

Do we as practitioners have a general challenge with leaking wells causing cross-contamination to deeper aquifers?

Swedish and Danish results and paths forward

NORDROCS
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Background

What is a leaking well

Leaks are caused by:

Missing or improper sealing

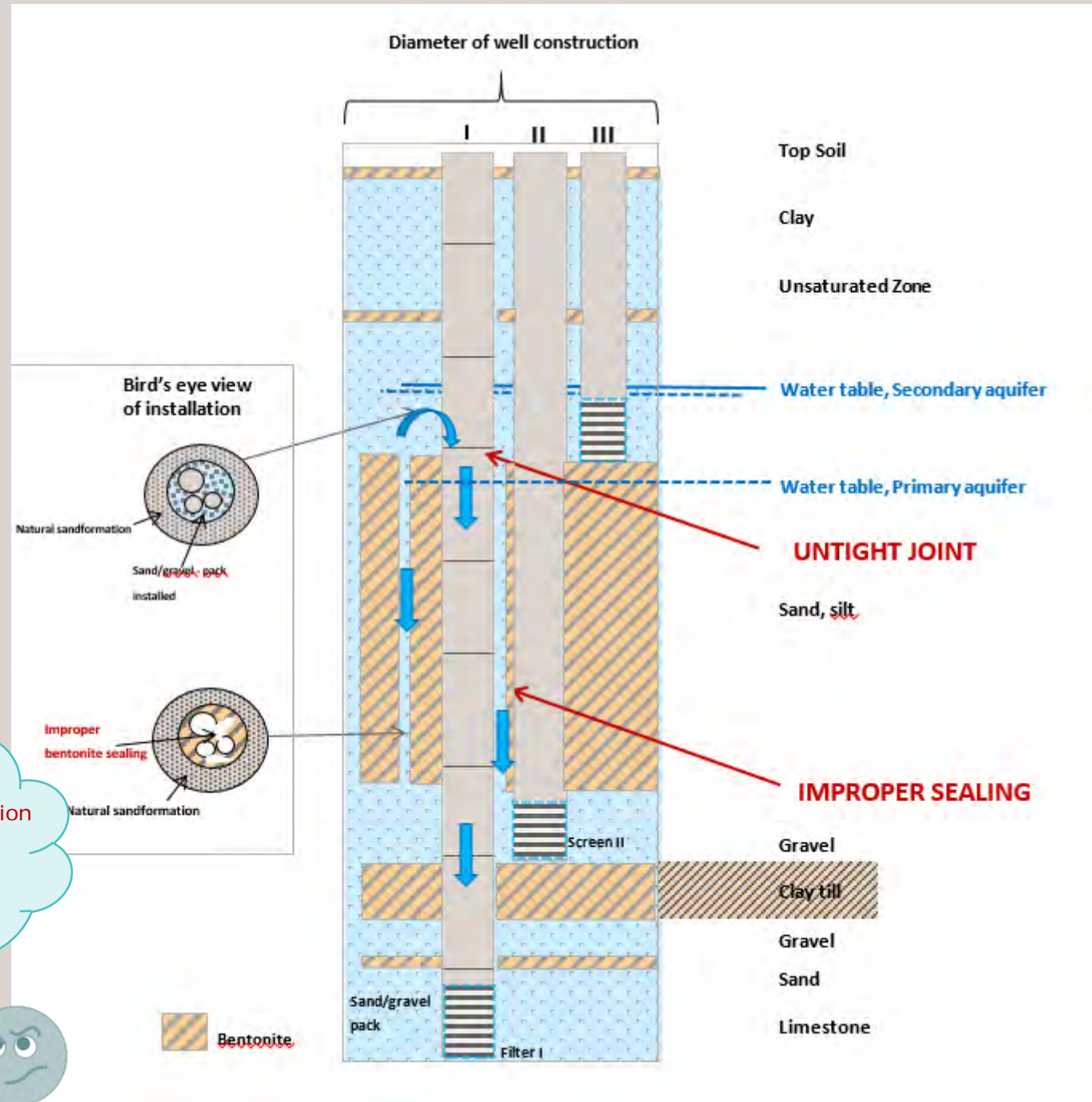
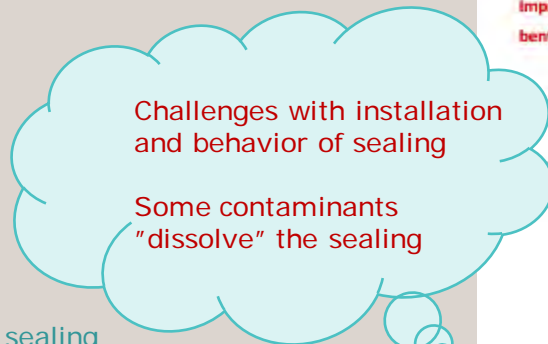
Joint of well casings that are not tight

