PIT LAKE TREATMENT AND MAINTENANCE AT LES MINES SELBAIE

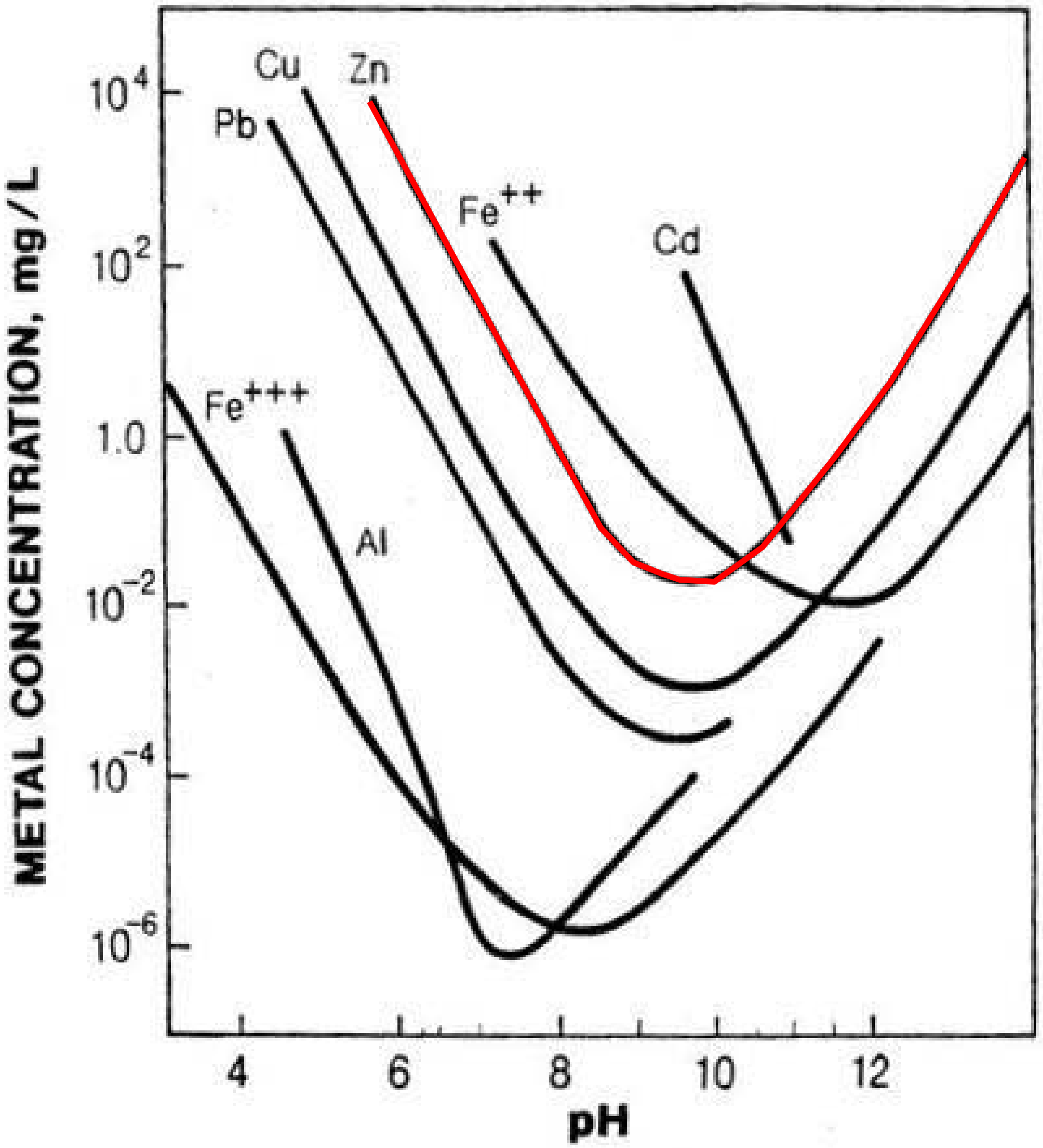
Presented by Bernard Aubé, M.A.Sc., P.Eng.
Co-authors: Denis Caron and Daniel Adam
from BHP Billiton, Les Mines Selbaie

Selbaie Problem (2005)

- 22 Mm^3 of water contained in a pit lake (closed in 2004)
- Due to deposition of contaminated wastes in the pit, 10 mg/L Zn were contained in the pit lake water
- Eventual plan is to overflow clean water from the lake when full (38 Mm^3 – 2010)
- Must meet 0.5 mg/L Zn and non-toxic

Bench Tests

- Designed to simulate scenarios:
  - Simple lime addition
  - Ferric sulphate addition
  - Mixing with other contaminated sources
  - Red Mud addition (aluminium refinery waste)
- Only lime addition discussed in detail as it was the chosen method



