



Photo: Rainer Rosendahl

# Definition and Classification of Finnish Acid Sulfate Soils

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# SYSTEMATIC MAPPING OF ASS STARTED 2009 in two projects

1. Catchment of two big rivers: Siikajoki-Pyhäjoki 2009 – 2012  
(EU (ERDF) and national /regional funds )  
**Action 1: Mapping (GTK)**



Euroopan unioni  
Euroopan aluekehitysrahasto

2. CATERMASS 2010-2012 LIFE+ (EU's environmental fund)

Climate Change Adaptation Tools for Environmental Risk  
Mitigation of Acid Sulfate Soils



**ACTION 1: Mapping and risk classification of ASS  
in Finland (GTK, ÅA, HY)  
The results should be available to the public**

**GTK and the ministry have agreed:**

- General Map of ASS over the whole potential area  
(+ some detailed mapping) by the end of 2015

**WE PROMISED TO MAKE A CLASSIFICATION OF FINNISH ASS  
AND FOR THAT  
WE NEEDED A DEFINITION OF FINNISH ASS**

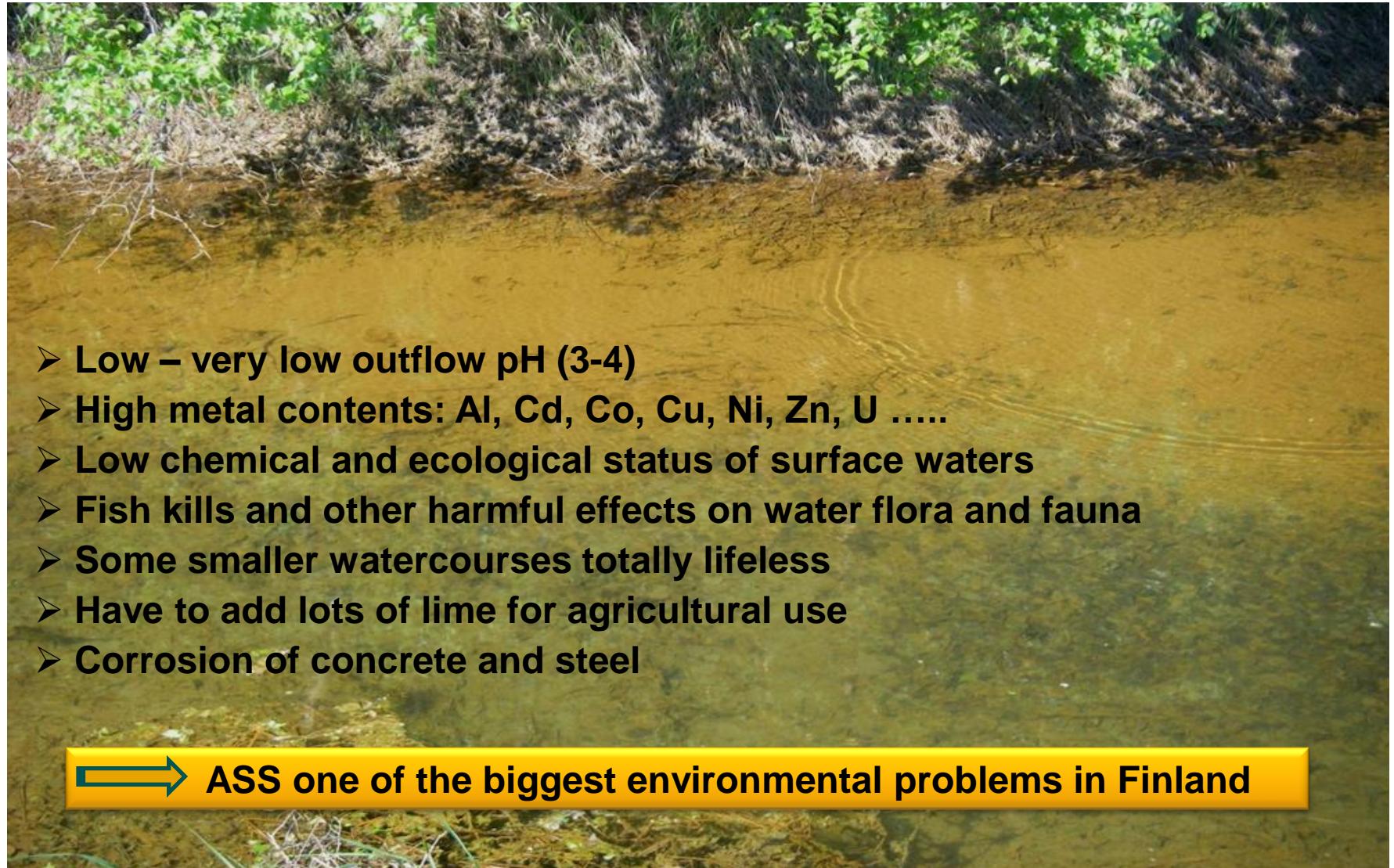
### **WHAT DO WE HAVE TO CONSIDER?**

**100 – 50 years ago ASS in Finland were an agricultural problem:  
How to get what growing and where?**

**From the 1960's onward:**

**Subsurface drainage, effective lowering of the water table  
→ Environmental issue (harmful effects on surface waters)**

# HARMFUL EFFECTS OF ASS



- Low – very low outflow pH (3-4)
- High metal contents: Al, Cd, Co, Cu, Ni, Zn, U .....
- Low chemical and ecological status of surface waters
- Fish kills and other harmful effects on water flora and fauna
- Some smaller watercourses totally lifeless
- Have to add lots of lime for agricultural use
- Corrosion of concrete and steel



**ASS one of the biggest environmental problems in Finland**

# Land use (in ASS landscape) cause oxidation:

- Draining agricultural and forest areas
- Peat production
- All kinds of building activities



