Les Mines Selbaie
Zinc Removal from Pit Lake

Laboratory
Limnocorrals
Batch Pit Treatment

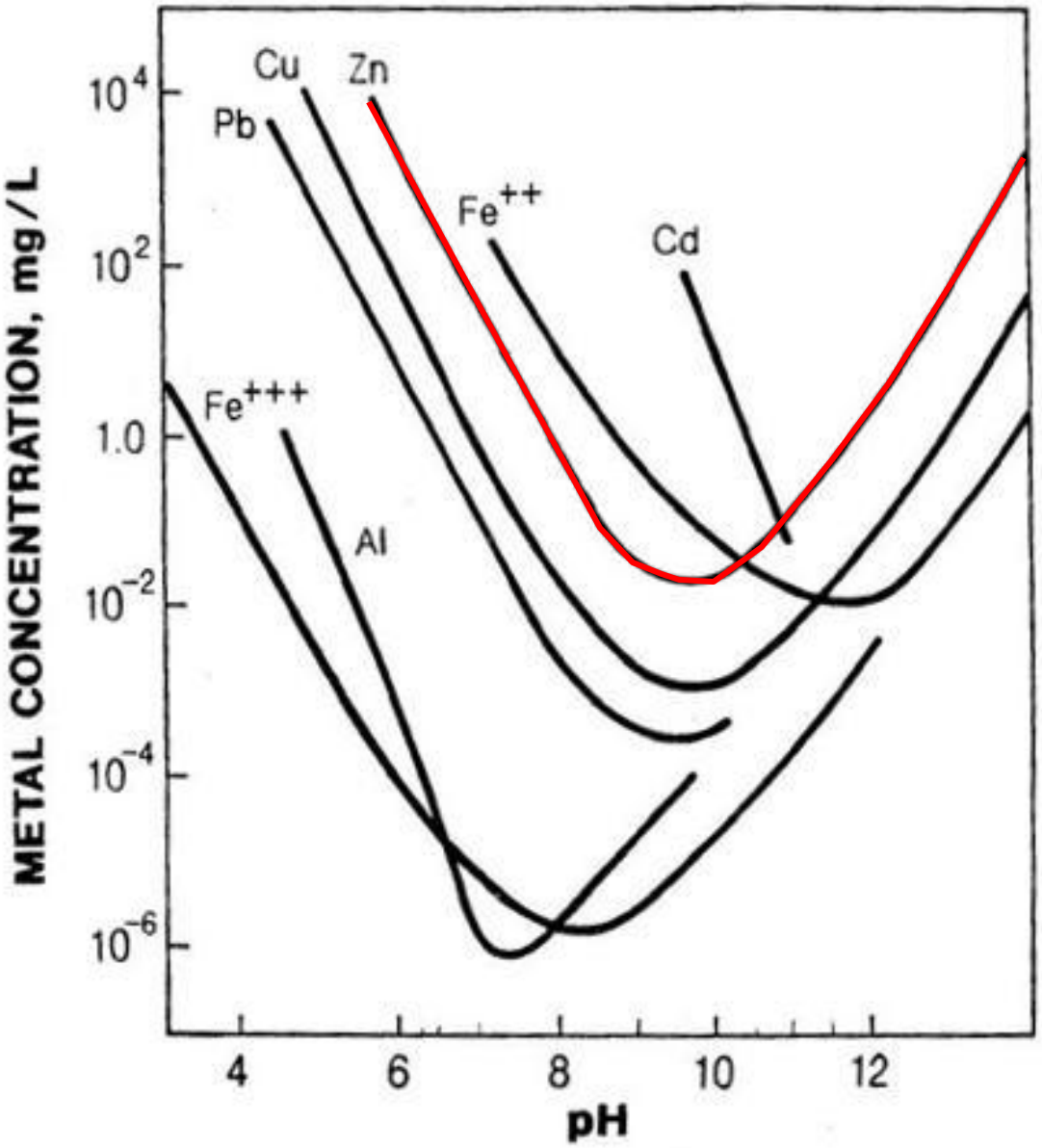
Bernie Aubé

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)
- 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 sources prior to liming
  - Red Mud addition (aluminium refinery waste)
- Only lime addition discussed in detail as it was the chosen method



Metal Precipitation

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Lime Addition Tests

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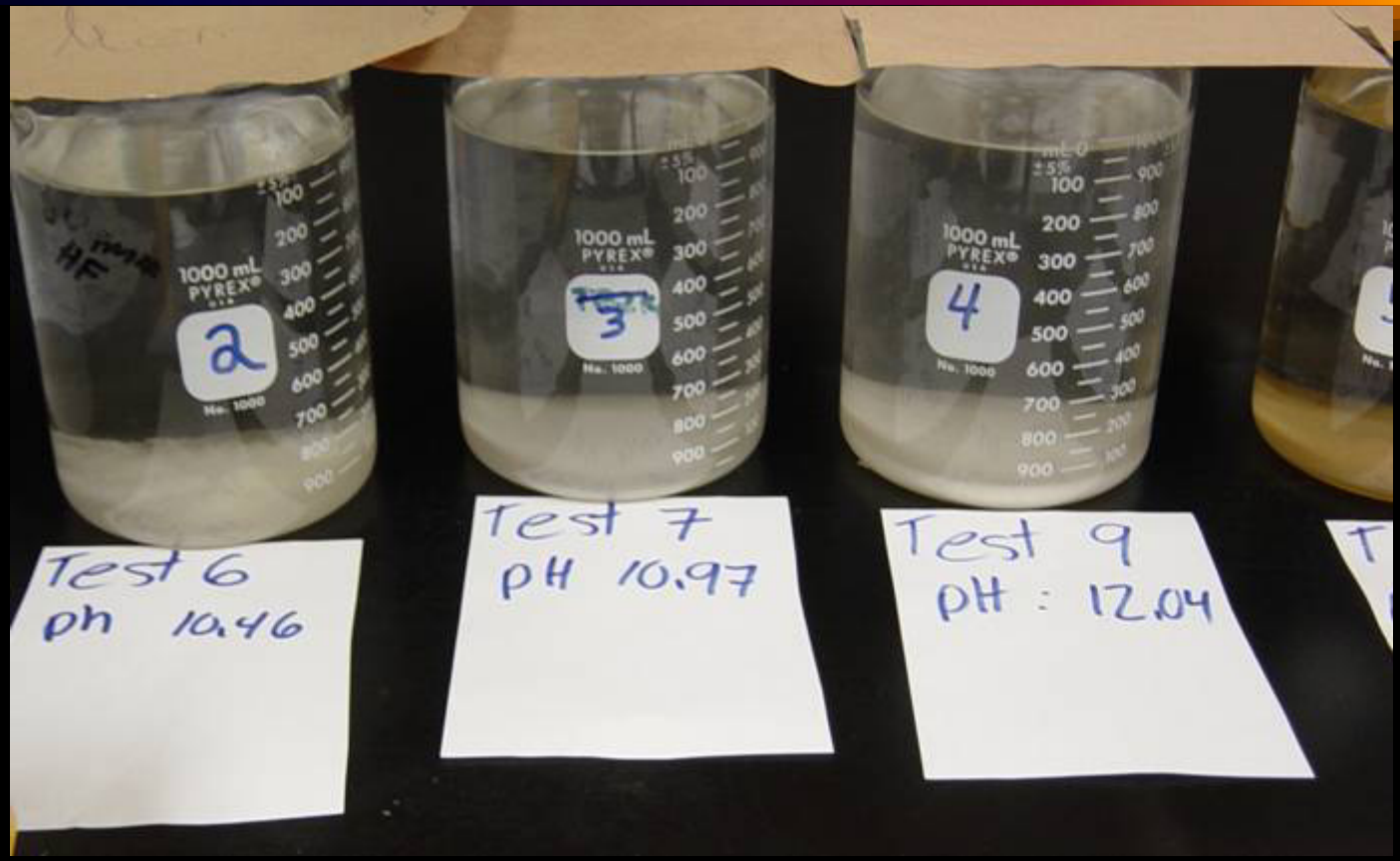
Lime Addition Tests