Leaking wells causes:

Wrong conclusions and risk assessments



Example of channels within bentonite sealing



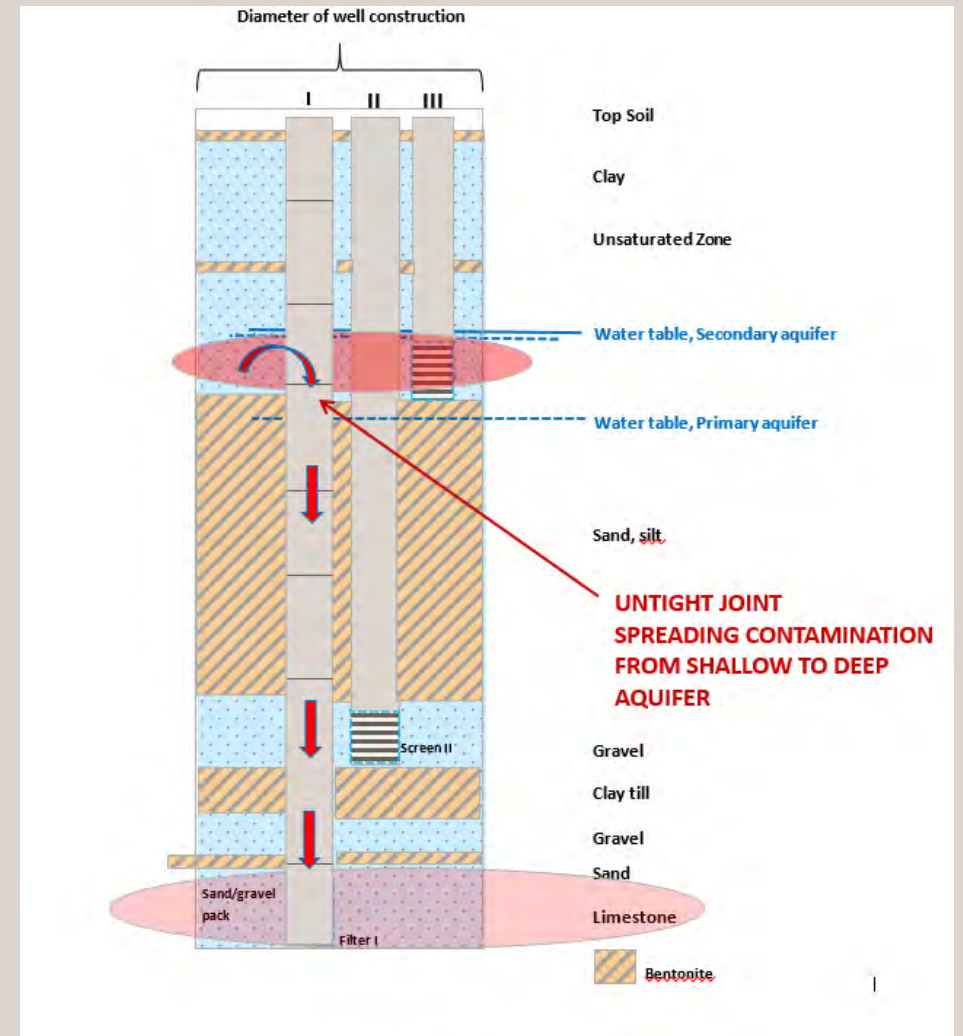
Why is this important

There is a risk of making wrong conclusions and the risk of spreading contamination

- **We risk a false positive result**
Contamination of samples caused by well construction

We introduce a contamination to uncontaminated aquifers

- **Consequences**
Waste of money for further investigations and / or unnecessary remediation
- Possible risk for nature end people



