Long term evaluation of Mine closure

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2019-10-02

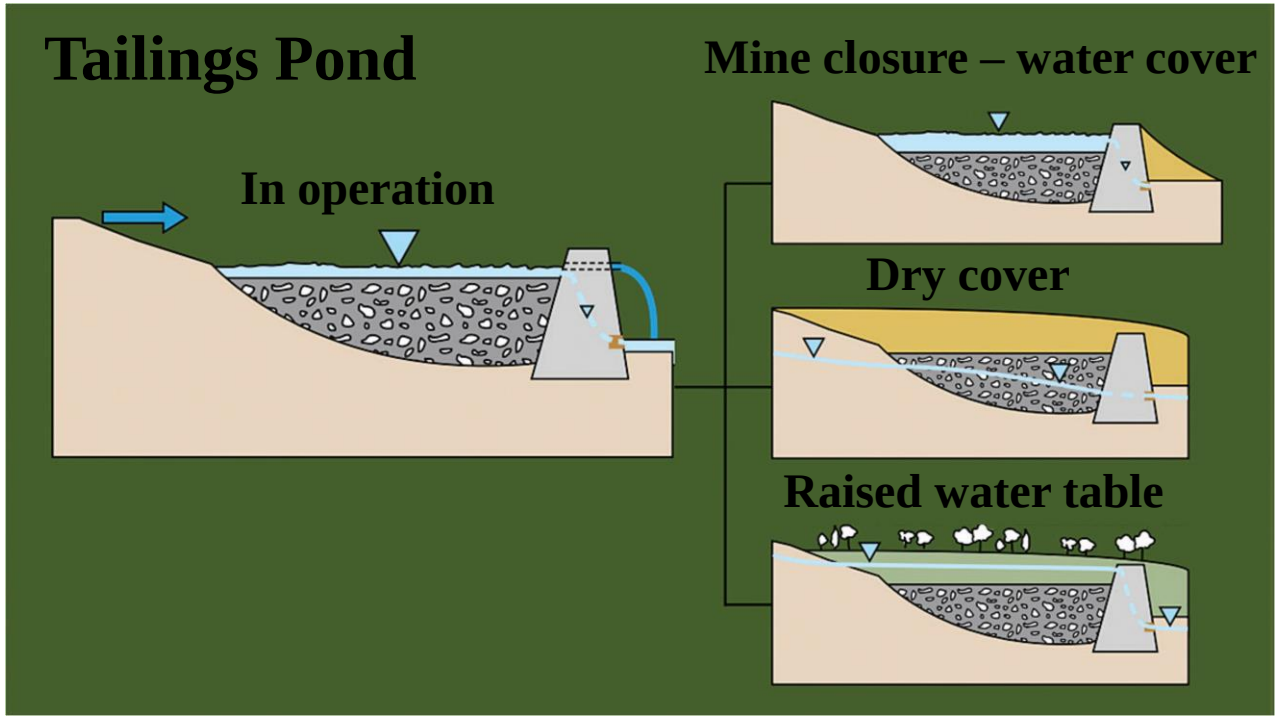
SGU Geological Survey of Sweden

Background - Methods for mine closure

Passive methods used in Sweden:

- Covers (dry, water)
- Raised groundwater table
- Combinations thereof

→ **Reduce oxygen transport**



Evaluation of mine closures By SGU and EPA:

- Closure actions → Un/successful → Complementary actions
- Better in time - Regulation - Knowledge
- Waste characterization, water balance - Seldom performed

Geological survey of Sweden – Mine closures

Svärtträsk (Zn-mine, closed in 2007):

