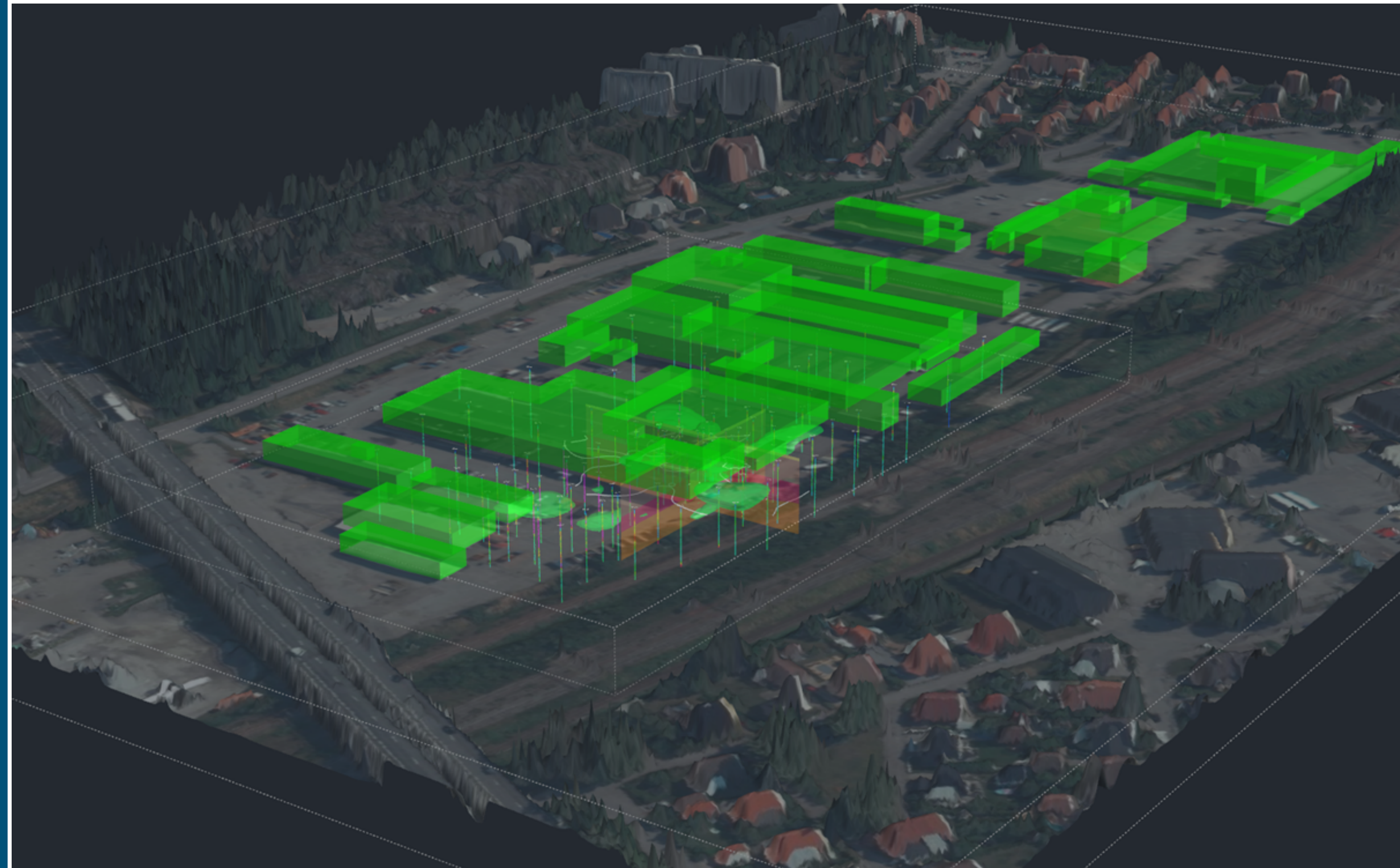




High Resolution/Remediation Design Characterization Allows Optimization of Residential Redevelopment Project



Gabriele Giorgio Ceriani
In-Situ Services Team Leader
Ejlskov A/S

Presentation Contents

- Setting the stage
- Site History and High-Resolution Remediation Design Works
- High Resolution Outputs and Lessons Learned



How can surgical in-situ bioremediation design be done if data is collected over over multiple field investigations an over many year?

Failure of remediation is often caused by lack of data

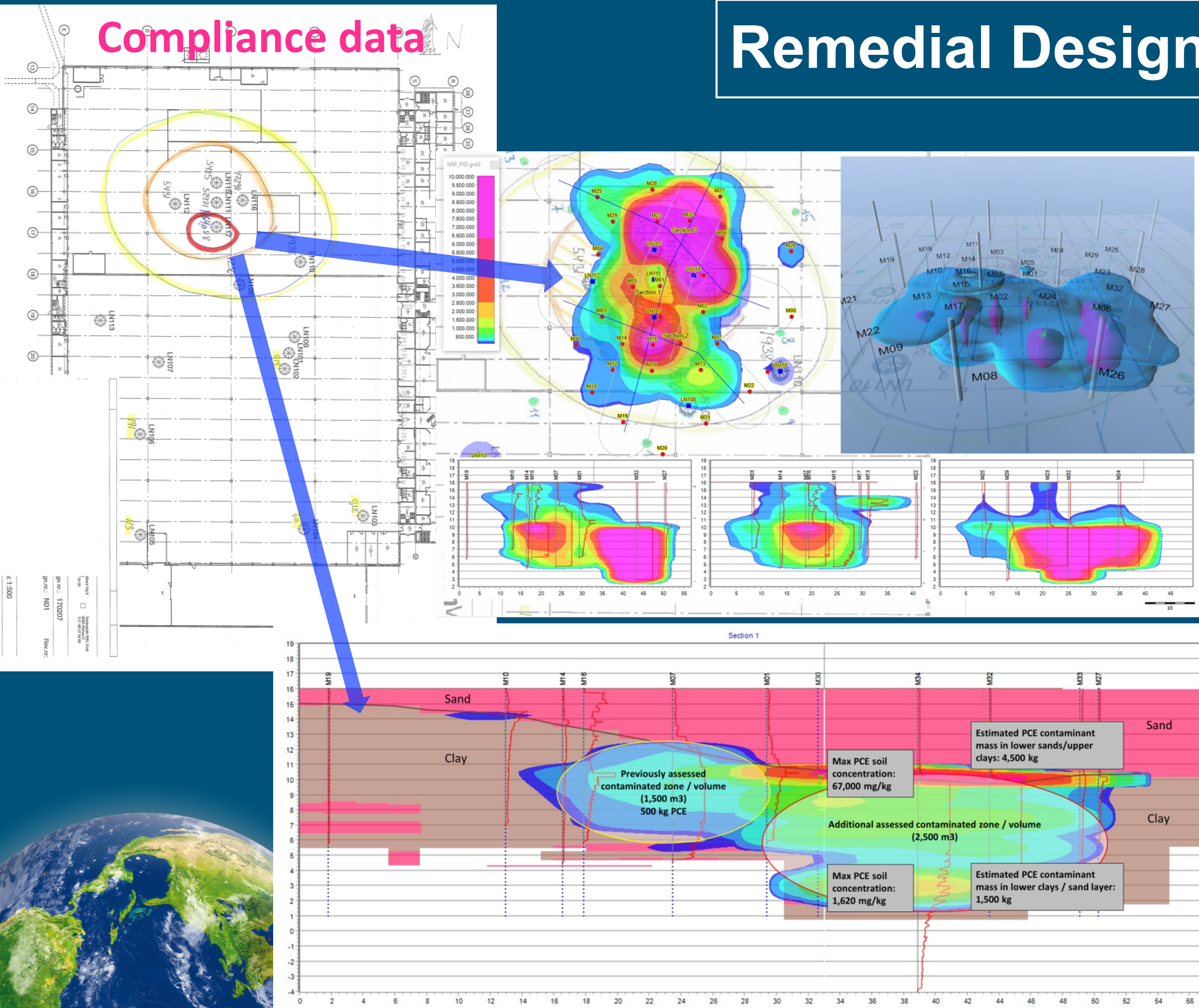


Compliance data

Remedial Design

Shifting focus from Compliance to Remedial Design

- We are often asked to design remediation from compliance data
- Problem is that compliance data is not collected for remedial design purpose
- Data collection *must serve the needs for a proper remedial design* else the risk of failure and enhanced cost are way too high.
- Bioremediation is the most sustainable and cost efficient remediation - but too often designed on limited and not for the purpose collected data.
- *As we do performance base remediation contracts* it requires that we are in control of the HRSC

