

Recent trends in Tailings Management practices in Sweden

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Three recent court rulings

- Storliden mine, Dragon Mining
(Facts and pictures provided by Dragon Mining and Golder Associates)
- Hötjärn, Boliden
(Facts and pictures provided by Boliden, SWECO, Bergab and Nils Eriksson)
- Fäboliden, Lappland Goldminers
(Facts and pictures provided by Lappland Goldminers)

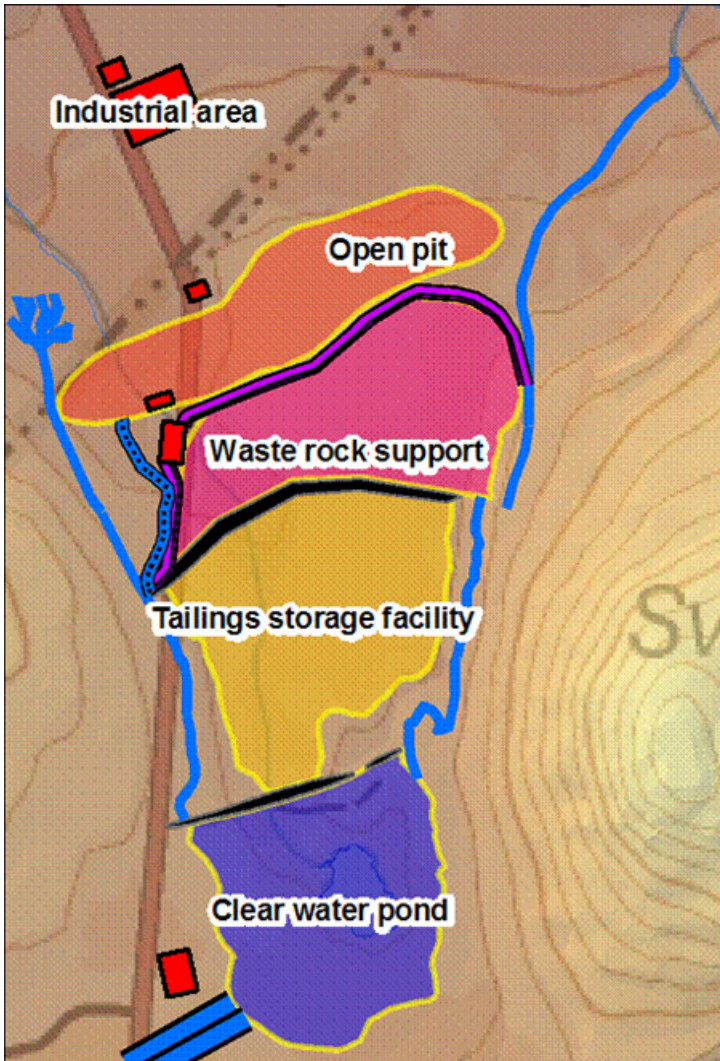
Svartliden basics

- Gold mine in operation since 03-2005
- Environmental permit 08-2003
- Appeal by EPA
- Court of appeal ruling 07-2005

