

Step-by-step investigations and remedial actions at a former industrial dry cleaner in Boden, Sweden. Lessons learned.

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SGU:s assignments with contaminated land

- Sites from former government operations
- Sites with no legal liabilities
- Bedrock storages of petroleum products

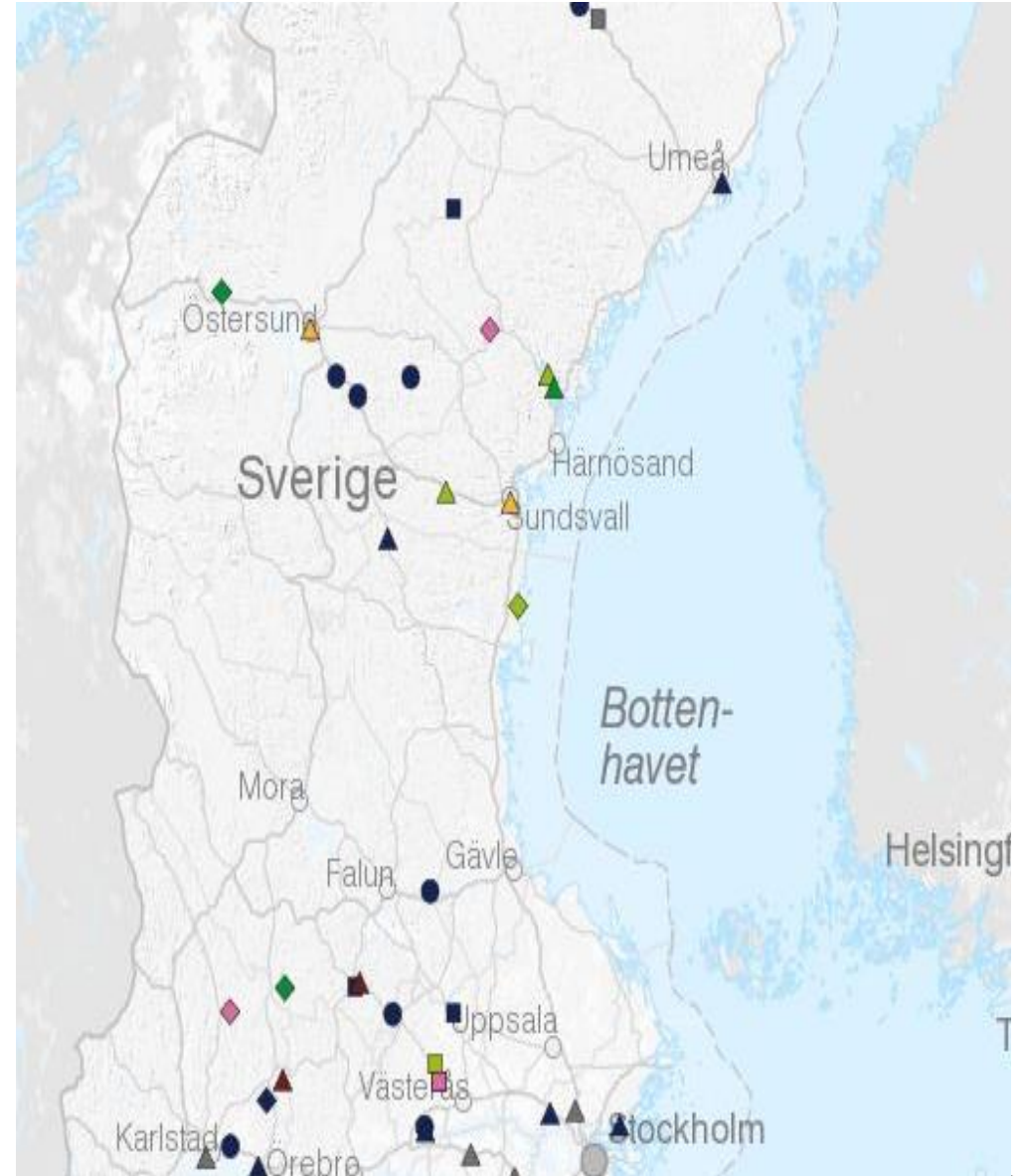


Sites in our portfolio – different characters

Complex sites:
CVOC

Uniform sites:
Forest nurseries, (DDT)

