

ACLARUS™
O Z O N E

PROJECT: City of Kawartha Lakes
PROJECT REF: COKL Full Pilot R.2
PROPOSED TO: MTE Consultants Inc

PREPARED BY: Kirsten Scott
DATE: May 6, 2022

Aclarus Ozone
1901 Fisher Dr. Peterborough ON. K9J6X6
888-705-8801

Proposal



aclarusozone.com

INTRODUCTION

Please note that some of the information included in this document may be marked Confidential and/or Proprietary. Aclarus Ozone is pleased to present this budgetary proposal to MTE Consultants Inc. for the City of Kawartha Lakes. This proposal is for budgetary & discussion purposes only.

Aclarus Ozone is an Ontario-based company that provides ozone-based solutions for water and wastewater treatment. The City of Kawartha Lakes Lindsay Drinking Water Plant, located at 33 Mary Street E, services over 10,000 residents and has identified a need to upgrade their existing water treatment system. The Town of Lindsay has been experiencing elevated levels of trihalomethanes (THMs) and haloacetic acids (HAAs) in their drinking water system during the summer months due to chlorination by-product formation. O. Reg. 169/03: Ontario Drinking Water Quality Standards require the maximum allowable levels of THMs and HAAs to be 100µg/L and 80µg/L respectively. As stated in the 2021 Lindsay Drinking Water System Annual Water Report, THM and HAA levels were exceeded, reporting running annual averages of 104.75µg/L and 85.50µg/L respectively on October 21, 2021.

The use of ozone as a treatment method has been explored to treat dissolved organic content in order to reduce the potential formation of disinfection by-products (DBPs). During 2021, a preliminary proof of concept study was performed by Aclarus Ozone and the City of Kawartha Lakes to determine the feasibility of ozonation as a solution to the DBPs issue. Samples were taken at two sampling ports, pre and post Acti-Flo treatment and were assessed for DBP formation potential. Preliminary results show that ozone can benefit the City of Kawartha Lakes Water plant by treating water following the Acti-Flo treatment stage. Further bench-scale studies will be conducted in the summer of 2022 to confirm results as well as explore the benefits of additional treatments such as hydrogen peroxide (H₂O₂). The details of the 2022 bench-scale studies can be found in a separate proposal, Ref: COKL Bench-Scale Study R.4.

A full-scale pilot study will be conducted at the Lindsay Drinking Water Plant during the summer months of 2022 to confirm the findings of the 2022 bench-scale study utilizing ozone and potentially hydrogen peroxide, if deemed applicable. Additionally, biological filtration will be applied to the pilot treatment train to determine if additional benefits exist for reduction in THM and HAA production. Prior studies performed by the University of Toronto found that the use of biological activated carbon (BAC) can reduce THM and HAA formation potential. However, when combined with pre-oxidation, the reduction was significantly improved, reducing THM formation potential by 38% and HAA formation potential by 36%. Due to the time frame required to obtain, prepare, seed and acclimate the activated carbon filter, it is not feasible to perform this testing on a bench-scale basis and therefore will only be conducted during the site-scale pilot study.

TREATMENT OBJECTIVES

The objective of this study is to achieve THM and HAA levels below allowable limits. The maximum allowable limit for trihalomethanes is 100µg/L and the limit for haloacetic acids is 80µg/L, according to the Ontario Drinking Water Guidelines. The post-treatment limit for study will be set at 60% of the maximum allowable load (MAL), with a post-treatment objective of 40% of the MAL; Therefore, the target concentrations after treatment for THMs and HAAs is 40µg/L and 32µg/L respectively with maximum allowable concentrations at 60µg/L and 48µg/L respectively.

TESTING ANALYSIS OVERVIEW

Upon delivery and set up of the Aclarus Pilot trailer, Aclarus staff will run water directly from the Post-Actiflo sampling port for up to 5 days for acclimation purposed; once the BAC filtration system has been acclimated, a baseline sample will be taken and analyzed for pH, alkalinity, total and residual chlorine, chemical oxygen demand (COD), total dissolved solids (TDS), dissolved organic content (DOC), an anion scan (chlorides, sulphate, nitrate, nitrite, bromide), THMs and HAAs.

