BOLTON & MENK
Real People. Real Solutions.

7533 Sunwood Drive NW
Suite 206
Ramsey, MN 55303-5119

Ph: (763) 433-2851
Fax: (763) 427-0833
Bolton-Menk.com

May 10, 2017

City of Silver Bay, MN
7 Davis Drive
Silver Bay, MN 55614

RE: Silver Bay Wastewater Treatment Facility Plan Amendment
Silver Bay, MN
BMI Project No.: M25.113173

The following letter is intended to serve as an amendment to the Silver Bay, MN (City) Wastewater Treatment Facility Plan for improvements to the Wastewater Treatment Facility. The Facility Plan for Silver Bay, MN was submitted to MPCA on March 3, 2017 and is pending approval.

Introduction

The City of Silver Bay, MN (City) owns and operates a Wastewater Treatment Facility (WWTF) that discharges in to Lake Superior. The facility has a current NPDES permit (No. MN0024899) that was issued on September 4, 2015 and will expire August 31, 2020. The facility consists of pre-treatment processes, a single stage trickling filter, and solids contact clarifiers as tertiary treatment. A Facility Plan for the Silver Bay WWTF was submitted to the Minnesota Pollution Control Agency (MPCA) for approval, which detailed recommended improvements to the facility.

The purpose of this letter is to serve as an amendment to the Silver Bay Wastewater Treatment Plant Facility Plan. This amendment will detail changes to the recommended alternative for improvements to the preliminary treatment infrastructure, other recommended improvements, and discuss applying for a variance relating to the mercury discharge limits. The following sections present the background from the original facility plan, the proposed changes to the facility plan alternatives, the new recommendation, and the costs associated with the changes.

Background

The Facility Plan for the City of Silver Bay detailed the existing conditions, flows, and loadings at the WWTF that were used to generate design flows and loadings for the alternatives for improvements at the WWTF. The summary of allocated design flows is shown in the Table 1 below.

Table 1 – Summary of Allocated Design Flows		
Parameter	**Existing Facility Design**	**New Design Flow**
Average Dry Weather Flow (mgd)	0.344	0.532
Average Wet Weather Flow (mgd)	0.919	0.919
Peak Hourly Wet Weather Flow (mgd)	3.191	3.480
Peak Instantaneous Wet Weather Flow (mgd)	3.476	3.682

Table 2 summarizes the existing and calculated 20-year design loadings that include all wastewater sources for the City of Silver Bay, MN.

Table 2 – Summary of Existing and Calculated 20-Year Loadings		
Parameter	**Existing/Historic Parameters**	**Future Design Parameters**
Year	2017	2037
Population	1,849	1,849
CBOD – Average Day (lbs./day)	327	370
CBOD – Peak Day (lbs./day)	2,920	3,302
TSS – Average Day (lbs./day)	537	547
TSS – Peak Day (lbs./day)	4,626	4,716
TKN – Average Day (lbs./day)	N/A	85
TKN – Peak Day (lbs./day)	N/A	213
P – Average Day (lbs./day)	10.2	15

The evaluation of the existing facility showed that the preliminary treatment infrastructure was in poor condition. The grit removal chamber is functional part time and is undersized for current flows and the manual bar screen has clogging and capacity issues. Some of the concrete is beginning to deteriorate and is in need of repair. Improvements to the preliminary treatment processes are needed to improve operation and treatment efficiency at the WWTF.

Another aspect that was evaluated with the Facility Plan was mercury removal treatment to comply with the NPDES mercury discharge limits. Within the NPDES permit are requirements for mercury monitoring and effluent limits. In accordance with the Great Lakes Initiative, the permit includes both interim and final effluent limits on total mercury. The interim limits are 3.8 nanograms per liter (ng/L) calendar month average and 7.0 ng/L daily maximum. The final limits are 1.9 ng/L calendar month average and 3.5 ng/L daily maximum. The City must comply with all the final limits no later than March 31, 2020.

The facility plan listed several alternatives for improvements relating to mercury removal. The first alternative was to enhance the existing solids contact clarifiers for mercury removal. This process is currently being undertaken as staff has been actively working at optimizing the solids contact clarifiers for mercury removal. The second option was to construct sand gravity filters to remove mercury. The filters would be designed to handle peak hourly flows without bypassing. The final option for mercury removal was to construct membrane filters. This option did have the highest capital cost and operation and maintenance costs over the previous two.