Metal Precipitation

EnvirAubé

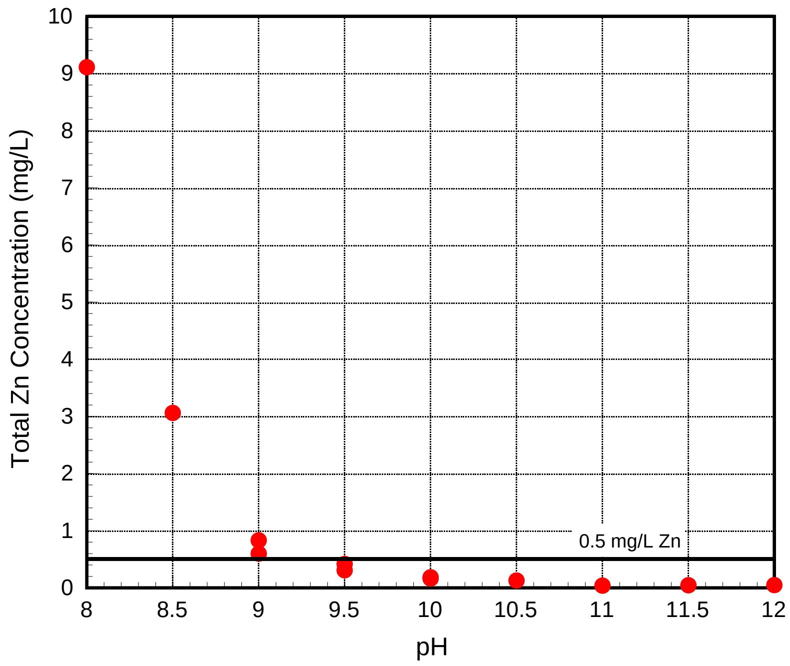
Test Methods

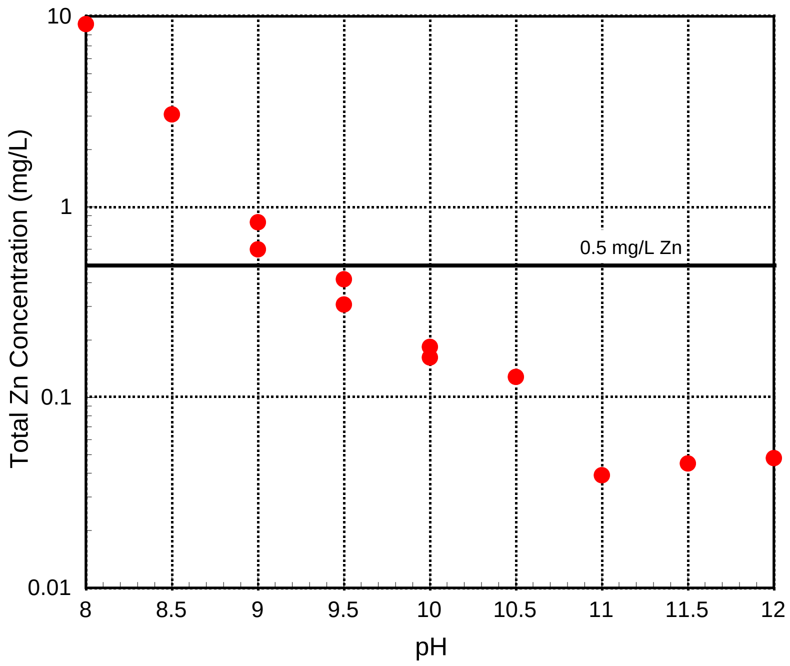
- Pit Lake Water collected
- 1-L samples treated for each test to a controlled pH with or without other additives
- Samples taken after 24 hours of settling (filtered and unfiltered), for Zn and some for all metals

