



WATER SAMPLE RESULTS AND RECOMMENDATIONS

WAPASU LAKE- MINBURN COUNTY

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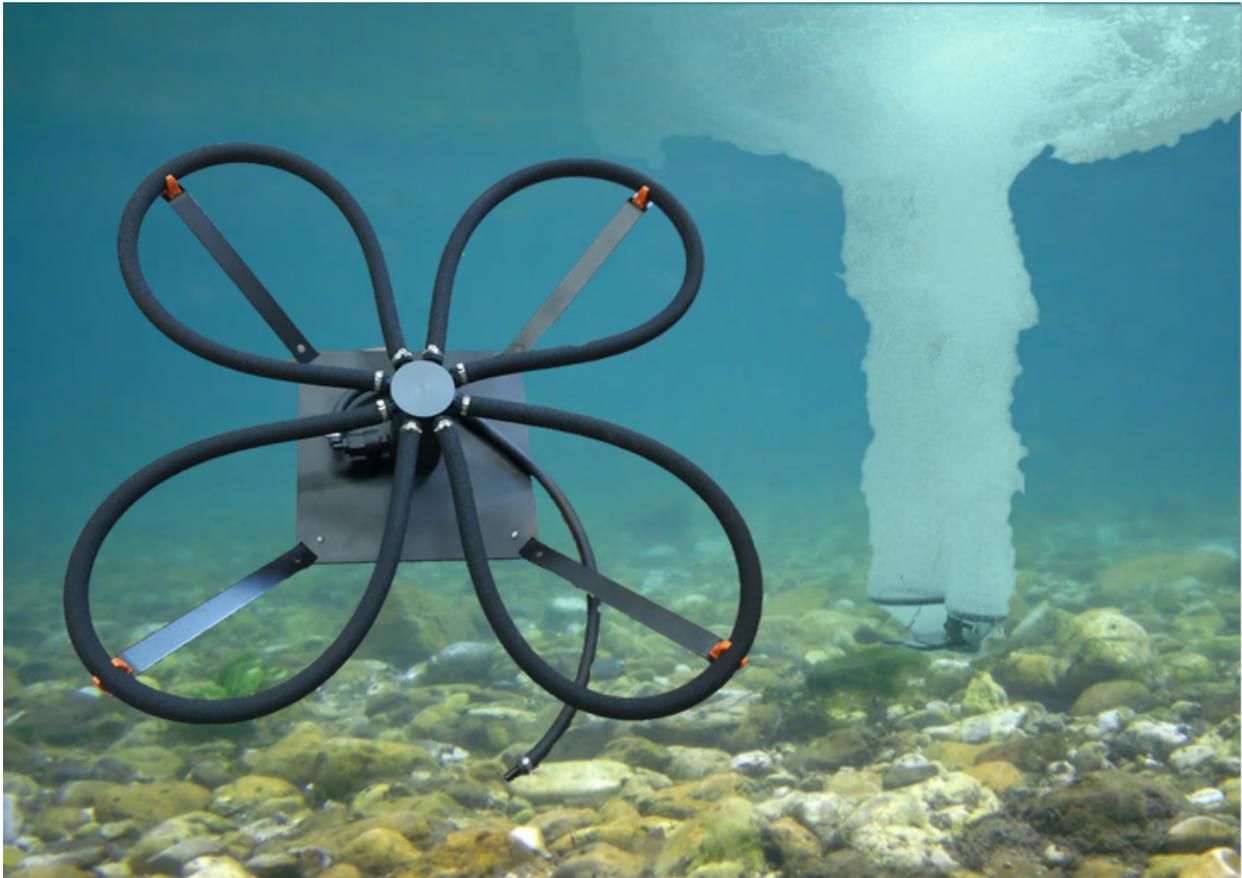




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Introduction

Waspasu Lake is 210 acres with a maximum depth of 5.8 feet. It presents with blue-green algae every summer. Exposure to cyanobacteria can have serious health implications, thus, limiting its public recreational uses. Pond Pro Canada's team arrived on site to do an area inspection, determine pond depth, collect samples, and test water to deliver remediation suggestions.