After evaluating all three options for mercury removal to help meet final mercury limits, the original facility plan recommended that the City construct sand gravity filters after the solids contact clarifiers to aide in mercury removal. The new filters would serve as a tertiary treatment using chemical addition upstream to sequester and capture the total mercury in the effluent waste stream to below permitted limits after filtration.

After further investigation and planning, it was determined that the construction of a gravity filtration system at the WWTF may be a significant financial investment for the City and may not be in the best interest of the City as a filtration building is expensive and requires more maintenance. The construction and operation of the facility could significantly increase user costs for the residents and businesses in Silver Bay. Therefore, the following alternative details improvements to the preliminary treatment process and other recommended improvements, along with applying for a variance for the mercury discharge limits at the WWTF.

Alternative (No. 1A)

The alternative for this amendment is broken up into two parts. The first part details improvements to the preliminary treatment infrastructure and other recommended improvements, while the second part details applying for a variance for mercury discharge limits. The two parts are discussed below:

a. Preliminary Treatment and Other Recommended Improvements

   Most of the infrastructure at the Silver Bay WWTF is in good condition to comply with permitted limits. However, as noted in the Facility Plan, the preliminary treatment system has several operational concerns as the manual bar screen has clogging issues and the grit removal equipment is outdated and is in need of replacement. In order to upgrade the pre-treatment infrastructure to meet the new design criteria, several important improvements are necessary. These improvements include: replacing the influent manhole, replacing the by-pass bar screen and channel, replacing the manual bar screen with a mechanical fine screen, replacing the grit

removal equipment, modifying and rehabilitating the grit removal structure, and constructing a new pre-treatment building. The pre-treatment improvements would be designed to handle the peak hourly flow of 3.48 MGD.

In addition to the preliminary treatment improvements, this alternative includes other recommended improvements including adding covers to all of the clarifiers, replacing pumps in the control building which pump water from the chorine contact tank to the solids contact clarifier splitter box, replacing the gas burner equipment on the digesters, and adding a digester mixer to the first stage anaerobic digester. Currently, there are no covers on any of the five clarifiers. For this alternative, three covers would be used to cover the three existing 40-foot (two primary and one secondary) clarifiers, and the other two would cover the two existing solids contact clarifiers.

The existing tertiary solids contact clarifiers recently underwent renovations to replace equipment and recoat the interior of the clarifiers in 2016. Both clarifiers are in good shape and have been well maintained. However, these most recent renovations did not provide covers for the clarifiers. Currently, the solids contact clarifiers are being used to achieve mercury removal at the WWTF. Mercury removal is a delicate process and can be easily disrupted by outside environmental factors such as rain, wind, temperature fluctuations, ice formation, and algae growth in the clarifiers.

Leaving the clarifiers uncovered allows for outside environmental factors to impact mercury removal. This can lead to erroneous and potentially high effluent mercury results in which mercury is present from other sources, not solely wastewater sources. During summer months, algae growth is a typical occurrence in uncovered clarifiers. Normally, the algae do not have a significant impact on effluent results. However, if the algae mass becomes too heavy and sluffs off and is discharged into the effluent waste stream, this can increase effluent pollutant loadings. This can occur relatively easily when wind or rain disturbs the water in the clarifier causing the algae to sluff off and travel to the clarifier discharge. When this occurs, nutrients trapped in the algae biomass, then become part of the effluent waste stream and are discharged with the effluent water.

Another common problem for uncovered clarifiers is ice formation in winter months. Ice formation has an effect on mercury removal as the kinetics of the chemical reactions slow to a point where they may become ineffective at sequestering the particulate mercury. Depending on how much ice cover is present in the clarifiers, it can have an impact on the performance of mercury removal. By covering the solids contact clarifiers, the potential that outside

environmental factors will affect the mercury concentration and removal in the solids contact clarifiers is reduced.

