**Design and implementation of an** erosion protection barrier for mercury-contaminated sediments at **Tollare, Sweden Andrew Petsonk** WSP Environmental, Stockholm, Sweden Jonas Jonsson WSP Civils, Stockholm, Sweden Fredrick Marelius Royal Institute of Technology, Stockholm, Sweden



## **Development plan**



- Decommissioned paper mill
- Four phases of construction
- 650-700 apartments, single- and multi-dwellings
- Harbor for private boats and small ferries
- Swimming area, beach walk, bridge to island





## The "Problem"

- Marine sediments with cellulose fibers
- Phenyl mercury from 1941 until 1964
- Prior to 2000
  - Numerous studies
  - Assumption that contamination poses a significant risk
  - No comprehensive risk assessment
- No detailed plan or construction permit without remediation of sediments
- Site owner (NCC) has no legal liability to remediate the sediments







## **Preliminary design, permitting**





### Field test 1 – 20 x 30 m area

- Geonet (Fortrac 20/13-20), 5 m broad sections, 1 m overlap between sections, floated into position and sunk
- Fill with 200 mm crushed rock 70-150 mm, first from landside, then from waterside
- Monitoring turbidity, sidescan, frogmen
- Settlement up to 2 m
- Risk for underwater landslide
- Sediments softer than expected, probably previously disturbed



### Field test 2 – 40 x 40 m area

- Filter point mattress (Foreshore), 1 x 1 m panels separated by injection channels, with 5 x 5 cm filter points, floated into position and sunk
- Laboratory scale tests
- Fill in two layers
  - 50 mm crushed rock 8-16 mm
  - 100 mm crushed rock 20-65 mm
- Monitoring turbidity, sidescan, frogmen
- Erosion test
- Settlement up to 0.25 m
- No risk for underwater landslide
- Sediments firmer than expected



# **Erosion test**

#### 12 m long boat

- 200 horsepower engine, max 1800 rpm
- Propeller diameter 0.95 m, max depth 1.6 m

#### Labelled observation points

Three succesive test phases

Rpm	Time (min)
700	6
1200	2
1700	2
	Rpm70012001700





# **Results from erosion test**Label 6 located 12 m from the propeller





# Full scale implementation

Carried out inside double silt screens
Oct 29-Nov 19, 2007 – inner screen installed
Nov 20-Dec 20, 2007 – mattress installation
Jan 7-Feb 5, 2008 – mattress installation
Mar 31-Apr 3, 2008 – placement of fill
Apr 7-Apr 10, 2008 – inspection, removal of inner screen





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# Monitoring

- Barrier thickness
- Settlement and movements
- Turbidity in 4 zones
  - Inside inner screen
  - Between inner and outer screens
  - Outside outer screen
  - Reference stations
- Sediment traps
- Water sampling
- Ocular observations





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![](_page_12_Picture_2.jpeg)

![](_page_13_Figure_0.jpeg)

![](_page_13_Picture_2.jpeg)

# Conclusions

- Scour protection for soft, fine-grained low-density sediments is difficult
- A suitable barrier must be
  - pervious to gas
  - impervious to particulate
  - sufficiently light so as to not induce excessive settlement
- Geonets and standard geotextiles not suitable
- Solution for Tollare was a custom-made filter point mattress with a thin scour protection layer
  - Implementation November 2007 April 2008
  - Geotechnical results to date are positive, although there has been some movement and chunks of fibrous sediment have broken off and moved around in the area, which was expected
  - Some spread of particulate and mercury indicated, but this is not expected to lead to complications

![](_page_14_Picture_12.jpeg)