Why is this important

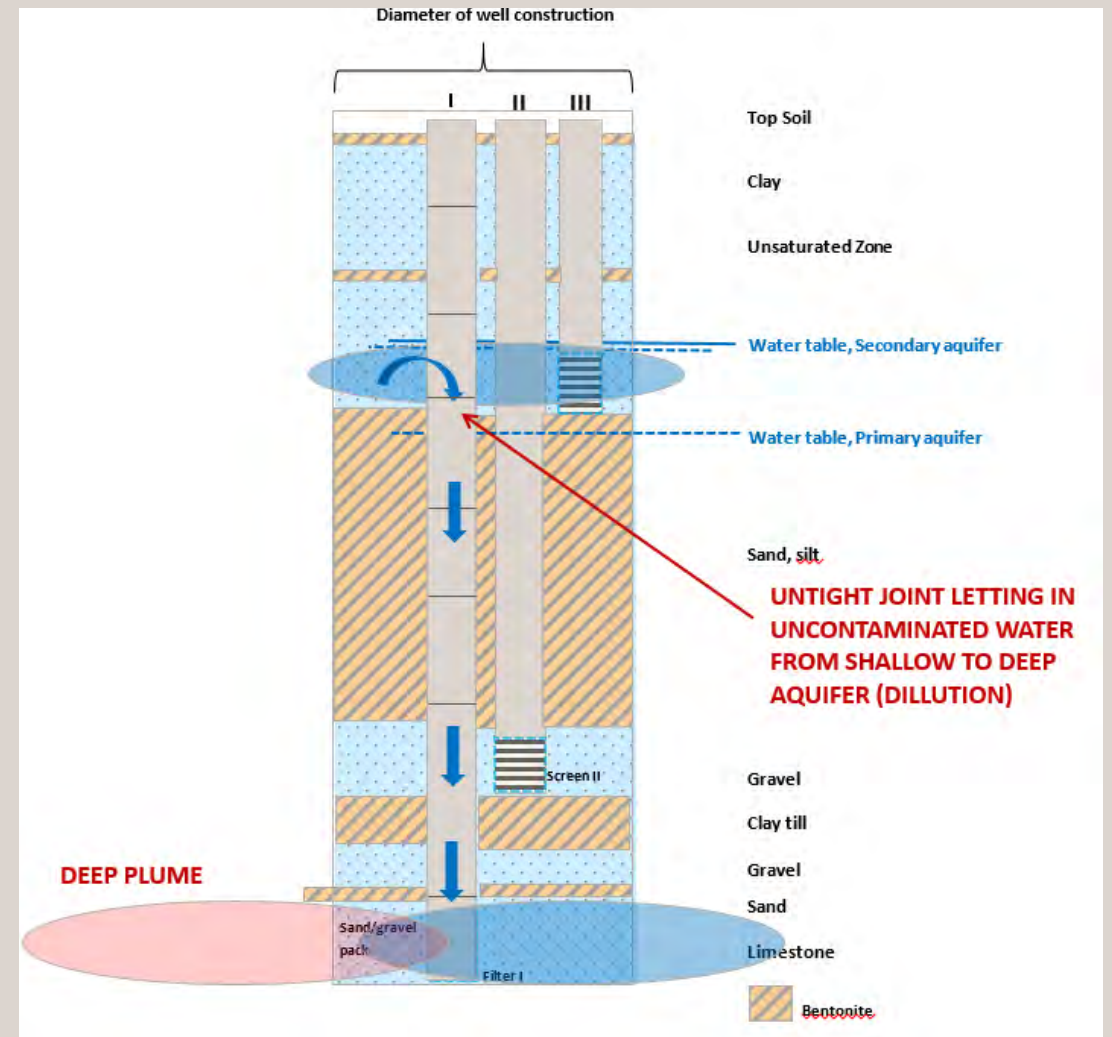
There is a risk of making wrong conclusions and the risk of ignoring contamination

- **We risk a false negative result**

Contamination diluted by clean water leaking in through the well construction

Contamination ignored

- **Consequence**
Risk for nature end people



Leaking wells do exist

When we look for leaks – we find leaks



Joint 14 meters below surface

Precipitation drips from water seeping in through joint



Broken casing 6 meters below surface

Contaminated groundwater dripping into casing and continues to screen in primary aquifer

Leaking wells do exist ...and it is not only a problem from the past!

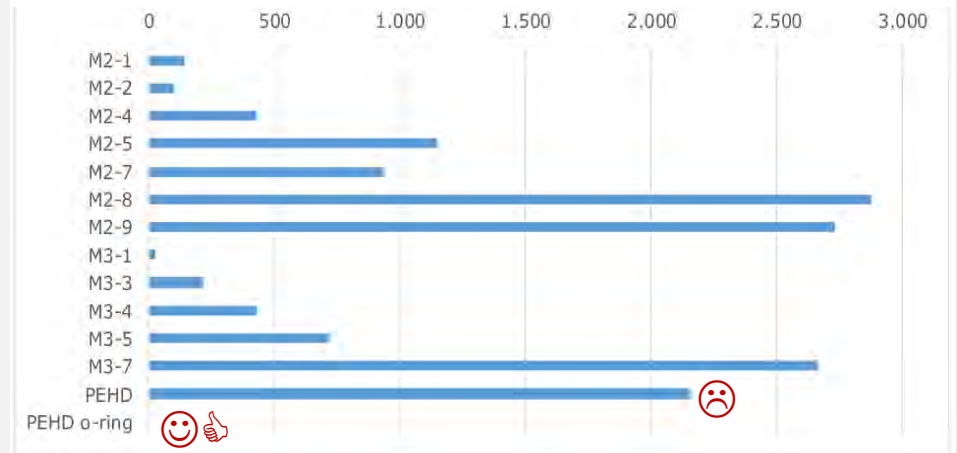
When we look for leaks – we find leaks



Video from well in Sweden
Droplets of DNAPL leaking through un-tight joint at top of screen 8,7 meters below surface