Medium complexity,
Military firing areas



The former industrial dry cleaner in Boden

- 1948 to 1980
- Initially varnolen (kerosene)
- PCE between 1970 and 1980
- 400–800 tonnes of PCE
- Wash water to the municipal sewer

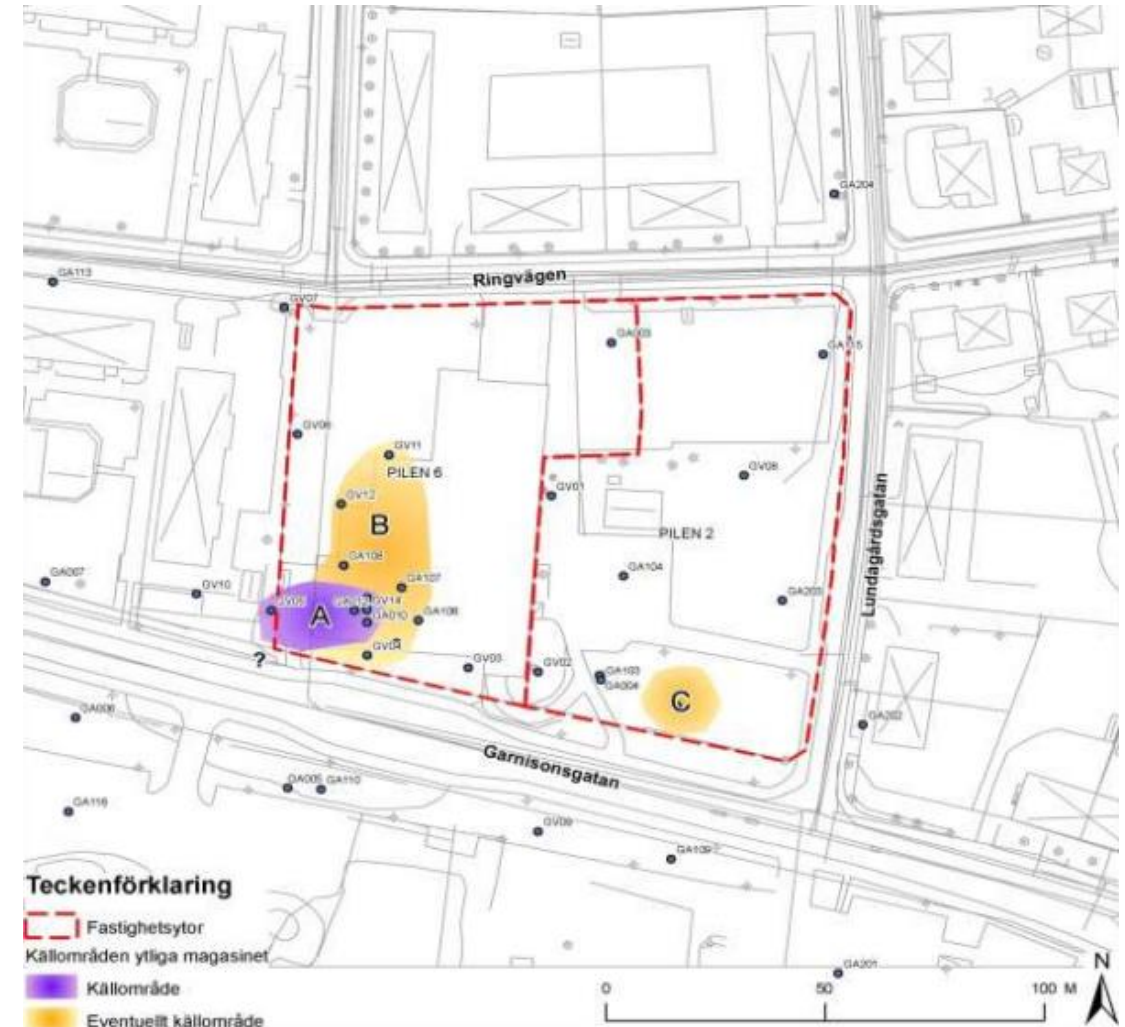


Early assessment of the contamination situation

- Few, scattered investigation points
- Auger drilling
- Standard soil intervals
- Mainly laboratory analysis

