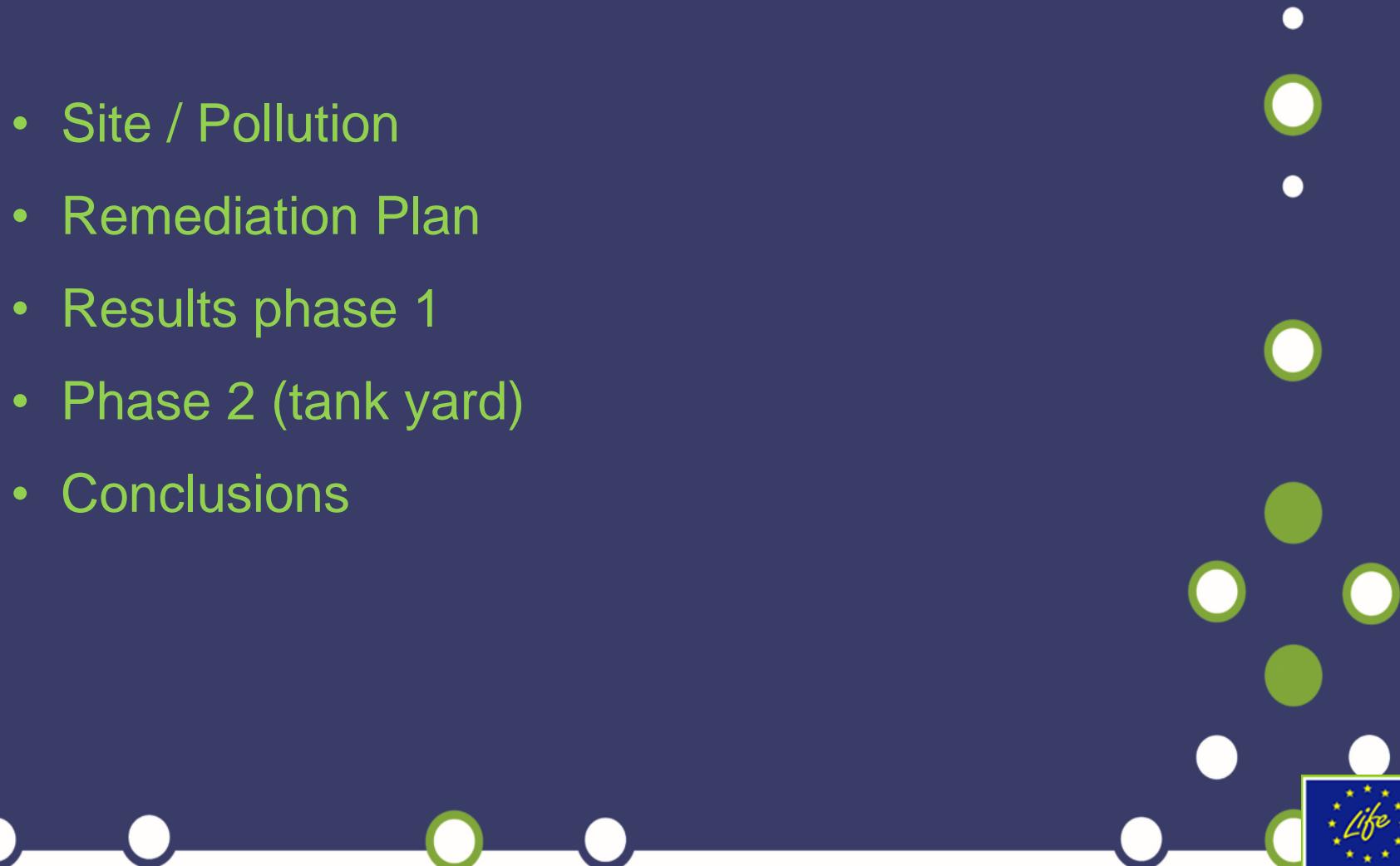


Implementing ISCO on an industrial EX-rated site

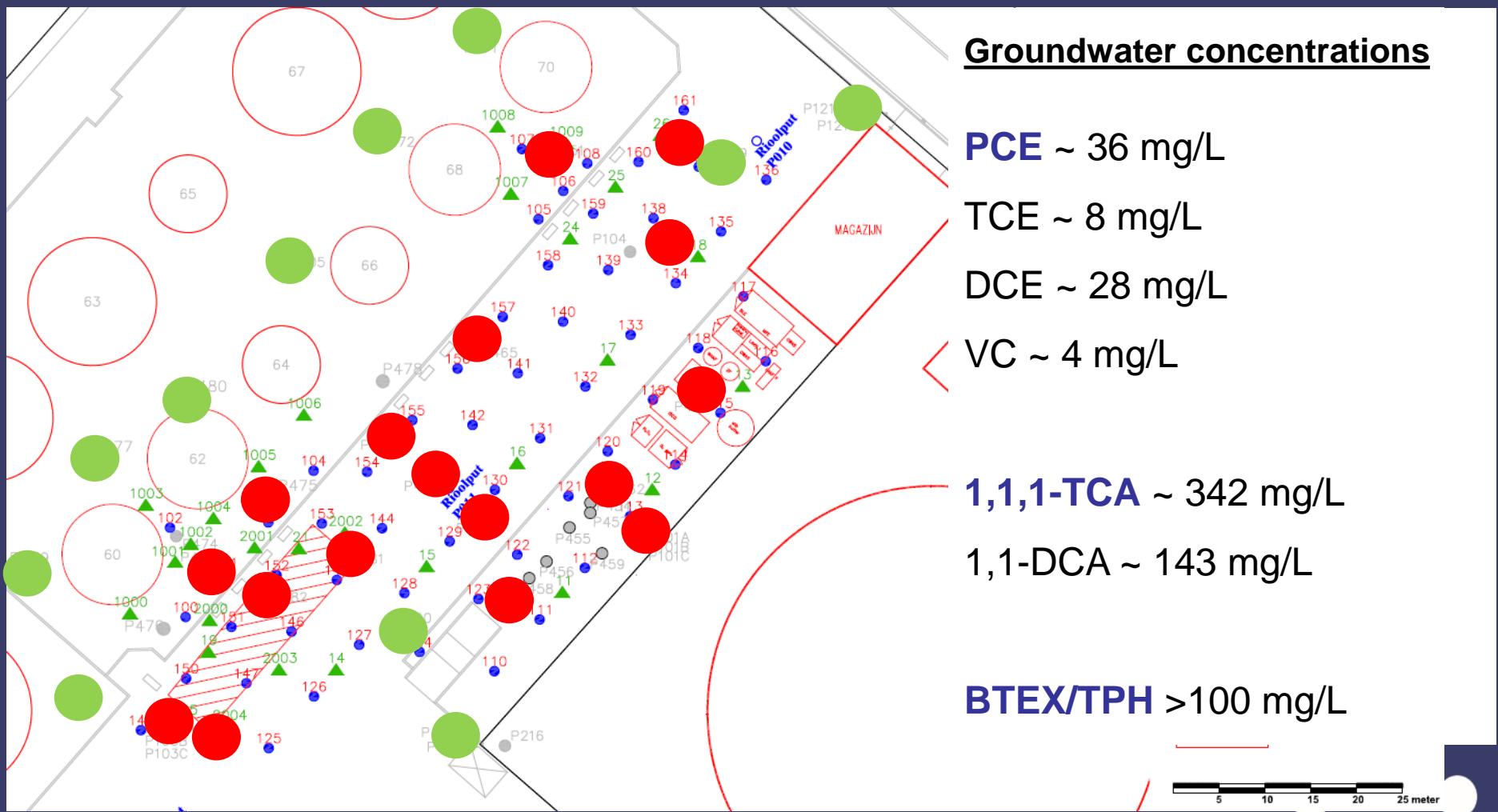
Contents

- Site / Pollution
 - Remediation Plan
 - Results phase 1
 - Phase 2 (tank yard)
 - Conclusions
- 
- 