Pond Pro Canada is a company based near Camrose, Alberta, that specializes in bringing the best water products and systems to the market. Under the operation of experienced biologist, Lorne Loudon, we create custom plans for your lake that are easy to use, economical, and effective. Our Can-Air Aeration Systems are designed, tested, and manufactured to be reliable in the harsh Canadian climate. We have a history of proven results with our aeration systems and pond products.

This report will cover the findings and results from Waspasu Lake and make a preliminary proposal with rough budgets, based on our knowledge and experience in aeration and pond technology.



Figure 1a. Waspasu Lake. Photo taken May 10, 2022.



Figure 1b. Waspasu Lake outlet. Photo taken May 10, 2022.

Test methods

Water samples were collected on Waspasu Lake on May 10, 2022, around noon. An aluminum boat was used to take water parameter measurements and collect water samples throughout the lake. Seven water samples were taken across the lake. The location of each sample point was measured using GPS mapping. While on the lake, the depth was measured using marked rope and weight. The dissolved oxygen was measured at various depths (surface, middle, bottom) using a Milwaukee oxygen reader. The water samples were collected by holding clear bottles 6 inches under water until full. Upon collecting samples, a visual inspection of the

water in the bottles appeared to have a translucent light brown colour, and minimal amounts of precipitates suspended in the water. After the samples were collected they were stored in dark, refrigerated (4°C) conditions prior to testing.

Testing was completed on May 10, 2022, by Pond Pro's biologists. We tested for turbidity (FNU), phosphate (mg/L), and pH using Milwaukee meters. The depth and dissolved oxygen (DO) were tested at Waspasu Lake during sampling. All test equipment was calibrated prior to testing. Not all locations had water samples taken.

Results

Results show samples to have an average pH of 9.03 (Table 1). The average turbidity level was 16.94 FNU (Table 1). The average phosphate levels measured were 2.27 mg/L. The average surface DO was 8.63 mg/L, middle DO was 5.40 mg/L and bottom DO was 2.53 mg/L.

Table 1. Data collected on May 10, 2022 at Waspasu Lake. The phosphate meter had a range of 0.00 mg/L - 2.50 mg/L.

Sample #	Sample Location	Depth (ft)	pH	Phosphate (mg/L)	Turbidity (FNU)
1	(culvert/ outlet)	-	9.24	-	14.47
2	53.363900, -111.624266	3.20	9.02	-	19.53
3	53.363359, -111.621169	5.00	8.92	2.50	18.63
4	53.363572, -111.618912	5.80	9.00	2.50	16.50
5	53.363261, -111.617509	5.80	9.01	1.36	17.98
6	53.362920, -111.615566	5.70	-	-	-
7	53.362987, -111.613614	5.30	9.03	2.50	17.03
8	53.362203, -111.611132	5.00	-	-	-
9	53.362997, -111.613480	5.60	-	-	-
10	53..360866, -111.615133	5.80	-	-	-
11	53.360719, -111.61.6623	5.40	-	-	-
12	53.360995, -111.615914	5.80	9.01	2.50	14.47
	Average	5.31	9.03	2.27	16.94

Table 2. Dissolved Oxygen was measured on May 10, 2022, at varying depths in Waspasu Lake using a Milwaukee meter. Not all sampling locations were measured for DO.

Sample	DO (mg/L)		
	Surface	Middle	Bottom
3	-	-	2.60
4	8.60	-	1.30
5	-	-	4.10
7	8.80	-	-
12	8.50	5.40	2.10
Average	8.63	5.40	2.53

Discussion

Phosphate

The natural phosphate levels typically range from 0.005 to 0.05 mg/L (Table 3). Algae blooms can occur at levels as low as 0.04 mg/L. An excess of phosphate, including from potential outside sources, resulted in a level of 2.27 mg/L in Waspasu Lake. This triggers algae blooms, causing odor, discolouration, and blue-green algae, making the lake unfit for recreational use. Long-term eutrophication can be triggered at 0.08 - 0.10 mg/L. Lake ranges based on Alberta Lake Management Society:

Table 3. Trophic status based on total phosphorus

Trophic State	Total Phosphorus (mg/L)
Oligotrophic	<0.01
Mesotrophic	0.01 - 0.03
Eutrophic	0.03 - 0.10
Hypereutrophic	>0.10

Turbidity

Turbidity is the measurement of relative clarity in water. It will be decreased (water clarity improved) in response to aeration or alum treatment. Not only can treating turbidity improve oxygen conditions, but people are more inclined to use a lake for recreational purposes if it looks “clear,” having low turbidity levels. Large amounts of algae dying off in the cooler seasons will increase turbidity.