# MAPPING PROCEDURE

existing data → potential areas → plan → field observation and sampling

Reconnaissance, 2-3 m



Kuva: Emmi Rankonen 2010

Drilling, 3 m  
Profile sampling



Kuva: Peter Edén 2011

pH from sample, data → database  
sampling → chemical analysis, incubation



Kuva: Olli Breilin 2009

# TYPICAL ASS PROFILE

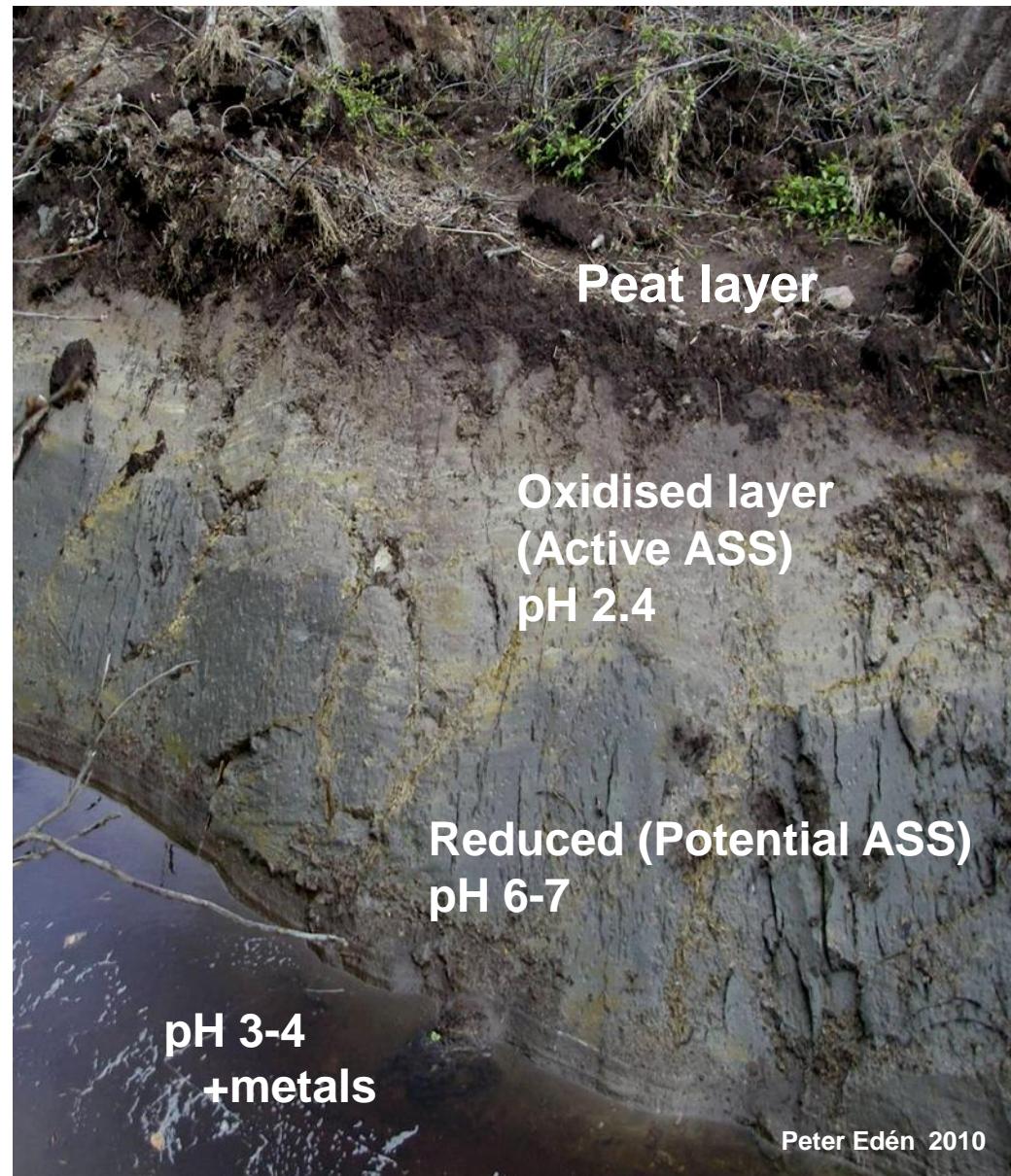
1. In natural state covered with peat

2. Draining / lowering of the water table

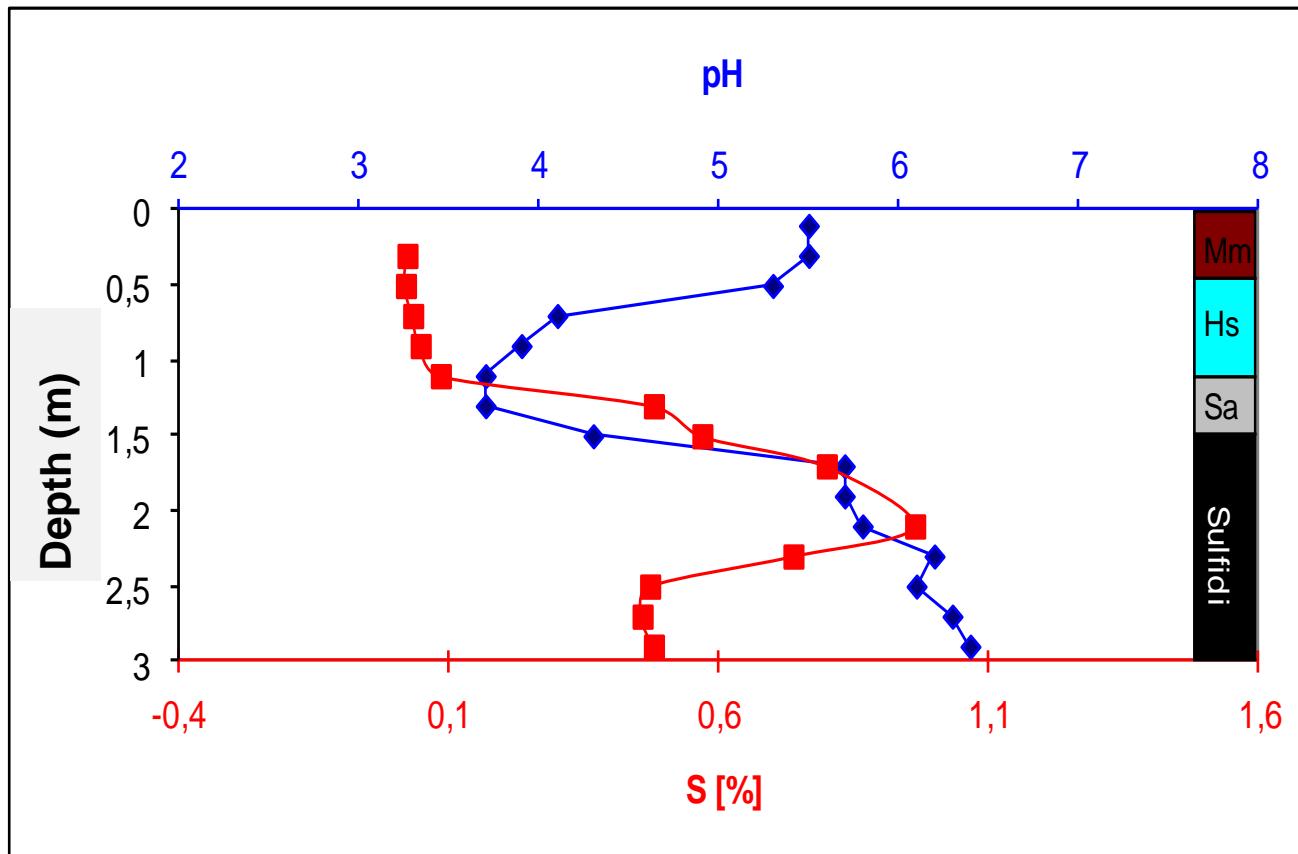
>> oxidation of the sulfides

>> sulfuric acid + metals

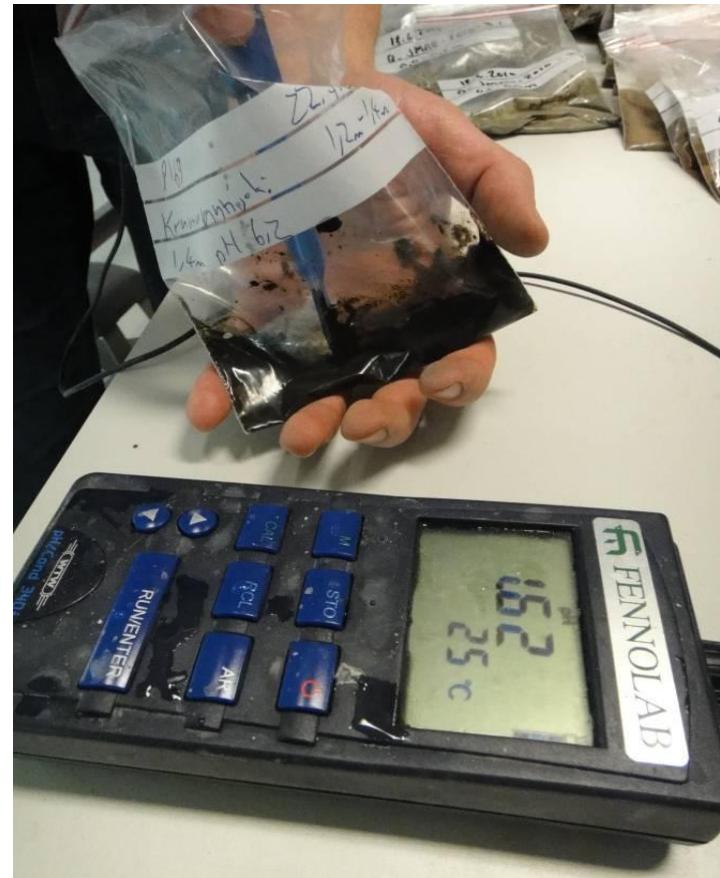
= active acid sulfate soil



# pH- and Sulfur-profiles

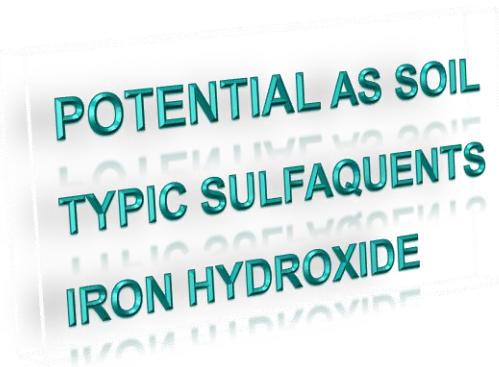


- Chemical analyses:  
Aqua Regia + ICP-OES  
→ Sulfur + 30 other elements
- Incubation (oxidation 10-16 weeks),  
measuring change in pH



Field pH 6,2  
Incubation: pH → 1,6

.... a definition and classification of the above .... !?