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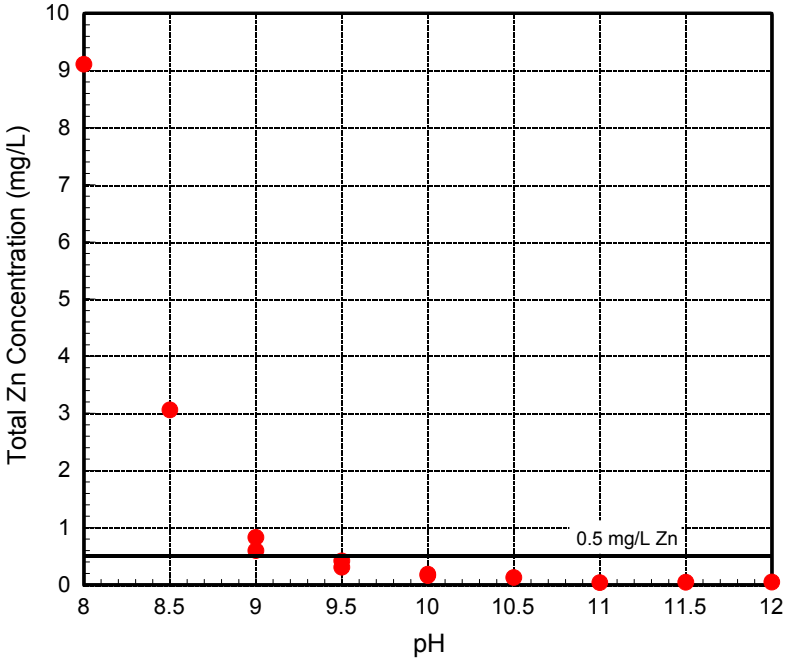
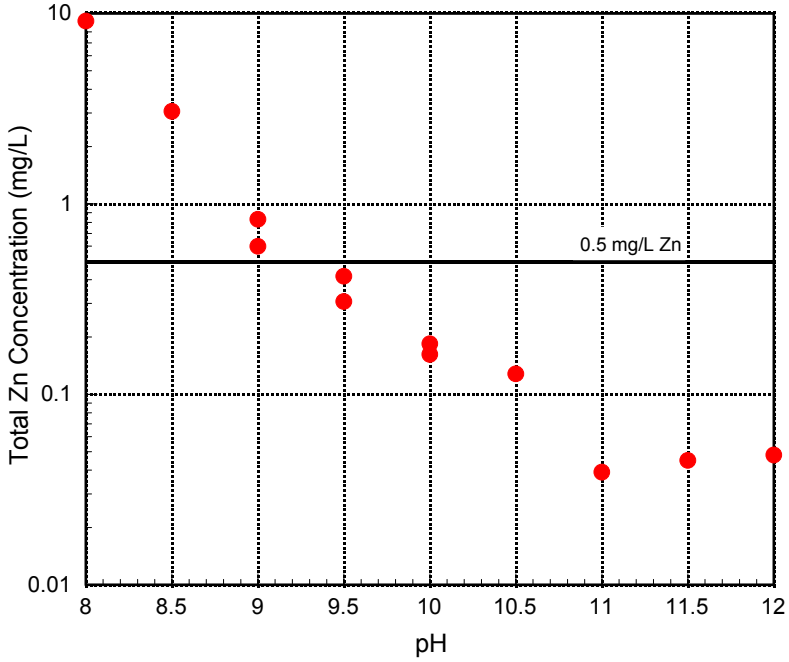
Straight Lime Addition

Results from Bench Tests





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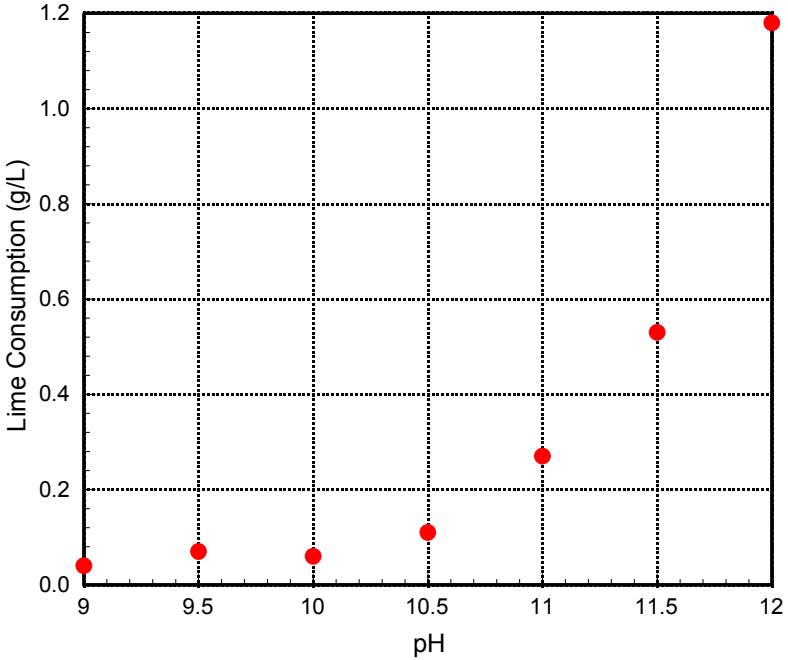
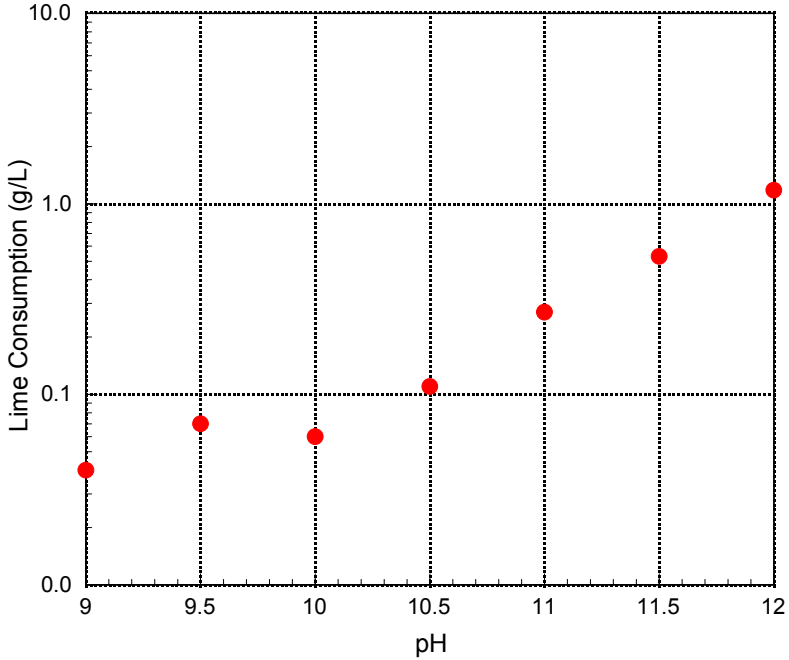
Straight Lime Addition

