



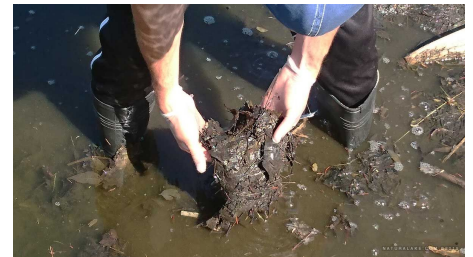
What's the Muck?

LLPOA Lake Committee - 2023

The following information has been taken from or paraphrased from Naturalake.com and Penn State Extension.

What is Muck?

- **Muck is a combination of organic debris such as dead algae, plants, grass clipping, leaves, or animal waste and inorganic sand, silt and gravel that builds up on the bottom of lakes and ponds.**
- **Problematic muck stores excess nitrogen and phosphorus that is readily available for algae and aquatic plants.** Too much muck can reduce water quality and clarity or create a toxic environment for fish or other organisms.
- **Muck can be treated and the health of the water body can be restored using several different techniques.**



From the 2015 Loch Lomond Summary Report:

- **Loch Lomond is hypereutrophic; ranked 150th out of 173 lakes in Lake County.**
- **Total phosphorus** in Loch Lomond averaged 0.196 mg/L which is a 33.5% decrease from the 2005 concentration of 0.295 mg/L but higher than the Illinois Environmental Protection Agency impairment rate of 0.050 mg/L. Sources of phosphorus include inputs from the watershed, local sources (i.e., lawn fertilizers and agricultural runoff).
- **Nitrogen** is the other nutrient critical for algal growth. The average Total Kjeldahl nitrogen (TKN) concentration for Loch Lomond was 1.54 mg/L, which was higher than the county median of 1.20 mg/L.
- **A Total Nitrogen to Total Phosphorus (TN:TP) ratio of 8:1** indicates that nitrogen was the nutrient limiting aquatic plant and algae growth in Loch Lomond.
 - The phosphorous trophic state index (TSIp) ranked Loch Lomond as **hypereutrophic with a TSIp value of 80.2. This means that the lake has high nutrients which can result in excess plant and algae growth.**
- **Although Loch Lomond is at the top of the watershed, it has lower water quality than the lakes it flows into. This is in part due to the lack of aquatic plants to stabilize sediments and take up excess nutrients.**

How Do We Treat or Remove Muck?

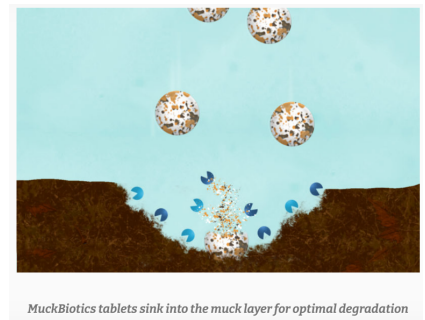
• Diffusers & Aerators

- A second technique for muck removal in a lake or pond is through **adding oxygen to the water**. Specialized equipment like **bottom diffusers or surface aerators** can add dissolved oxygen to the water column or the surface of the muck layer to varying degrees.
- **When dissolved oxygen is added to the muck layer it creates a favorable environment for the aerobic bacteria that love to digest the organic compounds.** Breaking down organic compounds found in muck aerobically is favored over anaerobic digestion because it does not generate any toxic compounds (methane or sulfur) as a byproduct. Stimulating the natural aerobic bacterial community reduces nitrogen and minimizes the release of phosphorus from the muck layer by creating an aerobic zone at the water sediment interface.
- Aeration may have limitations due to cost or power capabilities, but it can be an effective option for treating muck and offers the benefits of better circulation and dissolved oxygen too.



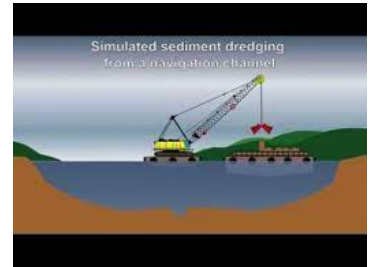
• Probiotic Tablets

- A third technique for muck removal is using a **tableted probiotic that speeds digestion of organic compounds and nutrients**. When applied, probiotic tablets sink into the muck layer and activate.
- **This process infuses muck with beneficial microorganisms, biostimulants, and vitamins for optimal degradation.** The bacteria, introduced from the pellets and naturally occurring, produce enzymes (catalysts) that speed up the breakdown of complex proteins, starches, and lipids into amino acids, simple sugars and fatty acids which are rapidly used in bacterial metabolism.
- The muck compacts, solubilizes, and washes out to varying degrees resulting in decreased muck levels, reduced nitrogen and less available phosphorus. Probiotic tablets are a low cost and environmentally friendly option for treating muck with significant organic content.