Lime Addition Tests

Straight Lime Addition

Zn Results from Bench Tests

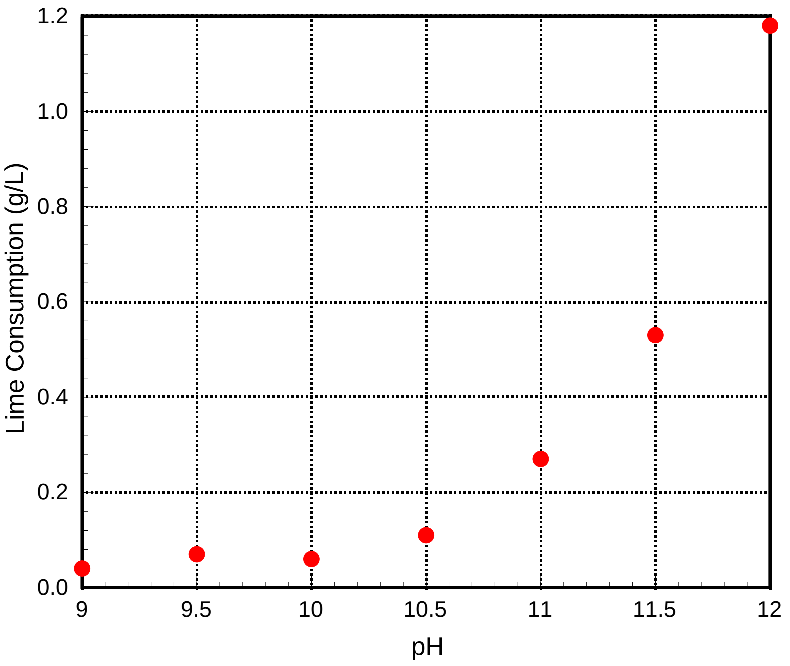


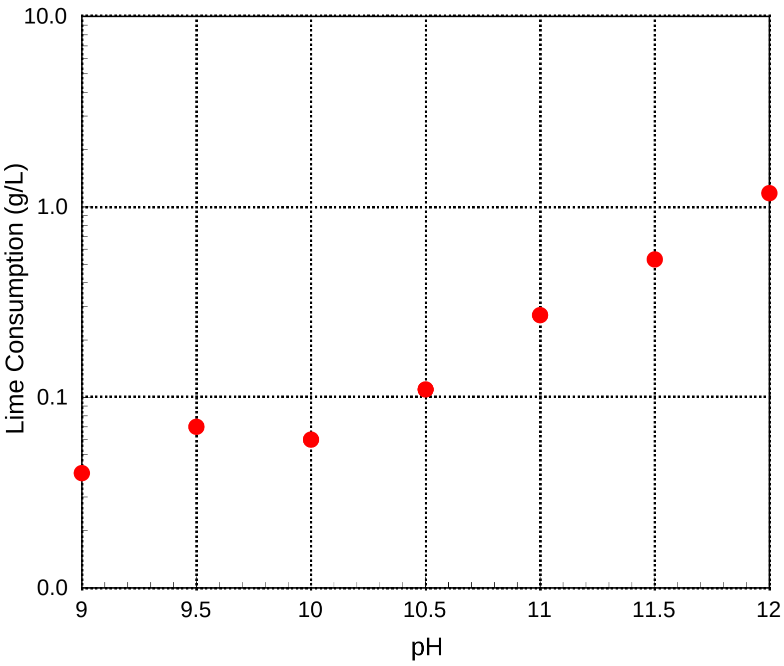


EnvirAubé

Straight Lime Addition

Lime Consumption Results from Bench Tests



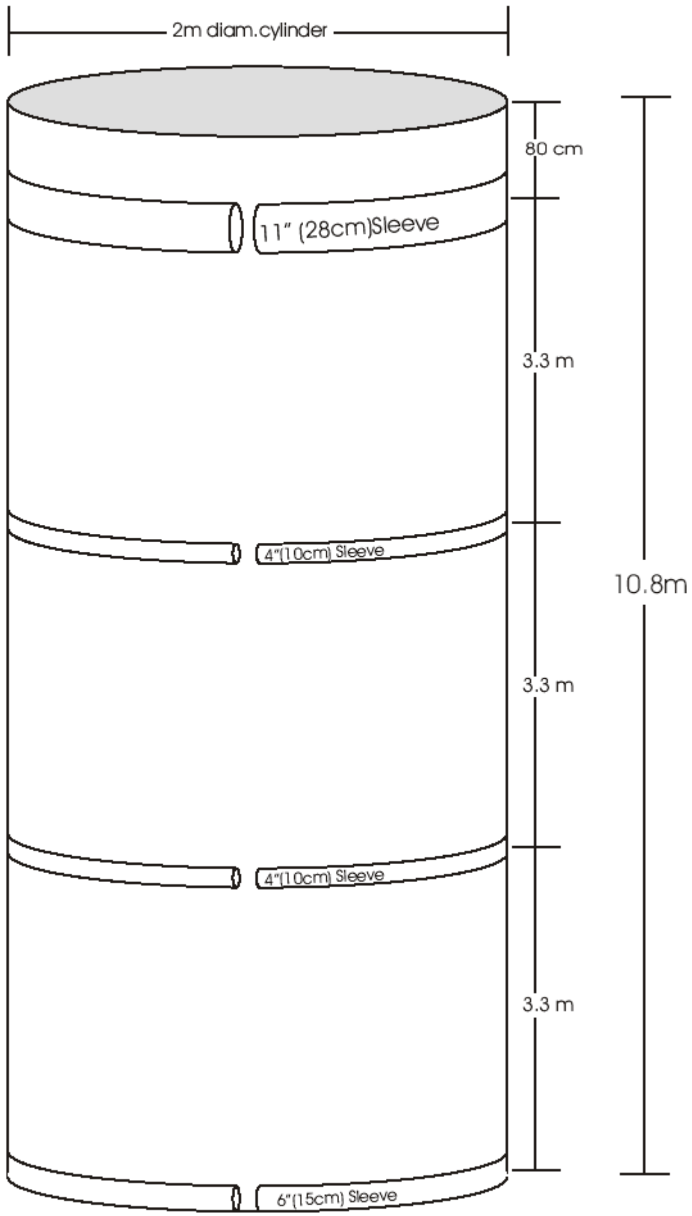


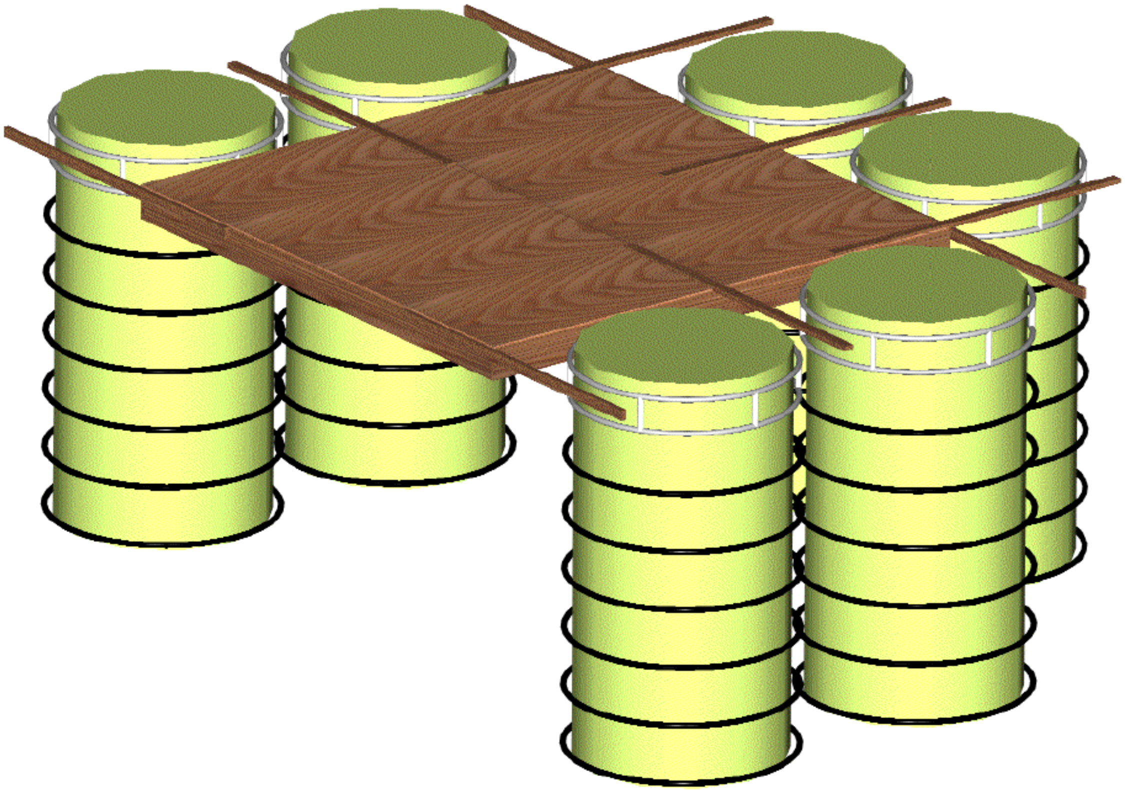
EnvirAubé

Straight Lime Addition

- pH 9.5:
  - Total Zn about 0.37 mg/L
- pH 10.0
  - Total Zn about 0.17 mg/L
  - Lime consumption 0.06 mg/L (use 0.08 g/L to be conservative)
  - Chosen as Benchmark test for straight lime addition

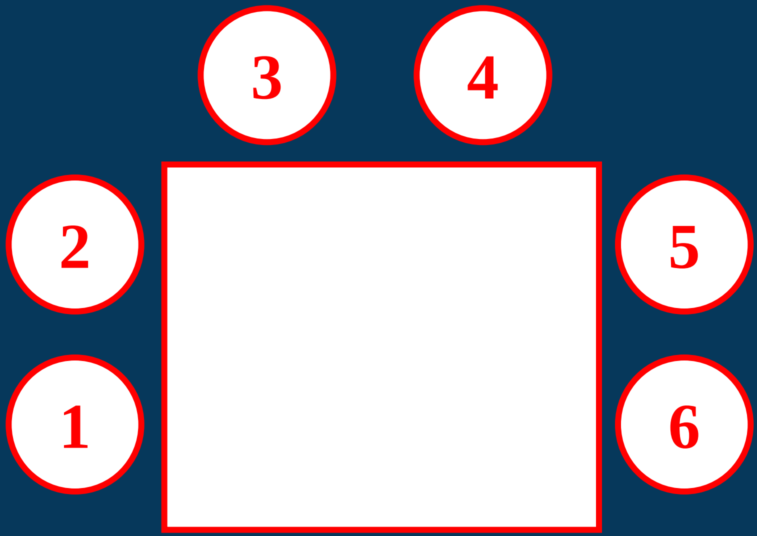
Limnocorrals





EnvirAubé

Limnocorrals



