RioTinto | Diavik

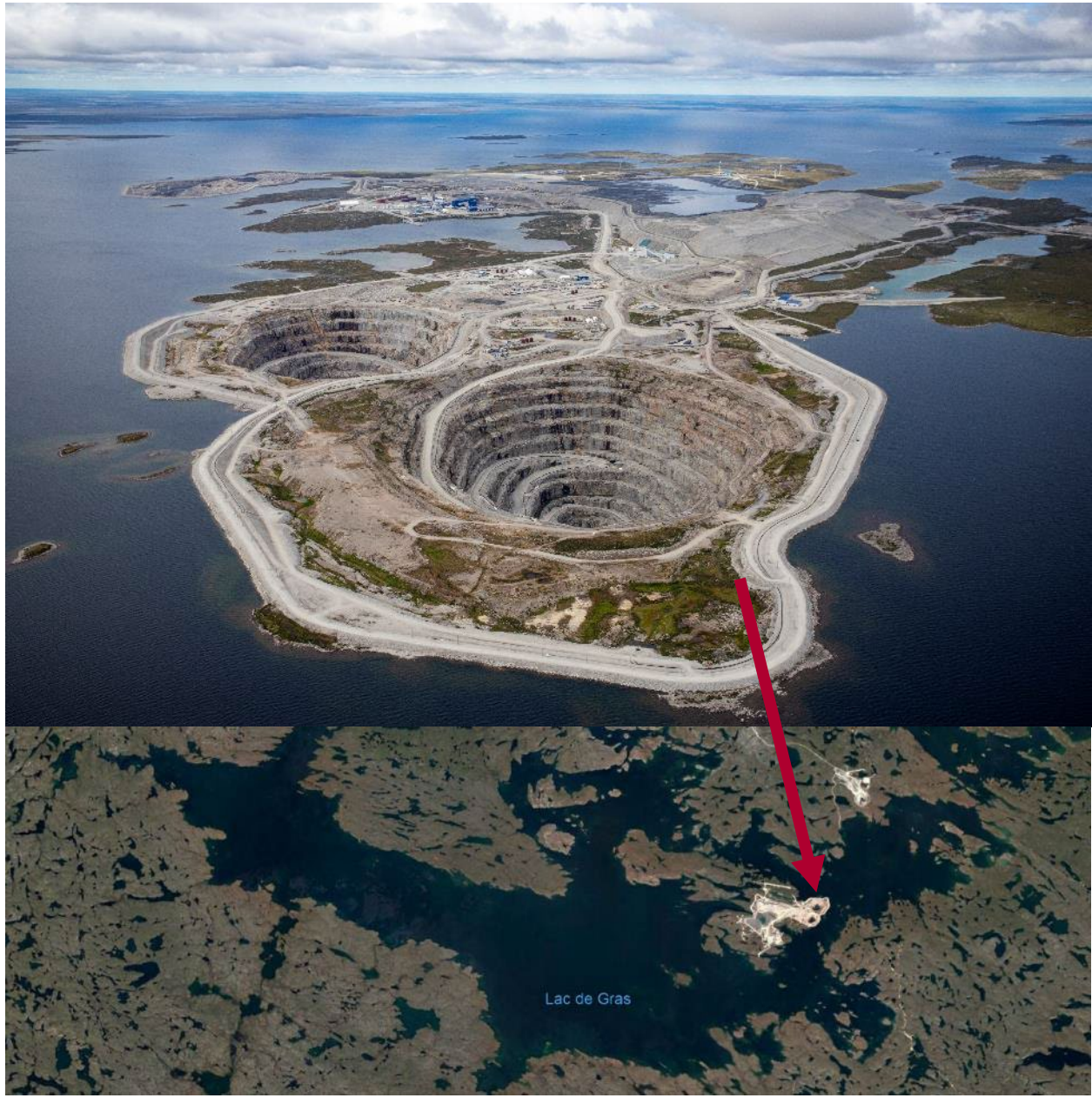
# Frame Lake Rehabilitation Project

City of Yellowknife – Council meeting

27 May 2024

# Project overview

- When Diavik was constructed, we dewatered small portions of Lac de Gras (~1%) for our dikes in accordance with our authorization and permitting, which resulted in a loss of fish habitat.
- Diavik has a Fisheries Authorization that requires compensation for the lost habitat.
- Diavik plans to rehabilitate Frame Lake to replace some of the lost habitat in Lac de Gras.
- Diavik has completed other compensation work around Lac de Gras and plans to restore the water in the pits at closure.
- Diavik has done years of engagement and preparation and has facilitated research to support the project.