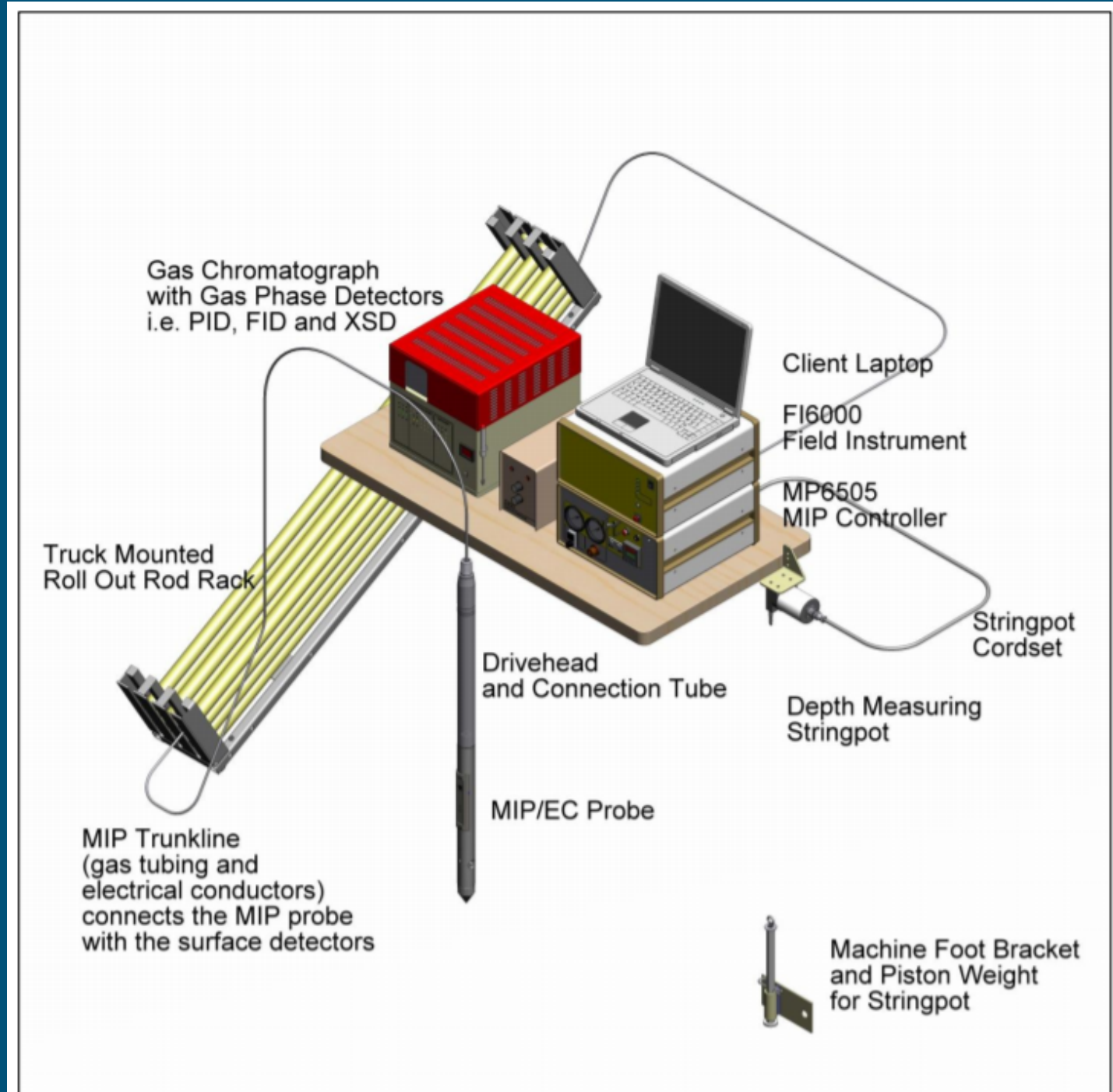
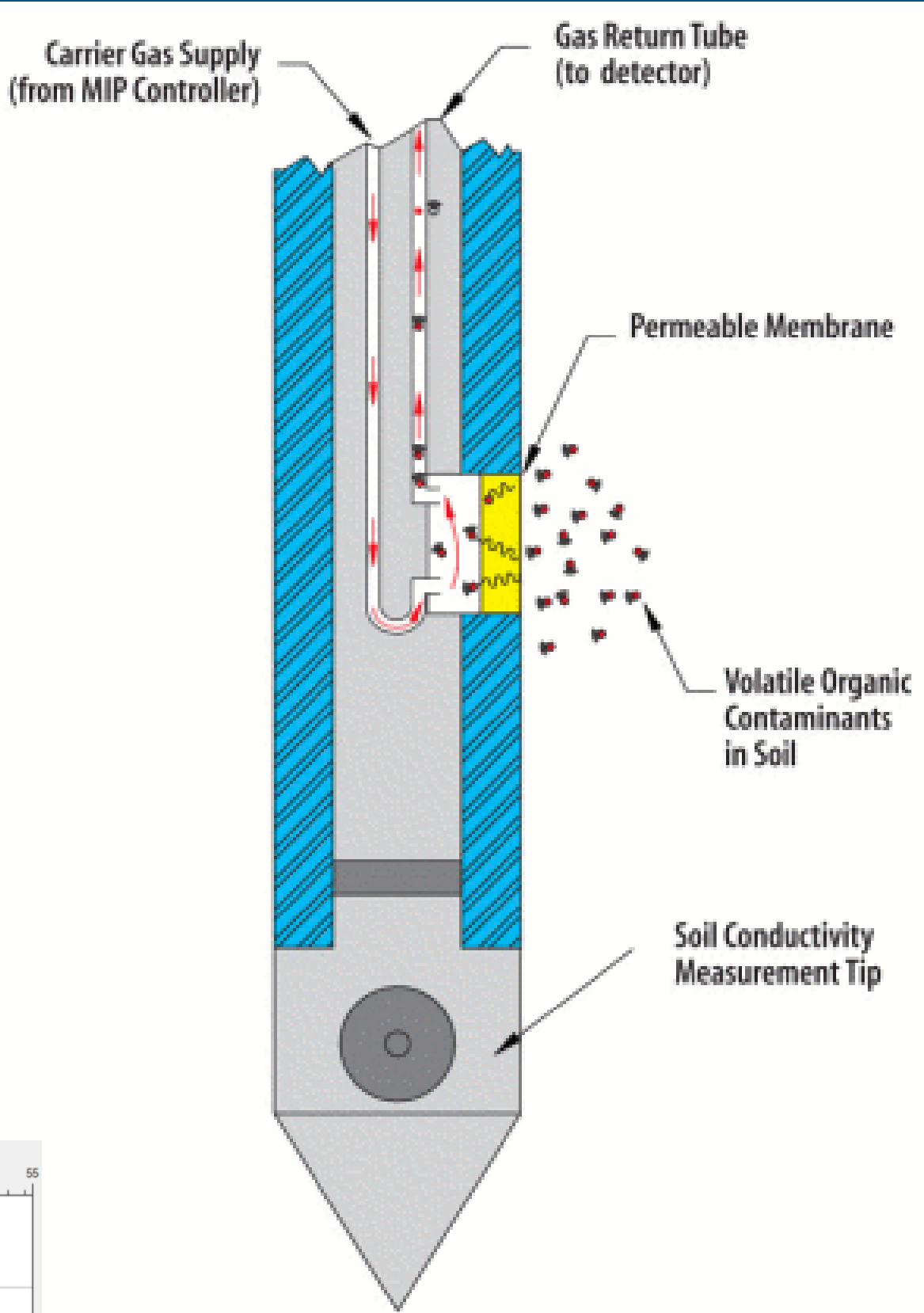


Membrane Interphase Probe (MIP) - Introduction

A system manufactured by Geoprobe Systems® for the detection and measurement of volatile organic compounds (VOCs) in the subsurface.

A heated probe carrying a permeable membrane is advanced to depth in the soil.

VOCs in the subsurface cross the membrane, enter into a carrier gas stream, and are swept to gas phase detectors at ground surface for measurement.



LIST OF COMPOUNDS ANALYSED BY RPI INC. LABORATORY

VOCs	Anions / Fatty acids	Dissolved gases
Vinyl Chloride	Lactate	Methane
1,1-Dichloroethene	Acetate	Ethane
trans-Dichloroethene	Propionate	Ethylene
1,1-Dichloroethane	Formate/Isobutyrate	Propane
cis-Dichloroethene	Butyrate	Propylene
Chloroform	Pyruvate	Isobutane
1,1,1-Trichloroethane	Chloride	n-Butane
1,2-Dichloroethane	Nitrite	Acetylene
Trichloroethene	Succinate	t-2-Butene
1,1,2-Trichloroethane	Nitrate	1-Butene
Tetrachloroethene	Sulfate	Isobutylene
	Phosphate	cis-2-Butene
Dimethyl Sulfide	Sulfide	1,3-Butadiene
MTBE		Methyl Acetylene
1,2-Dichloroethane		
Benzene		Carbon Dioxide
Toluene		
Ethylbenzene		
m/p-Xylene		
o-Xylene		
1,2,4-Trimethylbenzene		
Naphthalene		
TVPH (C5-C12)		
DRO (C12-C24)		

High density soil & groundwater data is always necessary to confirm and validate MIP qualitative data

OBS!!! MIP cannot quantify any soil or groundwater concentration nor speciate contaminants

Ejlskov ESM Software



Scene Object: 3D_Mercury_ALS_Scandinavia.grd3 (3D Grid)

General

Components

Outline

Axes

Clipping

Nodes

Voxels

Isosurfaces

Slices

Fences

☒ Active

Items

☒

50.00000

...

Volume: 367.15

Mean: 1878.38 mg/kg

V.Vol.: 635.45

Mass: 1172.4 kg, 2584.7 lb

☒

25.00000

...

Volume: 509.60

Mean: 1363.08 mg/kg

V.Vol.: 913.75

Mass: 1180.9 kg, 2603.4 lb

☒

2.50000

...

Volume: 1531.45

Mean: 459.03 mg/kg

V.Vol.: 2793.50

Mass: 1195.1 kg, 2634.6 lb

☒

0.01000

...

