Monitoring Remediation of Mercury Contaminated Sediments in Lake Turingen (Sweden)

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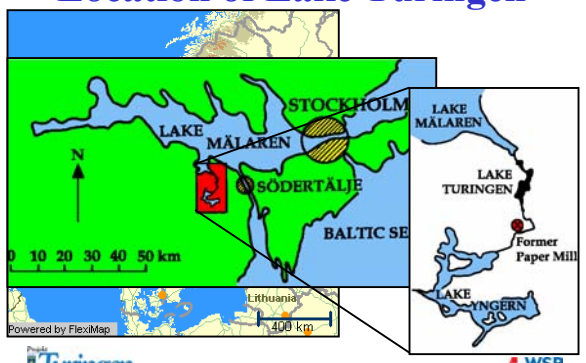
Lake Turingen WSP

Location of Lake Turingen



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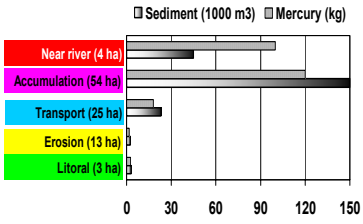
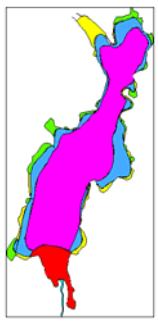
Large accumulation of mercury

- 100 kg in 2 dams upstream
- 250 kg in lake sediments





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Project Goals & Methods

- To isolate 90 – 95% of available Hg
- To reduce Hg-concentrations in fish to <0.5 mg/kg ww
- To ensure biological diversity in the system
- To provide greater recreational values

- A: New streambeds (1995-1996)
- B: Conventional capping (1999-2000)
- C: Capping w/ artificial sediment (2002-2003)
- D: New levee (2004)

Lake Turingen WSP

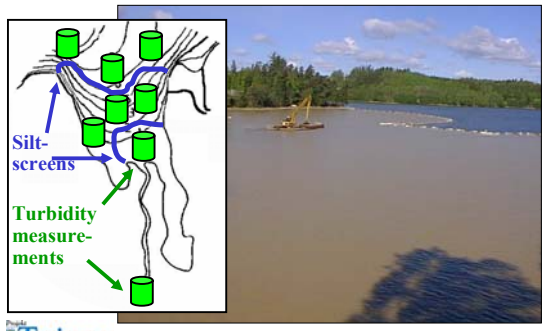
Construction Quality Control (CQC)

- Method verification
- Progress of remedial construction
- Conformance with specifications

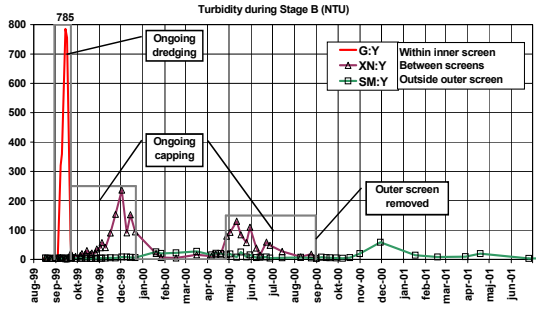
Environmental Monitoring (EM)