In retrospect:

- limited achieve research
- Low sampling resolution
- Substandard conceptual model
- No delineation of source areas



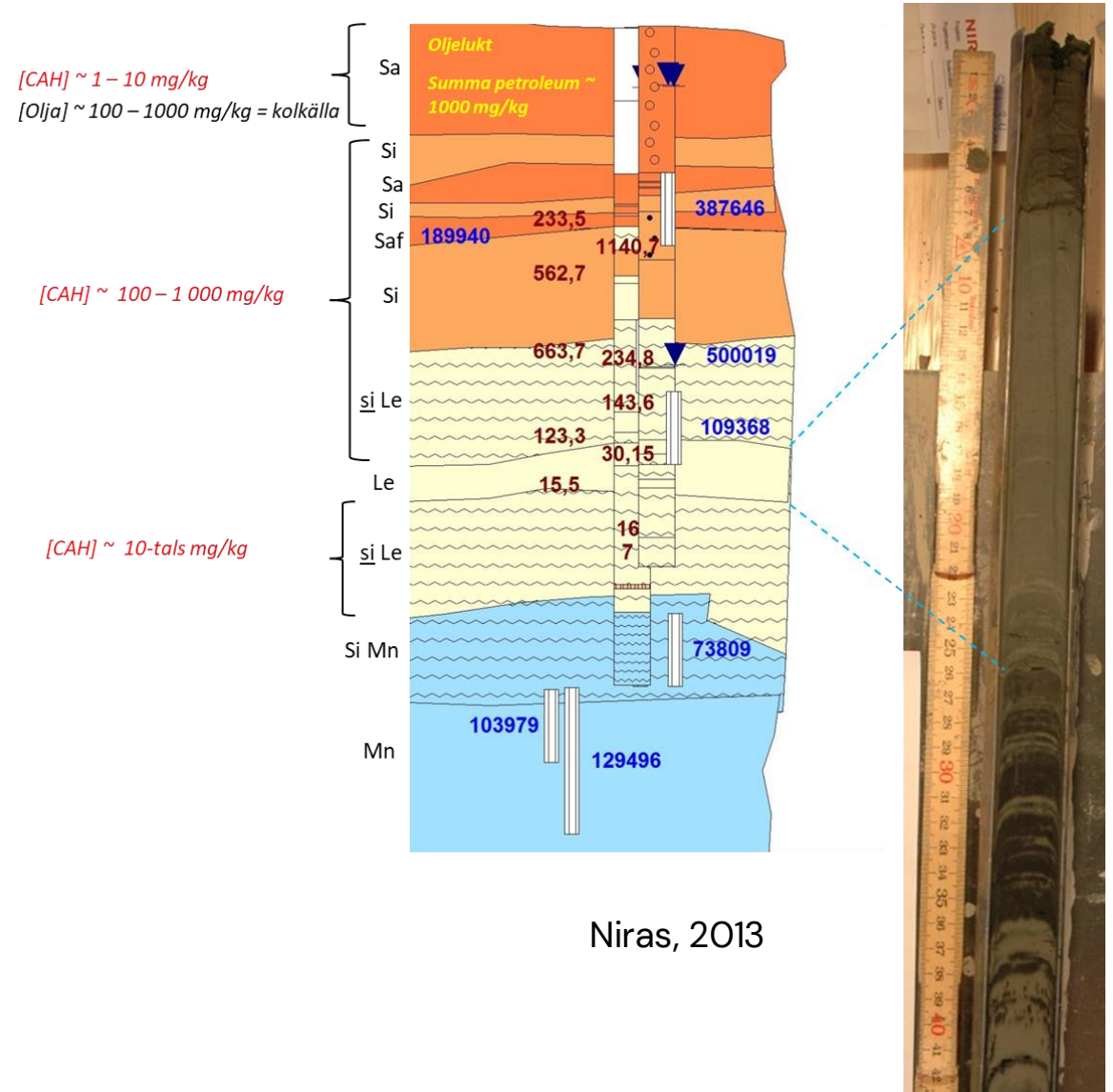
Pilot testing in identified source area

10 x 10 m test area.