Volume: 6563.45

Mean: 107.41 mg/kg

V.Vol.: 11211.75

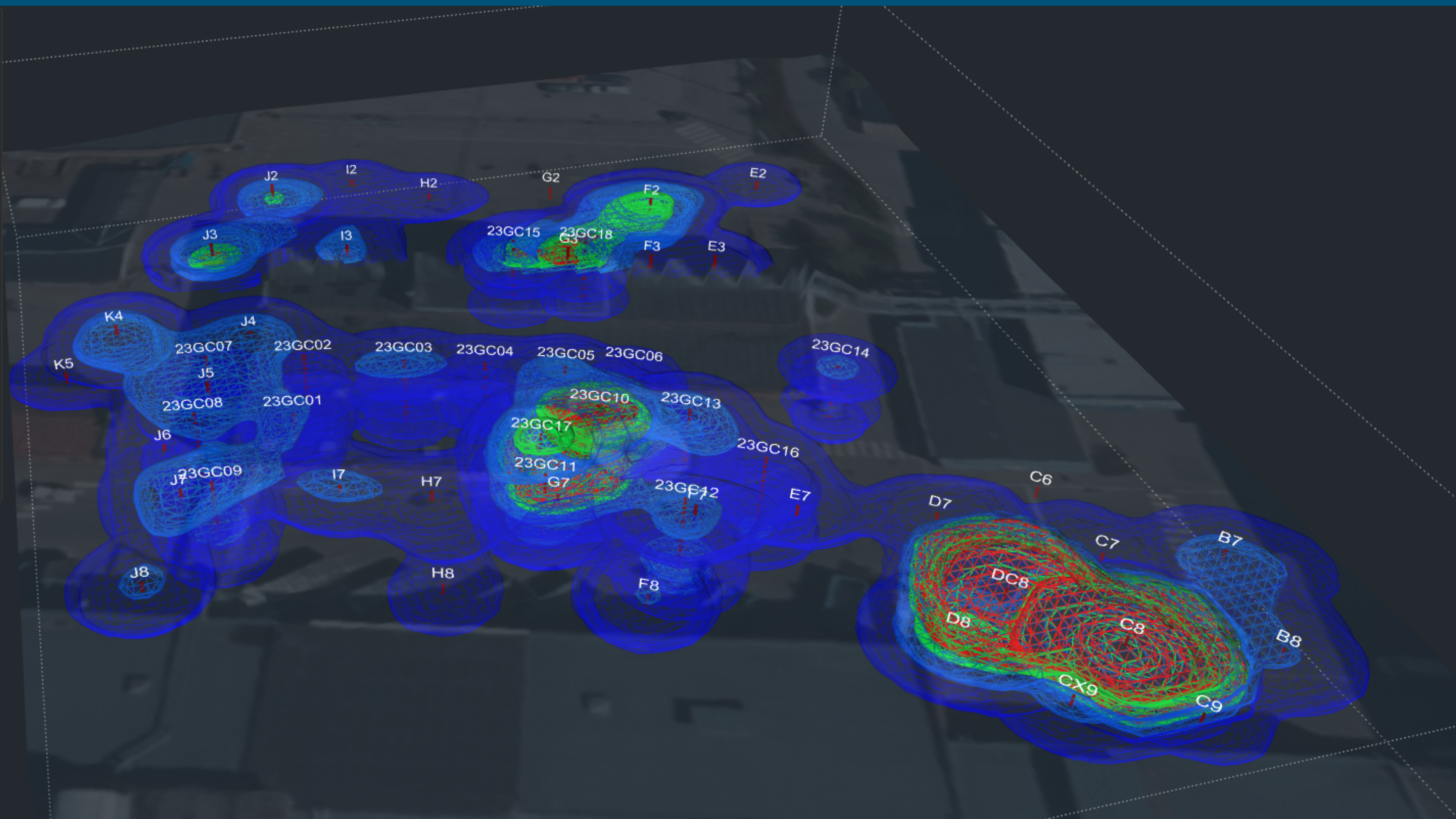
Mass: 1198.5 kg, 2642.2 lb

Actions...

OK

Apply

Close



JOIN OUR MISSION – CLEANING UP THE EARTH

How does it look?

EJLSKOV
Cleaning up the earth



JOIN OUR MISSION -

Site History and High Resolution Remediation Design Works

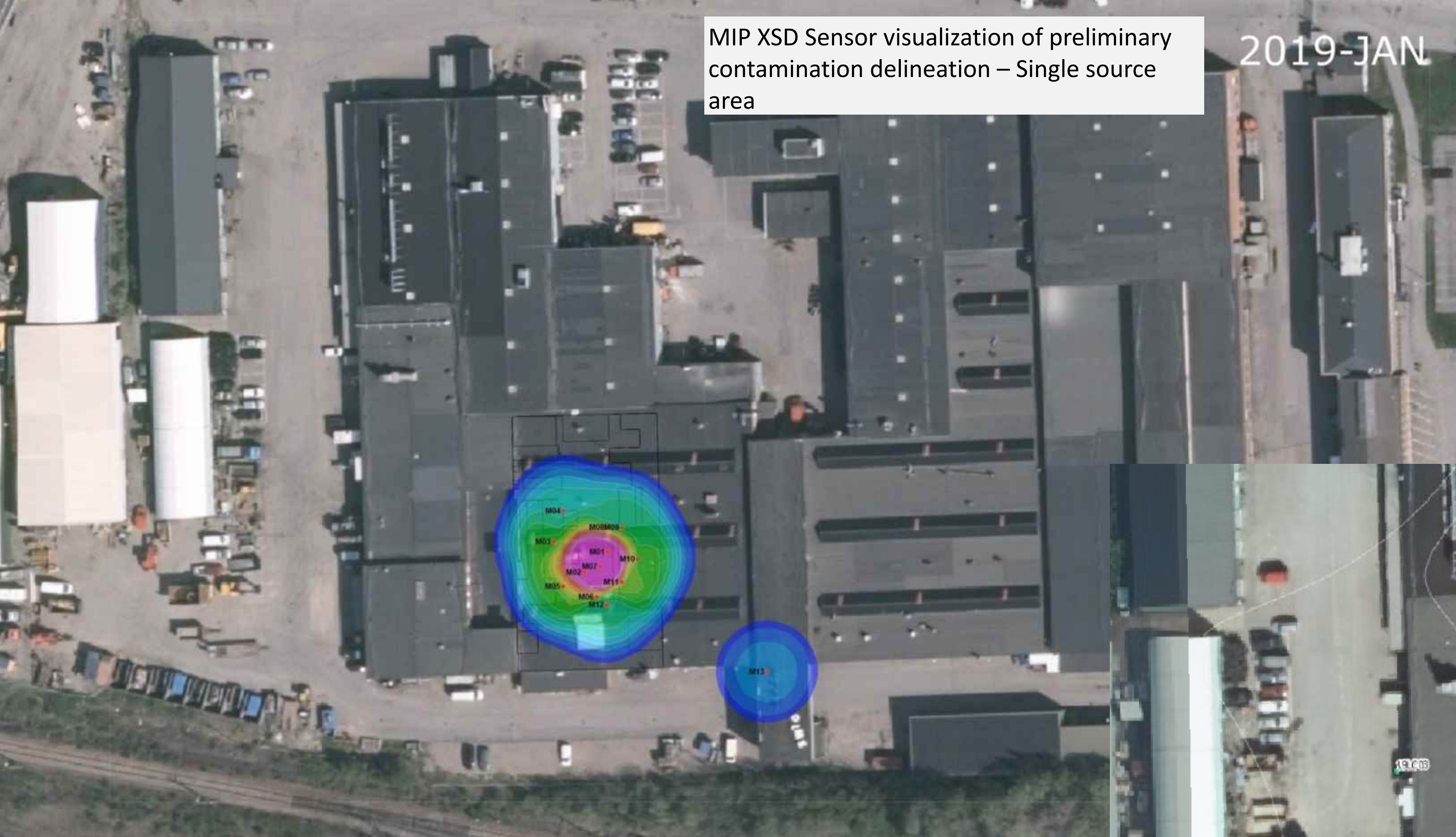


Site History

- 
- TCE used from the 1950s for the production of stainless steel milk tankers
 - Different types of small businesses present on site (tenants) in the past 20-30 years
 - Site planned for future mixed use – need for completing demolition, remediation and redevelopment