Lime Consumption Results from Bench Tests





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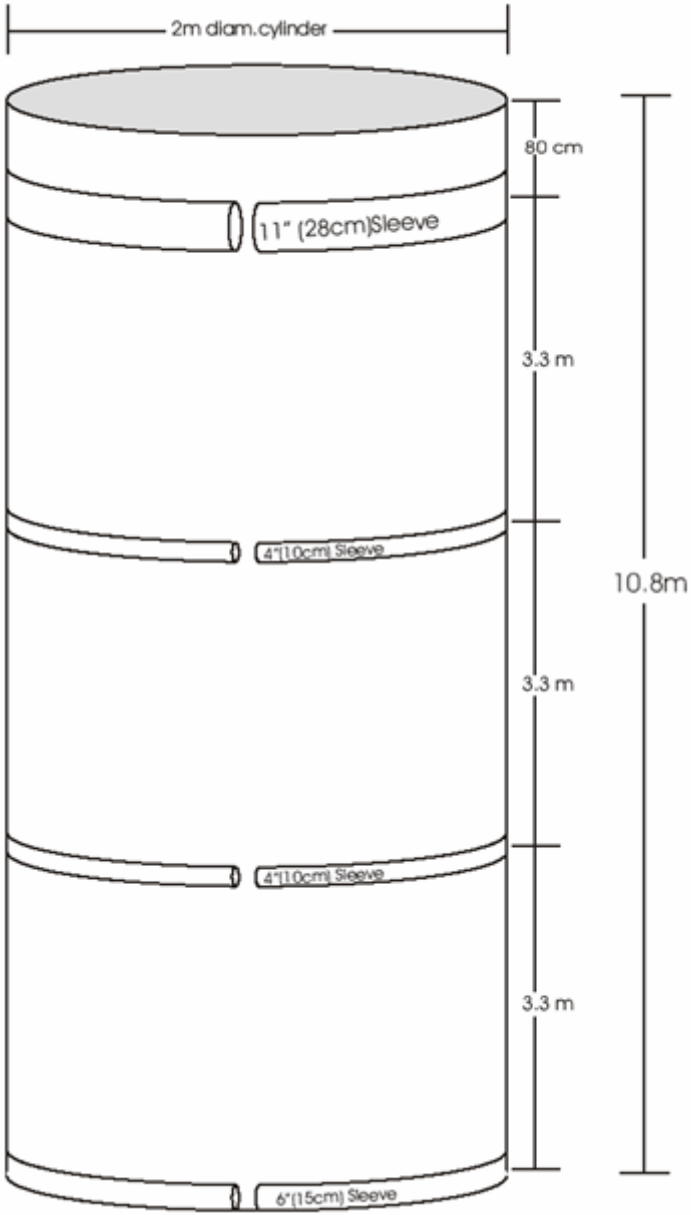
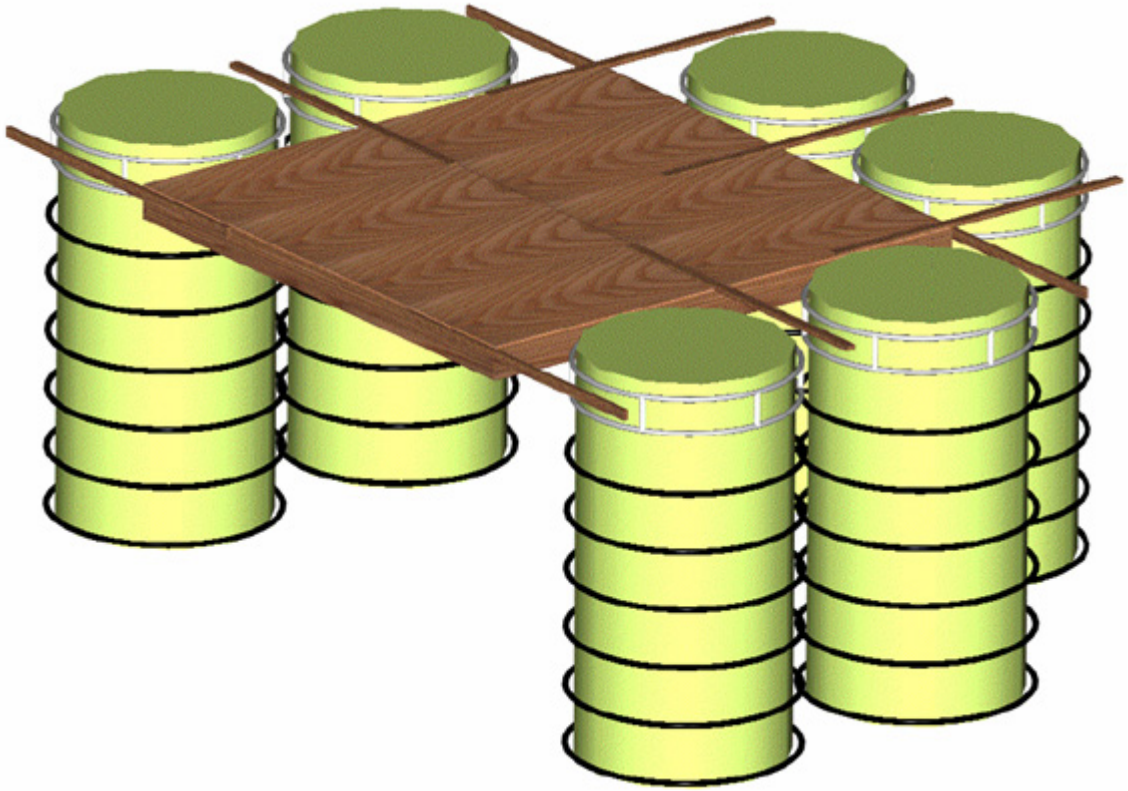
Straight Lime Addition

- 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





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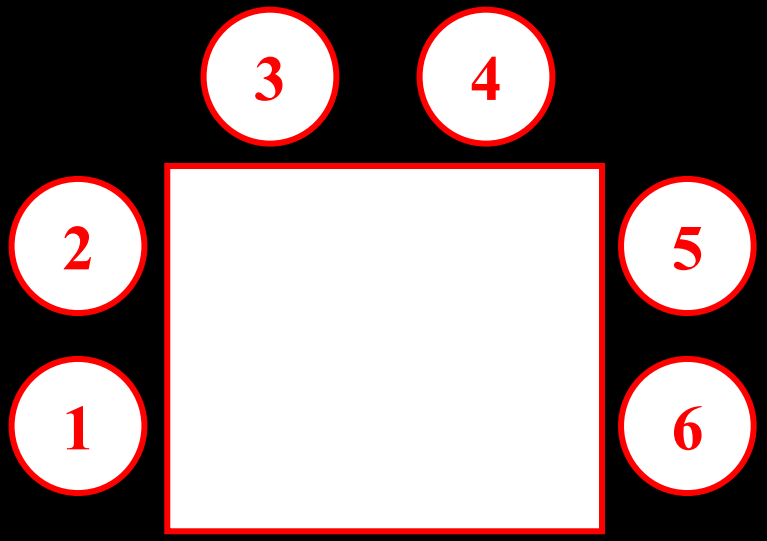
Limnocorrals