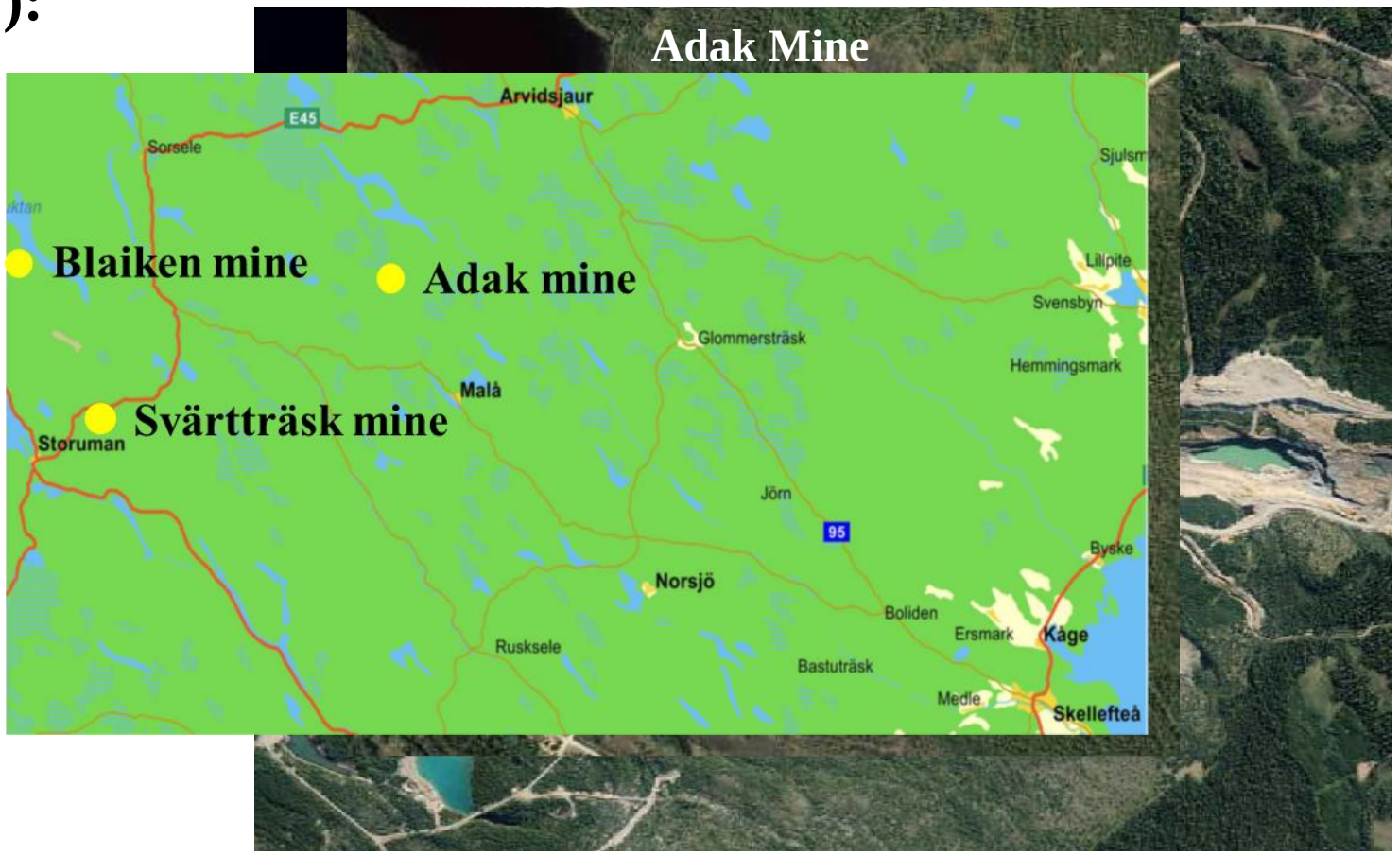
- Dry cover (applied in 2017/18)
- No evaluation yet (to recent)

Blaiken (Zn-mine, closed in 2007):