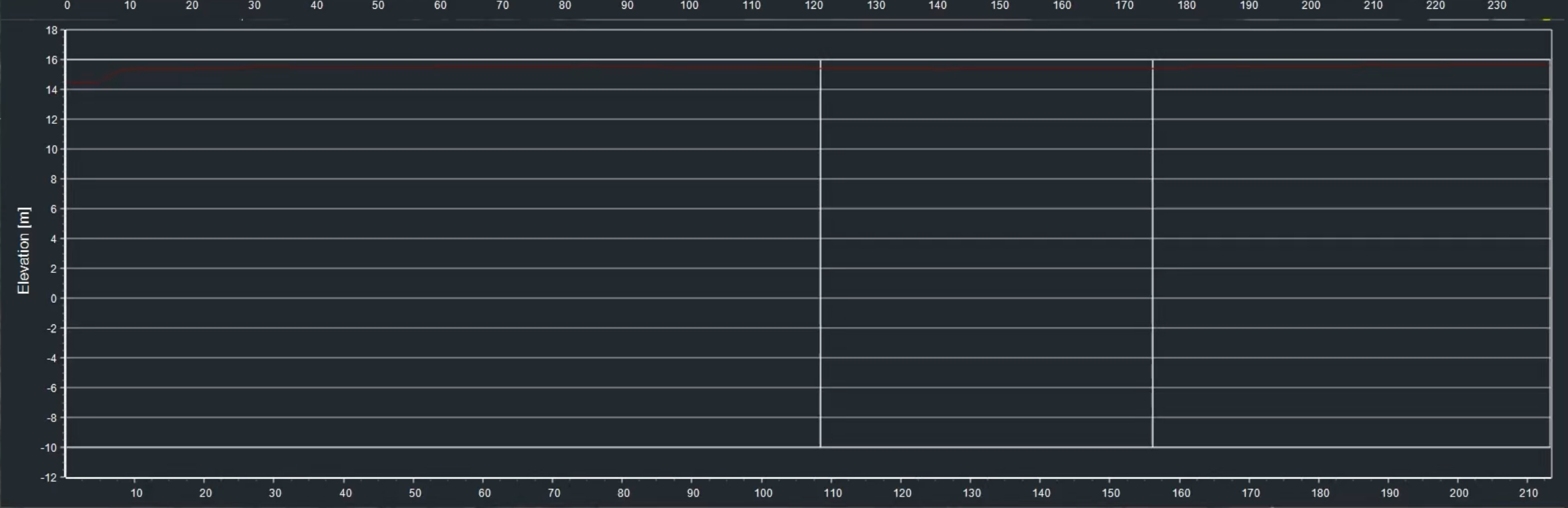
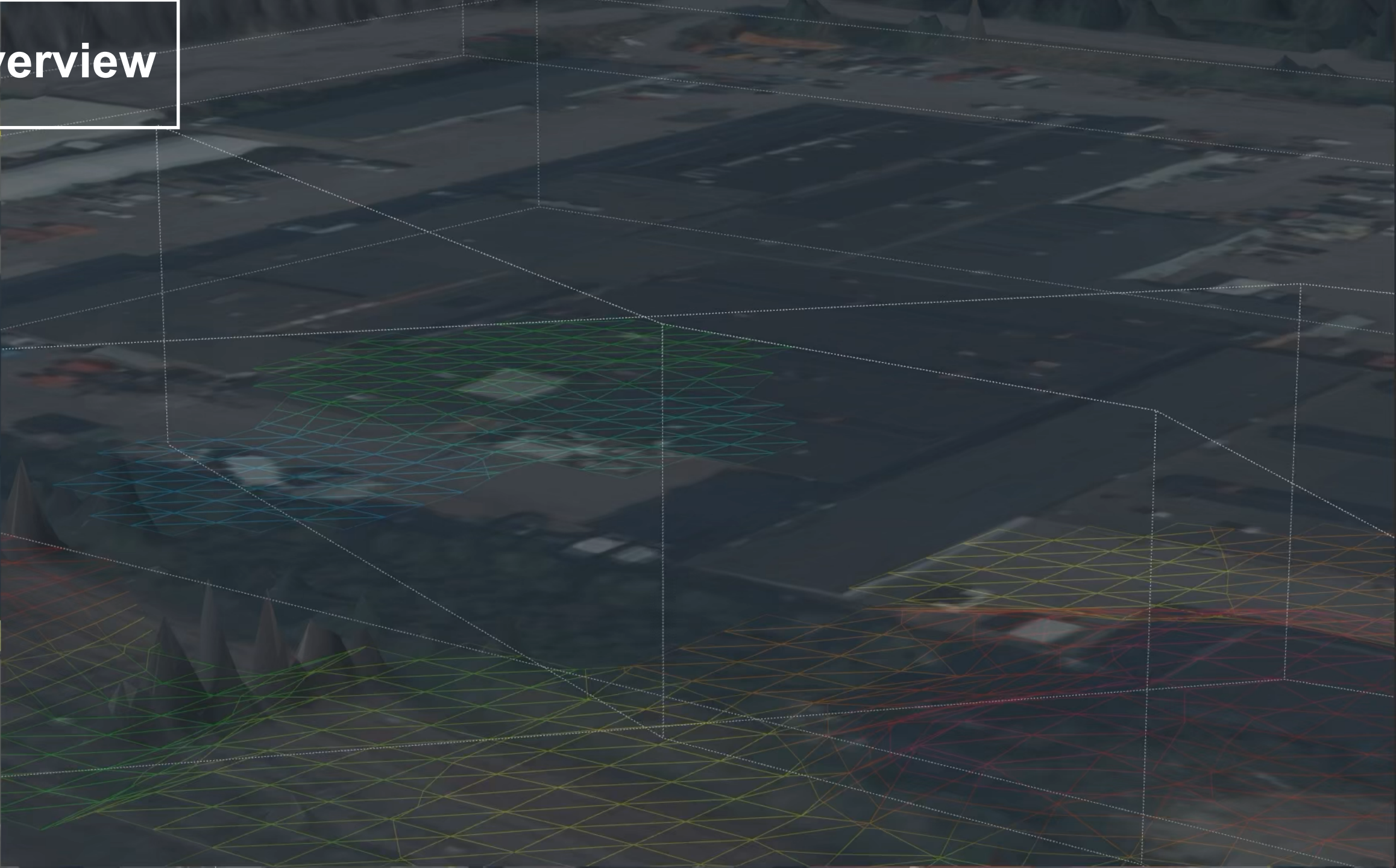
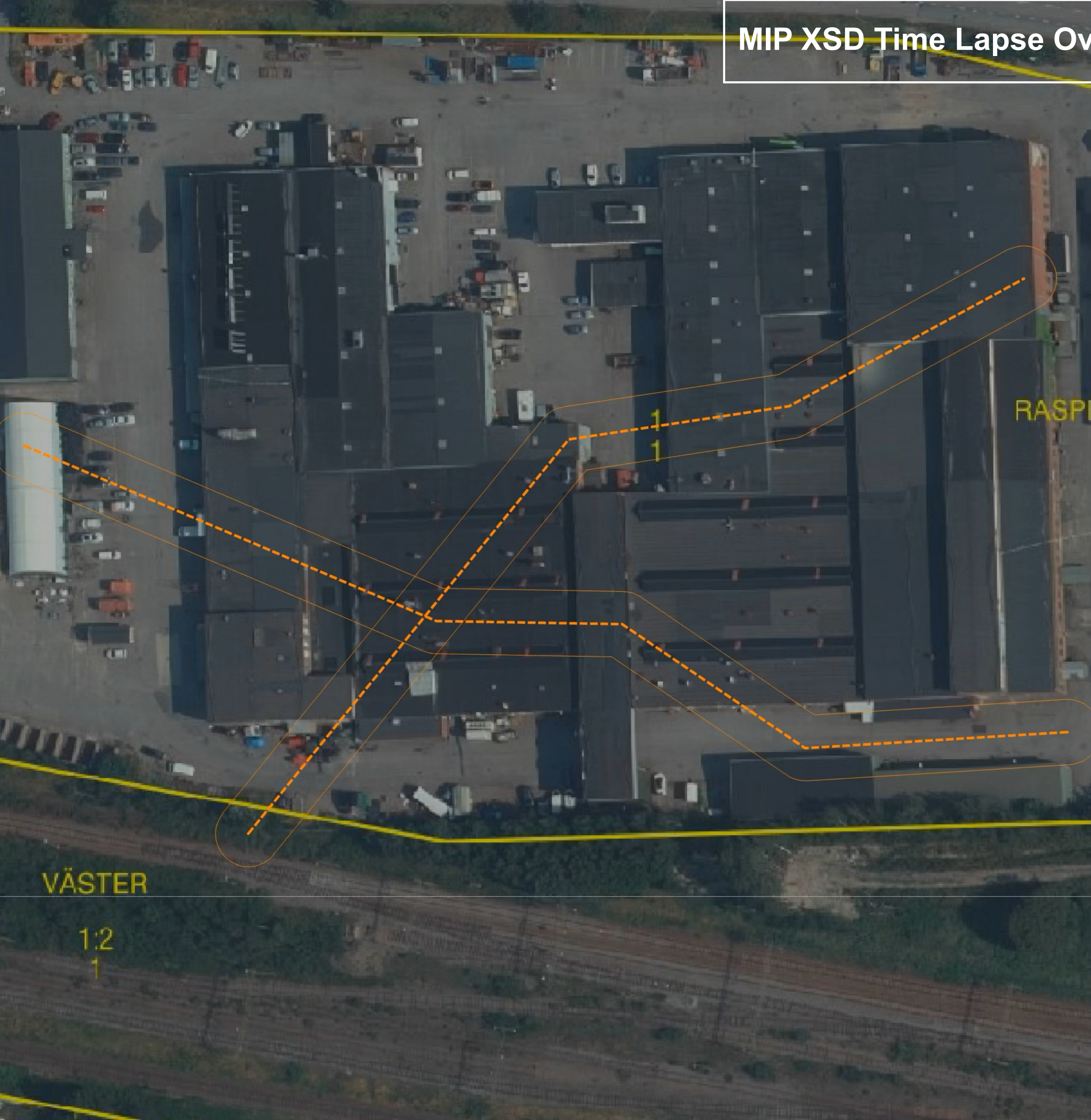
JOIN OUR MISSION – CLEANING UP THE EARTH



Consultant groundwater plume estimation
January 2019



MIP XSD Time Lapse Overview



Soil Cores and Groundwater Locations

- 31 soil cores and approx. 700 soil samples collected at high resolution following the MIP signal
- 60 short screen groundwater wells installed following the MIP signal
- > 75,000 € worth of analytical results saved through Ejlskov's technology providers laboratory (free of charge analyses)