- **Different tests completed with lime, including recirculation and surface treatment**
- **Additives (Red Mud, algae and fertiliser) also tested but proved unnecessary**

Limnocorrals

Recirculation Test

Limnocorral Conclusions

- Treatment to pH 10 or more works as predicted by lab (pH 9.5 insufficient)
- You cannot treat and release only from top layer of the pit as the natural mixing between layers will contaminate the surface water

Pit Treatment

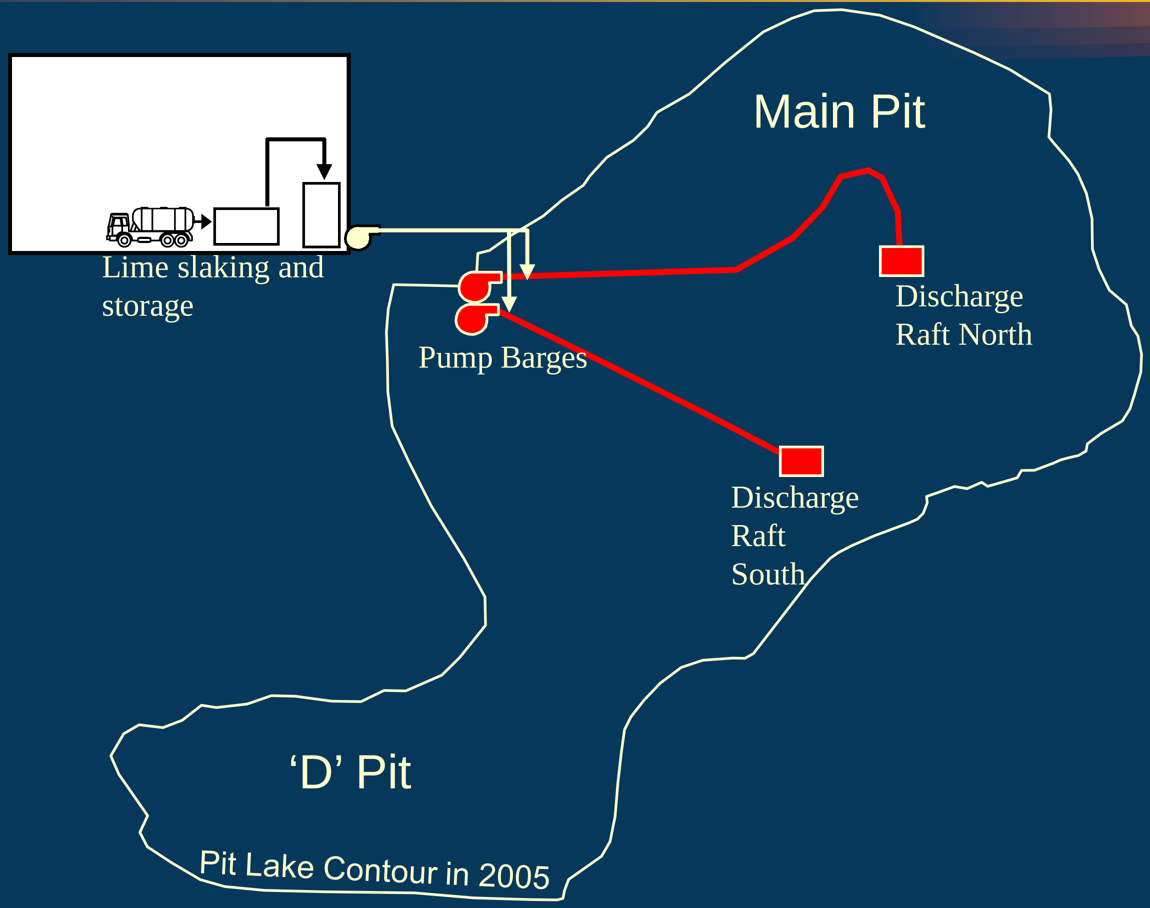
- Started September 14th, ended November 5th 2005
- 2000 tonnes of quicklime injected
- pH increased to about 10
- Zn concentrations taken from ~10 mg/L to less than 0.2 mg/L