Svartliden – the site



Basic facts



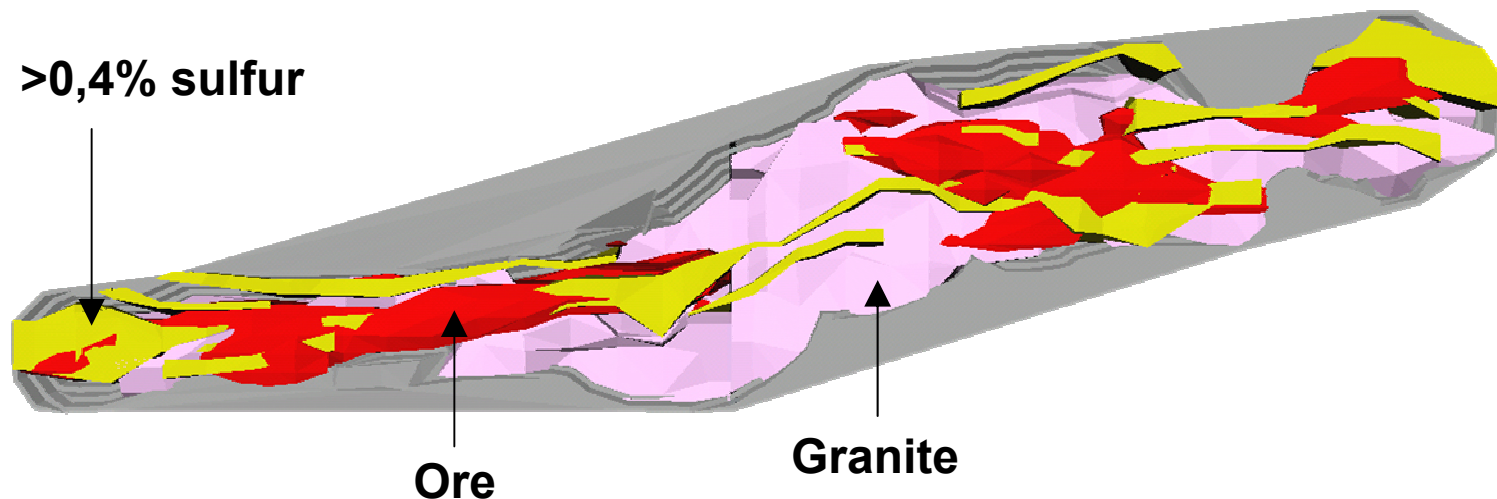
- Known orebase 1,6 Mt
~5 years ~5,5 g/ton gold
- Good indications for 2 more years of production
- Mining 0,3 Mton/year in 4 years
0,5 Mton/year in 3 years
- Gold production ~6 kg/day
→ 2000 kg/year
- ~50 employees
Dragon Mining Sweden
- ~20 employees
Mining contractor

Environmental issues

- Proximity to Natura 2000 protected areas
Paubäcken & Öreälven
- Sulfide minerals with potential for acid rock drainage
 - Extensive test work on Ore & Waste rock
- Ore has a relatively high content of arsenic
- Cyanide leaching process to extract gold