1. pH 10.7 at surface
2. Recirc. – suction at 7.5 m depth
3. Recirc. – injection at 9 m depth
4. Control
5. pH 9.5 at surface – Red Mud addition
6. pH 9.5 at surface – biological test

Limnocorrals

Recirculation Test

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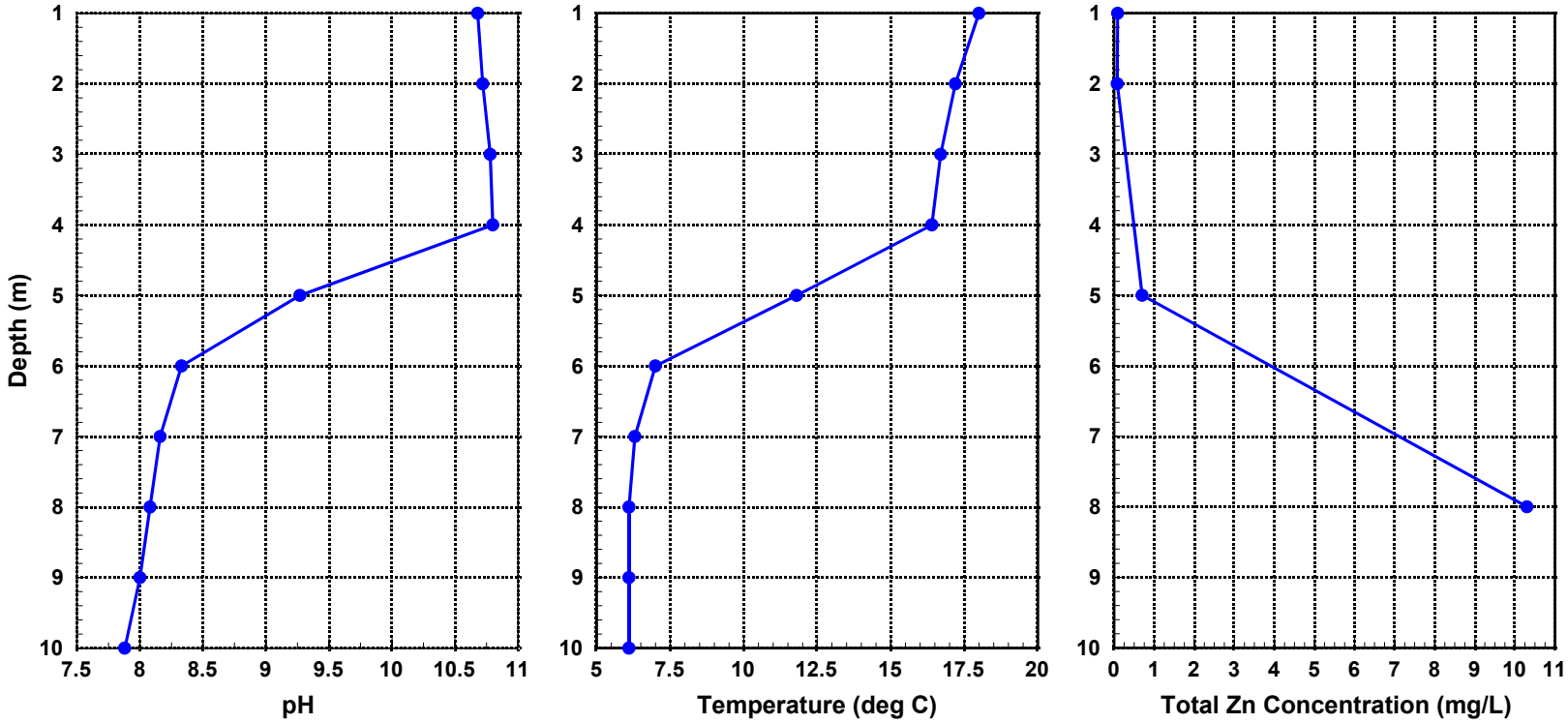
Initial Treatment Results

Limno 1



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Limnocorral Results

- Treatment to pH 10 or more works as evidenced by 2 limnocorrals
- Treatment to pH 9.5 is insufficient
- Thermocline presents a barrier to treatment
- Injection at depth does not work in a limnocorral with an open bottom – this is not a treatment conclusion, it is a test design flaw

Limnocorral Conclusions

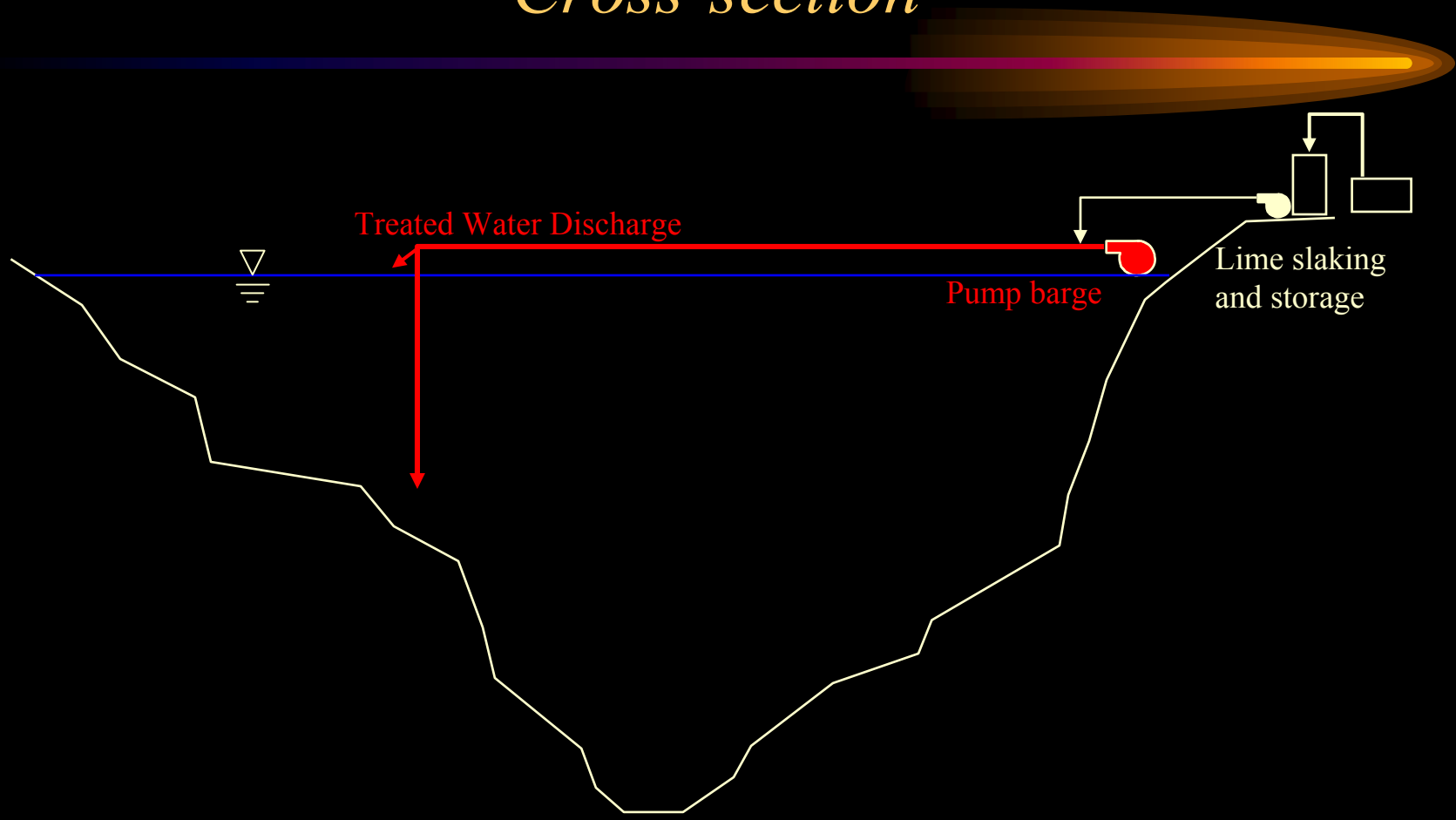
- You cannot treat and release only one layer of the pit as the thermocline presents a barrier to mixing
- Setpoint pH of 10 confirmed