Dissolved Oxygen (DO)

Dissolved oxygen corresponds with temperature and pressure. This measurement was within a healthy range, but is expected to decrease as the summer temperature increases. Blue-green algae can deplete oxygen causing fish and invertebrate die-off. In shallow ponds, DO can become supersaturated on the surface but have anoxic conditions occurring a few meters below. Throughout the summer, these anoxic conditions expand upwards. Treating the algae and/or providing aeration can stabilize these fluctuations and improve DO levels.

pH

Wapasu Lake has a high pH average tested at 9.03 (pure water is around 7). This alkaline environment could effect our treatment options as discussed under alum application. More seasonal testing is necessary to determine the effect algae is having on CO₂ levels. Increased algae causes a higher pH; this is perhaps what is being observed at Wapasu Lake. As well as decreasing algae, aeration will lower pH by making O₂ and carbon available to bacteria to produce gas.

Option 1: Aeration Recommendation

Pond Pro Canada proposes implementing a turn-key, 108-diffuser aeration system to aid in the reduction of nutrients and organics in Wapasu Lake, which ultimately results in annual algae blooms.

Aeration is considered to be a long-term investment to help improve water quality in the lake. This complete 108 diffuser system is designed to target approximately half of the lake. The reasons for this are:

- Improve the dissolved oxygen levels in the lake
- Cost awareness
- Allows for the settling of organics prior to the outlet
- Improve water quality near the beach and recreational areas

This aeration project aims to meet the goal outlined by Minurn County, which is to improve the water quality within Wapasu Lake and reducing phosphates to minimize future algae blooms.

Pond Pro's biologist-recommended proposal includes a long-term investment in a Can-Air Mega Fine Bubble Diffused Aeration System as a long-term solution to enhancing water quality and reducing phosphates. Pond Pro's Can-Air aeration systems are made in Canada and designed to withstand Canadian climates. We have sold and maintained over 4000 Can-Air aeration systems across Canada, and installed multiple systems in natural lakes, wastewater ponds, drinking water reservoirs, pulp and paper effluent ponds, and more. These industrial-grade stainless steel systems are economical, efficient, and durable.

Pond Pro Canada proposed a complete turn-key aeration system (Fig 2) using the following equipment:

- (108) Can-Air Mega diffusers
- Custom lengths of $\frac{3}{8}$ ", $\frac{1}{2}$ ", $\frac{5}{8}$ ", and $\frac{3}{4}$ " Can-Air AquaTube sinking airline
- (27) CA-250 1HP compressors
- (27) Compressor shelves with fan cooling
- Custom length of insulated airline
- All required fittings

Why Can-Air?

Through experience, research, and trial and error, Pond Pro Canada created its own line of fine-bubble bottom diffuser, known as Can-Air. Can-Air proudly boasts seven different diffuser models ranging from small pond diffusers to 8' x 8' industrial diffusers. All Can-Air diffusers are manufactured in Canada and are designed around our harsh Canadian climate. Pond Pro Canada has conducted various in-house studies to compare Can-Air efficiencies to our competitors' diffusers (Appendix A).

This system offers:

- Easy operation and maintenance with independent parts
 - Quick start up, low operator maintenance
 - Easy balancing of airlines
 - Easy isolation of any potential leak
- Custom aeration equipment designed to maximize efficiency and minimize sedimentation agitation to allow for settling in various cells
- Easy maintenance if needed – just remove single diffuser, repair, and replace
- Custom airline lengths to minimize airline splicing for leak reduction
- One of the largest fine bubble diffusers on the market
 - Fine bubbles (2-3 mm microbubbles) produced by diffusers are more efficient at transferring O₂ into water
 - Air lines on diffusers do not stretch
- Complete operational manuals and on-site training provided

Design Information:

- Total HP of proposed compressors = 1 HP per compressor = 27 HP total
- 2.5 CFM per diffuser
- Can-Air Mega Diffuser average theoretical flow rate = 11,561.06 gpm at 2.5 CFM tested at 3 m depth (Appendix A)
- Strategic diffuser placement to maximize aeration coverage
- Low maintenance; easily maintained by Minburn County operation staff
- Diffuser rebuilds every 8-12 years

Proposed Diffuser Layout



Figure 2. Pond Pro's recommend diffuser layout design.