JOIN OUR MISSION – CLEANING UP



High Resolution Outputs and Lessons Learned



High Resolution Output

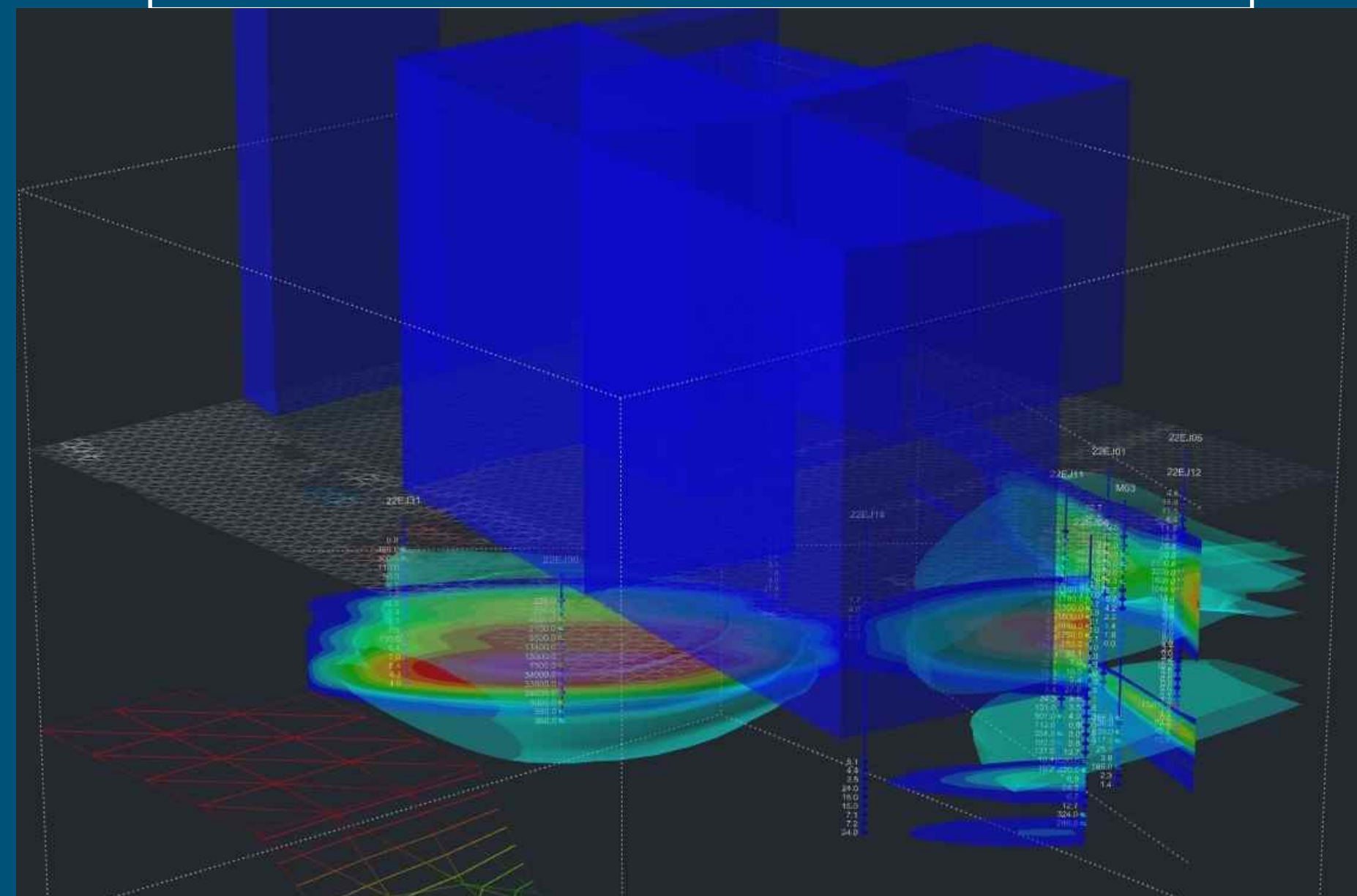


JOIN OUR MISSION – CLEANING UP

3D Soil Contamination Overview
under laser scan of existing
building

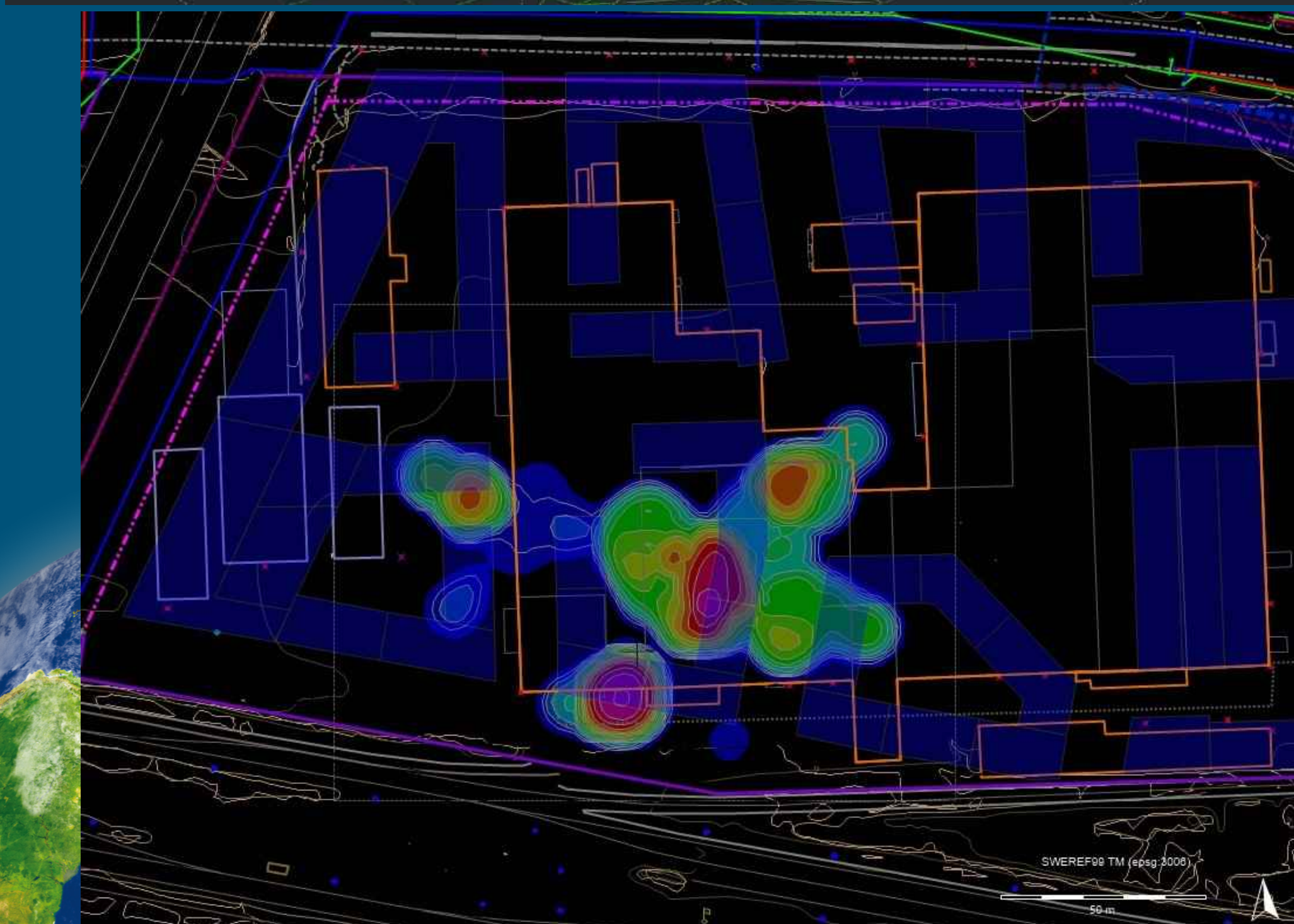


High Resolution Output - Soil



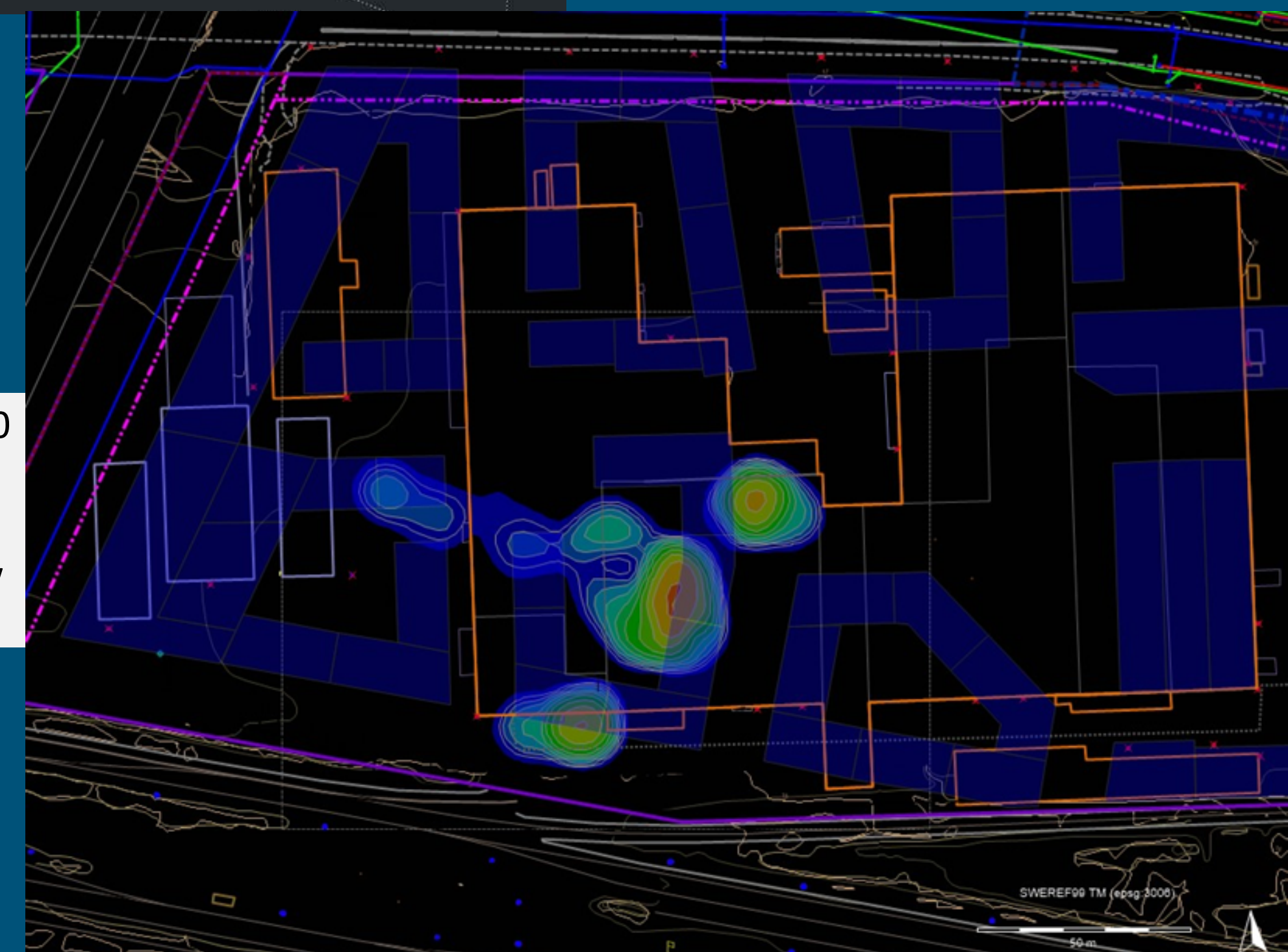
EJLSKOV
Cleaning up the earth

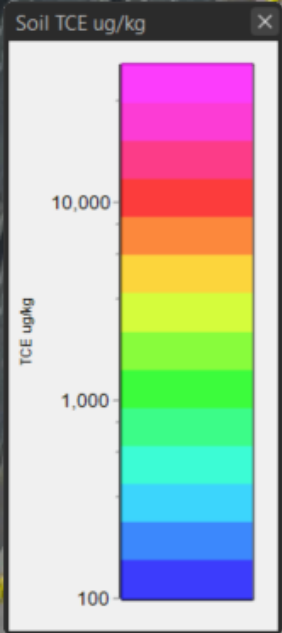