Detailed characterization with
MIP probing and soil coring

Complex soil conditions
Vertical leakage through clay
layers

Injection of ZVI and carbon
source

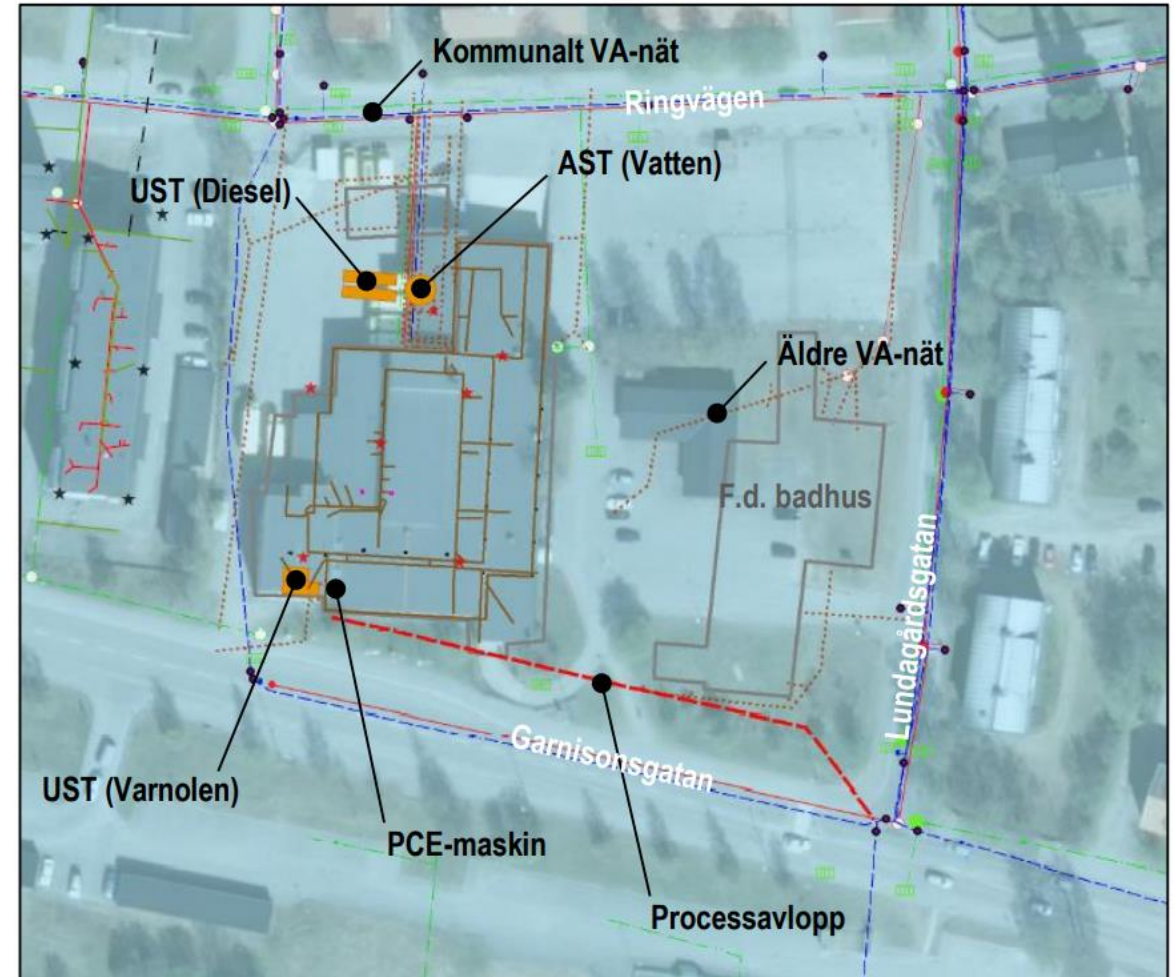


Back to basics prior to detailed investigations

Archival research

Significant findings:

- Utility for wash water
- Other utilities in the area
- Two UST
- Possible piles under main building
- Also, a former adjacent building on piles



Detailed investigations

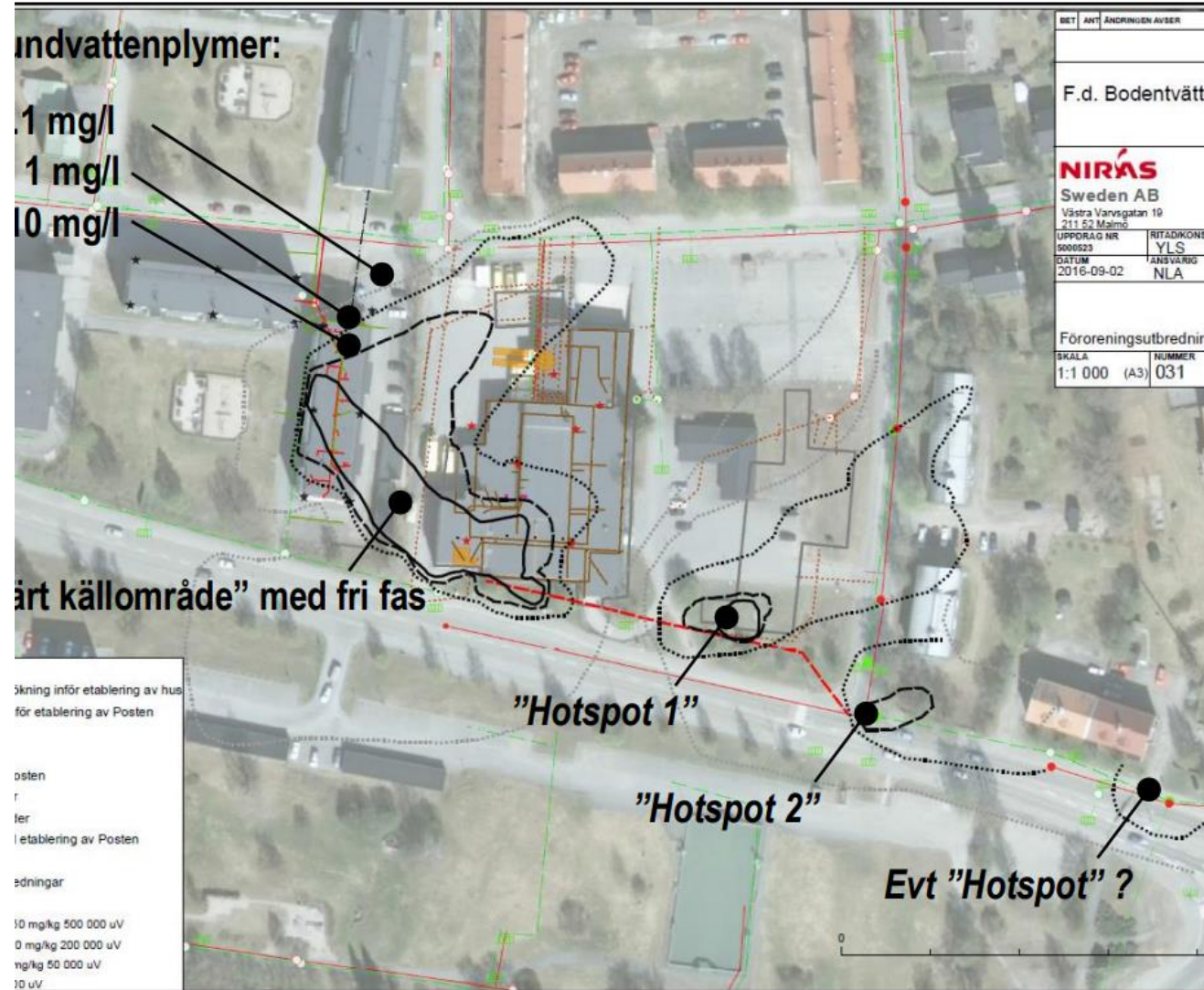
Annual surveys 2013 – 2019:

- MIP/MiHPT probing
- Core sampling
- Pore gas
- Gas surveys in utilities, outside and indoors
- Predrilling for MIP probing in underlying moraine
- Search excavation of possible forgotten utilities



Niras, 2016

A completely new and detailed understanding



More than 2 new hot spots!