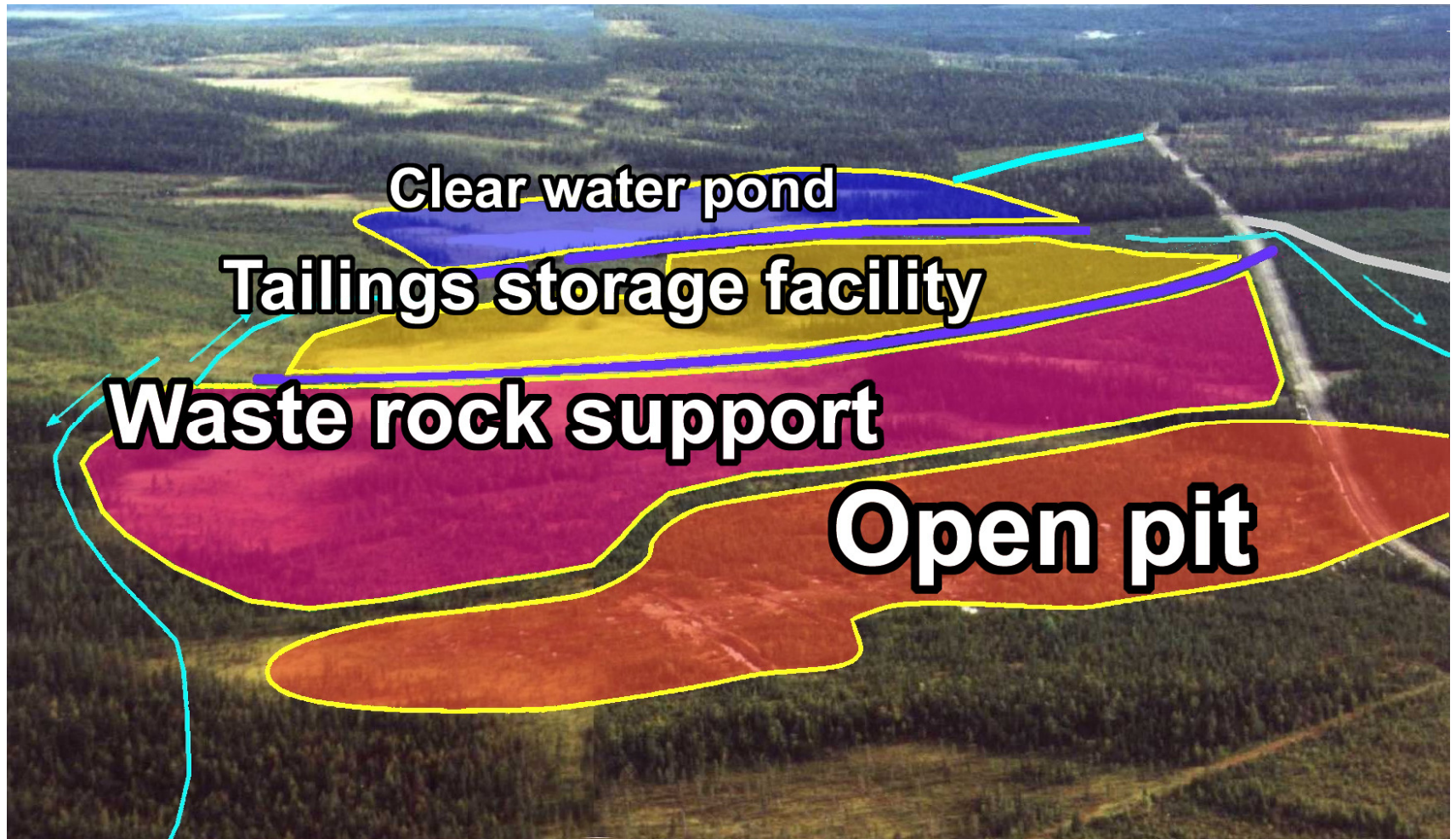
Operational waste rock characterization and handling

Pit model with cut off >1.5 g gold per ton



Rock type	Sulfur cont. %	Test result	Volume %
Buffer material	< 0,4	Neutralizing	~25
Normal handling	< 0,4	Non-acid prod.	~60
Special handling	> 0,4	Acid producing	~15

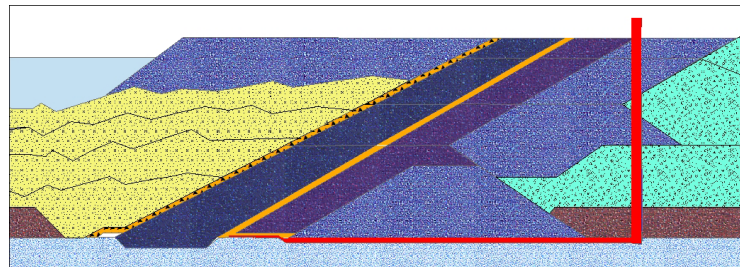
Layout



Safety of tailings embankment

- No risk of catastrophic dam failure (300-500 m of waste rock support)
- The embankment as such is designed with a safety factor
- Internal erosion with a major leakage is not probable with the beach construction
- Quality control during construction, operation and decommissioning

CONCLUSION: The embankment is designed and built according to BAT, to give a long term stable decommissioning



EPA position

- Opposes permit
 - Water cover not BAT
 - Dam design not long term stable

Environmental permit (2003)

- Dam design and closure plan accepted
- Strict water quality limits for discharge to clarification pond, e.g.:

Cu 0.009 mg/l

Cd 0.0003 mg/l

CN_{WAD} 0,5 mg/l

- Financial guarantee, cash deposit

1 MSEK up front,

1st year 12 MSEK,

2nd – 4th year 3 MSEK

- Permission to start construction works

Appeal

- Appeal by EPA
 - Design criteria for the embankment
 - 30 year verification period after closure
 - Adjustment of financial guarantee
-
- Court of appeal ruling 07-2005
 - Conditions amended in accordance with EPA requests

Construction of embankment



First gold production March 6, 2005



Svartliden Gold Mine



Hötjärn basics

- New TSF for disposal of 20 Mm³ tailings from existing concentrator, Boliden (existing TSF will be filled in 2009)
- Processes ore from surrounding mines
- 1.5 Mtonnes tailings per year
- Gold leach plant
- High sulphide content (15 – 40%)



Boliden area



Gillervatnet med Hötjärnsmagasinet
Flygbild 2008-06-03

Under-water placement of tailings



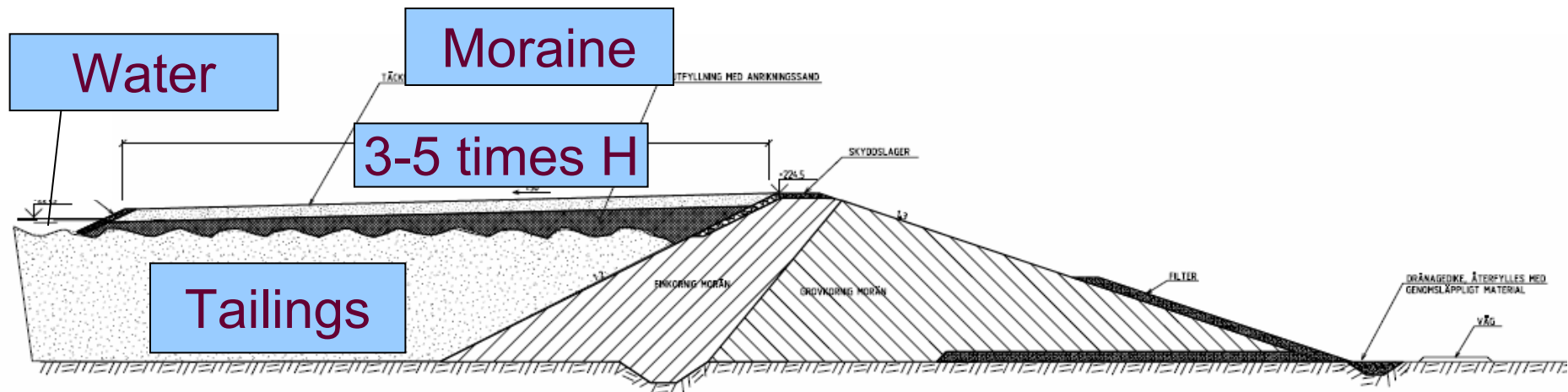
Closure by flooding

Some key issues

- Water balance – enough water to maintain the cover
 - Modeling, assessment of climate change
- Long term integrity of embankments – e.g. internal erosion
 - Dam design and beaches
- Resuspension of tailings
 - Diffusion barrier, wave breaks