3D Soil Contamination Overview
vs. future residential buildings



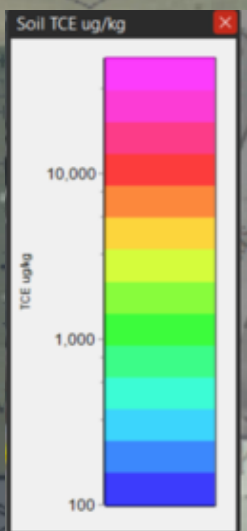
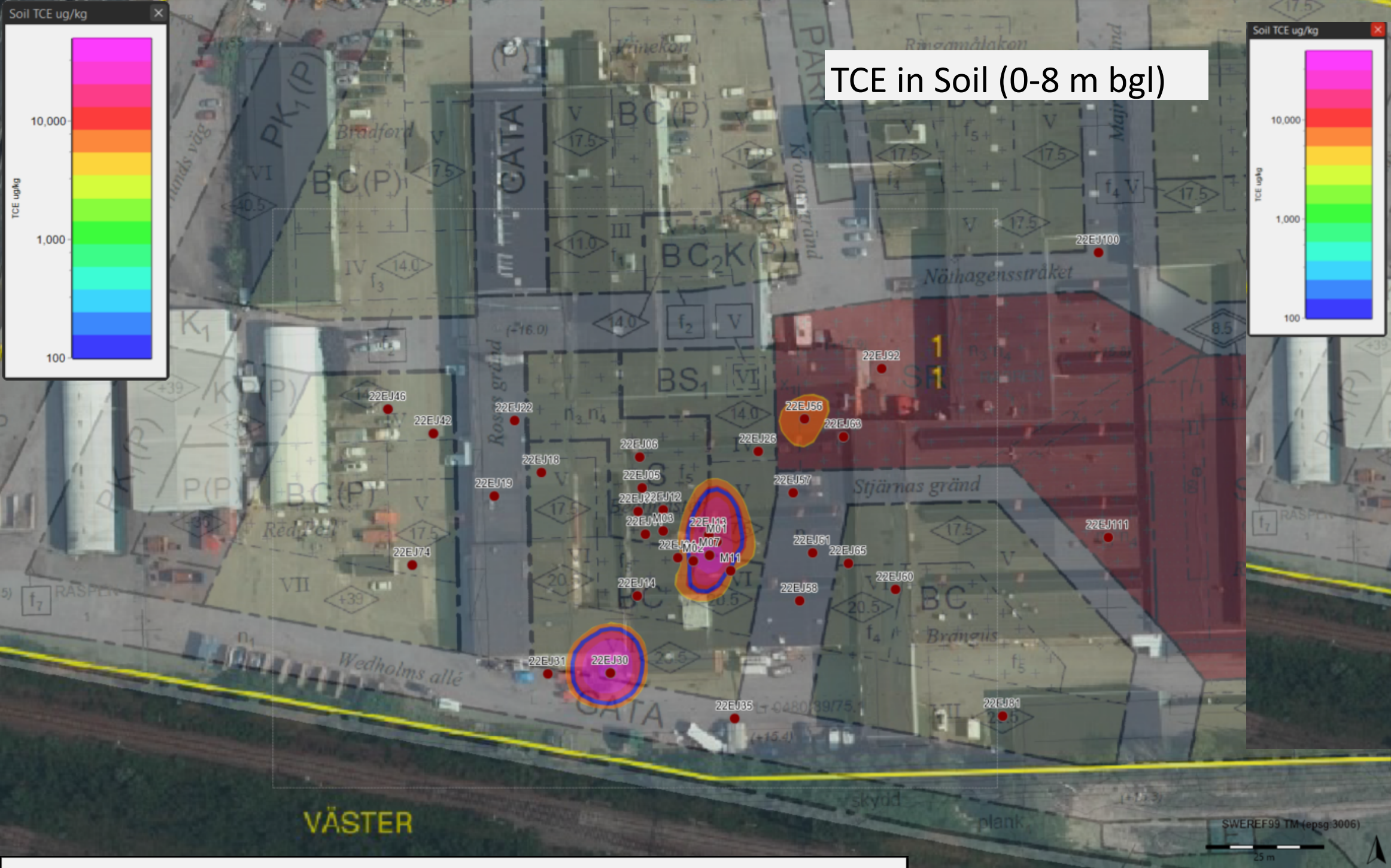
2D Soil Contamination Full
Overview – Orange shape
building (existing) vs. full blue
shapes (new residential
buildings)

2D Soil Contamination (0
to 3 m bgl) – Orange
shape building (existing)
vs. full blue shapes (new
residential buildings)





TCE in Soil (0-8 m bgl)