Four sampling trials will be run simultaneously in order to compare test results under the same environmental conditions. Three sampling events per week over a span of four weeks will take place in order to capture flow rate changes, temperature fluctuations and other environmental changes. Sampling events will take place on Monday, Wednesday, and Friday of each week, unless there is a need to alter days in order to capture a specific environmental factor. For each sampling event, samples will be collected before trailer treatment (post-Actiflo treatment), as well as after trailer treatment (final effluent). During the Ozone + Hydrogen Peroxide + BAC, three sample analysis will be collected, post-Actiflo, post ozone/H₂O₂, post BAC (final effluent). Below is a summary of water treatment trials and sampling events.

Figure 1: Summary of Water Treatment Trials and Sampling Events

Trial	Sample Events/week (Mon, Wed, Fri)	Duration (weeks)	Total Sample Events
Baseline	1	1	1
Ozone Only	3	4	12
Ozone + H ₂ O ₂	3	4	12
Ozone + BAC	3	4	12
Ozone + H ₂ O ₂ + BAC	3	4	12
Total			49

Figure 2: Summary of Sample Analysis

	Baseline	O3 Only		O3 + H ₂ O ₂		O3 + BAC		O3 + H ₂ O ₂ + BAC			Total
	-	Pre	Post	Pre	Post	Pre	Post	Pre	Post O3/H ₂ O ₂	Post BAC	-
pH, Alk	1	12	12	12	12	12	12	12	12	12	109
Total Chlorine	1	12	12	12	12	12	12	12	12	12	109
Residual Chlorine	1	12	12	12	12	12	12	12	12	12	109
COD	1	12	12	12	12	12	12	12	12	12	109
TDS	1	12	12	12	12	12	12	12	12	12	109
DOC	1	12	12	12	12	12	12	12	12	12	109
Anion Scan	1	12	12	12	12	12	12	12	12	12	109
THMs	1	12	12	12	12	12	12	12	12	12	109
HAAs	1	12	12	12	12	12	12	12	12	12	109

*Analysis is subject to change

PILOT TESTING SCHEDULE

Task	Duration	Anticipated Start	Anticipated Finish
Aclarus Trailer Delivery and Set up	1 days	TBD	TBD
Sampling Trials (As listed above)	4 weeks	TBD	TBD
Sample Analysis	10 days	TBD	TBD
Report	7 days	TBD	TBD

INSTALLATION RESPONSIBILITIES

Lindsay Drinking Water Treatment Plant personnel are responsible for the connections of the Aclarus Pilot trailer to the port locations of the Lindsay Drinking Water Plant under the supervision of Aclarus technicians. The Lindsay Drinking Water Treatment Plant must provide the water inlet and outlet connections and electrical connections as required. Aclarus will supply lengths of housing to connect from the Aclarus trailer through specified window to COKL connection ports.

PILOT SYSTEM DESIGN

The Lindsay Drinking Water System's maximum capacity is 30,685.5m³/day. On average the plant is operating at under half this capacity. During the summer months of 2021 (June-August) the average monthly treated water flow was 8262.7 m³/day, with a max daily flow of 11488.6 m³/day during the month of August according to the 2021 Annual Report.

The Aclarus Pilot trailer system has been preliminarily designed and sized based on the information provided in the aforementioned reports. The two-phase pilot project will test two potential treatment trains with optional hydrogen peroxide addition as illustrated below in Figure 1.