System Quote

The aeration system quote is in the range of \$350,000 - \$500,000. Price of installation is included in the cost range. A detailed item list will be provided upon further inquiry.

Option 2: Alum Treatment for Lake Management

Alum has been shown to be highly effective for the treatment of blue-green algae. Our team is equipped with the resources to spray the lake surface with liquid aluminum sulfate (alum). Alum binds to phosphates and makes them unavailable for several years. During this time, it improves water clarity and prevents algae blooms. Applied correctly, alum is non-toxic in the water, keeping the water safe for public use. Pond Pro Canada is one of the only Alberta-based businesses with the capacity to perform this procedure.

Based off our current findings, we recommend treating Wapasu Lake with 30 mg Al/L, or 101,087 kg, of aluminum sulfate 49%. We would distribute this along the entire surface of the lake with a barge in early spring, approximately 3-4 weeks after the ice melts. This treatment will take approximately 1 week to apply. We suspect the lake will be at its lowest pH during this time, ideally below 8.4. During this period, there will be higher levels of dissolved CO₂ in the water locked under the ice and free from the consumption of algae. The result of this should be a decreased pH. We can confirm this by conducting another pH test when the lake is frozen over during the winter.

Conducting another pH test is necessary to determine the contribution from naturally occurring ions in the ground. If the pH does not decrease to a desirable level over the winter, the lake will require an additional pre-treatment using acid solution to synthetically lower pH and prevent post-alum lake toxicity. In this event, we would discuss further options. We also propose collecting water samples from Wapasu Lake to assess post-alum concentrations for toxic affects.

For a shallow lake such as Wapasu, we expect to see a significant algae reduction maintained over at least a 5 year timespan.

Cost

Item	Cost
Alum	\$196,108.78 for a concentration of 30 mg/L <ul style="list-style-type: none"> Treatment can range from \$130,738 - \$262,000 depending on alum treatment rates (20mg/L- 40 mg/L, respectively)
Transportation <ul style="list-style-type: none"> Equipment Chemicals Staff 	\$10,000
Equipment Rental	\$33,000

<ul style="list-style-type: none"> ● Specialized barge ● Zoom Boom ● Other Required Lifting Equipment 	
On-site Labour/person	\$22,000
Additional Water Testing and Alberta Environment Consultations	\$5,500
Miscellaneous	\$5,000

Other Recommendations

Alum treatment will only be effective by eliminating external phosphorus sources. Prior to performing the alum treatment, the culvert on the north side of the lake must be raised to eliminate overflow from the wetland into the lake (Fig 3a.). By raising the culvert by about 2 feet it will increase the depth of Wapasu Lake, making aeration more efficient in the future.



Figure 3a. Lake outlet.



Figure 3b. Possible lake over flow

Conclusion

This report provides testing results and treatment options for blue-green algae in Wapasu Lake. Our tables indicated lake depths, pH, turbidity, phosphate levels, and dissolved oxygen (DO) levels. Phosphate levels were increased. We have proposed a comprehensive aeration system and an alternative alum treatment option to improve water quality. Our dedicated team of professionals looks forward to working with you to improve Wapasu Lake’s aquatic ecosystem, water quality, and make it available for safe public use.

Appendix A

Diffusers come in all shapes and sizes to aerate your pond most efficiently. Here at Pond Pro Canada Ltd., we have focused on designing the most efficient and effective aerator on the market. With years of aeration expertise, we recognize that not all diffusers are made equally. In fact, we have learned that diffuser and bubble size matters! With research to guide our diffuser design, Pond Pro Canada has made their most popular Can-Air diffusers BIGGER! This is because larger diffuser area directly correlates to higher water flow rate (Fig 4.) In addition to this, small bubbles rise slower to maximize oxygen transfer into the water. Therefore, Pond Pro Canada continues to use Pond Pro Fine Bubble Airline on all Can-Air diffusers to create fine 2-3mm microbubbles. Traditional airstones create coarser bubbles which are less efficient at transferring oxygen into the water.

