Technical Memo

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To: Scott Gilbertson, Alexandria Lake Area Sanitary District

From: Joe Bischoff, Wenck Associates, Inc.

Date: April 22, 2020

Subject: 2020 Lake Management Activities

The purpose of this memorandum is to provide a brief summary of our current understanding of carp populations in Lake Winona and to provide an outline for activities to pursue in 2020 through Spring of 2021. This memo also addresses activities for the alum treatment on Lake Agnes.

Carp Population Assessment and Impact Summary

Summary of Carp Population Dynamics

The Lake Winona, Lake Agnes, and Lake Henry chain of lakes has a history of poor water quality and a need for restoration. Lake Winona sits at the top of the chain of lakes and receives discharge from the ALASD WWTF. ALASD has worked diligently to reduce phosphorus loading to Lake Winona, reducing their phosphorus loading to the lake by more than half with minimal changes in lake water quality. The muted response of Lake Winona and the downstream lakes is likely the result of biological factors including carp infestation and a highly degraded or nonexistent submerged aquatic plant community.

Carp density in the chain of lakes, especially Lake Winona, was determined to be extremely high, well above established thresholds for impacting water quality and the SAV community. Carp appear to have established in the chain of lakes sometime between 2001 and 2008 (primarily 2002 based on the carp aging analysis), quickly reproducing to extremely high densities. This founding population spawned an enormous year class of carp that together with founders make up the majority of the hyperabundant population present currently. Following this initial infestation and reproduction event, carp recruitment appears to be sporadic with three recruitment classes (2002, 2005, and 2011) comprising the bulk of the carp surveyed in the chain of lakes. Carp recruitment appears to be minimal in recent years, likely limited by the already high population density utilizing the chain of lakes. There is some evidence that reproduction in might be occurring in Lake Winona itself which may be a result of limited egg predation by panfish whose abundance is low. Therefore, controlling the carp population in Lake Winona will require both isolation and periodic, targeted removals of carp.

Carp appear to move freely throughout the chain of lakes with carp biomass densities varying through the seasons as the fish move unimpeded between suitable habitats. Measured carp movements for a 25-day period in out of Lake Winona using PIT tags demonstrated approximately 7,000 fish moved in and out of the lake. Further, radio telemetry data suggest that carp move seasonally in and out of lake Winona. Carp that do spend extended time in Lake Winona tend to congregate around the WWTF's outfall. The

freedom of movement facilitates carp reproduction and survival by allowing carp spawning migrations to minimize the impacts of egg consumption by panfish populations. These movements throughout the system suggest that fish barriers are necessary to manage carp in the chain of lakes, especially in Lake Winona. Anecdotal evidence (carp scales and carcasses on the shores) suggest that carp also move between Lake L'homme Dieu and Lake Henry, the likely source of the carp infestation following the failure of a carp barrier around 2001. Lakes within the greater watershed may be affected by the carp populations that grow and reproduce in Lakes Winona/Agnes/Henry and control in these headwater lakes will presumably reduce carp in the overall watershed.

Aquatic plant communities in the chain of lakes are also highly degraded, a likely result of poor water quality and high carp densities. All three lakes demonstrated a limited areal extent of Submerged Aquatic Vegetation (SAV) communities, minimal species diversity, and were dominated by tolerant aquatic plant species.

Recommendations

Monitoring activities completed in 2019 verified that carp densities are very high in the chain of lakes and are likely degrading water quality and aquatic plant communities. While a better understanding of where carp reproduction occurs is needed, it is clear that the carp population must be reduced, and their movement restricted to effectively improve water quality in the lakes.

Over the next year, Wenck will collect and analyze movement data from the radio tags to inform the execution of carp management activities including removal of adult individuals and suppression of reproduction. Specific methods to sustainably manage the carp population will continue to be developed based on analysis of data collected and integrated into the ongoing work plan. However, carp should be removed from Lake Winona and movement into Lake Winona should be restricted. Wenck recommends pursuing the following activities in 2020:

1. Develop a carp removal plan that outlines the techniques to be employed, when these techniques are appropriate, and benchmarks or goals for the control of the carp population.