VOPAK Terminal ACS, Antwerp harbour



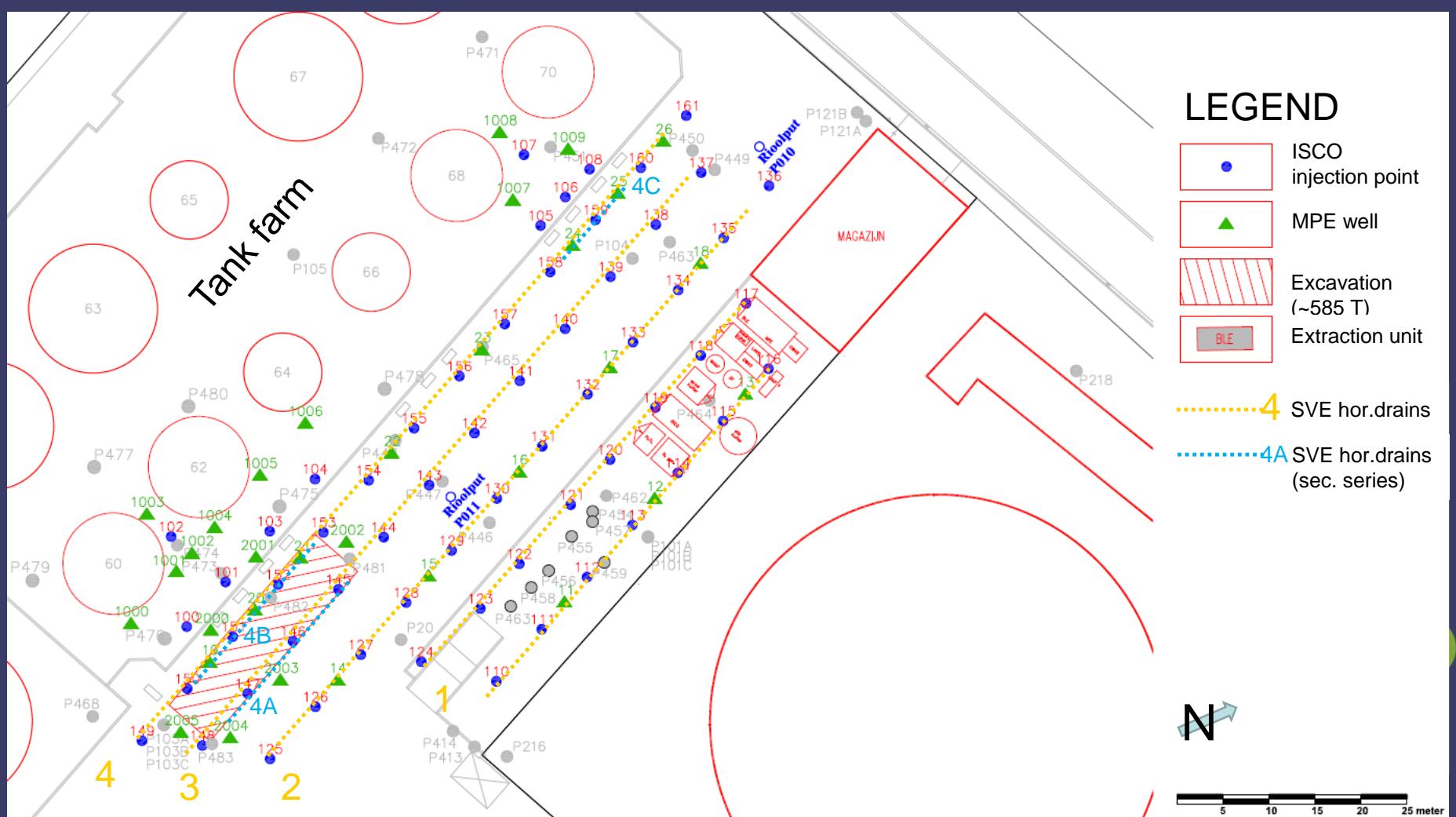
Pollution situation – Feb 2011



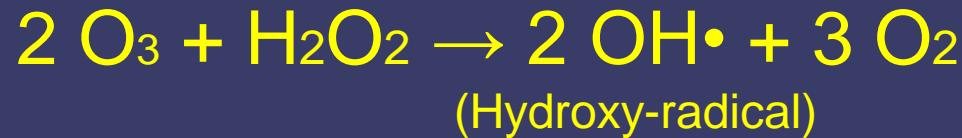
Defined remediation target concentration levels for groundwater (µg/L)

Chlorinated ethenes	PCE	400
	TCE	700
	DCE	500
	VC	50
Chlorinated ethanes	1,1,1-TCA	5000
	1,1-DCA	3300
BTEX	Benzene	100
	Toluene	7000
	Ethyl benzene	3000
	Xylenes	5000
Petroleum hydrocarbons	C5-C8	54000
	C8-C10	1200
	C10-C40	5000