Potential AS  
Soil  
Typic  
Sulfaquents  
Histic  
Sulfaquents

Ochric epipedon

Gleyic color

Ap horizon

*Thionic Endogleyic Cambisol*

Cambic horizon

Jarosite

Thionic horizon

... I don't have a clue of most of these terms!  
Markku! Peter Ö?

# **Definition and classification for Finland based on:**

**Earlier experiences**

**Observations of harmful effects of ASS**

**Observations and measurements from the mapping process**

**Land use**

**Climate**

**Seasonal variations**

**WRB and Soil Taxonomy do not apply to Finnish soils,  
environment and land use**

## **Definition of Acid Sulfate Soils in Finland**

**Acid sulfate soils are soils with elevated content of Sulfur and consisting of an oxidised acid horizon (actual acid sulfate soil) and / or a non-oxidised (reduced) sulfide-bearing horizon (potential acid sulfate soil).**

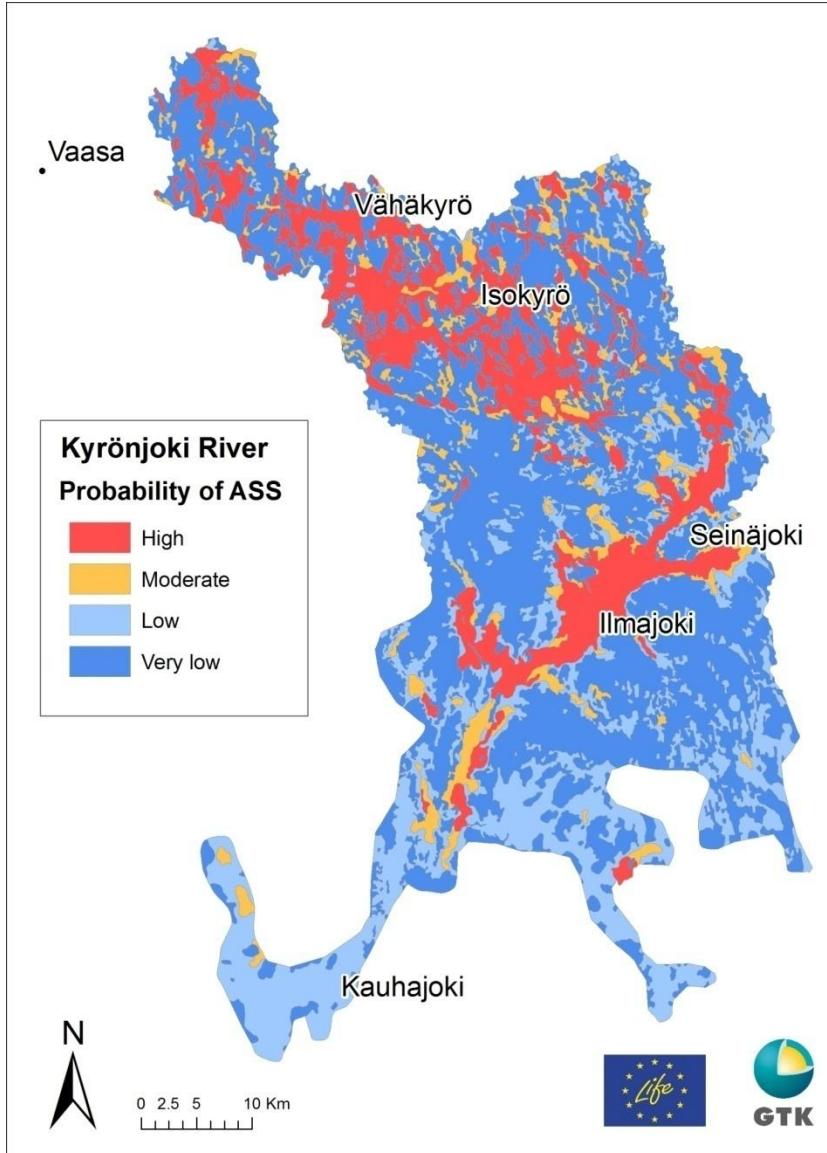
**Acid sulfate soils are usually gyttja-containing, fine-grained soils (clay or silt).**