Pit Treatment

- Started September 14th, ended November 5th 2005
- 2000 tonnes of quicklime injected
- pH increased to near 10 (likely higher – post treatment profiling completed late)
- Zn concentrations taken from ~10 mg/L to less than 0.2 mg/L

Pit Treatment

Cross-section



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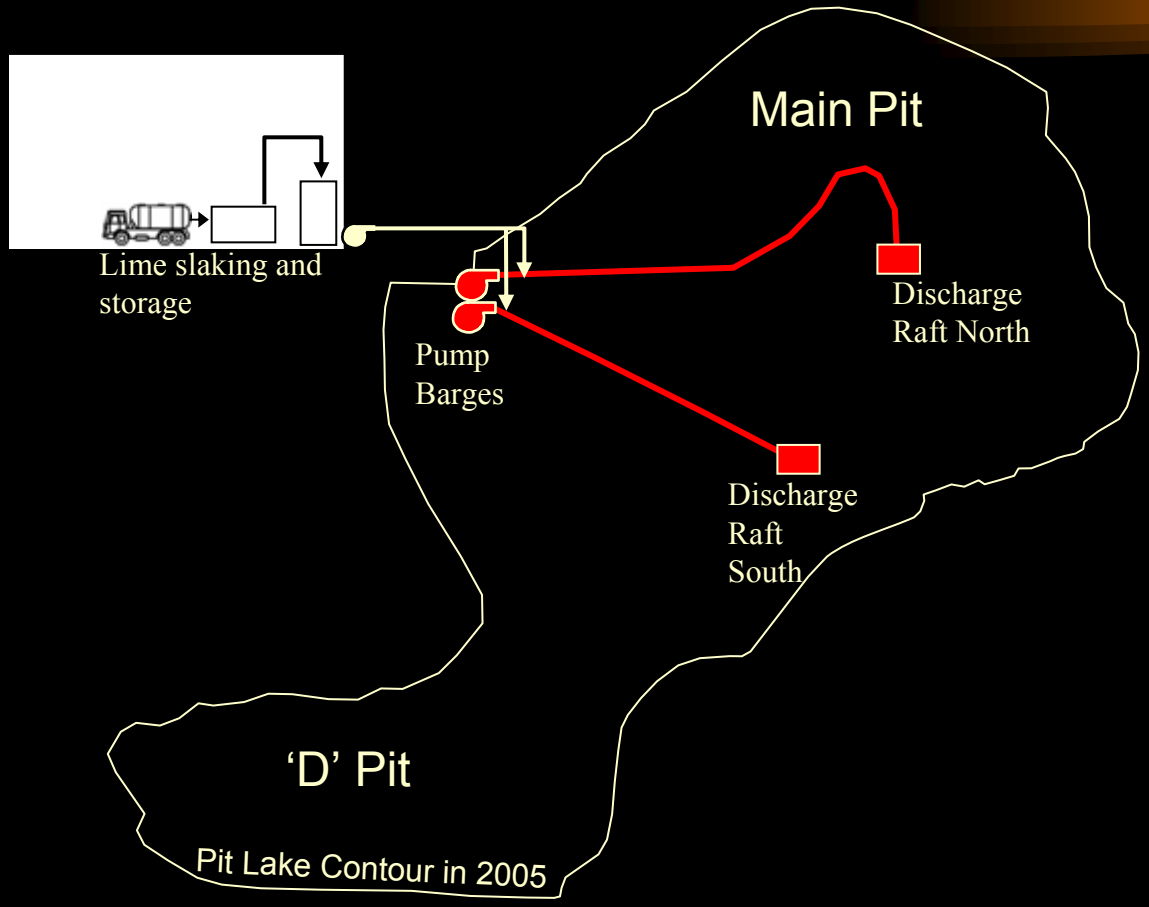
Pit Treatment

Plan View



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Portable Slaker & Storage Tank

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Pump barge & HDPE Pipes

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Steel Pipes Installation

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Diffuser Raft Location

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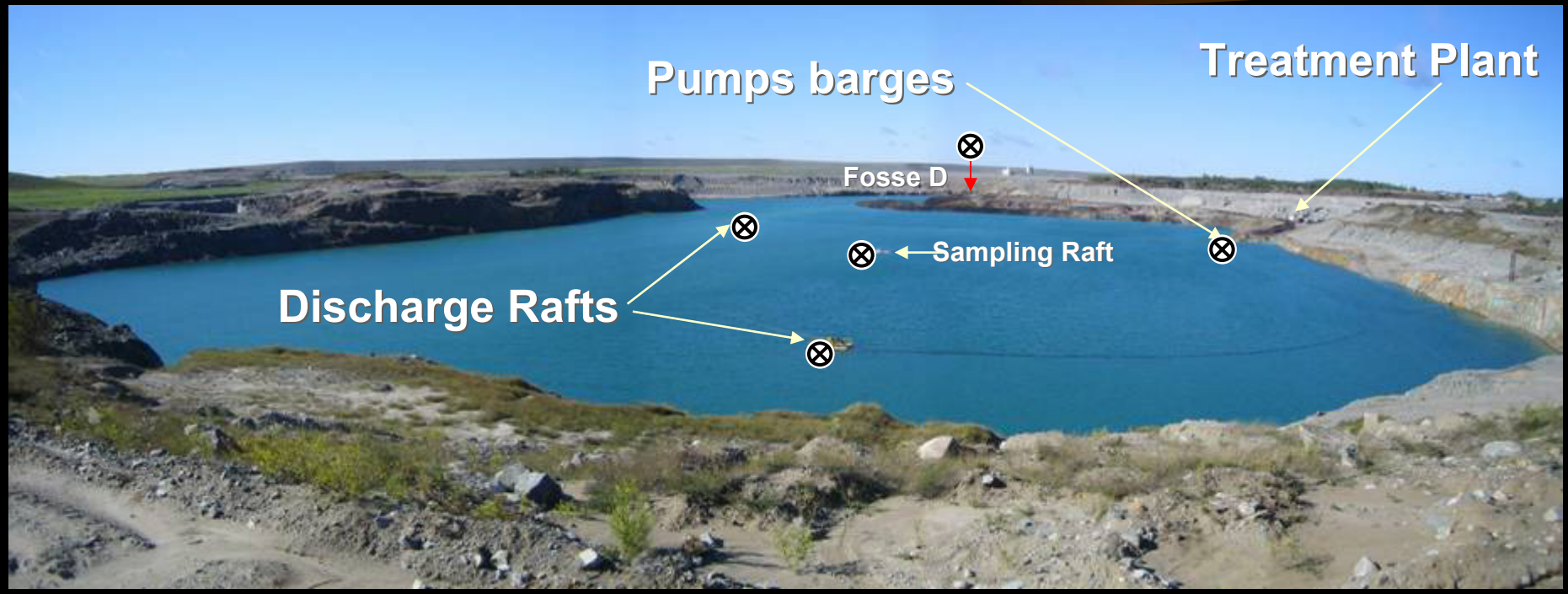
Pit Profile Locations



