Date: January 27, 2026

To: Barry Halverson, Lake Lawrence LMD Co-Chair

From: John Holz, SOLitude Lake Management

RE: Answers to Alum Presentation Questions

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1. I believe an early presentation suggested that the Alum they applied with perhaps Lanthanum? moved in the lake bottom. There was mention that a follow up core test found no Alum. I would like to hear John's response to that concern.

I believe your question pertains to a study conducted by Eutrophix following a combined aluminum and lanthanum application at Long Lake in 2021. SOLitude was not involved in either the lake application or the subsequent study. As such, it would not be professionally responsible for me to comment on the findings or implications of that work without first reviewing the study details.

For that reason, I have requested access to the report from Ryan Van Goethem at Eutrophix, who I understand is the primary author. I would be able to provide more informed and technical comments after reviewing the report.

However, based on my experience to date, I have not encountered issues with alum floc movement or ineffective phosphorus binding when alum is properly dosed and applied with appropriate controls and precision.

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2. Who is responsible for 24/7 safety/security at the land site (storage chem tanks and staged equip, HAZMAT etc)? To include signage and county notifications to the public.

SOLitude would be responsible for safety and security at the project staging area, which would likely be located at the boat launch. A security guard would be onsite during periods when our staff are not present. We also notify local law enforcement prior to mobilization, and they commonly add the site to their routine patrols during the project.

From a safety and regulatory standpoint, all operations are OSHA-approved. We prepare and implement a project-specific Health & Safety Plan (HASP) and a Spill Prevention, Control, and Countermeasure (SPCC) Plan. Chemical storage tanks are placed within secondary containment (spill guards) designed to capture any unexpected drips or leaks. All safety, security, and compliance measures are included in our project fee.

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3. Is it recommended we shut the lake down during applications, chemical load/unload operations etc. for both public safety and equipment access considerations.

Some clients elect to temporarily close the lake during the application; however, a full closure is not required. We do request that lake users be notified in advance of the project and instructed to maintain a safe distance from the treatment barge during operations.

Our staging area would likely be located at the boat launch, with restricted access to that immediate work area using fencing and signage. The boat launch itself does not need to be closed. We would plan to maintain safe and reasonable public access to the lake throughout the project.

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4. Today 1/22/26 our lake surface temperature was 42F, typical low is 40F in the winter, sometimes the lake surface freezes. Typical high is 80F at the surface in the summer. Bottom temperatures are not currently recorded on a regular basis.

Thank you for providing this information. Most of our alum applications in Washington have occurred during the spring or fall, and to date we have not encountered temperature-related constraints. Based on the temperatures you've described, I do not anticipate any operational or treatment limitations at Lake Lawrence. Temperature considerations are generally only restrictive in much colder climates than those typically encountered in this region.

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5. You mentioned the Fe-P bond is weaker with temperature. What happens to P-Fe bond in cold water at the anoxic layer. I.e., Does the Aluminum Sulphate release P back into the sediment as a function of seasonal temperature excursions?

To clarify, temperature does not weaken the iron–phosphorus (Fe–P) bond. The mechanism driving phosphorus release from iron-bound forms is the absence of oxygen, not temperature. Under anoxic conditions, ferric iron (Fe^{3+}) is reduced to ferrous iron (Fe^{2+}), which releases bound phosphorus into the porewater and overlying water column. My presentation addressed oxygen conditions as the controlling factor, not seasonal temperature changes.

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6. The canal is very shallow and narrow. Can this be treated?

We do have equipment capable of operating in shallow and narrow areas if treatment is required for a whole lake water column stripping dose. However, based on current

understanding, treatment of the canal is likely unnecessary unless data show that bottom waters in the canal become anoxic during the summer (this assumes a sediment inactivation dose targeted at areas of the lake that experience summer anoxia).