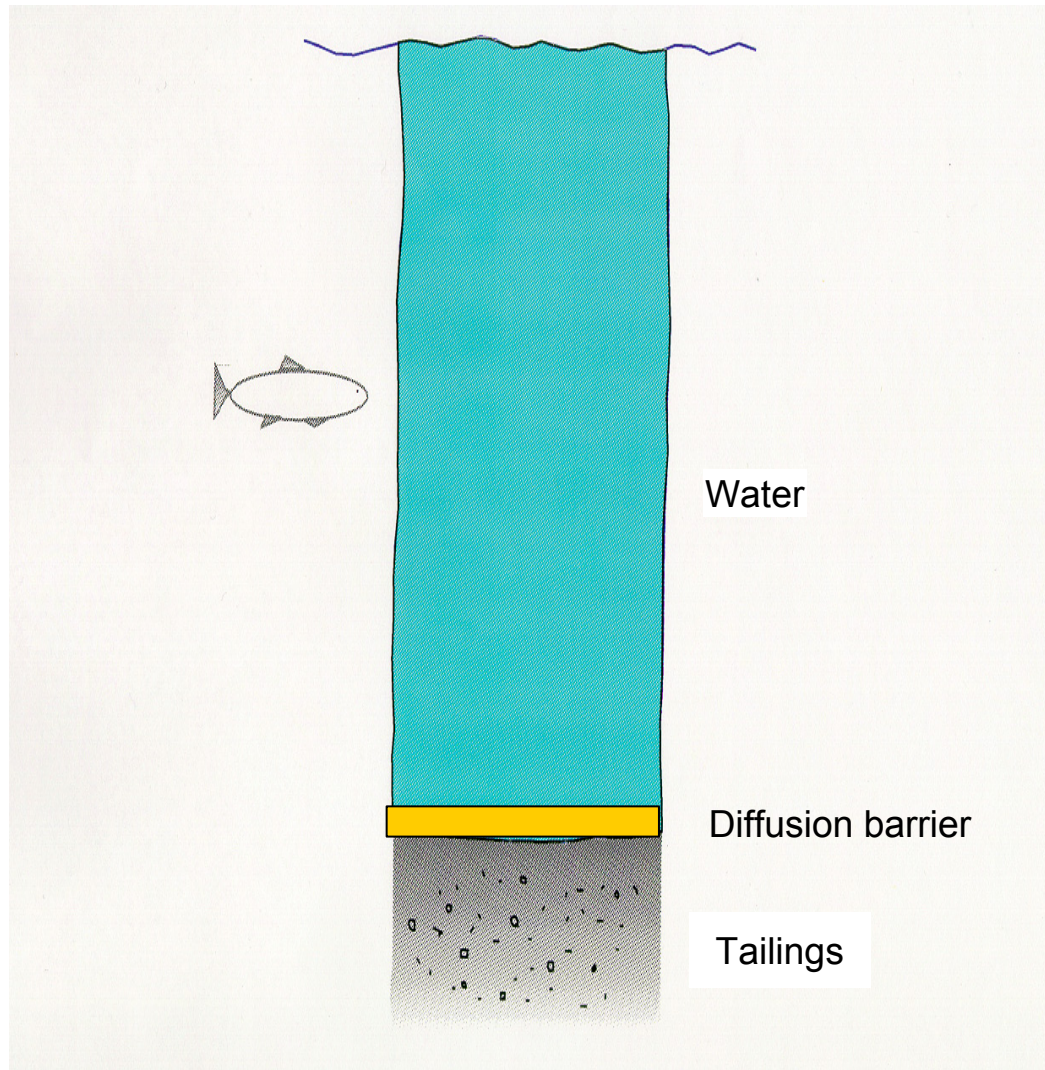


Water cover with beaches of moraine



- Construction of beaches along the embankment moves the free water table away from the dam and the hydraulic gradient is lowered – increases long term stability

Reducing oxygen diffusion



EPA on closure

- EPA wants to have a dry cover, BAT
- If flooding, combined with a 1m moraine cover

Financial guarantee

- Boliden proposes 36 MSEK
- Corporate guarantee
- EPA wants to have 192 MSEK (dry cover)
- Bank guarantee or pledge of assets

Environmental permit

- March 2006 - Environmental court rejects application, “psychological immissions” (worries regarding dam failure). Boliden appeals.
- November 2006 – Environmental Court of Appeal issues permit. Detailed conditions regarding dam construction, safety factor etc.
- Back to environmental court for other permit conditions

Environmental permit (cont)

- Dec 2007
- Water quality, limits
- Closure plan, water cover
- Financial security - 36 MSEK, bank guarantee
- Both Boliden and EPA appeals
- Permission to start construction works

Construction of Embankments



Court of Appeal

- Nov 2008 – Ruling of Environmental Court of Appeal
- Flooding accepted
- Financial security - “bank guarantee” becomes “guarantee by bank or other financial institution”
- Boliden considers appeal to High Court