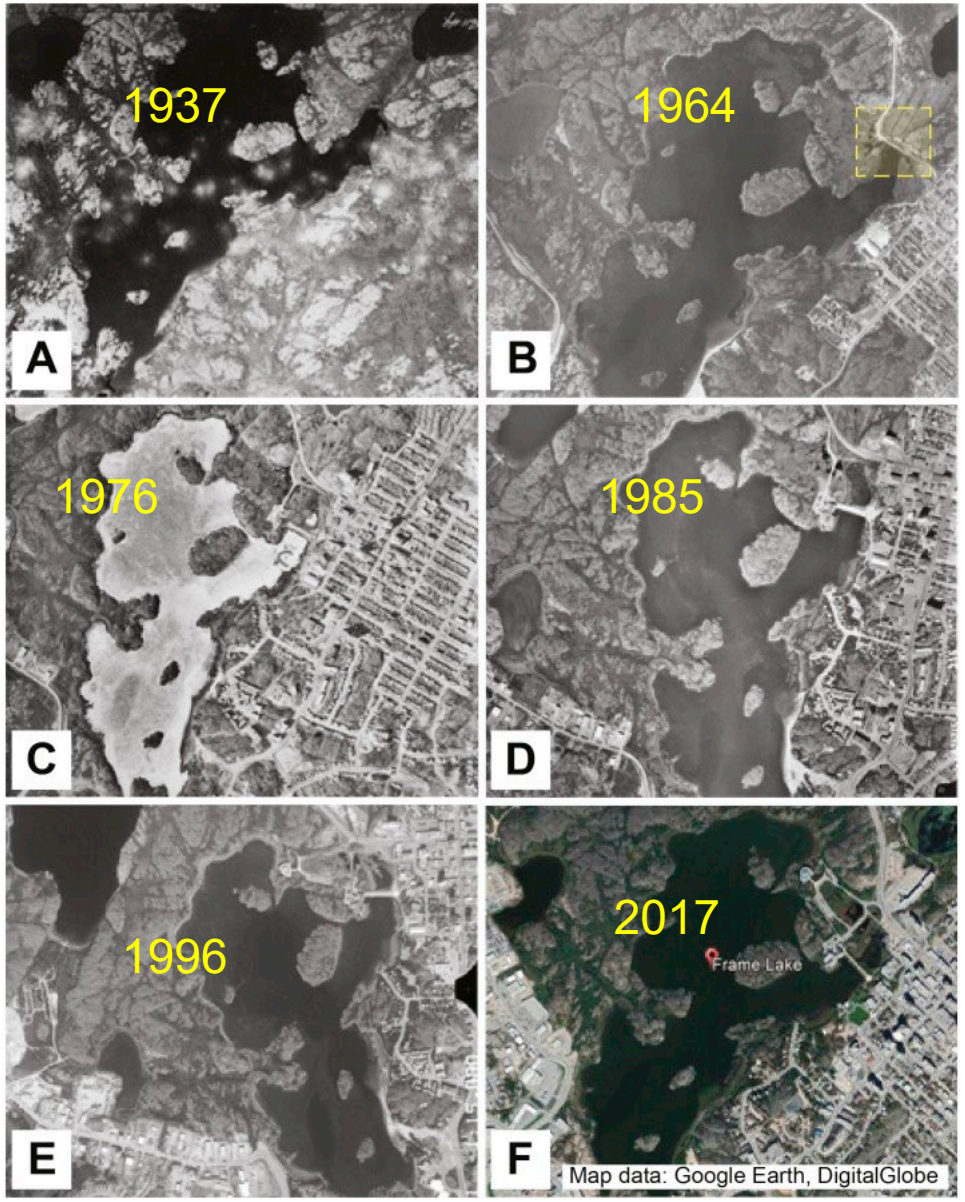
# Frame Lake historical context

- Located in the heart of Yellowknife, with City Hall and the NWT Legislative Assembly on its shore.
- Traditional Knowledge suggests that the Dené fished the lake prior to European settlement.
- McNiven Beach used to be a desirable place for recreation.
- Frame Lake has been degraded by pollution and changes in its drainage, leading to an increase in algae, low oxygen levels, and fish loss.
- This project is intended to increase fish habitat within the City of Yellowknife.

Recreational use of McNiven Beach on Frame Lake in a 1967 photo by Ted Grant. NWT Archives/Northwest Territories. Dept. of Information fonds/G-1979-023: 0146.