Pond Pro Canada's line-up of Can-Air diffuser are designed with research, economical value, and our harsh Canadian-climate in mind. With long lifespans (8-10 years between rebuilds), Can-Air diffusers are among the most efficient, economical, and low maintenance diffusers on the market, proving that not all diffusers are created equally!

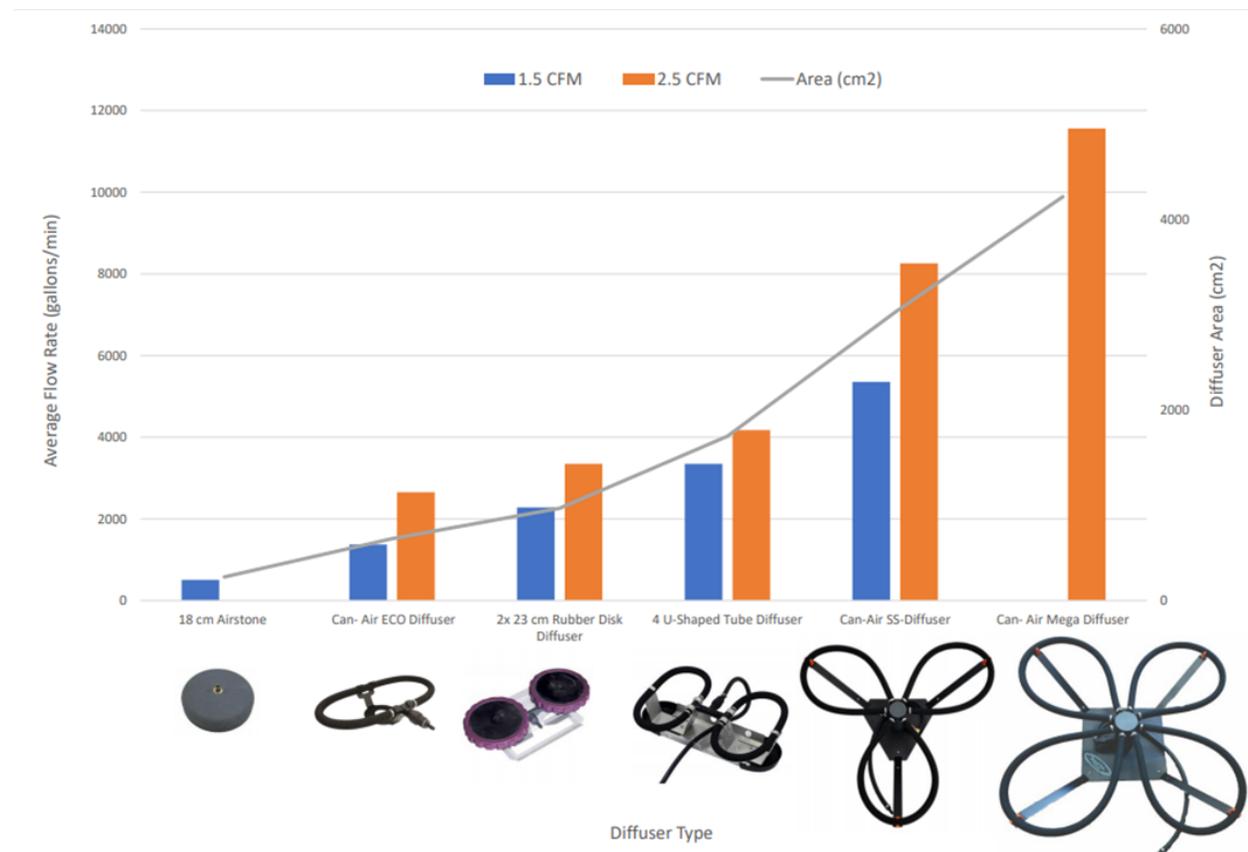


Figure 4. Average diffuser water flow rates (gpm) of various sized (cm²) diffusers.