Leakage out of joints in **liter per day** at 1 meter water column



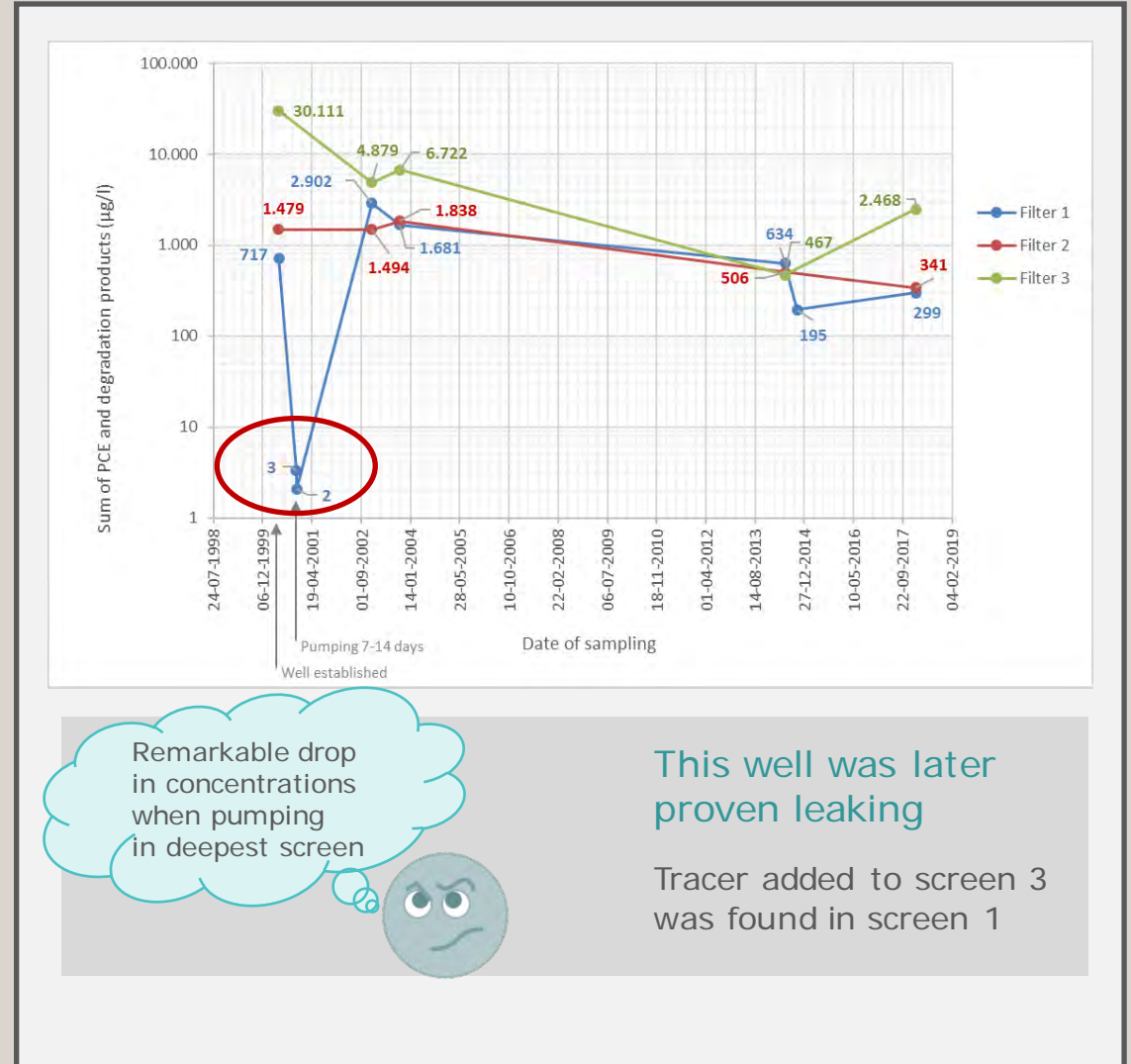
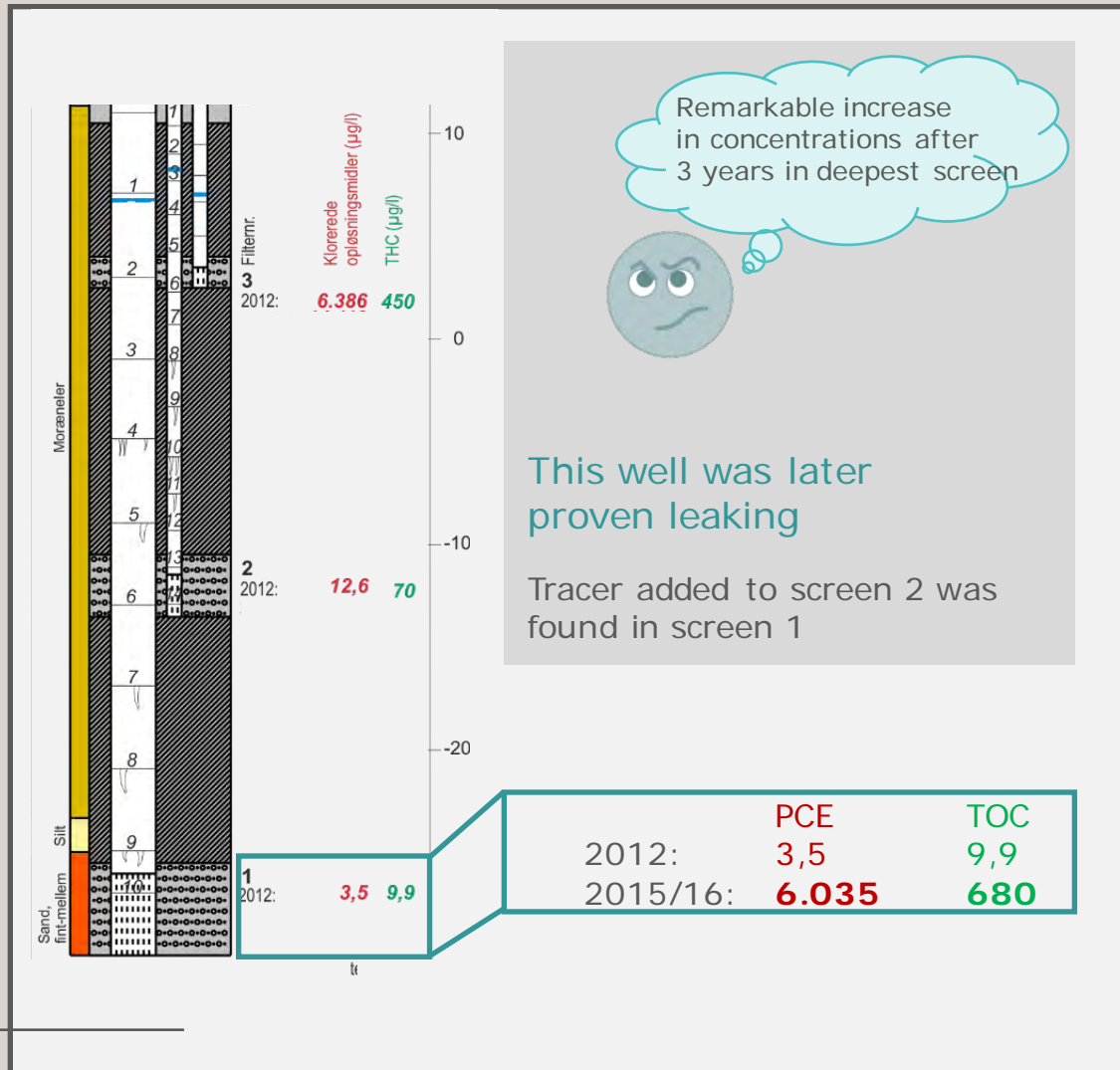
Experiment with joints from deep well in Denmark.
Between 100 and 2.800 liter water per day leaking out of joints per day