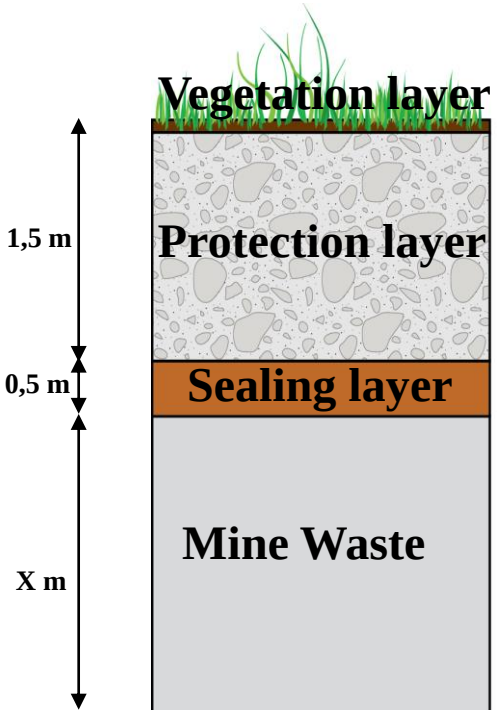
- Planning for remediation actions

Adak (Cu-mine, closed in 1977):

- Dry cover in 1999
- Some evaluations conducted



Overview – Adak mine



Mine waste:

- 6.3 Mton, As(4000 ppm), Zn (2500 ppm), Cu (1000 ppm)
- Pyrrhotite (5,7 wt. %)

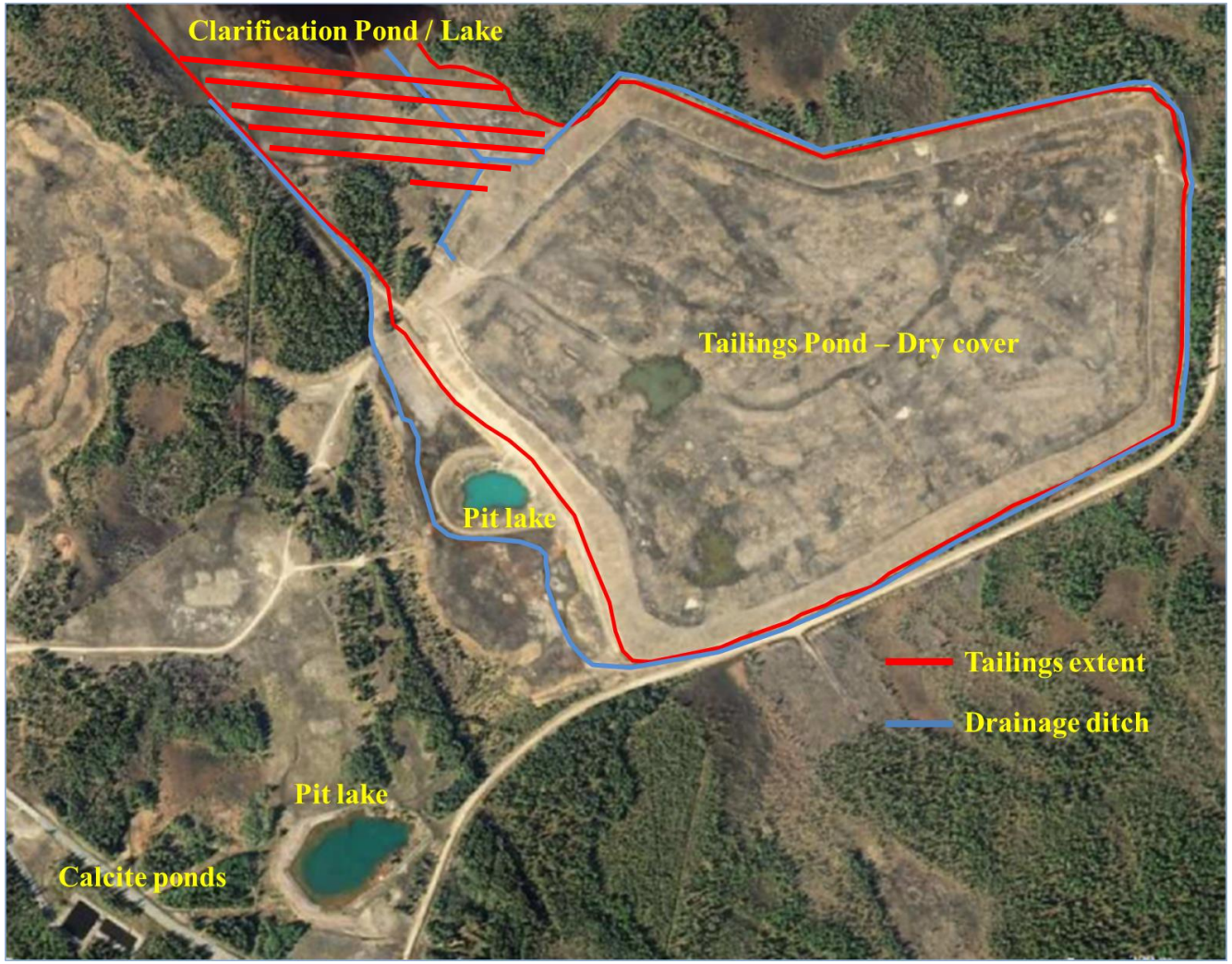
Action: Dry cover (applied in 1999):