# Frame Lake historical context: degradation

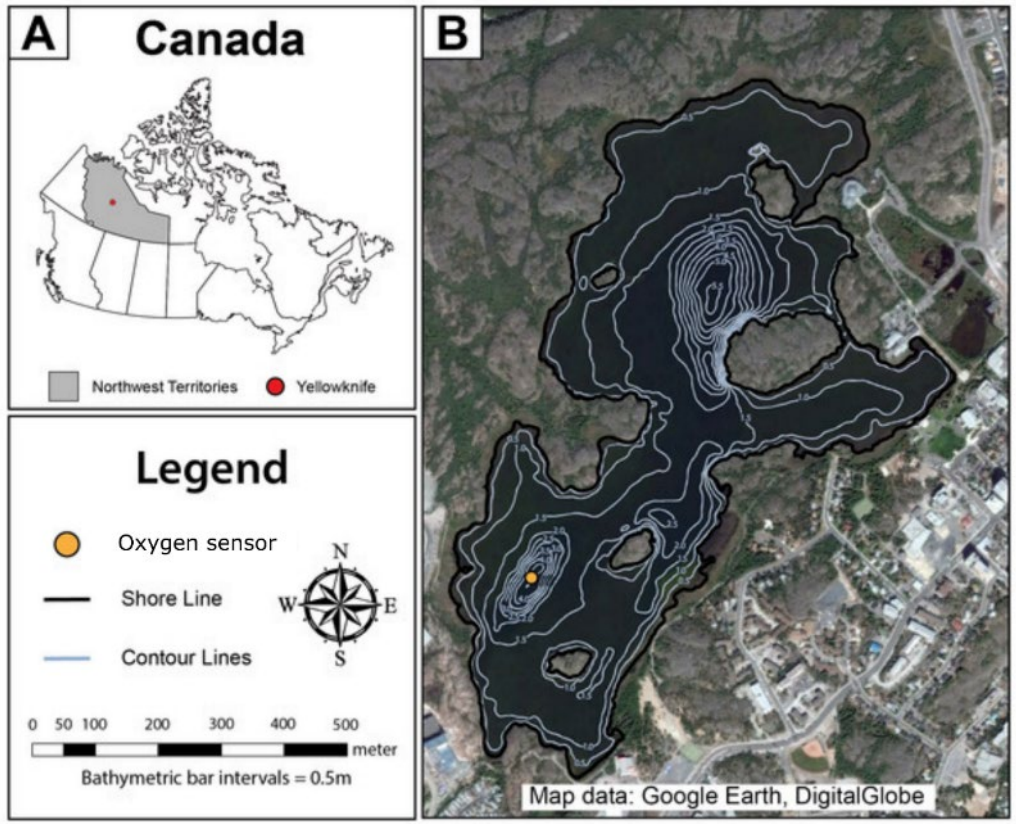
- Arsenic deposition as sediments from airborne gold mining emissions.
- Storm sewer system was installed which diverted runoff that would have reached the lake.
- Construction of a causeway that disrupted outflow, road infrastructure that disrupted inflow.
- Increased residential use around the lake over time.
- Surface runoff of poor quality from urbanized areas around the lake.