Pit Treatment

Cross-section

Pit Treatment

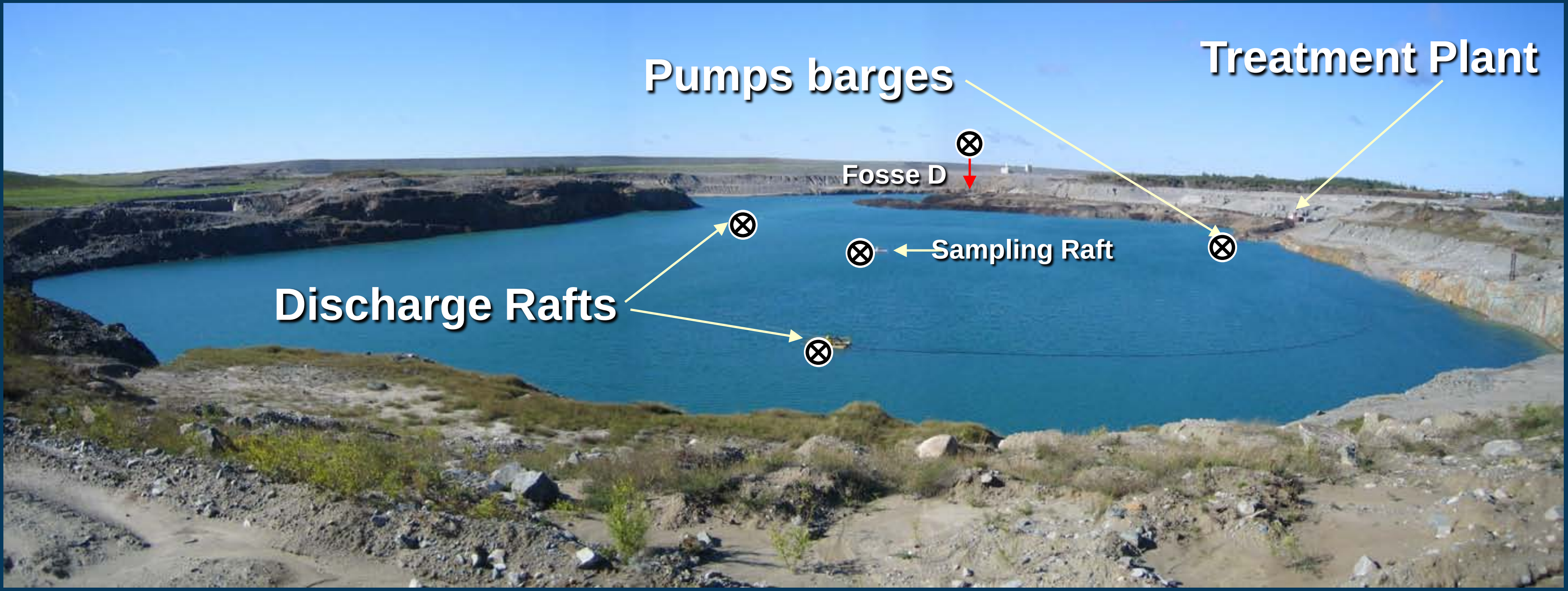
Plan View



EnvirAubé

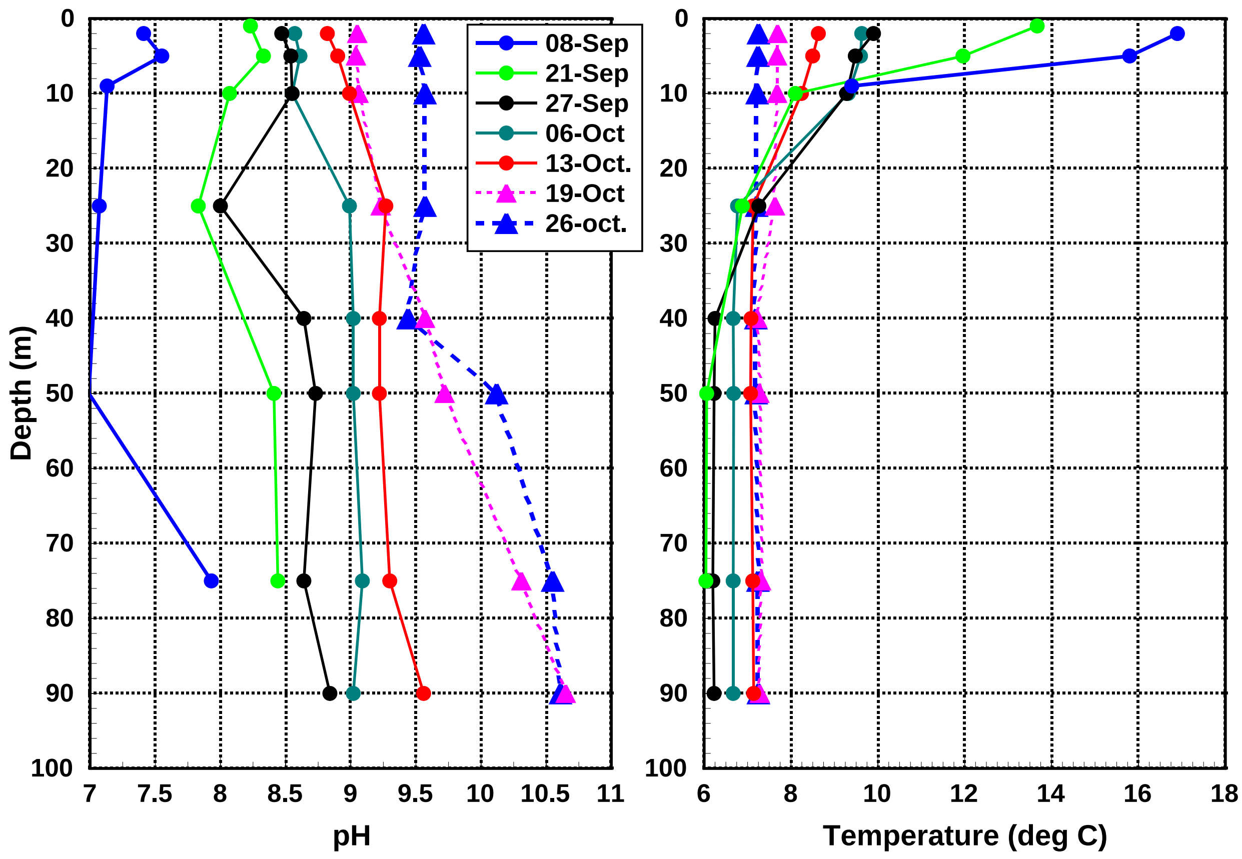
Portable Slaker & Storage Tank

Pit Profile Locations