Leakage from the utility pipe at 3 points

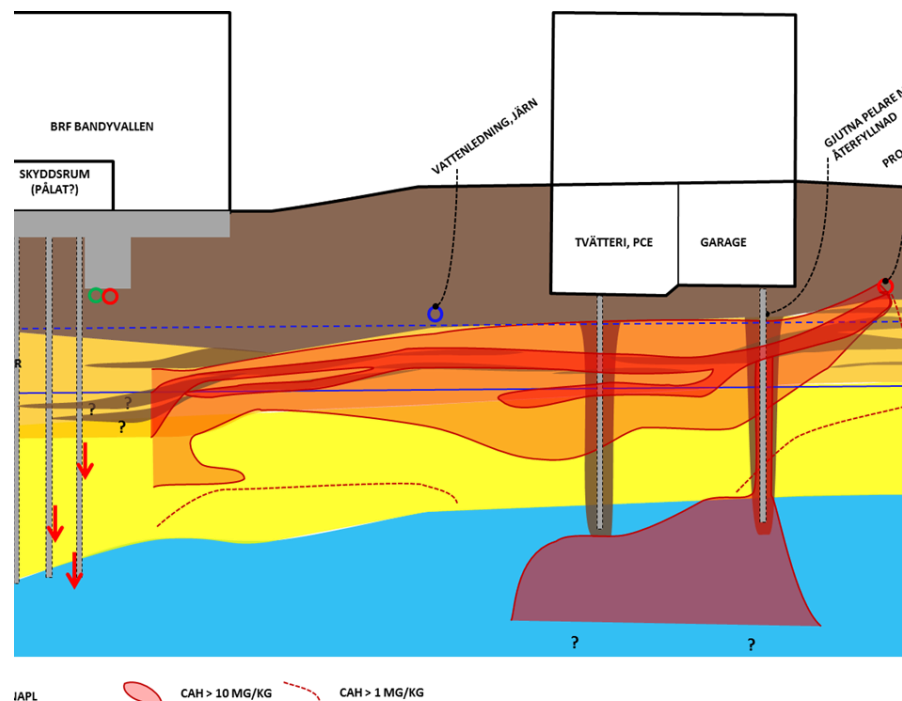
Shallow groundwater flow towards the NE

At Hot spot 1 old piles had caused a deeper migration.

Also next to Hot spot 2 the clay layers had been perforated.

At Hot spot 2 the utility pipe was connected to the municipal sewer system.
Possible additional hot spots