⊗ – Sampling locations

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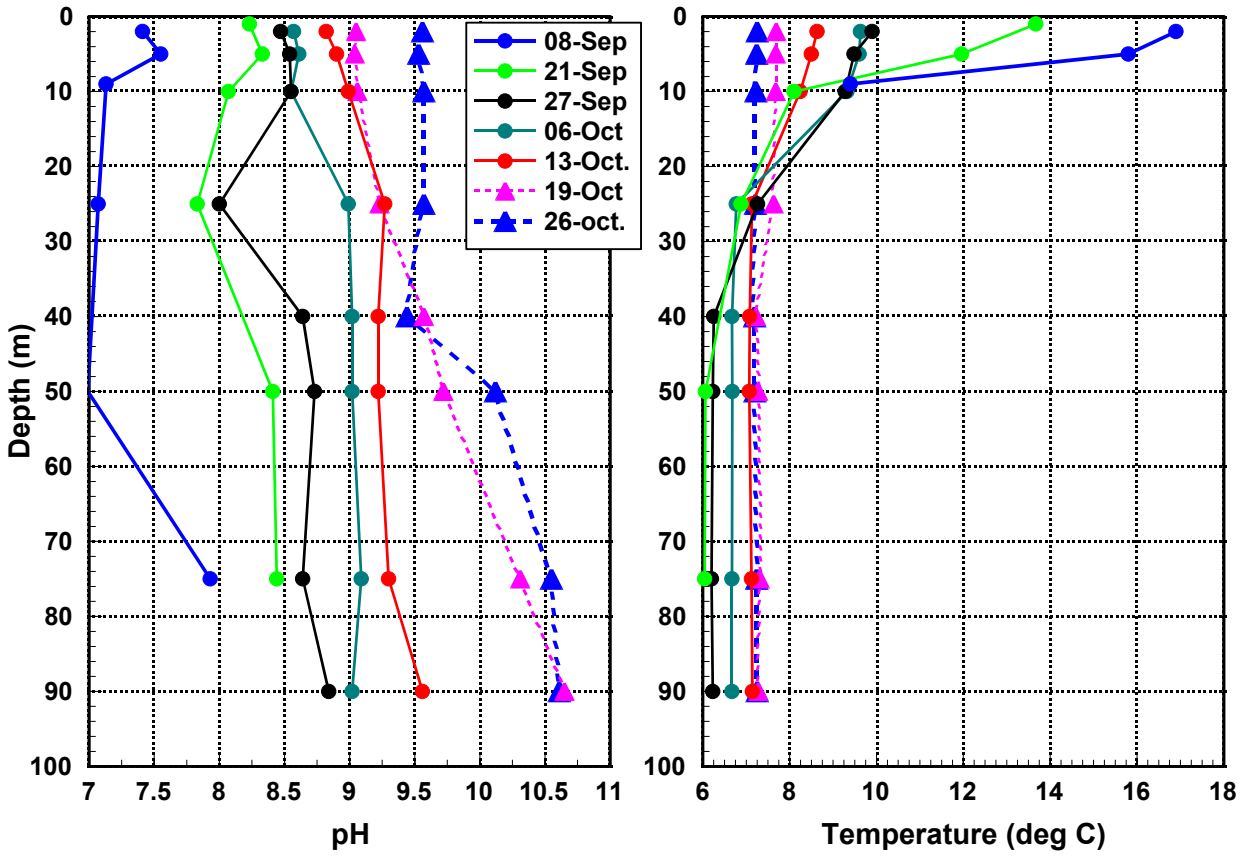
Main Pit Profiles

2005



Pit Profiles

- Last profile 10 days before end of treatment
- Last measured temperature without significant gradient (7.25 to 7.19 deg. C)

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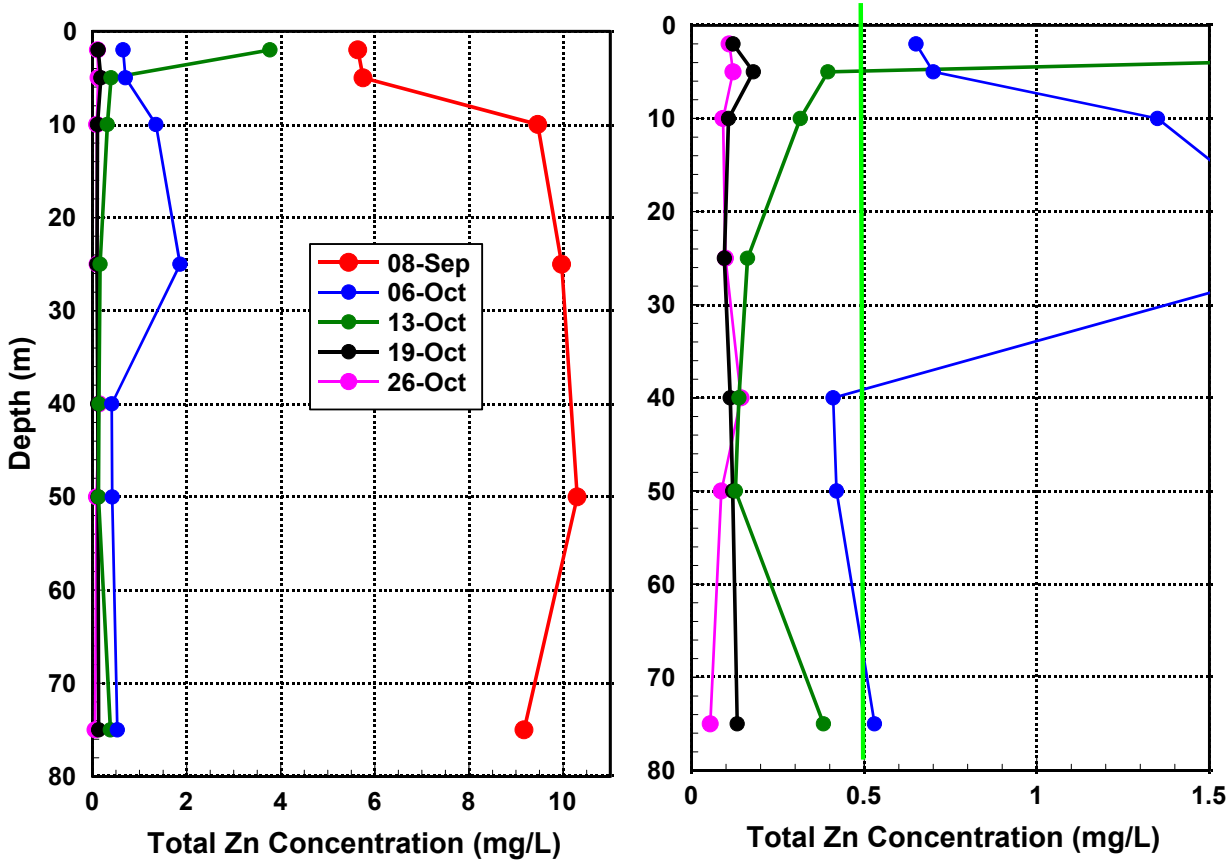
Pit Zn Profiles