- Sealing layer - Clayey till ($1 \cdot 10^{-8}$ m/s)

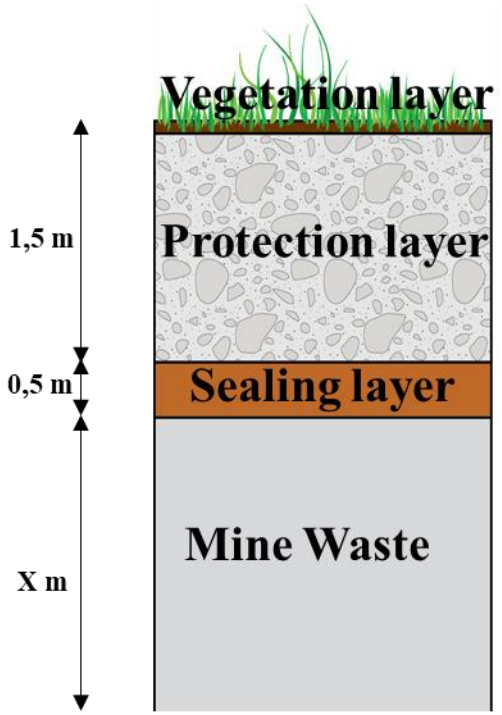
Other actions:

- Calcite ponds
- Drainage ditches

Evaluation of actions??



Evaluation of actions – Adak mine



Sealing layer:

- Low oxygen content - Effect from sulfide oxidation?
- Good compaction (Near original values)

Mine waste:

- Low portions of water soluble metals (1-5 wt. %) in oxidized tailings

Leaching of metals:

- Recipient monitoring (twice a year) – Low contents of Zn, Cu and As
- Monitoring in drainage ditches (twice a year, flow rates)