- **Dredging**

- **Dredging is the physical removal of muck.** Dredging comes in two basic forms: mechanical and hydraulic.
- **Mechanical dredging** involves the use of heavy equipment, an excavator for example, that scrapes the muck off the bottom and discards the material onto a barge or shoreline.
- **Hydraulic dredging** involves suction equipment that takes a slurry of muck and water off the bottom and sends it via pipeline to another location to be discarded. An advantage is the process removes both organic and inorganic compounds. *Specifically, the **phosphorus and nitrogen found in the muck are physically removed from the aquatic environment.***
- **Dredging can be hazardous in some environments, prohibitively expensive, and can release pockets of phosphorus and nitrogen into the water** from the underlying muck layers. Because of pumping or hauling costs, the muck is discarded so close to the water body that the matter and nutrients can just drain right back in.



- **Heavy Metal Testing**

- **The sediment in the lake was tested in 1988 and 2004 at the Bull Creek inlet, Dam, Southwest Inlet, and one Deep Hole near North Beach, and the heavy metals Arsenic, Cadmium, Copper, and Lead were present.**
- While the level of three metals dropped over the 16 years of testing at one site tested both years, the metals were measurably present. The Arsenic, Cadmium, and Lead may have come from local agriculture, while the Copper was probably from lake spraying (and the likely reason the level increased in 2004)
- **If the LLPOA decides to do, or allow, any dredging in the lake, additional sediment testing might need to be done** to know the current concentration of these heavy metals.

Sediment Analysis Comparison, Loch Lomond, 1988 vs 2004

All concentrations are mg/kg dry weight; 1 mg/kg = 1 ppm

	1988	1988	2004	2004				
					EPA Threshold Effect Concentration (mg/kg)	EPA Probable Effect Concentration (mg/kg)	WHO Heavy Metal Permissible Drinking Limits (ppm)	EPA Heavy Metal Permissible Drinking Limits (ppm)
Deep hole	5/10/1988	9/28/1988	8/2/2004	9/13/2004				
total solids			18.67	18.84				
arsenic	81	121	49	53	9.79	33	0.05	0.01
cadmium	4.8	5.3	<5.4	<1.68	0.99	4.98	0.005	0.005
copper	114.3	147.4	271	300	28	100	1.5	1.3
lead	47.6	63.2	46	48	35.8	128	0.05	0.015
Bull Creek inlet								
total solids			46.72	33.34				
arsenic			27.4	33				
cadmium			<2.1	<1.05				
copper			73.6	120				
lead			11	29				
Dam								
total solids			21.72	34.87				
arsenic			63.1	37				
cadmium			<4.6	<0.923				
copper			269	60				
lead			34	34				
Southwest inlet								
total solids			32.13	23.18				
arsenic			32.7	52				
cadmium			<3.1	<1.35				
copper			67.8	270				
lead			29	56				

Stopping the Causes of Muck

- **Monitor Water Quality** with measurements of clarity (Secchi disk), pH, Dissolved Oxygen
- **Prevent Excess Nutrients runoff** (*Most Important*) Runoffs from fertilizers, grass clippings discharged into the lake, and dog and goose feces add excess nutrients that cause algae growth, which reduces water clarity, which reduces sunlight getting deeper in the lake for aquatic plants, and reduces Dissolved Oxygen.
- **Prevent Sediment runoff** (*Most Important*) Runoffs from areas of erosion add soil particles, salts, sand (including sandy beaches), and minerals.
- **Install buffer strips** (*Easiest*) Buffer strips filter runoff into the lake, and reduce erosion
- **Increase oxygen** in the lake through aeration and diffusers.
- **Manage aquatic plants and algae.**
- **Add fences** to limit geese moving from lake to land

How Do We Decide What To Do?

- Evaluate each situation to see which muck removal technique is right.
 - If the muck is composed of mostly **inorganic compounds such as sand, silt, and gravel** from runoff it is likely that it will need to be **dredged**, provided they are not contaminated.
 - If the muck is composed of **organic compounds such as dead plants and algae, leaves, etc.** then using a **tablet probiotic to stimulate the muck layer** and restore the health of the lake or pond is a great option.
 - **Combining probiotic tablets with aeration always improves the speed of the muck degradation.**

Information & Other Resources

- **What is Pond Muck?:**
<https://naturalake.com/muck-build-up/#:~:text=What%20is%20Muck%3F,for%20algae%20and%20aquatic%20plants>
- **How to get rid of muck in a pond:**
<https://www.youtube.com/watch?v=6vMAUJM3Fgc>
- **Five Steps to a Healthy Pond (Penn State Extension):**
<https://www.youtube.com/watch?v=HfNJMQjhua4>
- **Assessment of the Effectiveness of Muck-Digesting Bacterial Pellets:**
https://www.gvsu.edu/cms4/asset/DFC9A03B-95B4-19D5-F96AB46C60F3F345/muck_digester_pellets_final_report.pdf
- <https://www.ovivowater.com/en/product/aerostrip-diffused-aeration/>
- <https://fwfarms.com/product/2562/>
- **Mechanical Dredging:** <https://www.youtube.com/watch?v=9ohre2m01z4>
- **Hydraulic Dredging:** <https://www.mossoak.com/our-obsession/blogs/new-hydraulic-dredging-techniques>