- Reference data
- Short-term effects
- Long-term effects

Stage B Capping



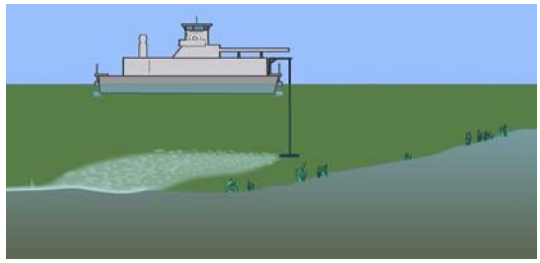
Function of protective screens



Stage C - artificial sediment

$AlCl_3 + 3NaOH \rightarrow Al(OH)_3 + 3Na^+ + 3Cl^-$

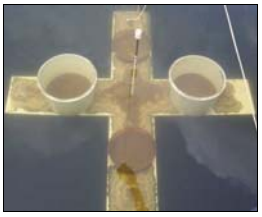
+ inert ballast + reinforcing materials



Underwater video

40 – 50

Sediment traps

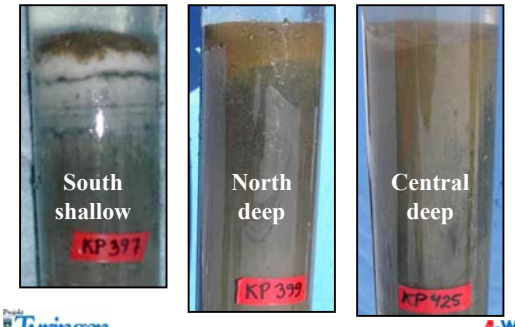


Core samples from test area

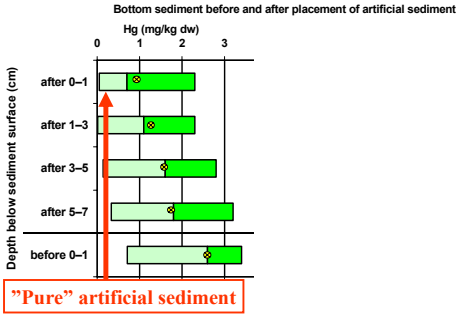
Scale in cm

After 1 treatment | After 2 treatments | After 3 treatments

Core samples from production



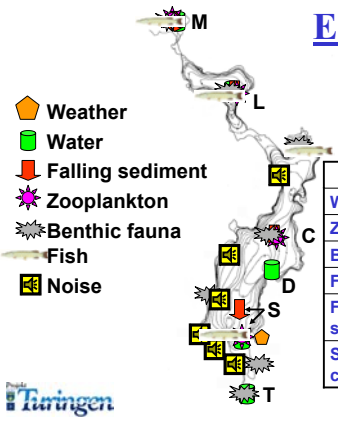
Chemical analyses of sediment



Sediment thickness

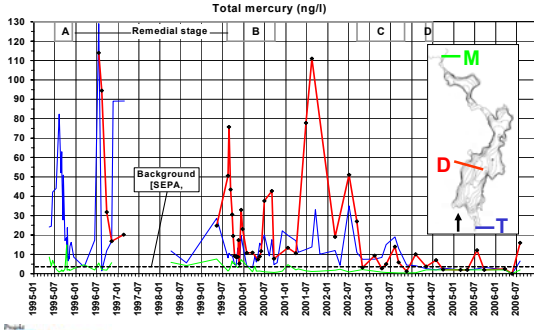
- Specified thickness (30 or 60 mm) achieved according to estimates based on contractor's use of raw materials and laboratory tests of consolidation.
- Observed thickness 2003 (sediment traps, core samples) usually less than estimates.
- Virtual thickness (pH4-Al) also less.
- Monitoring 2004-2006 indicates ongoing mixing of artificial and natural sediments, as well as spreading of artificial sediment particles.

Environmental monitoring stations

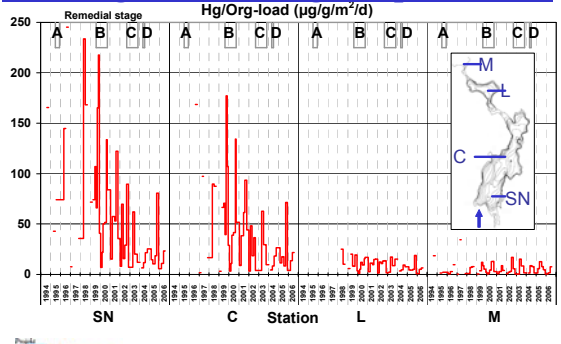


Hg-analyses	Tot	Me
Water	512	123
Zooplankton	139	89
Benthic fauna	167	6
Fish	172	—
Falling sediment	407	—
Sediment cores	573	—

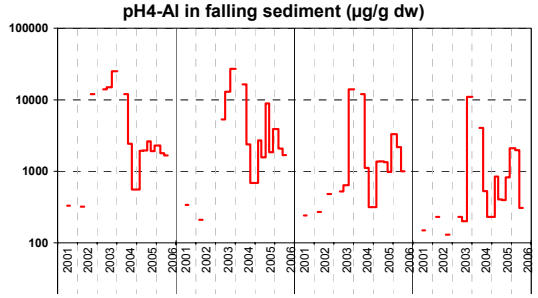
Mercury in water



Load Hg bound to organic particulate

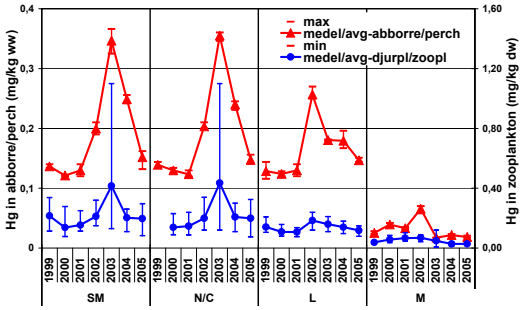


pH4-Al in falling sediment

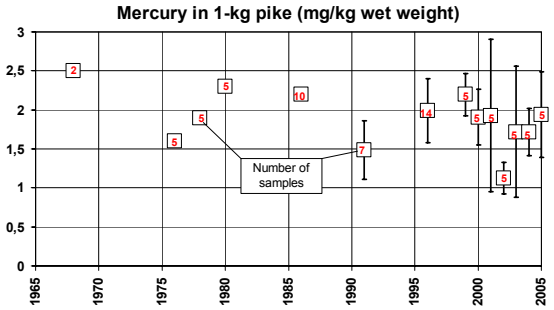


Recolonization by benthic fauna

Biota



Fish - Pike



Conclusions

- > 95% of mercury-contaminated sediments successfully isolated
- Artificial sediment is mixed with underlying material and is eroded
- Mercury tightly bound to sediment, uncertain if this effect is permanent
- Positive effects have been observed in falling sediment and water
- No effects yet seen in biota, although benthic fauna quickly recolonized artificial sediment
- Cost effective solution (10% of dredging)
- Artificial sediment can also be used to restore lakes contaminated with other substances

For more information

Projekt Turingen

http://www.turingen.se