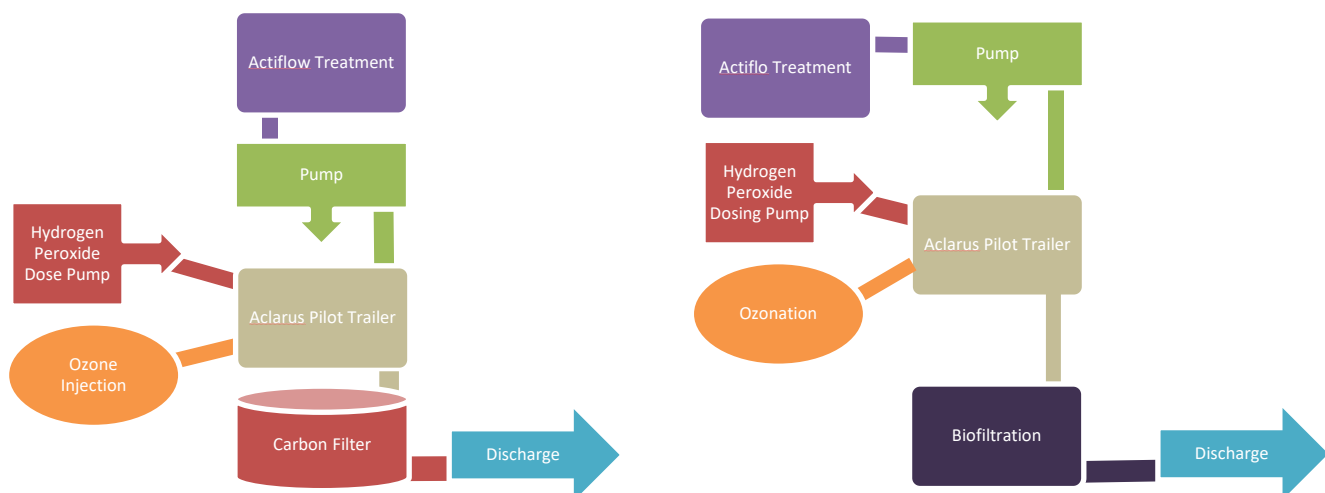


Figure 3-The two potential treatment trains for testing in the Aclarus Ozone pilot test.

Aclarus Pilot Trailer

An ozone system typically includes an oxygen gas source, ozone generator, and saturation system for the injection of ozone into the water for treatment. The calculated ozone dose is dependent on flow rate and contaminant load. Based on the information obtained from the bench-scale study, the anticipated applied ozone dose is 3 to 6 ppm for organic reductions. This dose is subject to change given the outcome of the bench-scale study and potential incorporation of hydrogen peroxide.

The pilot would involve the temporary installation of the Aclarus Ozone Pilot unit for delivery of up to 2.4 lps of post-Actiflow water flow to the system for treatment. The system would take a slipstream of the water fed from the current infrastructure and run it through an ozone production and saturation system that would produce up to 120 g/hr of ozone. This would have approximately 4 minutes of ozone contact time prior to filtration. Oxidation Reduction Potential (ORP) would be monitored at variable flows and ozone doses and samples at three stages of the treatment would be collected and submitted for testing through an accredited lab. The trailer's entire ozone system can be operated automatically with the built-in instrumentation and PLC or manually.

The general overview of the system components are as follows:

- 1) Air feed system: Conditions ambient air, by removing humidity, for compression and delivery to subsequent components at a set flow rate.
- 2) Oxygen Generator: Utilizes the compressed air from the air feed system to produce oxygen gas that is then fed to the ozone generator. This unit is automated to produce oxygen at 95% (+/- 5%) purity. This generator delivers oxygen gas at the required flow rate and pressure with a dew point of <-70°C. This system is designed to generate oxygen gas on-site and requires no additional supply.
- 3) Ozone Generator: Receives the oxygen feed gas and generates ~10% weight ozone gas at the required production to provide the correct ozone dose based on flow and demand. The system efficiently and effectively uses power to create a corona discharge that ionizes the oxygen gas which forms ozone for injection downstream. The ozone generator(s) are designed with internal monitoring and production adjustment components for stable ozone production that automatically changes based on inline monitoring.
- 4) Saturation System: Receives the generated ozone gas and injects it efficiently into the process water flow. The saturation of gas into water is vital in utilizing the created ozone and has been designed for optimal peak flow rates. Mass transfer of ozone into the water ranges from 88 to 95% depending on the conditions of the water (i.e., temperature, atmospheric pressure, contaminant level, etc.). The saturation system includes a booster pump, venturi injector, static mixer, degas separator, and ozone destruct for excess gas not consumed in the treatment process. Additionally, pressure gauges and backflow preventers are incorporated into the system design for safety of all components.
- 5) Controls system: Monitors and controls the entire system operation and monitors the condition of the treatment process. This consists of HMI/PLC user interface that can be remotely connected and monitored, ambient ozone monitor to detect leaks, inline oxidation reduction potential (ORP) probe indicating successful oxidation of the water, flow sensor. Various alarms and additional monitors are included to ensure proper equipment operation.