2. Design and installation of a carp barrier the discharge from North Pond to Lake Agnes to limit carp migration into Lake Winona. This task will require a number of meetings with the Minnesota DNR to develop an appropriate design and permits. Wenck Recommends considering a permeable rock berm that has been used successfully in Iowa (Figure 1).

3. Carp removal in Lake Winona, South Pond, and North Pond to lower carp densities below water quality thresholds. This will likely be accomplished through a mix of removal activities that may include seining, baited trapping, migration trapping, and electrofishing.

4. Continued tracking of radio tagged carp to further develop an understanding of carp spawning areas to minimize overall population size in the chain of lakes.

Figure 1. Example permeable rock berm fish barrier used in Iowa.

The next steps are to prepare for the installation of carp barrier at the outlet of lake Winona to prevent carp movement into the lake and to develop and execute a carp removal action plan to improve water quality in Lake Winona (Table 1). The District received approximately $50,000 from LCCMR (not included in Wenck's current scope of work) to conduct carp removals. No funding was provided for carp barriers, but the design and installation are required in the District's NPDES permit. Wenck's scope of work does include funding to

facilitate carp removal in Lake Winona including permitting support, managing local fisherman, facilitating the identification of disposal sites, and other activities as necessary. Wenck recommends ALASD start pursuing fish removals for this fall and winter. Wenck will work with the District in the summer of 2020 to develop a detailed carp removal plan for Lake Winona.

Table 1. Carp Management Activity Timeline.

Carp Management Activity	**Date**
Develop carp removal action plan for Lake Winona	May 2020
Approve proposal to permit and design carp barrier	June 2020
Approve plans and specifications for carp barrier	August 2020
Bid carp barrier project	August 2020
Select contractor	September 2020
Install barrier	October/November 2020
Seining events for carp removal (3 possible events)	October 2020 through February 2021

Lake Agnes Aluminum Sulfate Treatment

The purpose of the Lake Agnes alum application is to reduce sediment phosphorus release and improve water quality in the lake. Alum permanently bind phosphorus in the sediments preventing release into overlying water and subsequent algal production.

Lake Agnes receives discharge from ALASD's WWTF via Lake Winona in addition to stormwater discharge from the City of Alexandria. Previous analyses suggested that Lake Agnes is also impacted by a large internal phosphorus load with hypolimnetic phosphorus concentrations exceeding 1.2 mg/L total phosphorus (Wenck 2018). In fact, changes in hypolimnetic phosphorus suggest that peak sediment phosphorus release rates may exceed 32.8 mg/m^2/day. It is important to note that a hypolimnetic mass balance can often overestimate the release rate due to sensitivity in defining the hypolimnetic volume. However, internal phosphorus loading is clearly a significant source of phosphorus to Lake Agnes.

Initial project dosing suggests adding **144,354 gallons of aluminum sulfate (alum)** to areas of the lake greater than 15 feet in depth. The application should be split in two with the first application occurring in Fall of 2019 followed by a Fall of 2021 application. The overall estimated cost for the project is **$318,708** including materials, application, and mobilization (Table 2). Each application should take 2 to 4 days to complete.

Table 2. Alum quantities and costs for a treatment on Lake Agnes.

Item	Unit	Quantity	Unit Cost	Total Cost
Total alum application (76 acres; top 4 cm; g/m^2; 15-feet and deeper)				
Aluminum sulfate	Gal $Al_2(SO_4)_3$	144,354	$2.00	$288,708
Mobilization	Lump sum	2	$15,000	$30,000
			Total application cost estimate	**$318,708**

Following is the proposed schedule for implementing the Lake Agnes alum treatment (Table 3).

Table 3. Proposed timeline for implementing the Lake Agnes alum treatment

Date	**Task and Requested Board Action (if required)**
July 1, 2020	Approve Plans and Specifications; Request project go out to bid
July 10, 2020	Bid request published
July 24, 2020	Bid opening
August 12, 2020	Board award project
August 21, 2020	Contracts and bonds due to ALASD
September 8, 2020 to October 15, 2020	Completion of the initial alum treatment (half dose)
Summer/Fall, 2021	Sediment monitoring
June 1, 2022	Contract addendums due if necessary
September 9, 2022 to October 15, 2022	Final alum application
September 2023	Final sediment monitoring