⊗ – **Sampling locations**

Main Pit Profiles (2005)

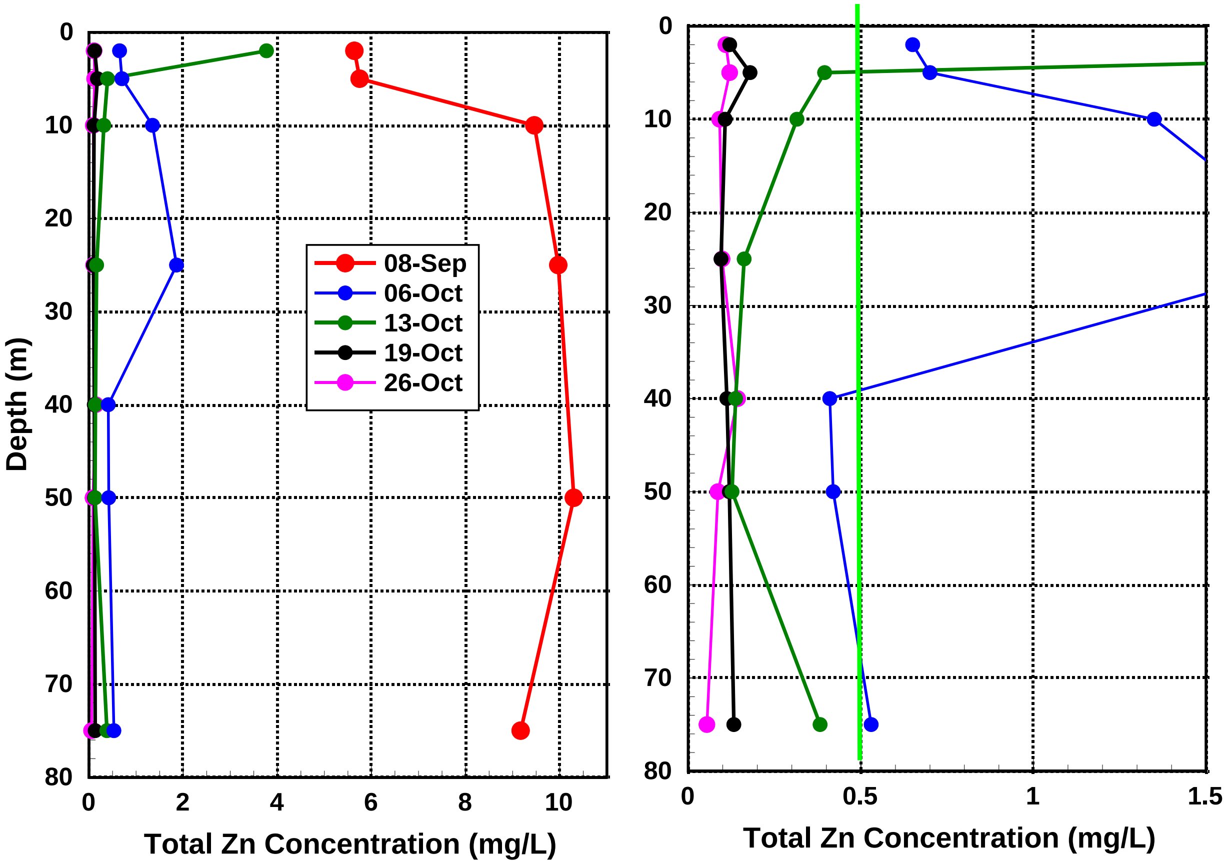


Pit Profiles

- Last profile 10 days before end of treatment
- Last measured temperature profile without significant gradient