A completely new detailed and precise understanding



Niras, 2016

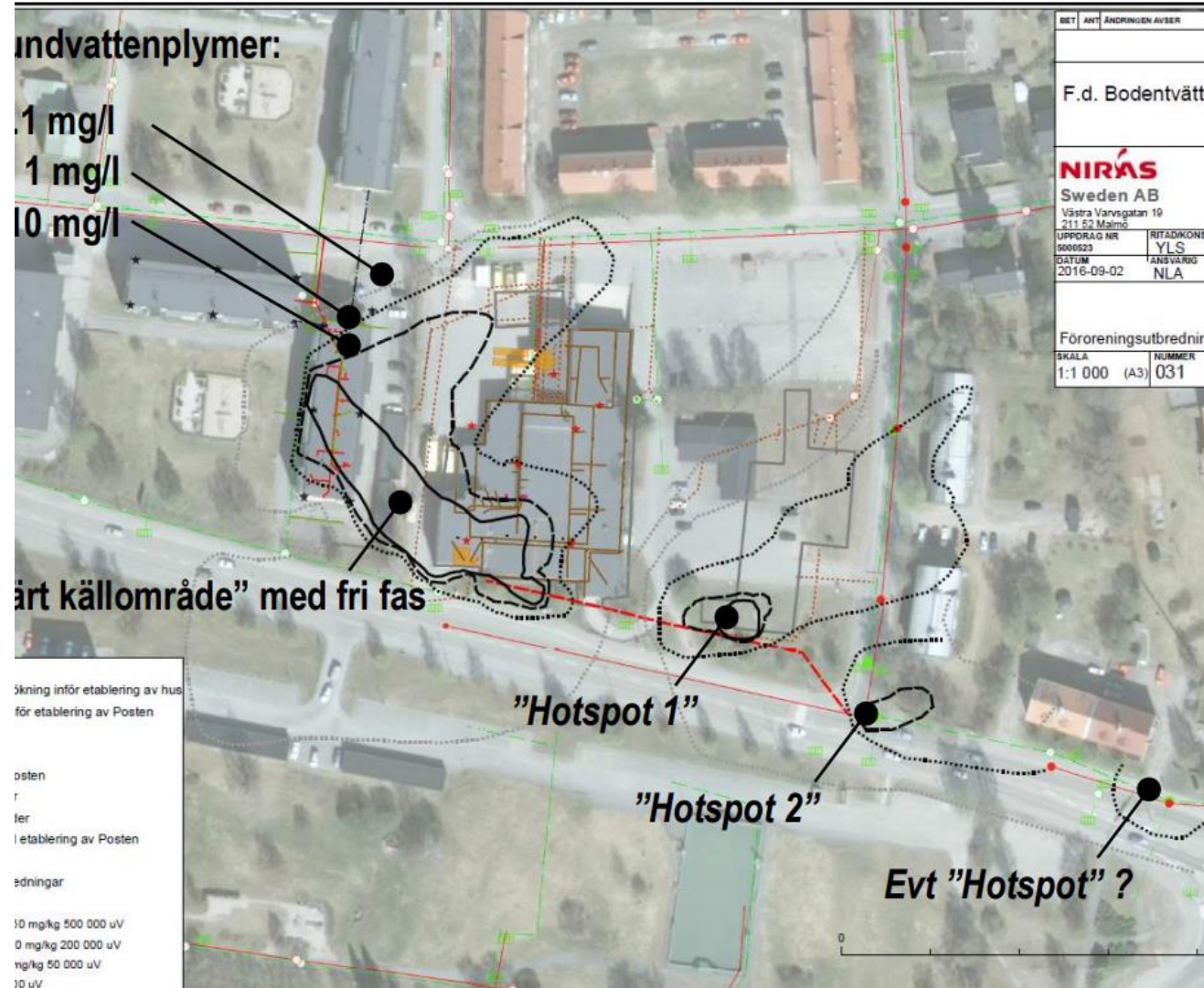
A continuous clay layer in the area (yellow)

A horizontal distribution of DNAPL (red) under the building

Extensive vertical migration of PCE to the underlying moraine (blue)

The PCE mass in the underlying moraine is large.