Use O-rings with your PEHD joints



Recognizing a leaking well

Be sceptic to your results - water samples taken over time or during pumping



Methods used to recognize a leaking well

Easy and available tools

- Video-inspection
- Pumping test
- Geophysical borehole logs
- Packer test
- Tracer tests

Video-inspection



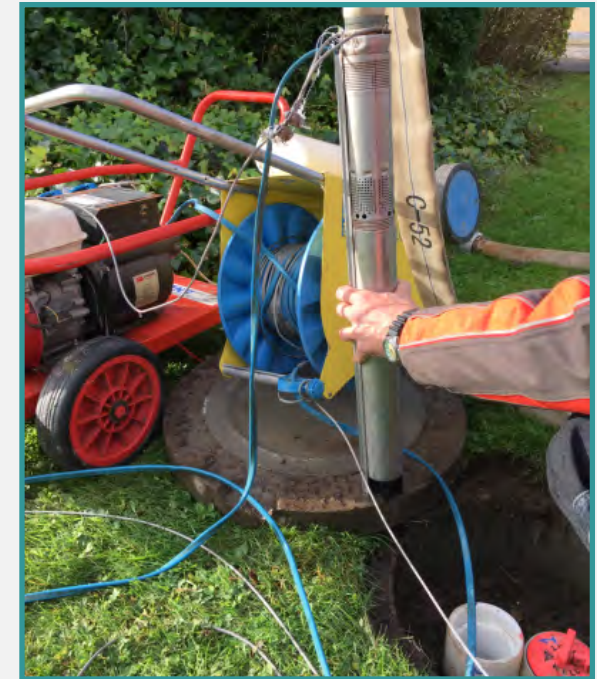
Tracer test



Packer test

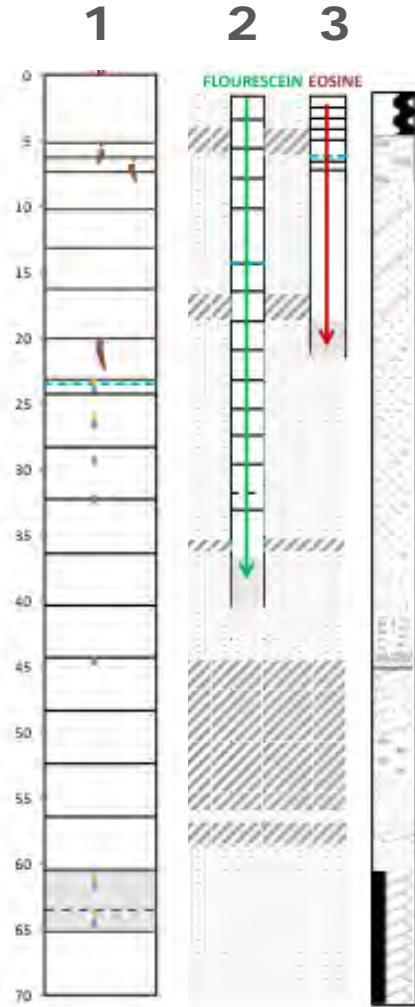


Pumping test



Tracer test used to prove a leak in well construction

Contamination in deep screen was a false positive – caused by well construction



What we did to test

- 2 different tracers were added to shallow screens (**2&3**)
- Passive samplers installed in water column of deep screen (**1**)
- Monitoring Background & 3 x in the following

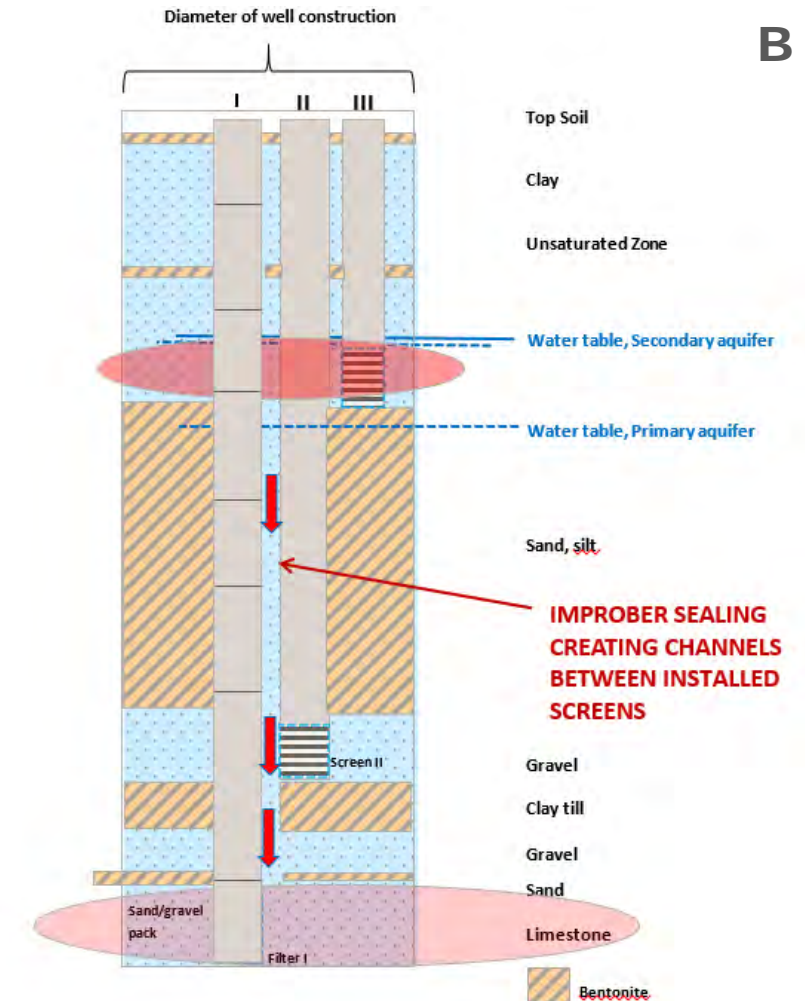
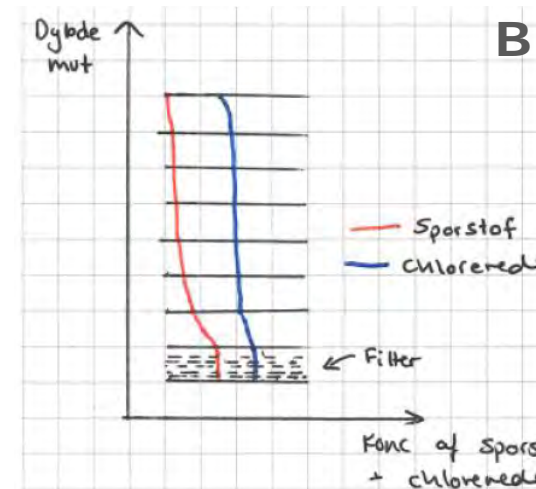
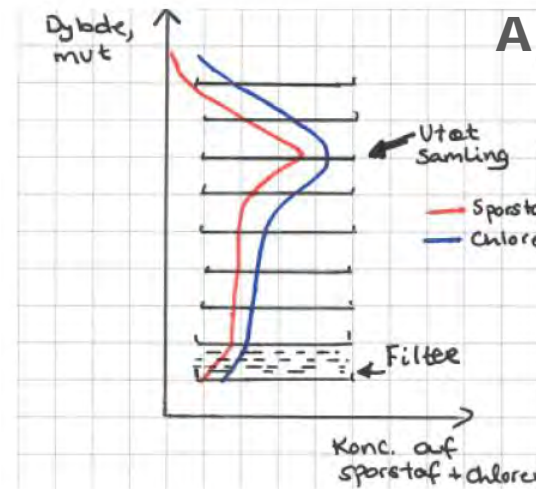