2005



Limno Zn Profiles

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

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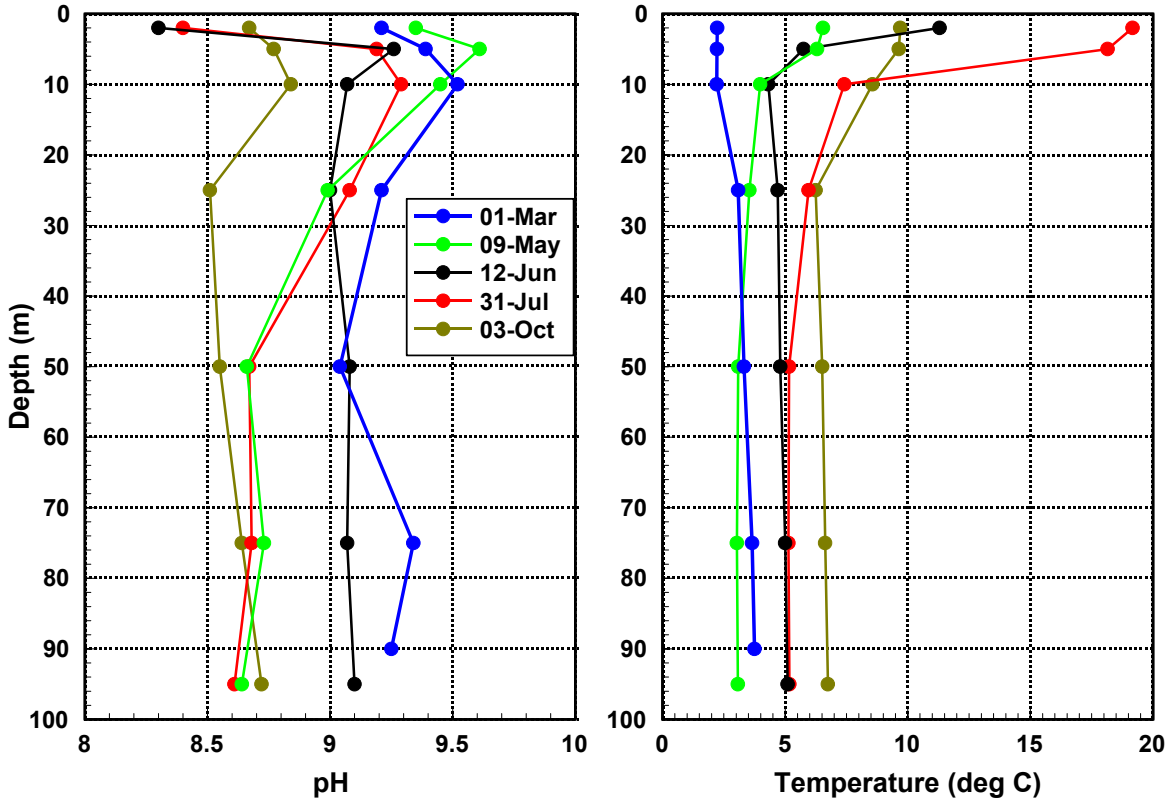
Pit pH Profiles After Treatment

2006



Post-Treatment

- Pit lake pH slowly decreasing despite significant added alkalinity
- Variability at surface due to liming runoff
- Thermal stratification in summer, mixing in fall

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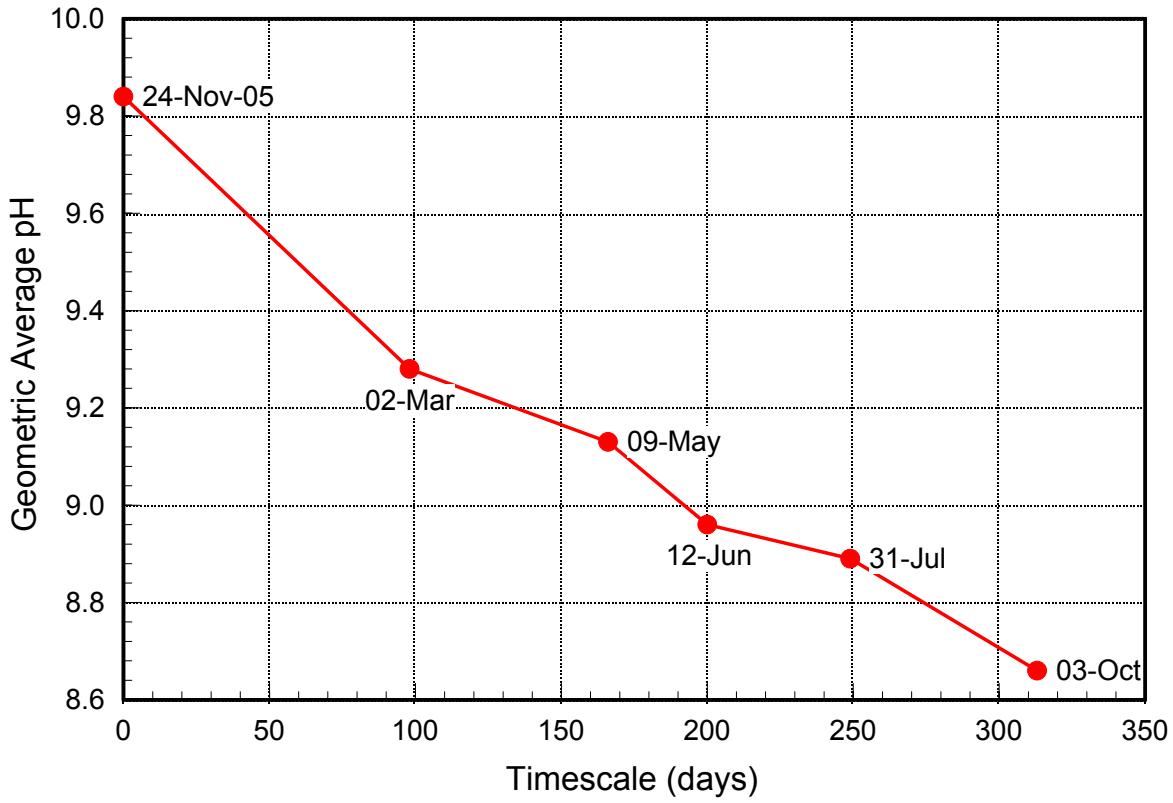
Average pH after Treatment