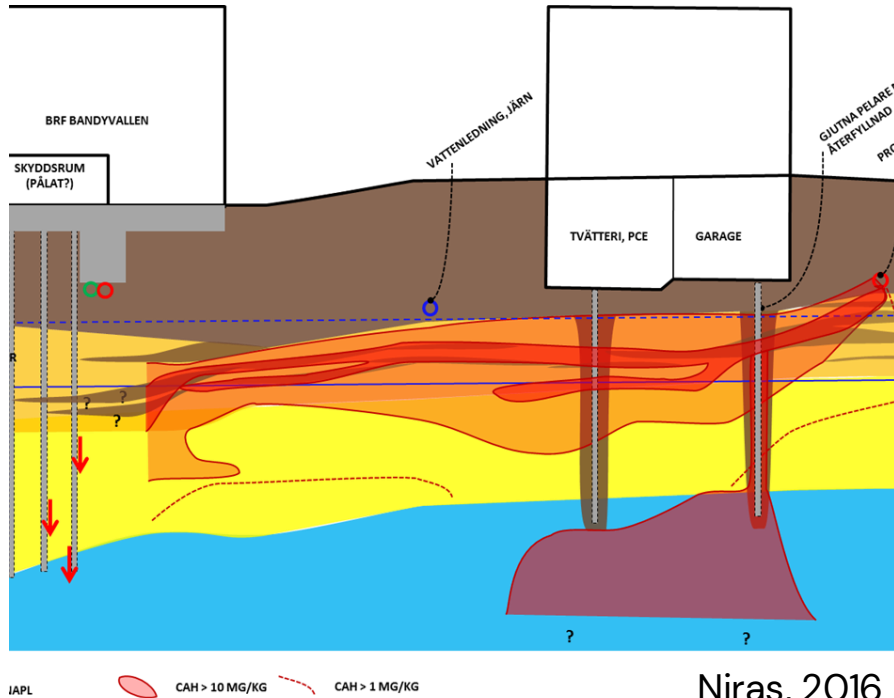
Potential risks – shallow contaminants



CVOC gases in indoor air in adjacent residential buildings.

- Below threshold values in the houses to the east. Highest concentrations 2 floors up!
- In the adjacent western building exceeding PCE gas concentration on the first floor, only.

Potential risks – deeper contaminants



Factors:

- A continuous clay layer exists in the area
- A downward gradient from the upper soil layers
- No existing groundwater extraction in the moraine.
- Moraine thickness up to 60 meters.
- None existing geoenery wells in the bedrock in the area.
- Estimated CVOOC flux in the moraine to the nearest surface water is not significant.

Conclusions:

- The deeper contaminants possess no health and nor environmental risk.

Remediation have been performed in several stages

An as soon as possible approach:

- 2018 – Excavation of Hot Spot 1
- 2019 – Exploration shaft and plugging of old pipe at the adjacent building
- 2023 – Excavation of Hot Spot 2
- 2024 – Demolition of the entire former dry cleaner building
- 2025 – Excavation of the upper soil main source area
- 2025 – Injection of ZVI and carbon source with directional drilling under the adjacent building



Convius Consulting, 2025

Lessons learned

Some of our lessons learned from the investigative phase

- Always search the archives
- Field investigations best conducted in stages – can take several years
- A high Q&A standard is essential
- Get an early understanding of potential health risks, and environmental risks
- Do not settle for inconsistencies in the data or vague assumptions
- A sufficiently detailed characterization of source areas is necessary prior to any assessments of remedial alternatives

Some of our lessons learned from the investigative phase

In terms of procurement:

Set clear goals for the consult's assignments. For example:

- Clarify the presence of pipes from property XX and their effect on dispersion of the CVOCs
- Clarify whether there are potential health risks in residential buildings
- Delimit and characterize the source contaminations sufficiently to be able to carry out a meaningful remedial alternatives analysis

Value skills and experience, when appropriate, rather than hourly rates

Where appropriate use a separate client support as an opportunity to broaden the perspectives

Some of our lessons learned from the remediation phase

Generally

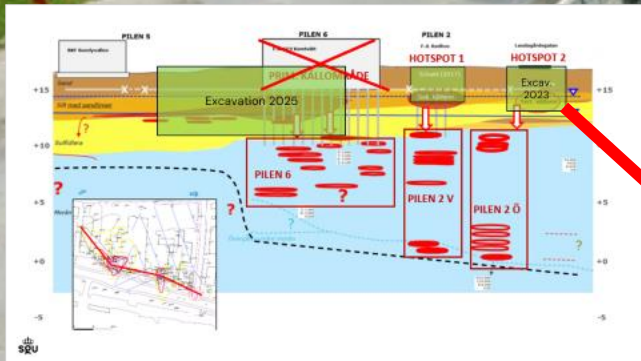
- When transitioning to the design phase. Reorganize the team?
- However, retain the knowledge on risks

Excavation:

- Don't underestimate the role of the client's construction manager
- Delimit the excavation area in advance if possible

In situ

- Carry out pilot trials when choosing technologies other than thermal remediation
- Decide early in the design phase appropriate form of contract (performance or design and build contract)
- There is a challenge with public procurement and patented products and technologies



What about the extensive PCE mass in the underlying moraine?



Strategy for the PCE in the underlying moraine

The conclusion of performed investigations:

This contamination means no risk to health or the environment with present land use



The proposal:

Establish areas subject to land-use restrictions

In the blue area:

- Any piling and drilling is prohibited
- restrictions on deep groundwater lowering in the upper soil layers

Within a 150 m radius:

- Drilling for the installations of geothermal heating is prohibited.