The advantages for this alternative include greatly increasing screening efficiency and grit removal by adding a fine screen and new vortex grit removal equipment. The existing system has limitations, especially during winter months when freezing temperatures impact the operation of the manual bar screen. The addition of a new building, screening equipment, and grit removal equipment will remove more solids and debris, which can help improve downstream treatment efficiency. By removing debris and grit upstream, it may be possible to reduce wear on pumps and increase the pumping efficiency. The other improvements noted in this alternative would increase the life of the respective equipment while providing improved efficiency in treatment. The clarifier covers are important as they prevent freezing during winter months and algae growth during summer months, which can affect treatment performance, especially when dealing with mercury and phosphorus limits. Adding clarifier covers could potentially help improve mercury removal efficiency.

b. Variance for Mercury

As stated earlier in this letter the existing solids contact clarifiers are currently being used to remove mercury from the wastewater using chemical addition. Table 3 and Figure 1 below show the historical mercury data through the beginning of March 2017. Results after March 8, 2017 were not available at the time this letter was written. The data indicates that the solids contact clarifier's remove on average over 90% of the influent total mercury. However, even with the high percentage of mercury removal, it is uncertain if the clarifiers can achieve 100% compliance with the low-level permitted final mercury limits.

Trends in the data indicate that the calendar monthly average total mercury concentrations have been decreasing since December of 2016 where the calendar month average total mercury concentration was 2.68 ng/L. Results from February 2017 (last month with complete data) show a calendar month average of 1.63 ng/L as total mercury. The downward trend shows promising results for low-level mercury in the effluent waste stream from the solids contact clarifiers. However, the short window of time does not allow for seasonal variations and other factors, but the overall trend is very promising. When looking at the data, some of the daily maximum values have exceeded permitted final limits in that time which could lead to violations on the permit. Depending on how high the daily maximum concentration is, that test result could increase the calendar monthly average concentration above permitted final limits. Therefore, with changing

environmental conditions and fluctuating mercury results, achieving 100% compliance with the permitted low-level mercury limits is uncertain and additional measures relating to mercury limits should be taken.

Table 3 – Historical Mercury Data (2014 – 2017)

Sample Date	Influent		Effluent				Combined Average Total mercury (ng/L) [3]	Effluent TSS (mg/L) [4]	WWTF Flow (MGD)	Total Mercury Percent Removal
	Total Mercury (ng/L)	Dissolved Mercury (ng/L)	Clarifier No. 1 Total Mercury (ng/L) [1] [2]	Clarifier No. 1 Dissolved Mercury (ng/L)	Clarifier No. 2 Total Mercury (ng/L) [2]	Clarifier No. 2 Dissolved Mercury (ng/L)				
June 18, 2014	26.2				2.07		2.07	6.0		92.1%
Oct. 22, 2014	65.4	2.32			3.19	1.95	3.19	1.6	0.433	95.1%
Nov. 9, 2014					1.42		1.42	1.5	0.215	N/A
Jan. 14, 2015	43.2				0.7	<0.5	0.7	0.5	0.23	98.4%
Feb. 4, 2015					0.661	<0.5	0.661	2.0	0.128	N/A
April 1, 2015	74.8	3.46			2.68	0.907	2.68	2.4	0.165	96.4%
May 31, 2015	51.1				3.07	2.18	3.07	3.3	0.244	94.0%
Sep. 30, 2015	25.8	1.76			5.56	1.4	5.56	2.2	0.448	78.4%
Jan 6, 2016	62.6	2.09			0.656	<0.5	0.656	1.0	0.525	99.0%
May 18, 2106	194				1.55	0.822	1.55		0.317	99.2%
May 31, 2016	159				1.88	<0.5	1.88	1.4	0.324	98.8%
July 6, 2016	35.1	1.72			4.95	1.04	4.95		0.636	85.9%
Oct. 18, 2016	12.2		2.12				2.12		0.342	82.6%
Oct. 27, 2016	55.5		2.98	0.723			2.98		0.532	94.6%
Dec. 7, 2016	11.9	1.42					2.47			79.2%
Dec. 13, 2016	43.9						1.43			96.7%
Dec. 21, 2016	35.5	2.68	1.44	< 0.50	6.34	0.526	3.89			89.0%
Dec. 28, 2016	20.7	1.63					2.92			85.9%
Jan. 4, 2017	24.6	2.51					3.00			87.8%
Jan. 11, 2017	31.4		1.58		5.34		3.46			89.0%
Jan. 18, 2017	27.3	3.87	1.36	< 0.50	0.923	<0.50	1.14			95.8%
Jan. 25, 2017	45.3	2.88	1.26	< 0.50	1.71	< 0.50	1.49	7.5		96.7%
Feb. 1, 2017	22.1	1.32	1.60	< 0.50	0.521	< 0.50	1.06			95.2%
Feb. 8, 2017	31.9	3.99	2.02	< 0.50	0.5	< 0.50	1.26			95.2%
Feb. 15, 2017	40.8	2.34	0.897	0.734	0.644	0.592	0.771			96.1%
Feb. 22, 2017	14.6	3.12	5.26	1.01	1.63	0.838	3.445			98.1%
Mar. 1, 2017	13.2	1.72	1.29	< 0.50	0.5	< 0.50	0.895			76.4%
Mar. 8, 2017	11.5	1.74	2.03	< 0.50	0.801	< 0.50	1.416			93.2%
Average	45.8	2.4	1.98	0.823	2.15	1.14	2.22	2.67	0.333	91.9 %