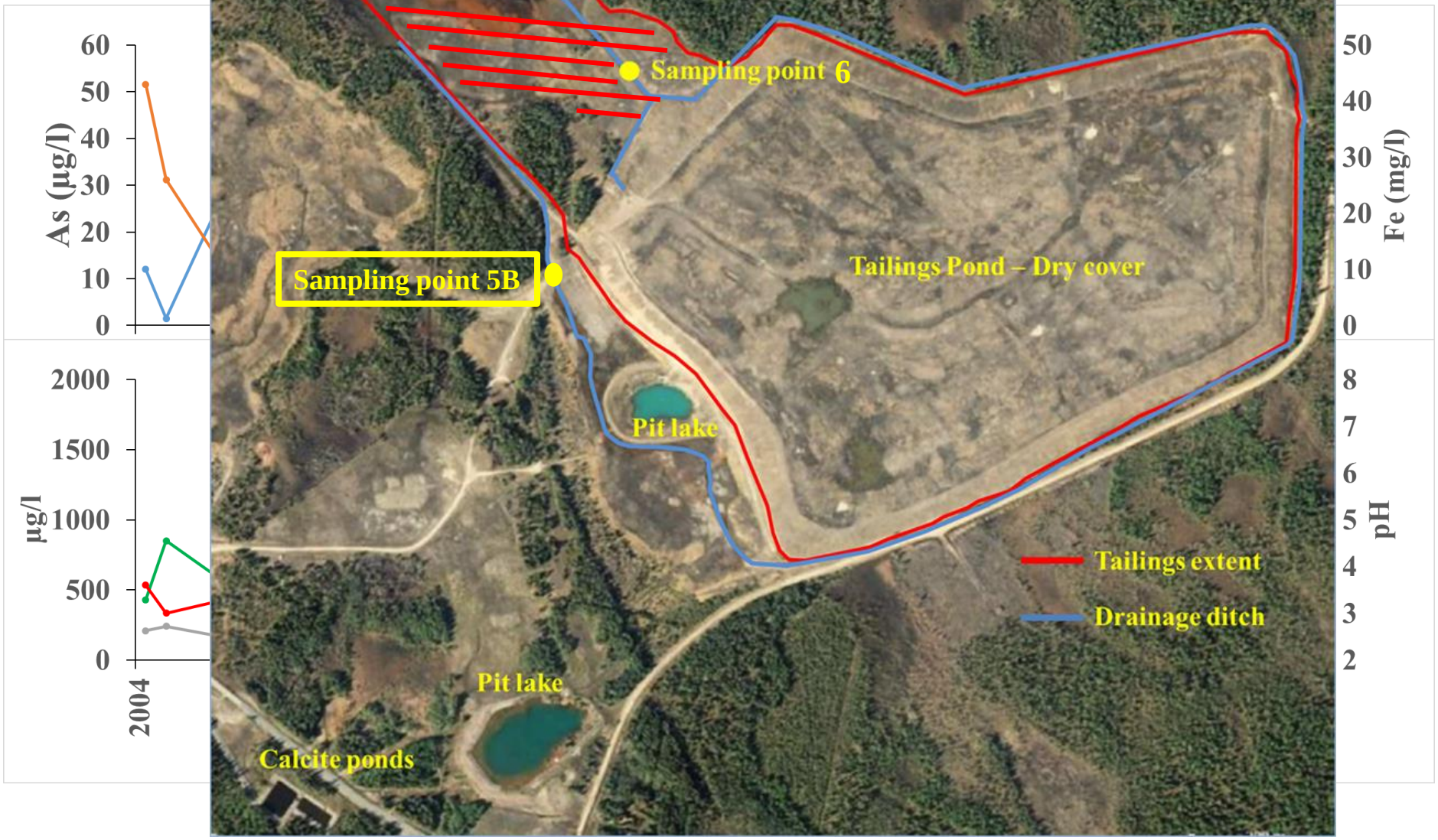
Leaching of As, Cu and Zn – Drainage ditches

Situation in 1998 (prior to soil cover):
Cu: 1500 µg/L
As: 200 µg/L
Zn: 3500 µg/L
(unfiltred samples)
Acidic pH

Situation in 2018:
Cu: 500 µg/L
As: 160 µg/L
Zn: 700 µg/L
pH: < 3

Conclusion: Wash-off?, another source? Remobilisation of secondary As-Fe?

Leaching of As, Cu and Zn – Drainage ditches



Situation in 1998 (prior to soil cover):
Cu: 1000 µg/L
As: 150 µg/L
Zn: 800 µg/L
(unfiltred samples)
Acidic pH

Situation in 2018:
Cu: 100 µg/L
As: 2 µg/L
Zn: 500 µg/L
pH: < 3

Conclusion: Wash-off?, Another source?
Still pH < 3

Complementary actions?

