Making a difference...together

APPENDIX A

ELK LAKE
REMEDIATION OPTIONS
June 21, 2017

In April 2017, the Elk/Beaver Lake Initiative Intergovernmental Working Group (IWG) agreed to eliminate dredging, full-lift aeration and laminar-flow oxygenation and lanthanum-modified bentonite clay from the potential remediation options. The group selected high-efficiency hypolimnetic oxygenation as the preferred remediation option.

Factors that were weighed by the IWG to select between remediation options were: price, likelihood of success, long-term operation and maintenance or reapplication costs, disruption to lake users and long-term effectiveness.

Selected Remediation Option

High-efficiency hypolimnetic oxygenation

- System requires shoreline infrastructure to pump lake water into an mixing chamber, an oxygen generator (or oxygen tank), piping and a diffuser to return the oxygenated water to the deepest part of the lake.
- Mixes pure oxygen (90-95%) with the lake water as opposed to air (21% oxygen) resulting in a high-efficiency of oxygenation.
- Can be operated only at the times of the year when needed (approximately March to September) and through a system of monitoring and control, can be adjusted month-to-month to meet the oxygen needs of the lake.
- Will improve fish habitat.
- Less expensive than lanthanum-modified bentonite clay, comparable cost to full-lift aeration but doesn't interfere with lake surface uses such as rowing.

Eliminated Remediation Options

Dredging

- Based on estimates from a similar Burnaby Lake project, estimates of the cost of dredging Elk Lake would range from $66 to $120 million.
- Extensive land area (several hectares) would be needed to dewater the dredge material prior to transport, and securing such a location would be costly and likely involve environmental assessments before and after use.
- Newly-exposed lake sediments would likely be very acidic and high in oxidizing iron, and additional treatment would likely be needed to protect water quality and aquatic biota following dredging.

Full-lift Hypolimnetic Aeration

- Full-lift hypolimnetic aeration systems require a separator box to be located on the lake surface. This structure would interfere with water recreation activities such as rowing and boating.
- If not properly sized or maintained, the underwater riser and exit tubes can stir up sediment and increase both phosphorus and hydrogen sulfide in the water which can cause severe cyanobacteria blooms.

- There are better available technologies that will discharge a greater concentration of oxygen directly at the sediment-water interface without stirring up sediment.

Laminar-flow Oxygenation

- Laminar-flow oxygenation would disrupt the summer thermocline of the lake, and the lake would mix entirely every three days.
- This would result in an increase in deep water temperature from a fish-friendly 8°C to 19-22°C.
- This option was eliminated because it will raise summer water temperature above the Ministry of Environment Water Quality Objective of 15°C, and would be detrimental to cold-water fishery.

Lanthanum-modified bentonite clay

- Treatment can only prevent the release of iron/manganese-bound phosphorus, which accounts for only 41% of total sediment phosphorus, the remaining 59% of organic-bound phosphorus (e.g., in sediment bacteria and micro-organisms) would not be affected.
- Multiple dosing events (~once every 3 years) are usually needed to maintain low internal phosphorus loading, and each event would cost an estimated $2.4 million.
- Treatment would have no effect on dissolved oxygen concentrations, and would thus not improve summer fish habitat or promote the decomposition of organic material on the lake sediment.