(1) Clarifier No. 1 was out of service until August 25, 2016 and came online on August 26, 2016 when renovations began on tertiary clarifier No. 2.
(2) Both clarifiers became operational on November 14, 2016.
(3) Average effluent total mercury concentrations are the average mercury concentrations between samples taken from tertiary clarifier No. 1 and tertiary clarifier No. 2.
(4) TSS data represents composite calendar month average and was not collected with the mercury samples

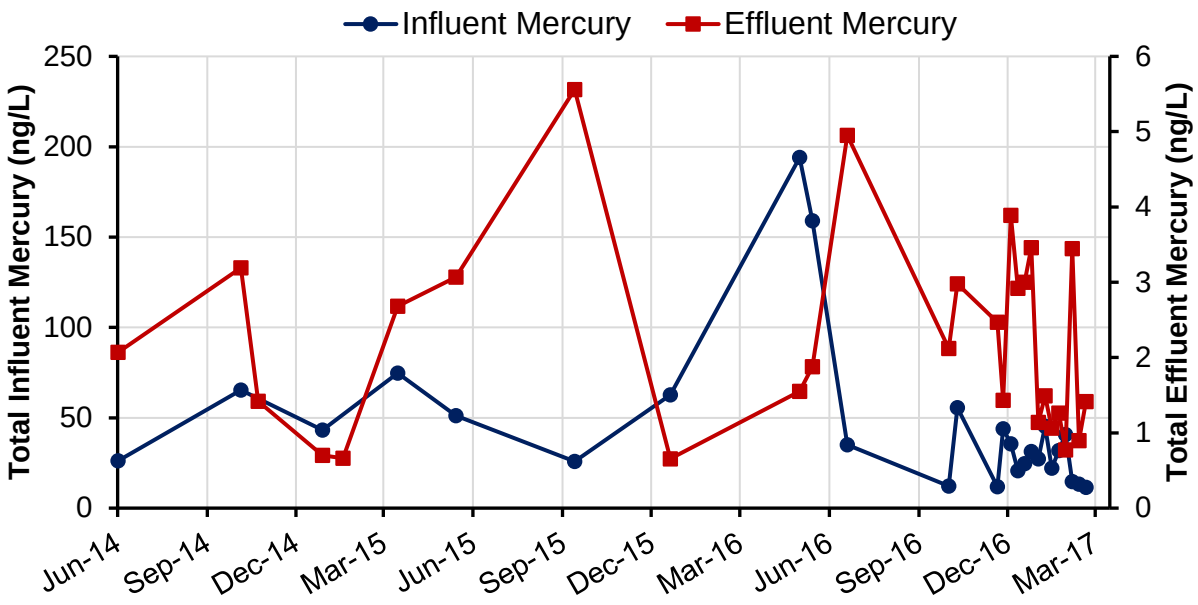

Figure 1: Total Influent and Effluent Mercury Results

As noted in the Facility Plan, the WWTF has a final mercury limit of 1.9 ng/L for a calendar month average and a daily maximum of 3.5 ng/L, which the facility must achieve by the deadline of March 31, 2020. The alternatives discussed in the facility plan are all feasible options that could reduce effluent mercury levels at the WWTF. However, there is concern that even with an advanced treatment system the WWTF could still discharge elevated levels of mercury if optimum conditions do not exist. Therefore, with the costs associated with construction of a new advanced treatment facility aimed at reducing effluent mercury levels, it would be a significant investment for the City. If the City were to invest in an advanced treatment system, the costs for users could significantly increase (in the form of monthly user charges). With the potential to significantly increase user costs, a variance is the best option for the City to continue moving forward while maintaining and optimizing its current treatment process.