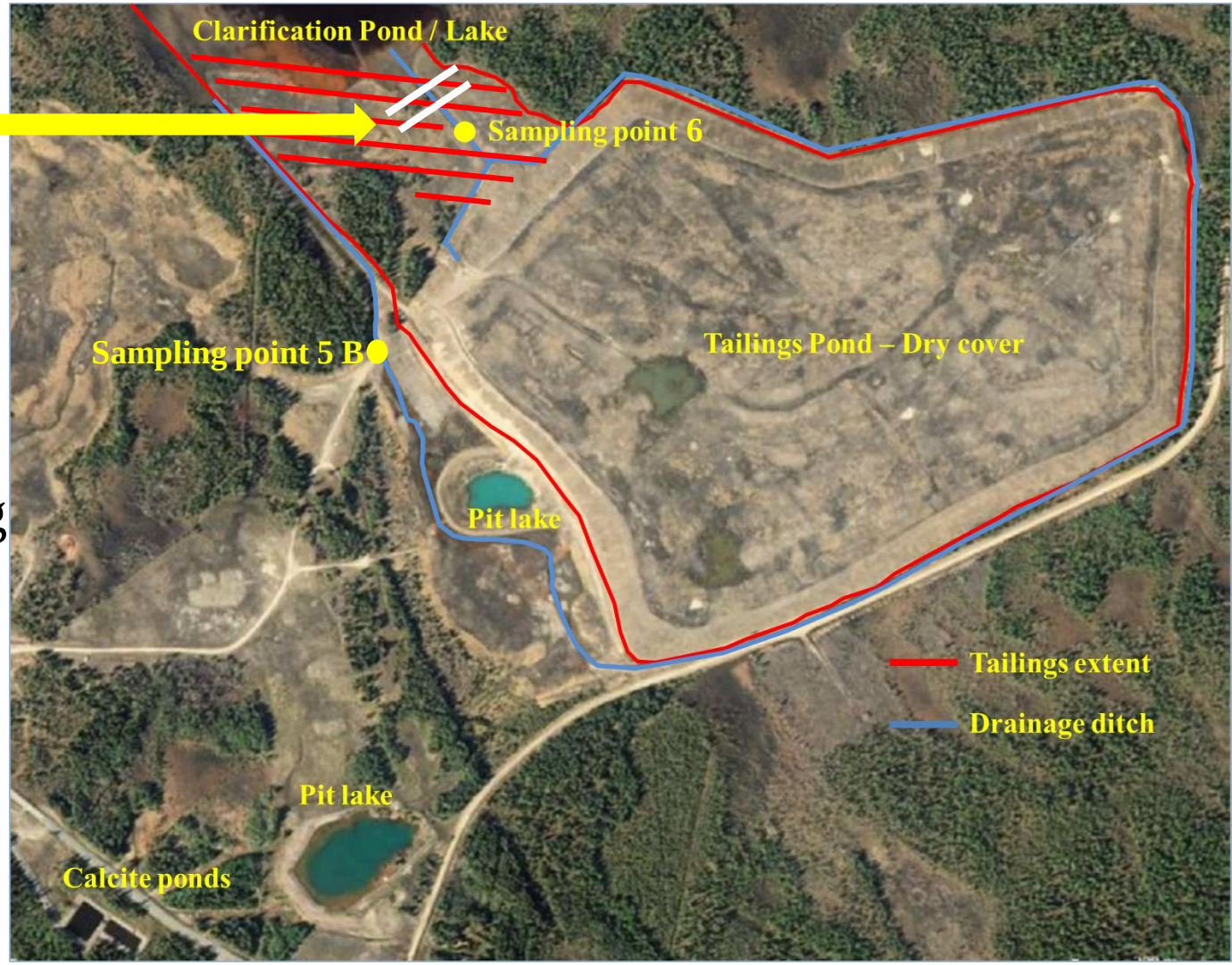
Complementary actions - Adak

Suggested action: Calcite barriers

Aim: Raise pH in outlet water

Further studies:

- Future metal load and acidity
- Contact time Calcite/Acid water /Clogging
- Placement of dredged material



Final remarks

Mine closure Adak:

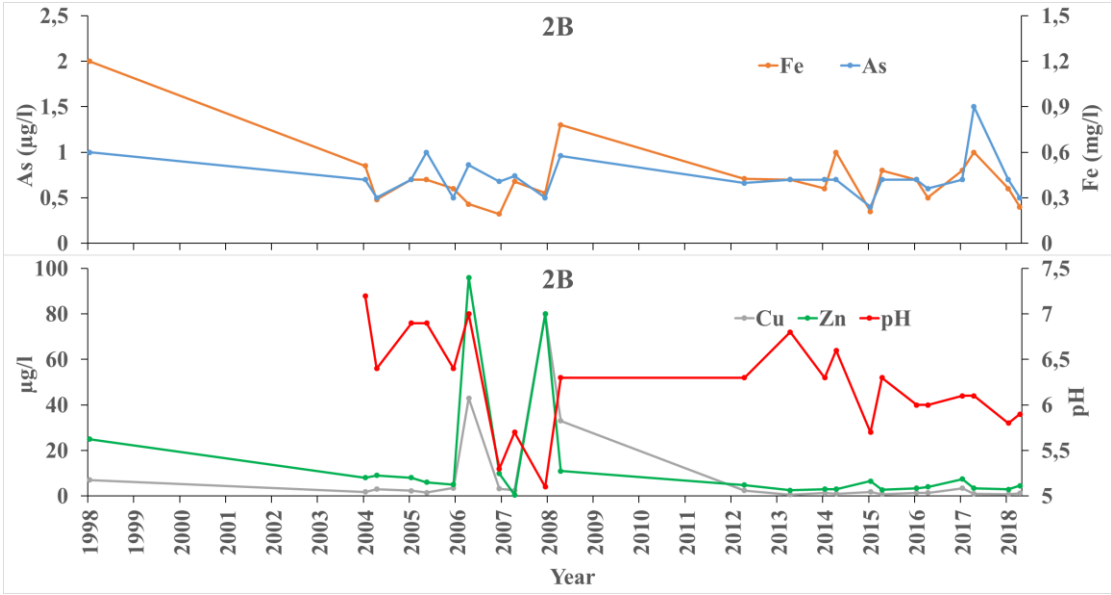
- Evaluation of Old data/analyses/methods
- Complex site/Not designed for mine closure
- Long term data-set/Before dry cover

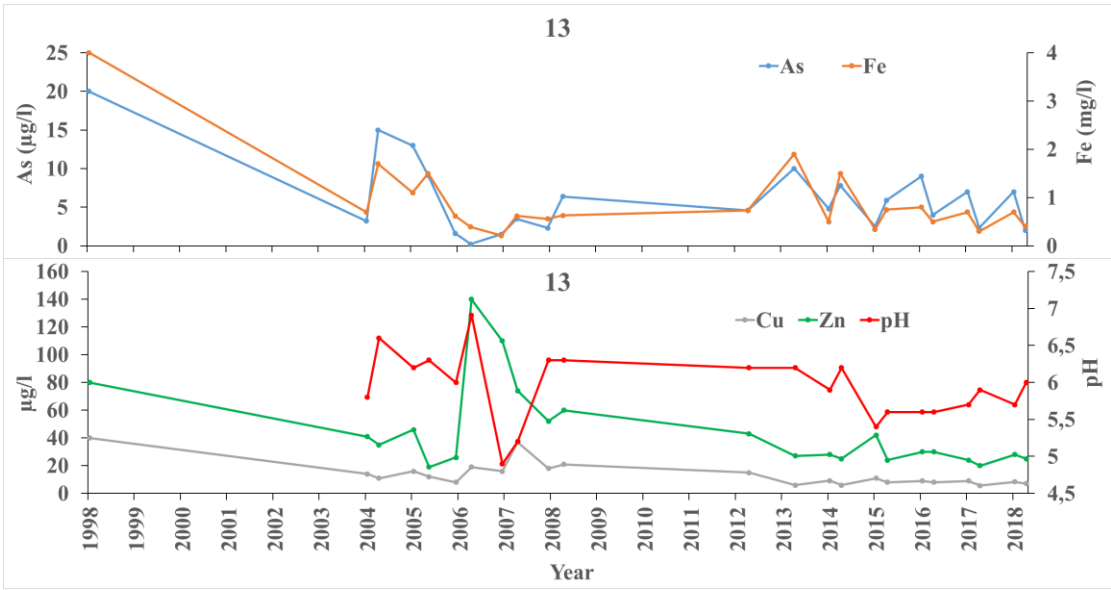
Future mine closure (Blaiken, Svärttträsk):