2005-2006



Post-Treatment

- Average pH decreasing steadily
- Greater decrease between July and October could be due to 3-week plant shutdown
- Equilibrium pH expected to be 7.5

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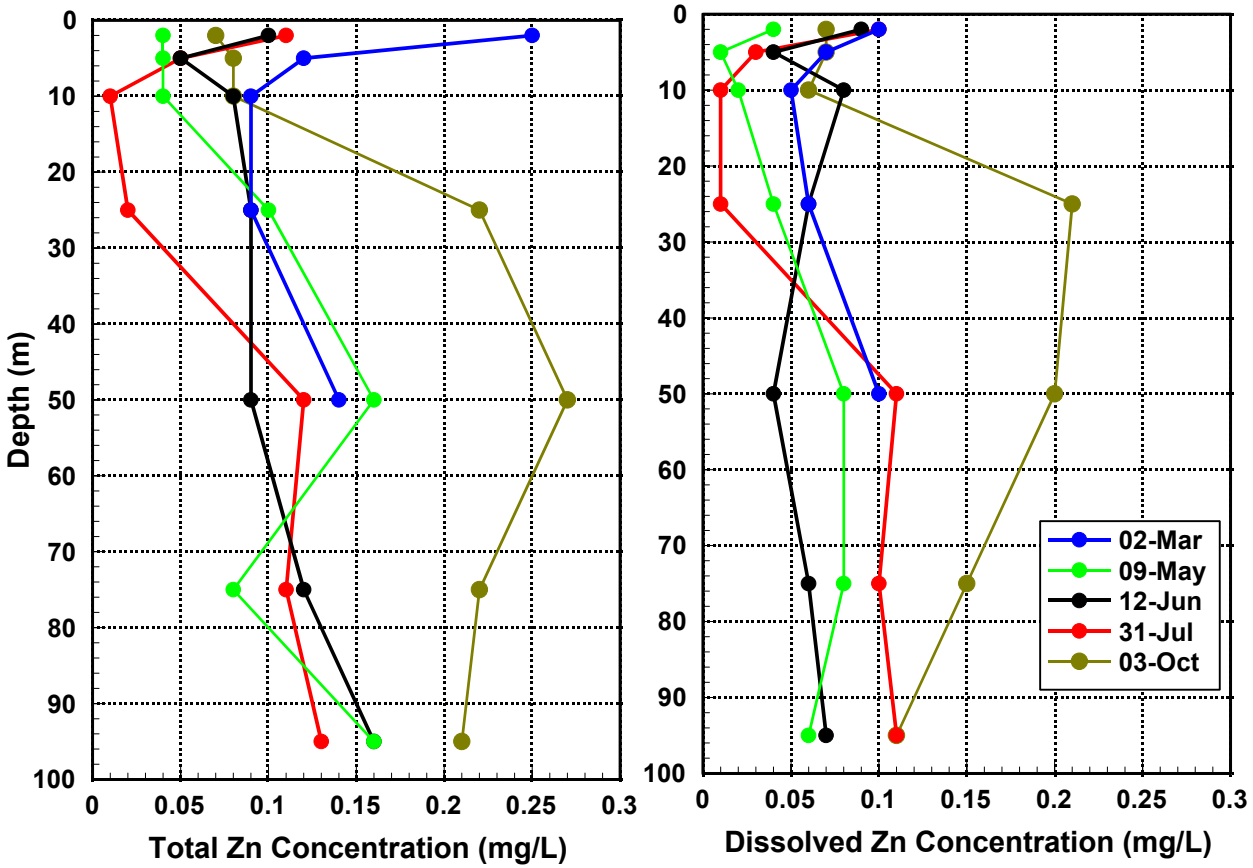
Pit Zn Profiles after Treatment

2006



Pit Zn Profiles

- Even though pH is decreasing, Zn load still low
- Over-liming runoff helping to maintain low Zn at surface

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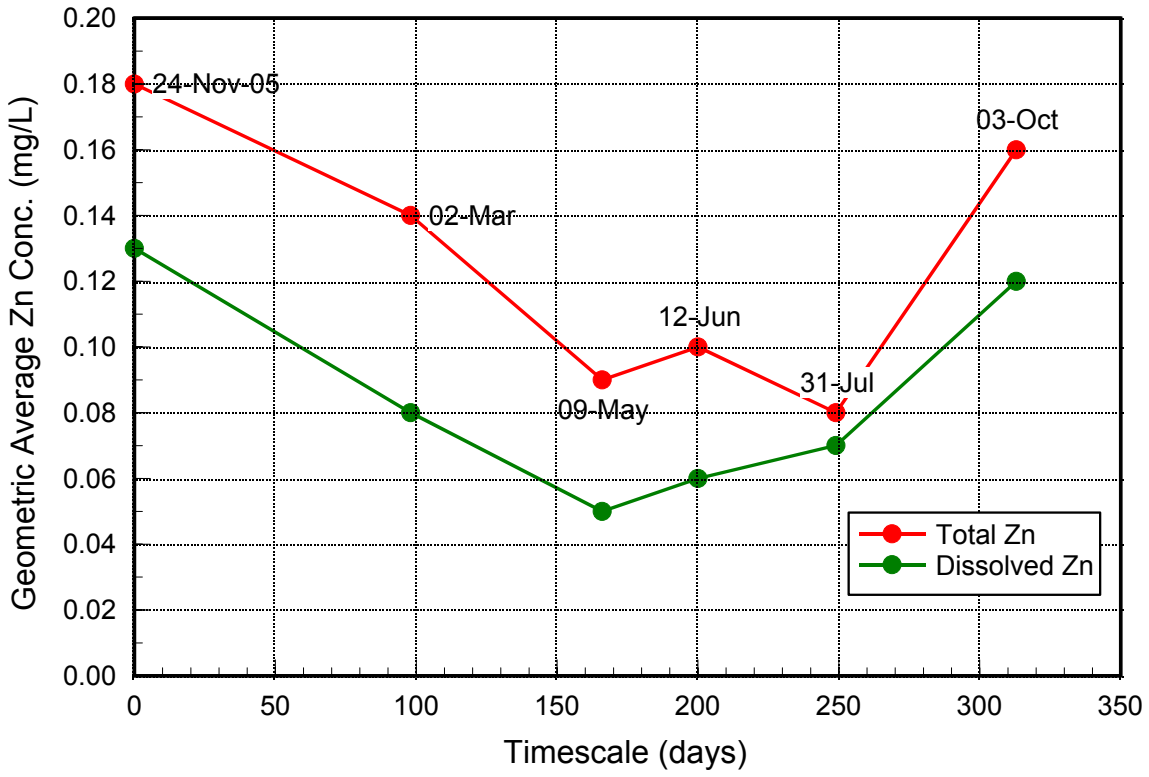
Average Zn Concentrations after Treatment



Pit Zn Concentrations

- Recent results show increasing trend
- New surface liming system may compensate particularly in spring 2007

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Pit Treatment

- pH increased in line with predictions
- Zn and Cd treatment met predictions
- 2000 t CaO was a good target
- Lake water passed toxicity testing
- Pit Treatment System a Success!!
- Maintaining high pH and low Zn concentrations remaining challenge