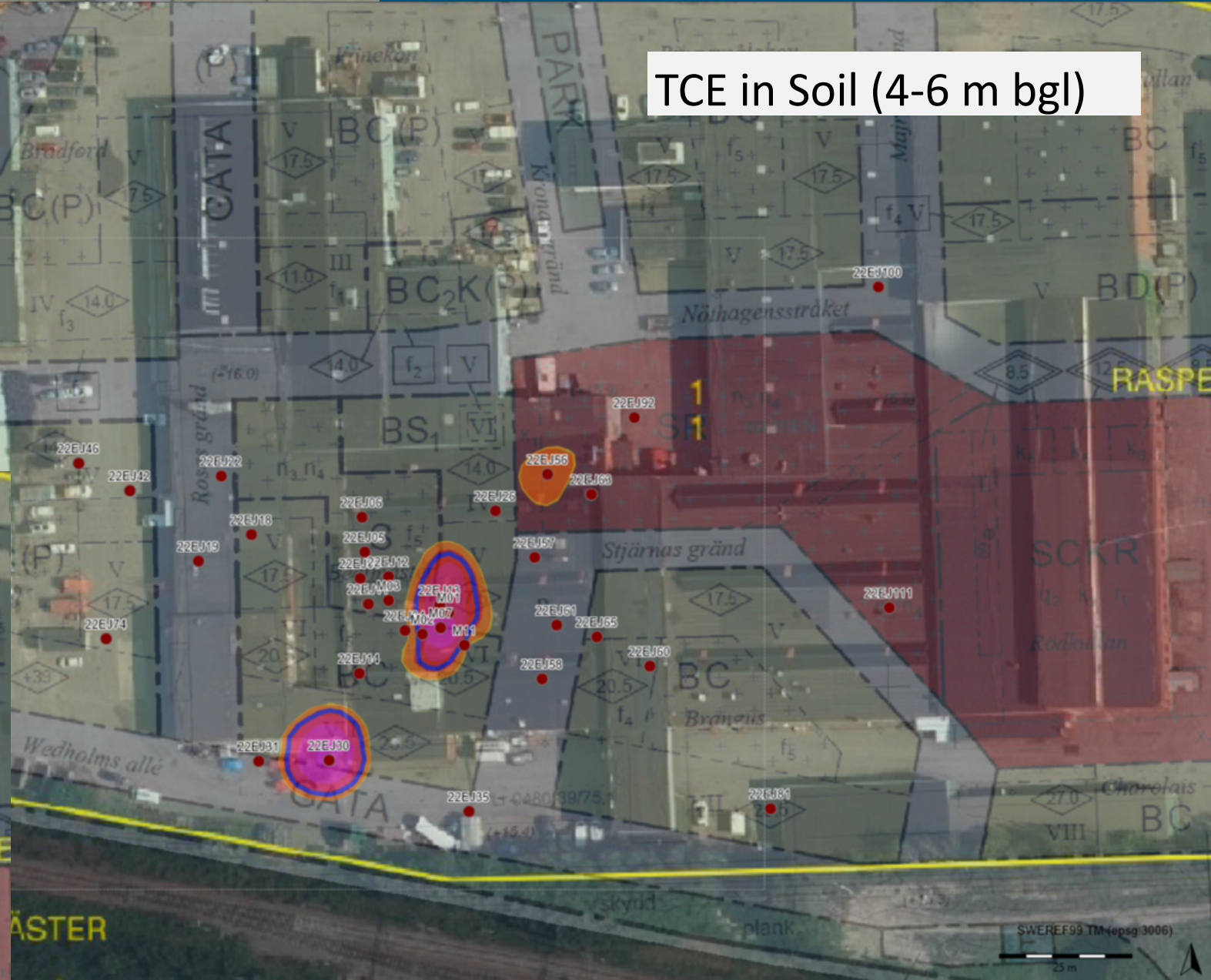
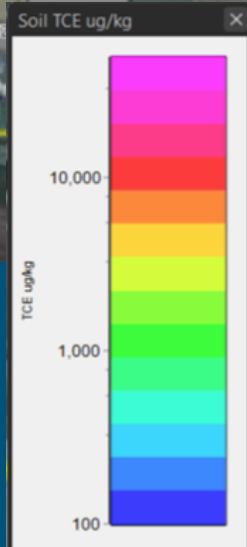
TCE in Soil (2-4 m bgl)



EJLSKOV

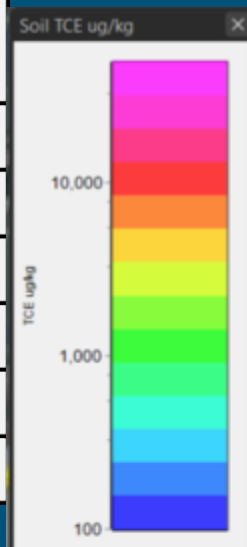
Cleaning up the earth

TCE in Soil (4-6 m bgl)

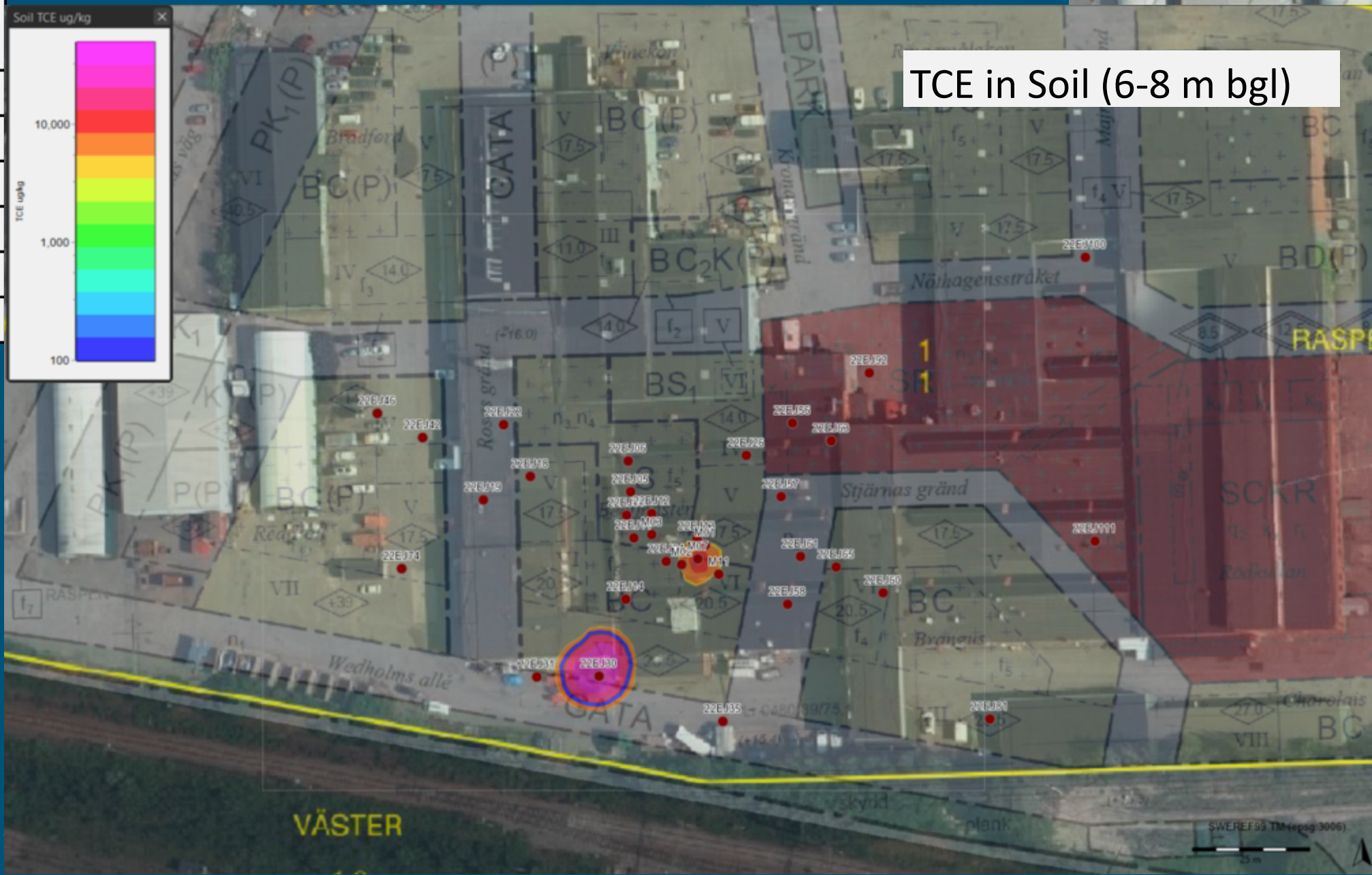


SOIL (above 5 mg/kg TCE)

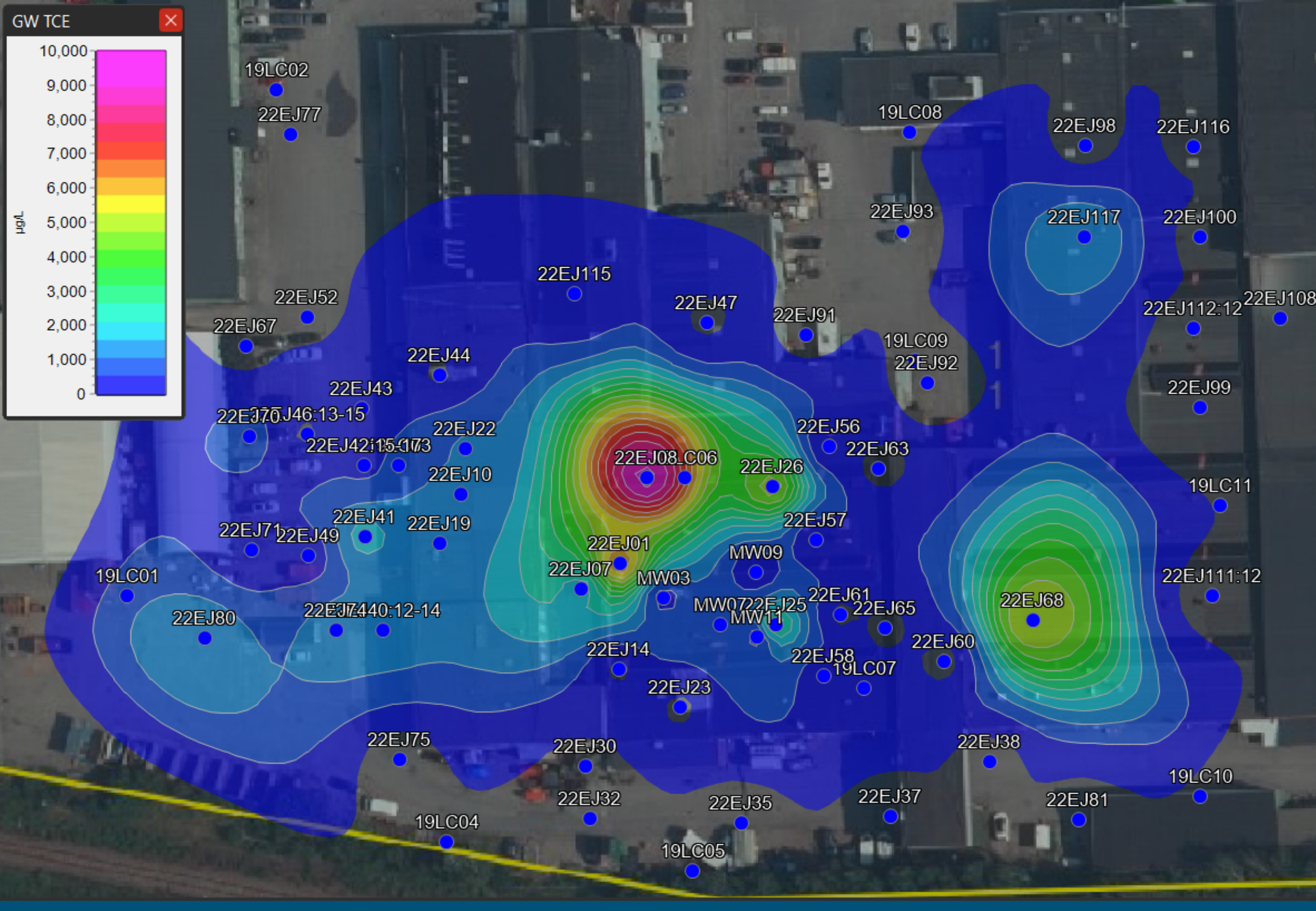
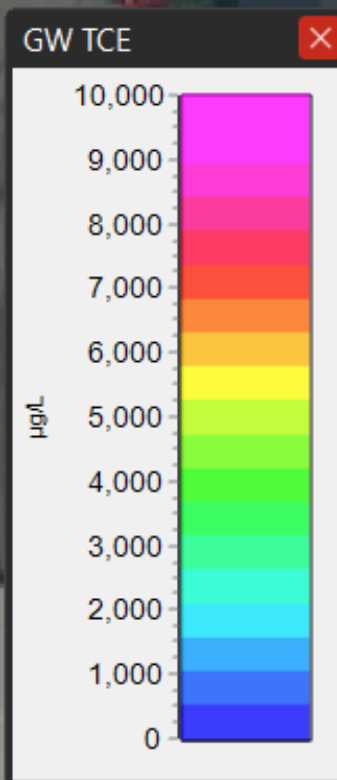
Depth Range	Volume	Estimated mass TCE	Soil Mass
m bgl	m3	kg	ton
0 to 2	0	0	0
2 to 4	250	3-7	450
4 to 6	850	15-20	1530
6 to 8	250	4-8	450
Total	1350	22-35	2430