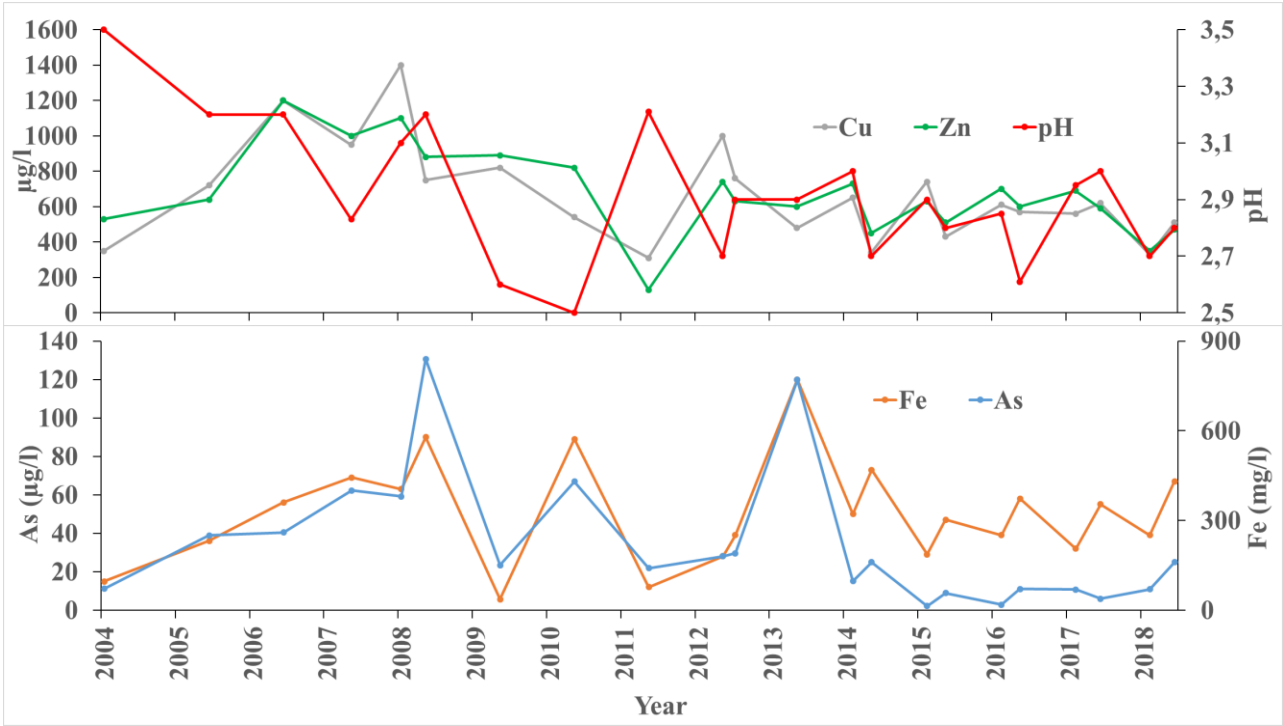
- Planning for closure (waste characterization/water balance)
- Evaluation of covers (oxygen/water transport) – data for models

Thank you for your attention!


Rudtjebäcken
Rudtjejaure
P13
P6
P5B
P3D
P2B
Skeppträskån
N
Provpunkt
Dräneringsdike
Dräneringsdike sandmagasin
Vattendrag
Adaks Sandmagasin
Utspolad sand
Morantäkt
Adaks dagbrott
Lindskolds dagbrott
Damm
0 0,2 0,4 0,6 0,8
Kilometers


2B
Fe
As
As (µg/l)
Fe (mg/l)
2B
Cu
Zn
pH
µg/l
pH
Year


13
As
Fe
As (µg/l)
Fe (mg/l)
13
Cu
Zn
pH
µg/l
pH
Year



Situation år 1997 (före torrtäckning): **Cu: 1700 µg/L** **As: 400 µg/L** **Zn: 4000 µg/L** **(unfiltred samples)Surt pH**	**Situation år 2018:** **Cu: 500 µg/L** **As: 160 µg/L** **Zn: 500 µg/L** **pH: < 3**	**Flöde i diket: 0,2-1,2 Liter/s** **Mätningar och analyser 2ggr/år (maj och sep-okt)**