EnvirAubé

Pit Zn Profiles (2005)

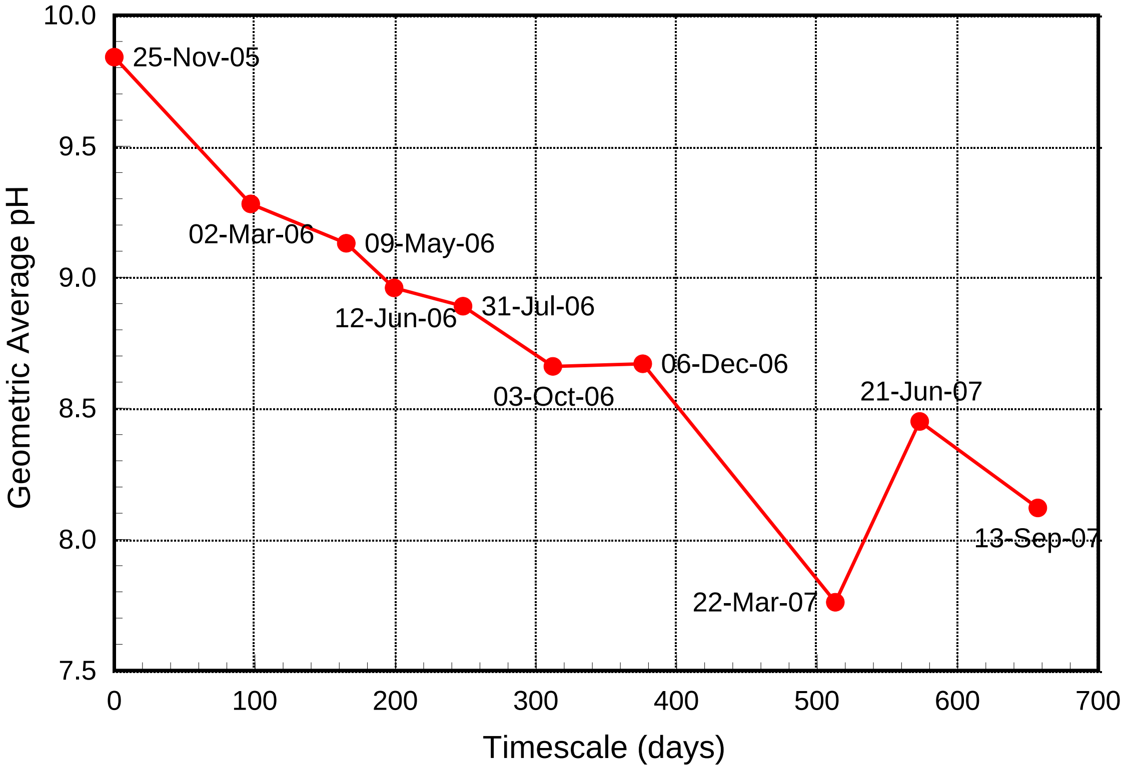


Limno Zn Profiles

- Zn Concentrations below 0.2 mg/L target at all depths before end of treatment

EnvirAubé

Average pH Since Treatment

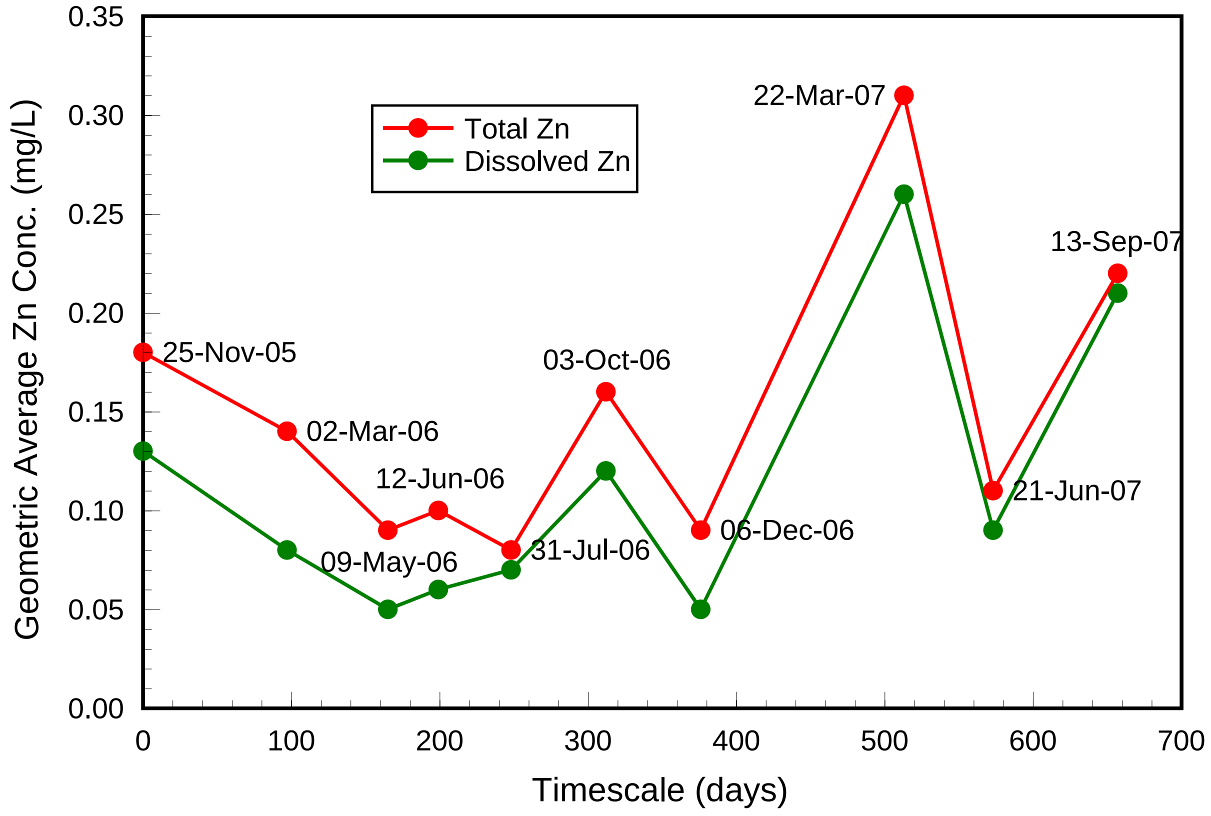


Post-Treatment pH

- Nov. 25 (20 days after treatment) – perfectly mixed, pH 9.83
- pH continues to decrease when treatment plant not in operation
- pH either maintained or increased when liming

EnvirAubé

Average Zn Since Treatment

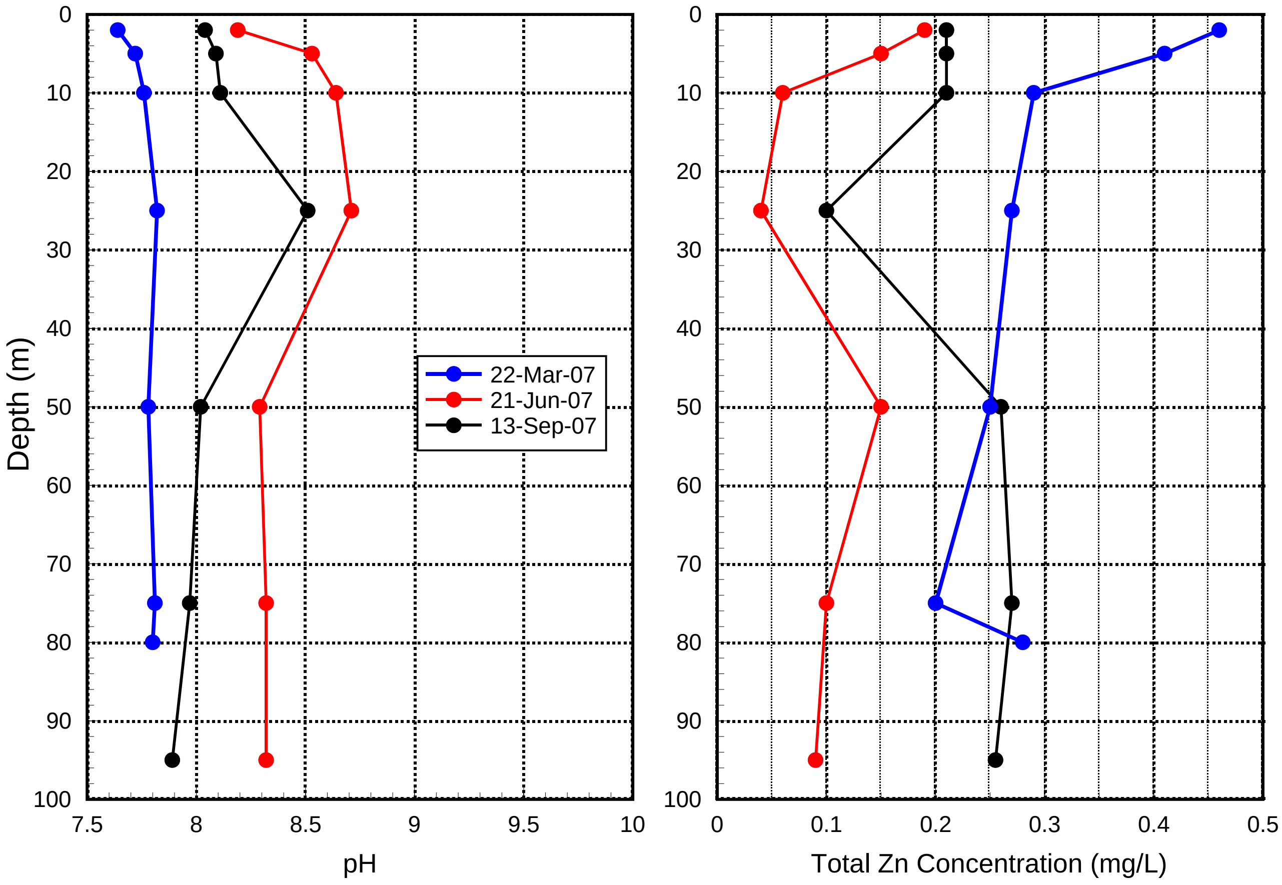


Post-Treatment Zn

- Initial decrease in winter
- Loadings increase when plant is not operating
- Major source is likely contaminated wastes
- Results from this spring clearly show that significant lime addition during runoff helps to control Zn concentrations

EnvirAubé

Pit Profiles in 2007



- The pH was low prior to spring thaw - lime added during runoff increased pH significantly
- Zn concentrations decreased at surface to less than 0.2 mg/L
- Untreated runoff and acidity from wastes decreased pH over summer

EnvirAubé

Pit Treatment

- pH increased in line with predictions
- Zn and Cd treatment met predictions
- 2000 t CaO was the right target
- Pit Treatment System a Success!!
- Maintaining high pH and low Zn concentrations appear feasible
- Zn loads from contaminated wastes should abate once completely submerged (2008)