A variance is essentially an extended compliance date. The City would still be required to continue efforts to reduce effluent mercury to try to meet final limits and provide annual updates on these efforts. A variance is good for five (5) years and is renewable if the conditions prohibiting mercury treatment still exist. A variance is not common and requires MPCA and Environmental Protection Agency (EPA) approval. However, in the case of Silver Bay, a variance would prove to be the best course of action regarding mercury discharge limits.

Recommendation

It is recommended the City select the alternative 1A described above in this Facility Plan Amendment and proceed with improvements to the preliminary treatment infrastructure and applying for a variance for mercury discharge limits. The preliminary treatment improvements will significantly improve the treatment facilities ability to remove grit and other debris from the wastewater and protect downstream equipment, along with eliminating problems due to capacity issues. This alternative also fixes other recommended improvement needs such as replacing pumps and other equipment, coating the clarifiers (if needed), and adding covers to all the clarifiers. The variance will provide an opportunity for the City to continue optimizing the existing treatment as construction of a new facility would be a significant economic impact on the City, residents, and businesses. Overall, this alternative provides the best option for the City to upgrade necessary infrastructure while minimizing the cost to users.

Cost

This section presents cost opinions for the alternative discussed in this amendment. The cost opinions presented herein are meant to be used as a guideline in the decision-making process. The accuracy of these cost opinions should be considered within +/- 25% of actual project costs.

Table 3 – Capital Cost Opinion
City of Silver Bay, Minnesota

Item	Alternative No. 1A – Preliminary Treatment plus Misc. Improvements
General	
General/Mobilization	$100,000
Site Improvements/Earthwork	$250,000
Preliminary Treatment and Misc. Improvements	
Demo Existing Pre-Treatment Building	$30,000
Fine Screen Equipment	$100,000
Grit Removal Equipment & Structure Modifications	$175,000
Construction of Pre-treatment Building	$450,000
Pumps/Piping/Valves	$350,000
Digester Equipment	$200,000
HVAC	$100,000
Electrical and Controls	$275,000
Clarifier Covers	$400,000
Subtotal	**$2,430,000**
Contingencies (10%)	$243,000
Engineering/Administration/Legal (15%)	$364,500
TOTAL	**$3,037,500**

The following table presents the potential impact to user costs for users in Silver Bay, MN.

Table 4 – Potential Financing and User Costs City of Silver Bay, Minnesota	
Item	**Bonding at 1.5%**
Capital cost (Alternative 1A)	$3,037,500
Net Cost	$3,037,500
20-Year Annual Cost	$176,921
Annual Operating Cost (For New Construction)	$20,000
Existing OM&R and Debt Services*	$220,000
Total Annual Debt Service + OM&R Costs	$416,921
Projected Residential Connection Cost Increase (monthly)	$16.99
Existing Fixed Residential Costs (monthly)	$38.42
Total Residential Connection Cost (Monthly Fixed Fee)**	**$55.41**
Total Residential Connection Cost (Monthly Fixed Fee)**	**$55 - $60**
* Approximate cost for existing O&M plus electrical and chemical costs, and debt services ** Cost may fall within this range with the proposed project cost depending on the level of funding that is received	

Although not presented here, if the City were to construct gravity sand filters presented in the original Facility Plan for mercury removal with little to no grant money, the user costs would significantly increase and surpass $70 per user. Above this threshold, the user costs would rise to more than 2% of the Medium Household Income for Silver Bay, MN. The proposed project minimizes the potential increase to user costs.

Schedule

The proposed implementation schedule for the recommended project described above is presented in Table 5.

Table 5 – Project Implementation Schedule - City of Silver Bay	
Item	**Date**
Public Hearing / Council Approval of Facility Plan	May 2017
Design Period	October 2017 – January 2018
Submit Plans and Specifications to MPCA	March 2018
Advertise to Receive Construction Bids	April – June 2018
Begin Construction*	September 2018
Submit Construction Progress Report*	September 2019
Finish Construction and Initiate New Facilities*	March 1, 2020 (no later)
Obtain Variance for Mercury Limit**	March 31, 2020 (no later)
** Per permit compliance schedule* *** Dependent upon variance for mercury*	

Sincerely,

Bolton & Menk, Inc.

John Graupman, P.E.
Principal Engineer