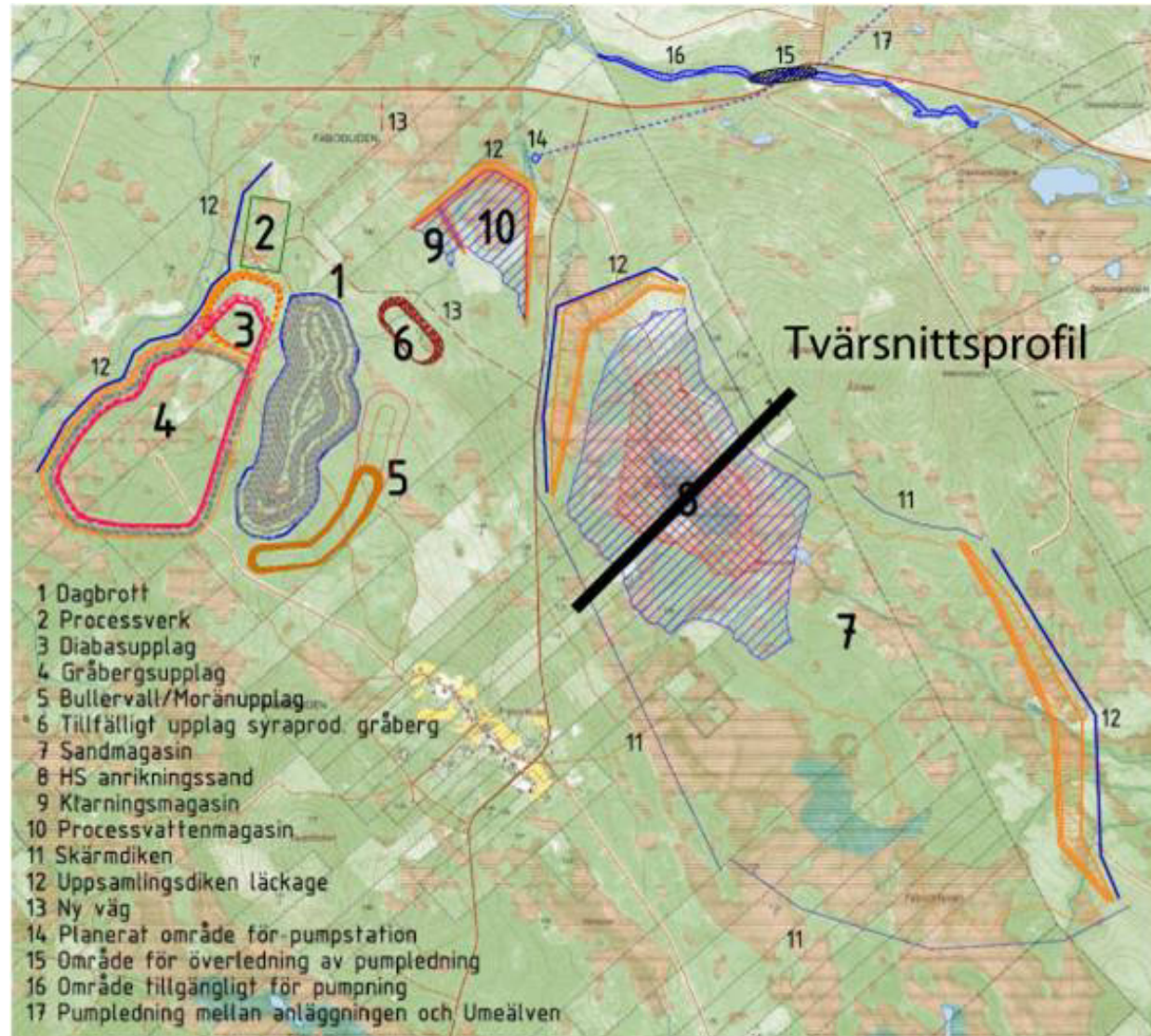
Fäboliden basics

- Planned open pit gold mine
- Ore and reserves, 22 Mton @ 2.2 g Au/ton
- 4.5% As in the ore
- Concentration + CN leaching
- Environmental permit 12-2007
- Appeals by EPA and local stakeholders
- Ruling by Court of appeal 09-2008