## Actual Acid Sulfate Soil (AASS)

- field-pH < 4,0 as a result of oxidation of sulfides and measured directly from the sample of oxidised minerogenic sediment or gyttja (not peat)
- if pH is 4.0-4.4 and there is no observation of underlying sulfide, further determinations are required (incubation or Sulfur content)

## Potential Acid Sulfate Soil (PASS)

- Sulfur in the form of sulfides (reduced)
- pH  $\geq$  6.0
- $S_{(tot)} \geq 0.2 \%$
- incubated pH  $\leq$  4,0 and drop more than 0,5 units compared to field-pH



General map showing probability for ASS. Not for use at property level!

# RISK CLASSIFICATION OF FINNISH ACID SULFATE SOILS (GTK, ÅA ja HY)

## 1. Sulfides occur

CLASS 1	STARTING DEPTH OF PASS (m)
1	0-1,0
2	1,0-1,5
3	1,5-2,0
4	2,0-3,0
5	sulfides entirely oxidised
6	no sulfides at 0-3 m depth

Mapping depth 3 m

Classification for a site / sample is given in this form:

**Sulfides starting depth / pH<sub>min</sub> / S(tot)**

E.g., **2 / A / II**

## 2. Field pH<sub>min</sub>

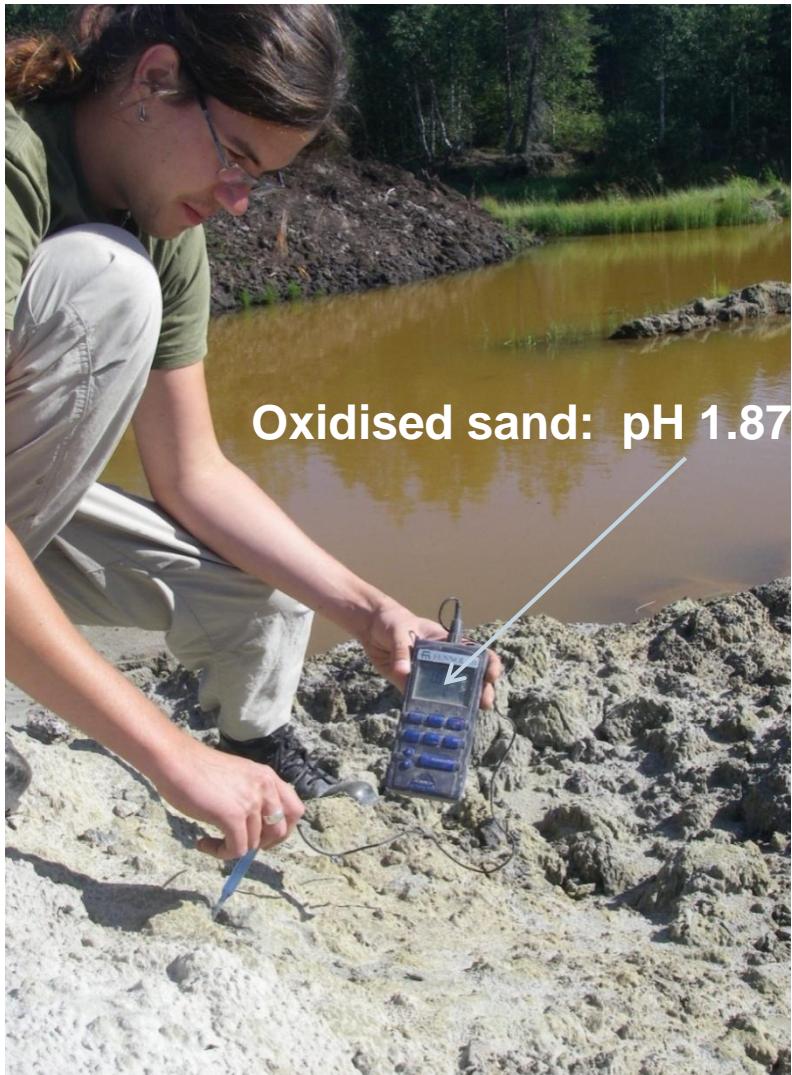
CLASS 2	Minimum pH (0-3 m depth)
A	< 3,5
B	3,5 - 3,9
C	4,0 - 4,4
D	≥ 4,5

