execution costs[1].

The information provided by the data collection will be used to more accurately compute the required alum doses. Properly dosed alum applications have been shown to reduce 90-95% of internal load. The current internal load is estimated to be 284 lbs/yr TP (Wenck 2016); the TMDL requires a 90% reduction of 255 lbs/yr TP, meaning with proper dosing the project has the potential to achieve the entire required internal load reduction. Follow-up sediment coring will determine the effectiveness of the first application, a second alum application, and a final sediment coring that will show the final effectiveness of the overall treatment (akin to an as-built). Additional water quality monitoring and observation will also be required. A rough estimate of the cost of implementation is $3,300-$4,000 per acre treated, with approximately 42 acres requiring treatment.

Table 1. Estimated costs for feasibility studies and data collection.

Component	Activity	Cost
Internal Loading (Sediment Release)	Sediment coring	$ 2,080
	Laboratory sediment analysis	5,990
	Reporting, alum dosing & monitoring	4,850
	Subtotal, Internal Loading (Sediment Release)	12,920
Internal Loading (Fish Management)	Field survey	3,000
	Permit procurement, report	2,000
	Analysis & discussion of next steps	1,000
	Subtotal, Fish Community Management	6,000
Project Management		2,000
	Total, Feasibility Studies/Data Collection	$ 20,920

Table 2. Estimated costs for implementation/execution.

Component	Activity	Cost
Internal Loading	Alum Application	$69,300 - $84,000
	Follow-up Sediment Coring	12,920
	Follow-up Water Quality Monitoring	1,000
	Second Alum Application	$69,300 - $84,000
	Final Sediment Coring	12,920
	Subtotal, Internal Loading	$165,440 - $194,840
Fish Management	Post-Removal Population Assessment	3,500
	Permit Procurement	1,040
	Implant Radio Tags	10,000
	Commercial Carp Removal(s)	30,000
	Subtotal, Fish Population Management	44,540
	Post-Alum Application & Herbicide Field Surveys	5,000

[1] Implementation/Execution costs provided in Table 2 should be considered preliminary and illustrative at this point and are based on available information and listed assumptions. The numbers will change as additional data are collected and analyzed, appropriate next steps are identified, and external companies contacted for bids.

Component	Activity	Cost
Aquatic Vegetation Management	Permit Procurement	1,000
	Herbicide Spot Treatments	5,000
	Reports	2,400
	Subtotal, Aquatic Vegetation Management	13,400
Project Management		2,000
	Total Implementation/Execution	$225,380 - $254,780

Fish Community Management

A fish survey conducted in September 2018 indicates that the carp population is at the critical impairment threshold, but it is not past the threshold, suggesting that while carp are certainly contributing to the water quality issues in Crystal Lake, they are not the sole reason. The carp identified in the survey were relatively small in size, suggesting that the carp issues in the lake are likely to worsen with time as the fish grow.

Because conducting a carp population survey in September is not the most ideal time, a follow-up survey is recommended for the summer of 2019 to refine the density calculation and to determine a recommended course of action. Options could vary from no action to active removal of carp. Costs for the 2018 survey are provided in Table 1. Table 2 provides an estimate for the implementation of a fish community management program, including a post-alum application survey the year following the final alum treatment as well as the assumption that the carp will exceed the critical impairment threshold and commercial carp removal will be required.

Aquatic Vegetation Management

Aquatic vegetation surveys carried out in 2013 and 2018 yielded similar results in the extreme lack of submerged aquatic vegetation, confirming the lake does not currently support native pondweed species common in healthy shallow and deep lakes throughout Minnesota. Upon completion of the alum treatments and fish management practices (if required), water clarity would be improved, and a positive vegetative response would be anticipated. Exactly what that response would look like is unknown. A desirable outcome would be one in which a diverse system of native vegetation becomes established, out-competing aquatic invasive species (AIS) but remaining below nuisance levels.

Because small amounts of AIS have been observed in the lake during the recent surveys (curly-leaf pondweed and Eurasian milfoil) and anecdotal evidence suggests these species used to be at nuisance levels along the northwest shore, the possibility exists that AIS begin to establish themselves, requiring active management. Because a vegetation survey took place in 2018 and major changes to the vegetation population would not be anticipated prior to the alum treatments, aquatic vegetation management is not proposed to commence until following the alum treatments and assumed carp removal. Table 2 provides an estimate of the aquatic plan management program, assuming that some herbicide spot treatments will be required to control AIS.

Proposed Timeline

Scheduling of the proposed activities is flexible in nature, but a proposed timeline could be as listed in Table 3.

Table 3: Proposed timeline of activities.

Component	Activity	Month/Year
Internal Loading (sediment)	Sediment coring	February 2019
	Laboratory sediment analysis	March 2019
	Reporting, alum dosing & monitoring	April-May 2019
Fish Population Management	Field survey	June 2019
	Permit procurement, report	June 2019
	Analysis & Discussion of Next Steps	June 2019
	Permit procurement	July 2019
	Commercial carp removal	July 2019
Internal Loading (sediment)	Alum application	August/2019
	Follow-up water quality monitoring	Sept 2019-Oct 2020
	Follow-up sediment coring	February/2020
Aquatic Plant Management	Post-alum application & herbicide field surveys	May & Sept 2020
	Permit procurement	May 2020
	Herbicide spot treatments	June 2020
	Reports	June & October 2020
Internal Loading (sediment)	Second alum application	July 2020
Fish Population Management	Post-alum application field survey	August 2020
Internal Loading (sediment)	Final sediment coring & water quality monitoring	August 2020

Funding Sources

The Commission's CIP includes generic "Lake Internal Load Improvement Projects," which "could include rough fish removal and installation of fish barriers, chemical treatment such as alum, drawdowns, whole-lake aquatic vegetation treatment, etc." The Crystal Lake Management Plan could with a Minor Plan Amendment fall under that project, which would be funded 100% by the Commission through the county tax levy to be certified in 2019 and collected in 2020. The Commissions and Robbinsdale could also consider applying for a Clean Water Fund grant to fund a portion of the costs.

The Commission and City could begin this project in spring 2019 if the City was willing to up front costs incurred prior to the receipt of tax levy proceeds approximately July 2020. In this scenario the Commission probably would not apply for a CWF grant for implementation a significant share of the cost would have already been incurred by the time a grant agreement was executed, and those costs would not be eligible to match grant funds.

If the Commission and the City decide to wait until 2020 to start, the Commission could undertake a Minor Plan Amendment and certify a levy as well as apply for grants in 2019. The timeline set forth in Table 3 would then be pushed back a year.

References

Gagliano, Laci. 2018 January 02. Robbinsdale Tells Excess Phosphorus in Crystal Lake to Take a Hike. Sun Post. https://www.hometownsource.com/sun_post/robbinsdale-tells-excess-phosphorus-in-crystal-lake-to-take-a/article_259b2dae-f0de-11e7-9db2-9344b45f1fe6.html

Wenck Associates, Inc. 2008. Crystal Lake Nutrient TMDL. http://www.pca.state.mn.us/index.php/view-document.html?gid=7906

Wenck Associates, Inc. 2009. Crystal Lake Nutrient TMDL Implementation Plan. http://www.pca.state.mn.us/index.php/view-document.html?gid=7909

Wenck Associates, Inc. 2016. Crystal Lake Nutrient TMDL Five Year Review. https://www.pca.state.mn.us/sites/default/files/wq-iw8-07n.pdf