Tracer test used to prove a leak in well construction

Contamination in deep screen was a false positive – caused by well construction

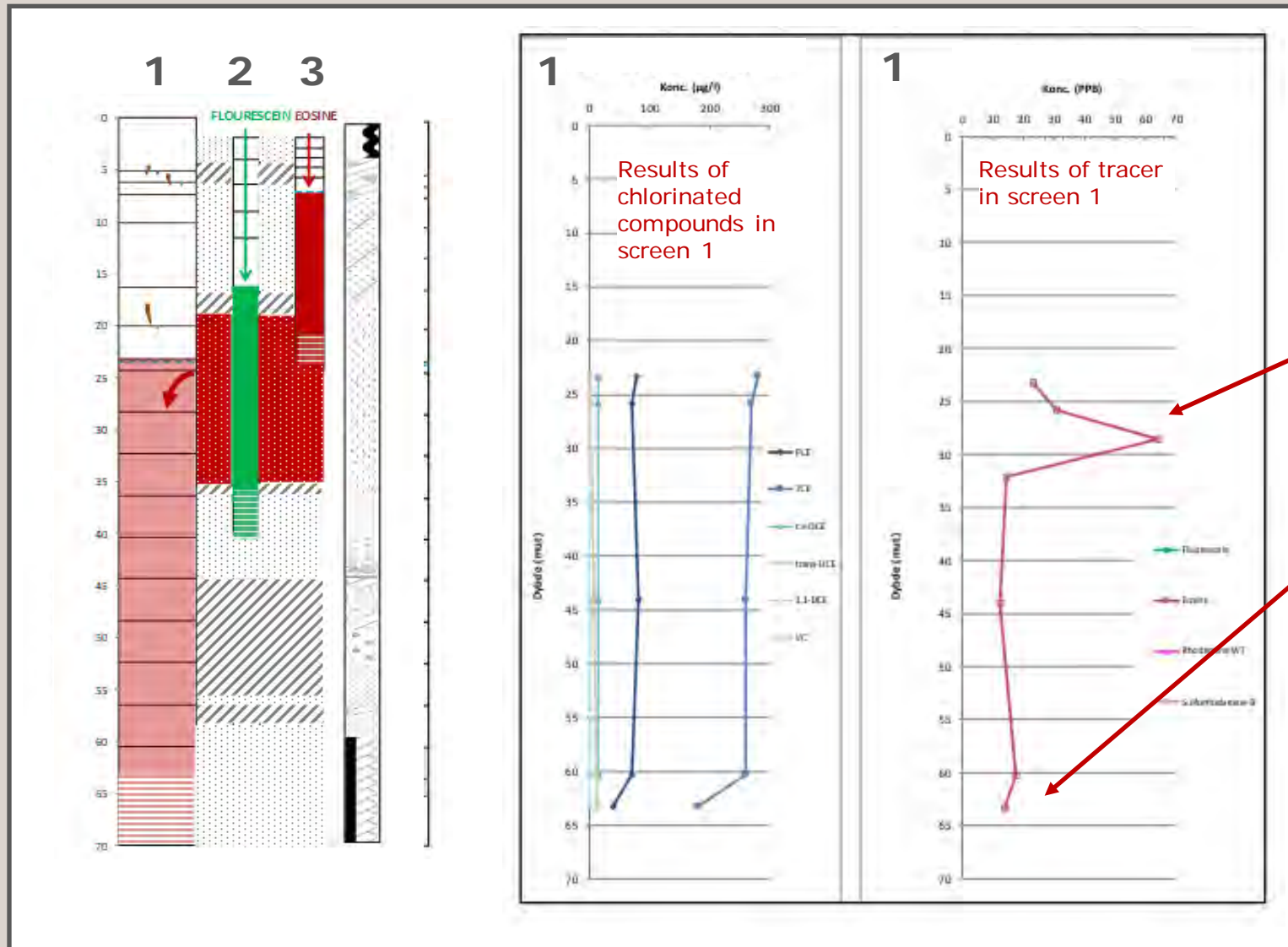
Questions we wanted to answer

- Was there a leak from shallow aquifer to deep aquifer?
- How would results look if the leak was caused by:
 - **(A)** untight joint
 - **(B)** improper sealing



Tracer test used to prove a leak in well construction

We avoided to drill deep wells and thereby avoided to spend >300.000 DKK or more



Results showed clearly

- Untight joint causing shallow groundwater to enter deep aquifer

Tracer entering through untight joint

Tracer & PCE diluted in deep screen
uncontaminated groundwater passes horizontally through the screen

What can consultants do now?

Consider the need for drilling and analyze the situation

- Use the **precautionary principles**
 - Make a risk analysis regarding the need to drill in heavily contaminated areas
- Always **use sealing materials** in full depth when installing wells
- Consider to **abandon and seal the well compliantly** if it was unintended located in a hot-spot
- **Choose** sealing material according the location
 - Avoid bentonite pellets in unsaturated zone
 - **We will gain more knowledge in the near future about this...**

Danish study is carried out

(Initiated by COWI, GEO, NIRAS, ORBICON)

Sponsored by Regions, Miljøstyrelsen, ATV, AVJ, TUP)