## 3. Sulfur (complement)

COMPLEMENT	Total S-content (%)*
I	S(tot) ≥ 1,0 %
II	0,6 % ≤ S(tot) < 1,0 %
III	0,2 % ≤ S(tot) < 0,6 %
IV	S(tot) < 0,2 %

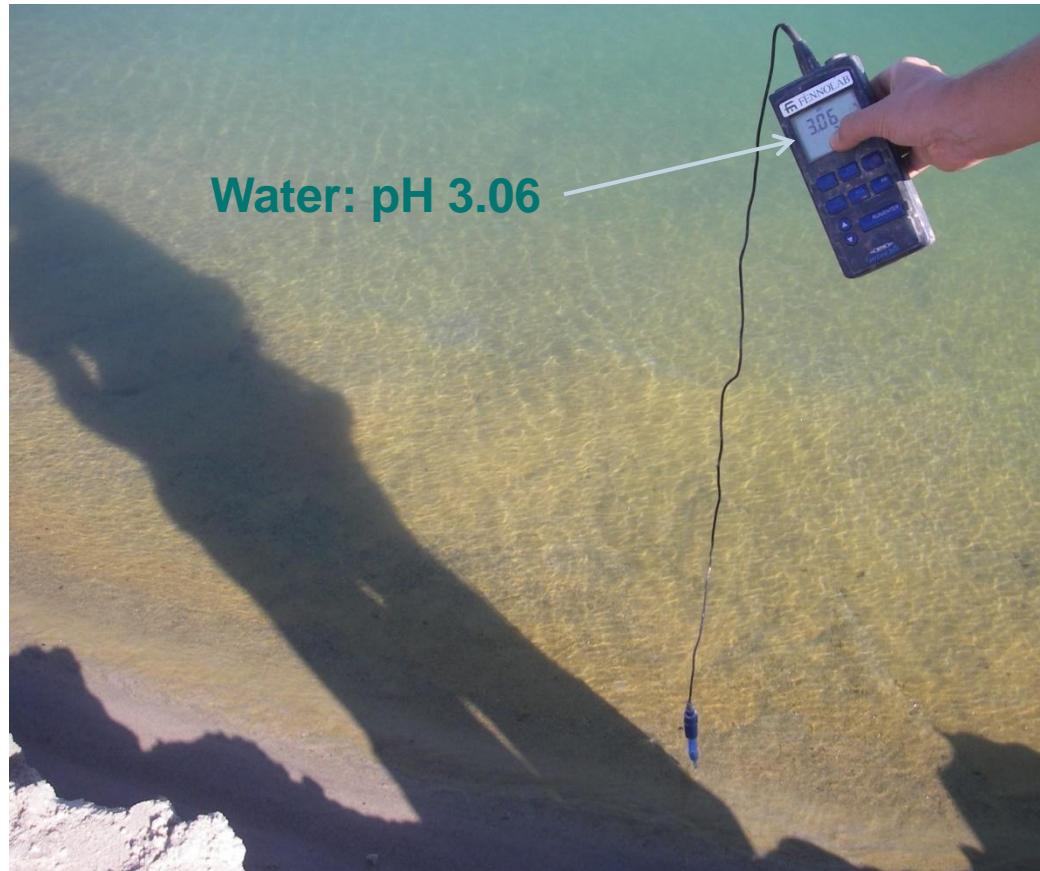
\*Given as the mean for the uppermost 40 cm of the sulfidic (PASS) horizon

The Definition and Classification have not been finally tested in practice! E.g.:



New in Finland! Acid sands!  
 $S < 0.1\%$ . Fish kills reported.

And sulfidic till!?



**THANK YOU**

**TACK**

**KIITOS**



Peter Edén