Biological Filtration

Aclarus will retrofit the pilot trailer with biological activated carbon filters. The biological portion of the pilot will include four parallel Watts One Tank cartridge filters containing seeded activated carbon. The filters will be operated with an empty bed contact time (EBCT) of approximately 10 minutes. Each filter will contain a bottom supporting layer of sand in addition to the biological active carbon. The carbon will be acquired pre-exhausted and will require approximately four weeks of seeding time before the start of the pilot project.

PILOT PROCESS FLOW

This is a two-stage pilot which will entail treating water taken directly following the Acti-flo system. Staff of the Lindsay Drinking Water Plant will need to make appropriate modifications (electrical hook-ups, plumbing connections) on-site before the mobile trailer unit is commissioned on-site.

- 1) The Aclarus treatment trailer will be parked at Building 1, location A, as illustrated in Figure 2. The system will take water following the Acti-Flo system (Figure 3) through the water treatment building and outside to an external holding tank. From the external holding tank, a booster pump will drive the water into the Aclarus mobile trailer unit where it will be treated and filtered. Following treatment, the water will be sampled for analysis before discharging to sanitary drain.
- 2) The second phase of the pilot testing will include a biological filtration, the Aclarus Pilot trailer will be fitted with four Watts filters containing seeded biologically active carbon. The treatment train will replicate phase 1, however, biofiltration will replace activated carbon filtration after oxidation. Following the biological filtration, the effluent will be sampled for analysis before discharging to sanitary drain.



Figure 2- Building 1, Location A – Pilot Trailer Location



Figure 3- Acti-Flo System at Lindsay Drinking Water Plant



Figure 4- View of building where the hosing will come from the Acti-Flo System into an external holding tank.

NOTE: All Aclarus Staff on-site will have a copy of the issued WSIB certificate. Aclarus is not liable for any damage/injury/harm to personnel, or the Lindsay Drinking Water Plant caused on-site by the treatment trailer. Copies of insurance available upon request.

SUMMARY

Aclarus is pleased to provide this budgetary proposal to MTE Consultants Inc and hope it meets your requirements. This proposal does not accurately reflect all operating expenditure costs or capital expenditure costs. The results from this pilot test will be directly reflected in the design of the full-scale system and its components to ensure full treatment of the drinking water supply.

COMMERCIAL TERMS

Client:	City of Kawartha lakes
Project:	On-Site Pilot Trailer Testing
Ex Works Incoterms 2022/05/06:	Peterborough, Ontario.
Shipping:	4-6 Weeks after reception of deposit and P.O.
Payment Terms (OAC):	50 % deposit upon acceptance of PO; 50% due Ex Works (EXW) Incoterms 2020
Pricing	Subject to Bench Scales Test # 2 Results, price will not exceed estimates below.

Aclarus Ozone Summary	Quantity
Aclarus Pilot Trailer Project Scope: The scope of the project is to perform full pilot testing to evaluate the efficacy of ozone, H2O2, and biofiltration for THM & HAAs reduction at the Lindsay Drinking Water Plant. Test plan is as per scope in Proposal document. <ul style="list-style-type: none"> • Delivery to site & set up of trailer. • COKL to connect main power and water to trailer with Aclarus Assistance. • 4 Weeks • Teardown & remove trailer • Site technical representative on site on & off during testing 	1
Total	\$ 16,000.00 CAD

Aclarus Analytical Pricing	Quantity
<ul style="list-style-type: none"> • Test # 1 Ozone Only • Test # 2 Ozone & Hydrogen Peroxide • Test # 3 Ozone & Biofiltration • Test # 4 Ozone & Hydrogen Peroxide & Bio Filtration 	As per Proposals Testing Analysis Overview
Total	\$ 45,600.00 CAD

*Plus, applicable taxes.
Pricing valid for 15 days*