It is important to note that internal phosphorus loading affects the entire lake and is not limited to the areas where algae are most visible. Algae are often observed in shallow or near-shore areas because of greater sunlight and water movement patterns, not because those sediments are the primary source of phosphorus. This can be confusing and sometimes leads to the assumption that shallow areas must be treated simply because more algae are seen there.

In most lakes, the primary source of internal phosphorus comes from deeper sediments where the overlying water becomes low in oxygen (anoxic) during summer stratification. Phosphorus released from these deeper sediments is then mixed and distributed throughout the lake, supporting algae growth across the entire system. By reducing phosphorus release from these deeper, anoxia-prone sediments, phosphorus levels are lowered lake-wide, including in shallow areas.

While some phosphorus release can occur from shallow sediments, these areas typically remain oxygenated, and release rates are much lower. As a result, sediment nutrient inactivation treatments such as alum are generally focused on deeper areas where they provide the greatest benefit for the cost. If needed, phosphorus release rates can be measured in both shallow and deep areas to confirm their relative contributions and guide treatment decisions.

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7. Once the alum is applied and the lake water clears, doesn't the sunshine more easily penetrate through the water column, thereby increasing plant growth?

Any activity that improves water clarity—including alum application—can increase light penetration into the water column and may allow aquatic plants to colonize slightly deeper areas than previously observed. Lake Lawrence already appears to have an aquatic plant management plan in place, which would remain relevant following an alum application.

Historically, our clients have expressed a strong preference for managing aquatic plants rather than dealing with cyanobacterial blooms, potential toxin production, and associated lake closures. Plant growth is generally viewed as a more manageable and predictable condition.

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8. Do you close the lake during treatment? For how long?

Please see the response to Question #3 regarding lake access and closure considerations.

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9. Will WA Fish & Wildlife let you use the boat launch?

Use of the boat launch typically requires a permit from Washington Department of Fish & Wildlife. On our previous projects, WDFW has consistently issued the necessary permits upon request.

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10. Slide #9 - How Anoxic must the sediment be to release P from the Iron in the Sediment?

Dissolved Oxygen at Surface-Water Interface	**Iron-Bound P Behavior**
> 2 mg/L	Iron bound stable; P retained
0.5–2 mg/L	Transitional; limited P release
< 0.5 mg/L	Iron reduction begins; Initial release of loosely sorbed P
0 mg/L	Strong P release

Importantly, phosphorus release is often observed before complete anoxia in the overlying water column because sediment porewater becomes anoxic prior to the water above the sediment.

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11. Slide #22 - When the treatments done for each of these lakes and who would be a point of contact to call to discuss their experience/results?

For the following lakes: **Black (2021), Blackmans (2025), Green (2016), Heart (2018), Wapato (2017)**

Rob Zisette
Principal Scientist, Herrera

Phone: 206-787-8262
Email: rzisette@herrerainc.com

For the following lakes: **Fenwick (2024), Ketchum (2021–2025), Long (2019), Moses (2017), Waughop (2020, 2024)**

Shannon Brattebo
Environmental Engineer, Tetra Tech
Phone: 509-232-4312
Email: shannon.brattebo@tetratech.com

Note that the Moses Lake application was a pilot-scale treatment conducted in a cove of the lake. Our original local contact has since passed away. Shannon Brattebo remains actively involved in multiple Moses Lake studies, works closely with the local stakeholder group, and would be an appropriate point of contact for general questions regarding that project.

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12. Question - Slide 31 Lump Sum Cost Estimate = $110 per pound of P .. Does that include the use of the buffering agent (Sodium Aluminate)?

Following SOLitude's presentation to the Lake Lawrence group on January 22, 2026, we consulted with Herrera to further refine our understanding of the aluminum dose, application strategy, and underlying project assumptions. Based on the additional information obtained during that consultation, our lump-sum cost estimate to perform a sediment phosphorus inactivation treatment using alum with a buffering agent (sodium aluminate) is $195 per pound of phosphorus inactivated.