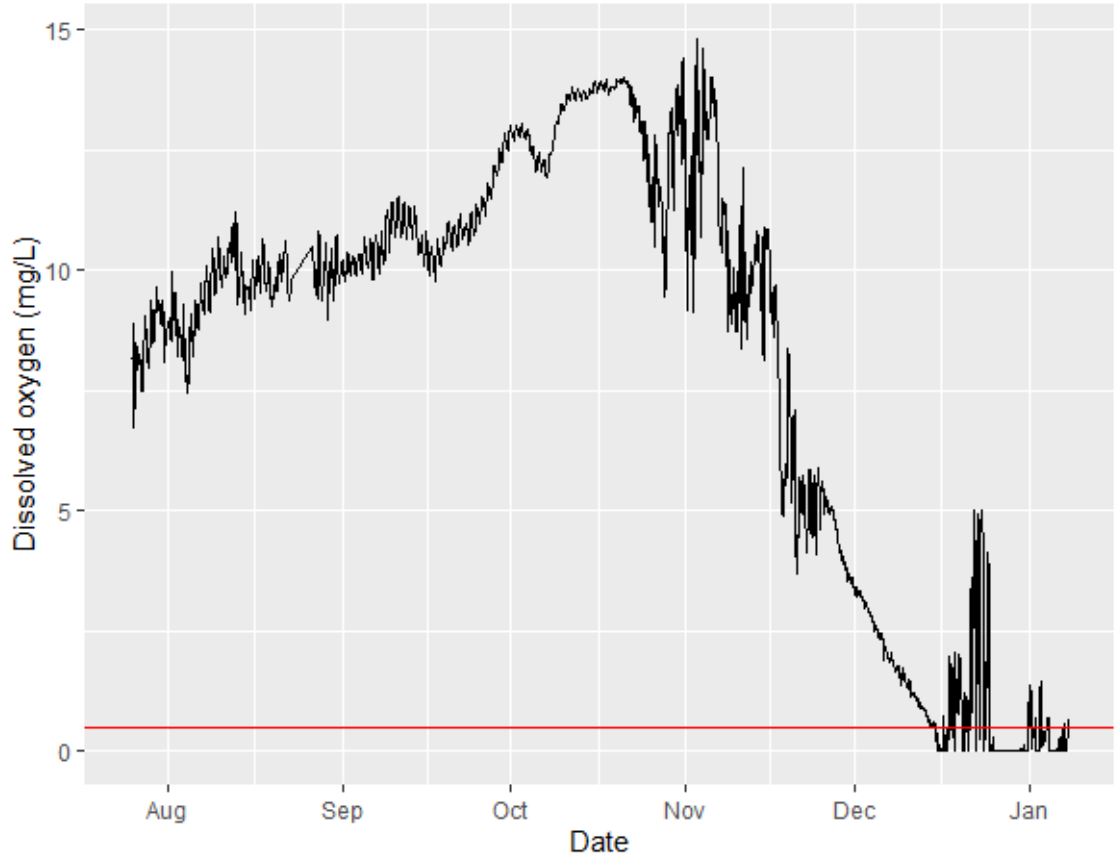

Gavel et al. 2018

# Frame Lake's oxygen levels

Every year the oxygen levels in Frame Lake decrease to zero, meaning no fish can survive.




Surface area: 84 ha
Maximum depth: 5.5 m




Winter 2019 – baseline

# Potential solutions explored

## Dredging ✗

- Dredging could be a more permanent solution.
- However, significant concerns with dredging due to legacy arsenic contamination.
- Cost is likely very high for dredging alone.
- Sediment disposal concerns, resuspension concerns.

## Increasing flow ✗

- Increasing flow rate would likely reduce residence time (decreasing the time that the water stays in the lake) and reduce problems with eutrophication (the richness of nutrients).
- Engineering complexity and construction costs to reconnect inflows/outflows likely significant.

## Aeration ✓

- May allow oxygen levels to remain high enough to prevent winterkill.
- May help reduce nutrient concentrations in the water and enhance decomposition of organics in sediment.
- Better value.

# How aeration works

**Tibean ICE Unit**

- Oxygenates deep water without creating open water during the winter.
- Outlet produces horizontal flow.
- The oxygenated water would provide a refuge for fish over winter.
- Potential to increase aerobic microbial activity, enhancing the breakdown of organic material and eventually reducing the draw-down of oxygen levels in winter.


**Individual parts**

Left:

1 - Floating tanks
2 - Upstream pipe (Telescope)
3 - Degassing chamber
4 - Mixing device
5 - Suction fence
6 - Covering fence
7 - Downstream pipe
8 - Oxygen input
9 - Submersible pump with ejector
10 - Main ballast tanks

Right:

TIBEAN Basic III Ice

# Monitoring, lake impact, safety

- Once installed, Great Slave Snowmobile Association will communicate with membership about the device, which will have a strobe light beacon on top.
- Device will protrude roughly 1 metre above the ice.
- WSP will do sampling / monitoring work on the project, with research assistance by U of Waterloo, Wilfrid Laurier U on a defined schedule.
- A chemical analysis of water quality will be done each season (four times per year), sediment quality and benthic invertebrates will be sampled during the fall after the first year of operations, under ice dissolved oxygen testing will be done monthly during ice cover for two years.
- Maintenance for Phase 1 contracted to Det'on Cho Nahanni Construction Ltd.
- Project lessons learned could inform rehabilitation of other lakes with similar human induced oxygen limitations.

# Project milestones

**Improve aquatic environment in Frame Lake such that it is suitable to sustain fish populations**

**Reintroduce native fish species**

**Achieve a level of success that is supported by long-term commitment to rehabilitation by stakeholders**

Two years

- Install aerator
- Monitor nutrients, metals, dissolved organic and inorganic carbon, major ions, and chlorophyll *a*
- Monitor zooplankton, macroinvertebrates and sediments

Two years

- Northern pike, ninespine stickleback, walleye, lake chub are possibilities
- Possible translocation using non-harmful methods such as fyke nets: fish transported from nearby lakes
- Work with DFO on licensing, animal sources, animal welfare, release plans, and monitoring

Ongoing after monitoring results

- Identify long-term partner(s) with interest in on-going rehabilitation
- Hand over maintenance, monitoring responsibilities
- Mark successes in research and community impact

# Next steps

**Summer 2024**

- Installation planned for **Tuesday, 4 June** at Matonabee Street
- There may be slight disruptions for a few hours while the aerator is placed into the lake
- Public awareness and device testing
- Activate device during winter months
- Begin monitoring results

**Summer 2026**

- Reintroduce fish (pending results)
- Begin further water quality and fish monitoring

**Fall 2028 and beyond**

- Handover project to partner organization to complete long term monitoring and maintenance

Rio Tinto