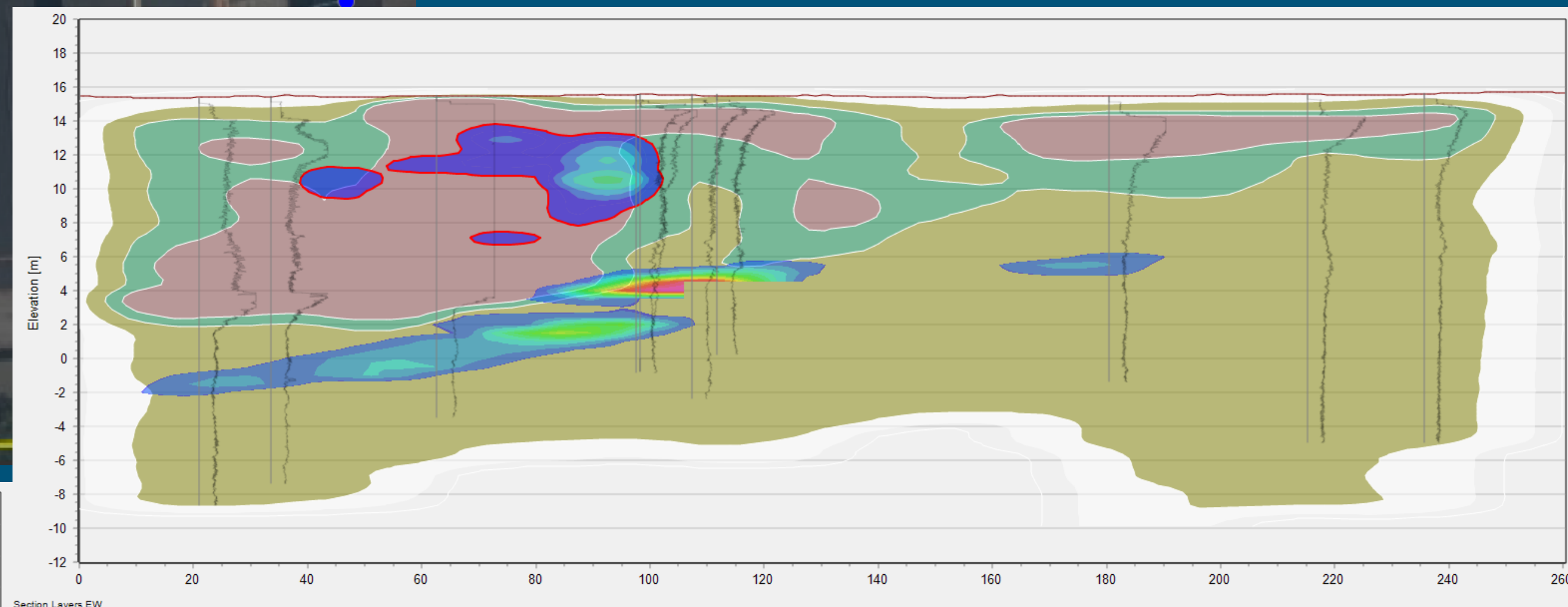
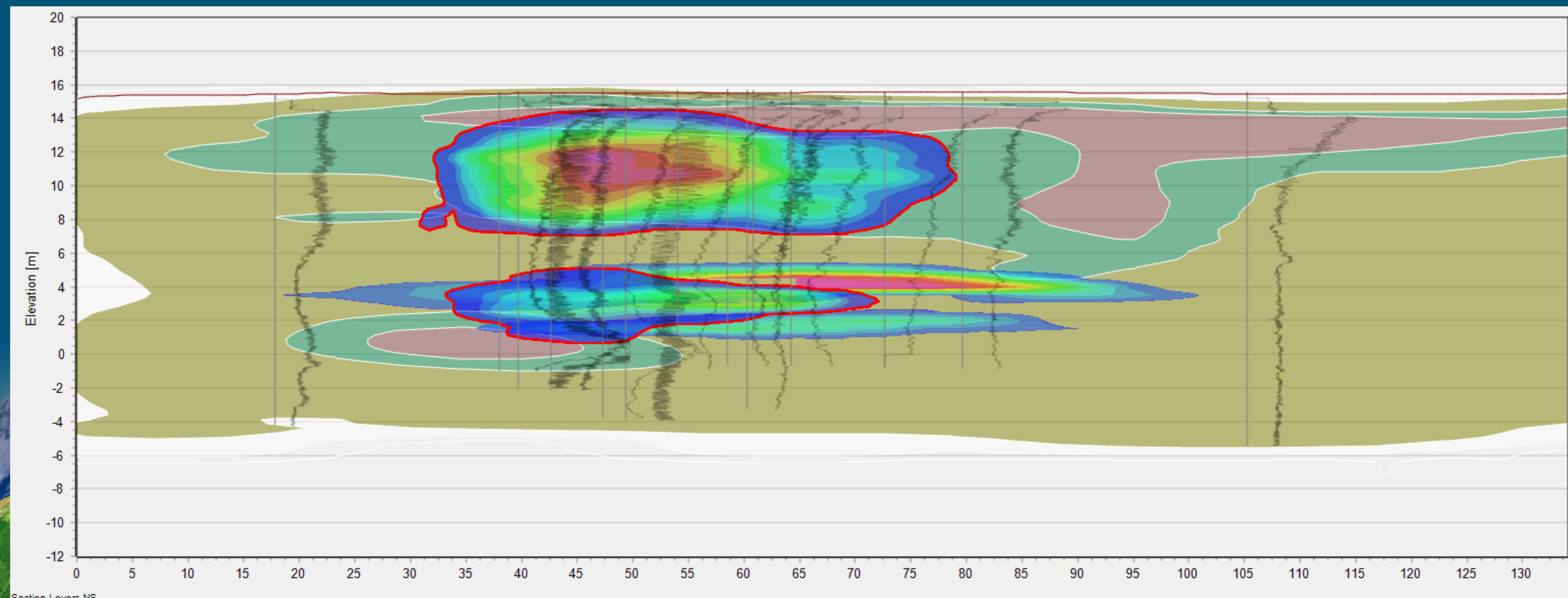
TCE in Soil (6-8 m bgl)



JOIN OUR MI



GW TCE Contamination Plume



Dark brown and green layers represent clay (brown) and silty clay (green) formation

Light brown shows silty/sandy formation

Soil contamination profiling can help understanding migration pathways towards groundwater and indoor air conditions

Qualitative and quantitative data evaluation helps improving the overall CSM

Lessons Learned and Future Steps

- Quantitative high resolution environmental data is key to any project long term success
- In-Situ / Ex-Situ Remediation Design should always be based on an “engineered” approach and not on “best guess” approach
- On redevelopment sites, use of “big data” should be introduced at an early phase of the project to ensure more sustainable planning of future land use (e.g. avoid planning building schools on contaminated soil or groundwater)
- Use of High Resolution Remedial Design tools despite being costly (as an appearance) will never be a waste of money long term (e.g. case displayed ended with a 1 €/m³ of investigated soil average cost) – how much does it cost to treat soil&gw?
- For this specific project, In-Situ remediation activities will be executed in specific order to streamline groundwater clean up time, demolition activities and final soil remediation under specific new buildings
- Just because some say things can be kept cheap, it doesn’t mean it will be a success.





Ejlskov
ejlskov.com