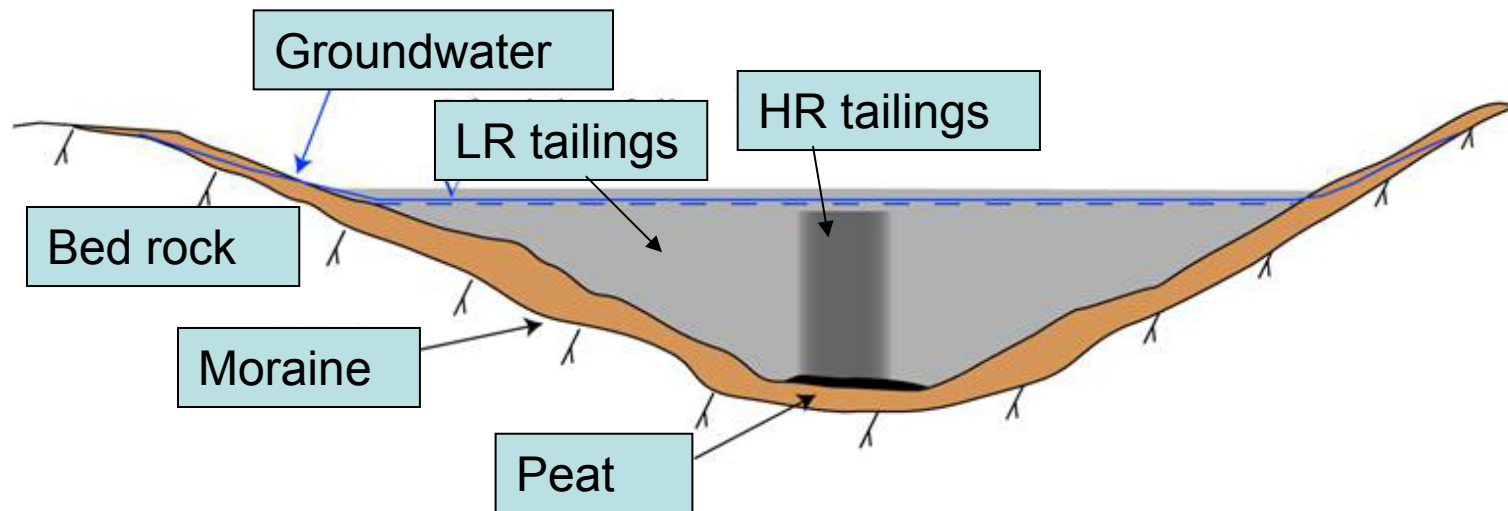
Fäboliden application

- Biological treatment plant for N-reduction in process water
- Tailings and waste rock separation (Criteria to be developed, AP and As)
- Precipitation of As using iron(III)sulphate
- Closure of TSF by combination of simple dry cover, water saturation and water cover
- Financial guarantee 55 MSEK, (25 MSEK cash deposit before commencement + quarterly production related deposits)

Fäboliden Footprint



Fäboliden TSF



Appeal by EPA

- Better characterization, detailed waste management plan
- Detailed closure plan – 30 year follow up of dams after closure, evaluation of independent experts
- Financial guarantee, 107+ MSEK cash deposit up front

Court of Appeal

- Ruling 09-2008
- Accepts build up of guarantee over time
- Adjustment of total amount
- Detailed waste management and closure plan to be presented to, and approved by, county administration
- Review of dams by independent experts after 30 years
- Detailed criteria for dam design

Summary of issues

- Appeals are the rule
- Waste characterization
- Closure and long term aspects
 - Water covers and dams (water balance, climate change, dam integrity)
 - Financial guarantees (form more than amount)