What can consultants do now?

Avoid making new leaking wells

- Avoid more than one screen per well
- Right method of applying the sealing materials
- Be aware of pipe materials and if joints with O-rings can be used
- Don't leave wells at location for longer time than needed
- Make right demands on the drilling-entrepreneur
methods and materials to use and how to document the installation procedure
- Monitor amount of sealing material used

An available method to seal a drilling

You don't have to wait

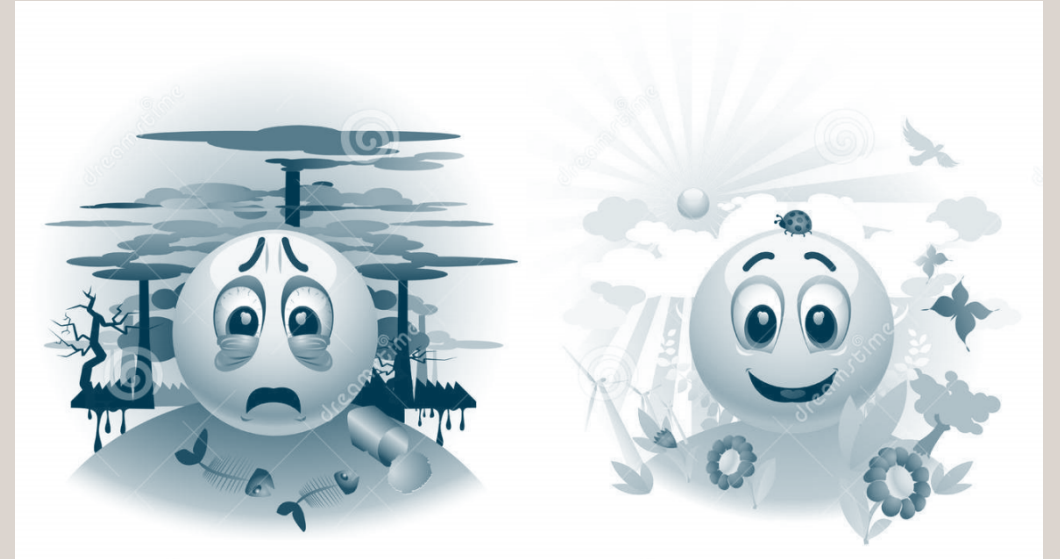


- A liquid sealant product based on mixture of cement and bentonite is pumped in a hose from the plastic tank to the bottom of the drilling through the casing
- This is an alternative to bentonite pellets – it can be used already today
- The method has a much better chance to fill out all available spaces and make a proof sealing

Wish list forward

We as practitioners wish to have guidelines

- **Improvements** of well-installation material and methods
- **Guidelines** (e.g. from Swedish Geotechnical Society)
- **Authorities who requires** that best available materials and practice is used



We don't wish to risk introducing more contamination when we work to investigate and reduce contamination

Thanks for listening!

Please find us to discuss it further in the future!

Thanks to:

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