Installed remediation system



Ozone / peroxide injection



$$\text{OH}\cdot = 2.86 \text{ V}$$

$$\text{O}\cdot = 2.42 \text{ V}$$

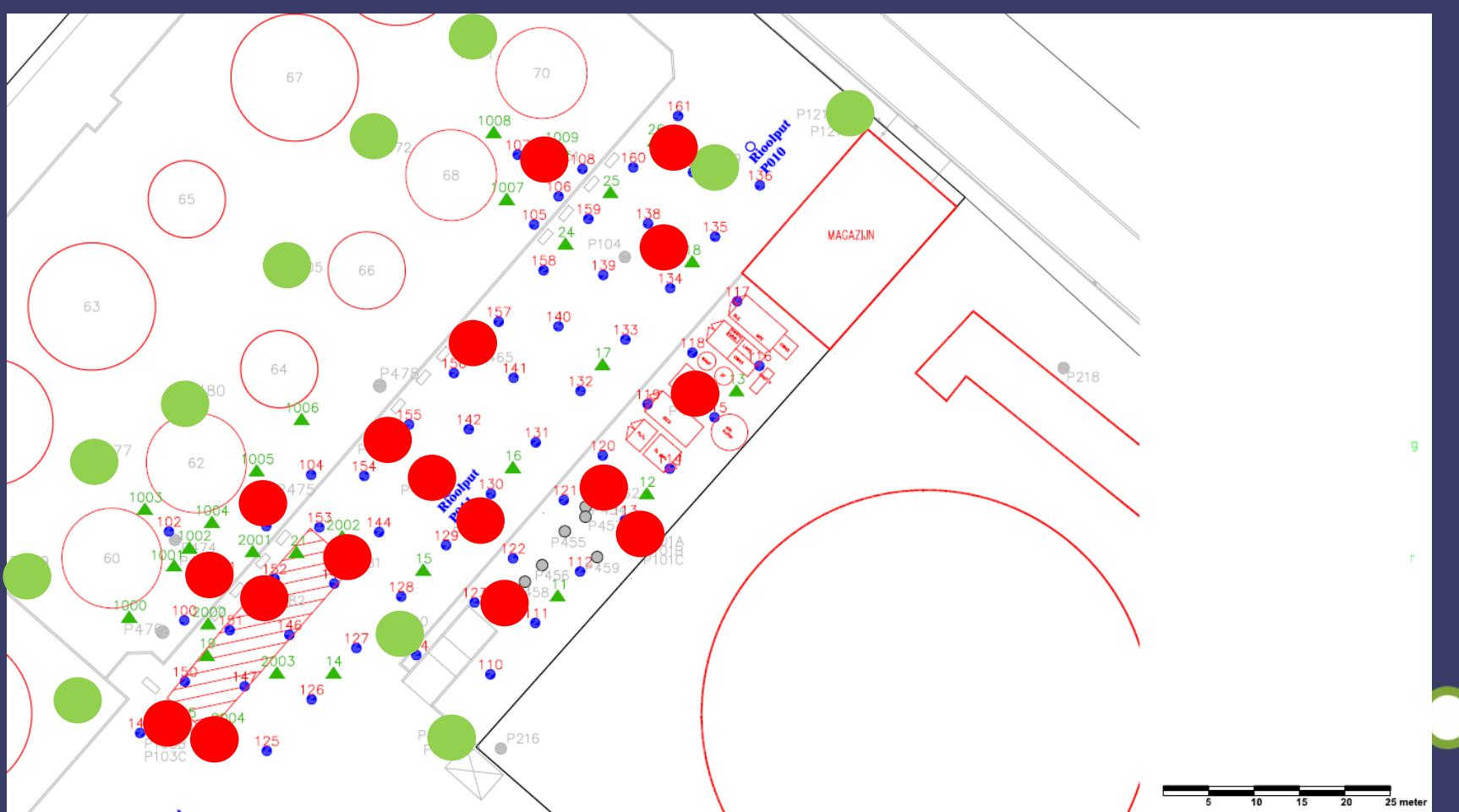
$$\text{O}_3 = 2.07 \text{ V}$$

$$\text{H}_2\text{O}_2 = 1.78 \text{ V}$$

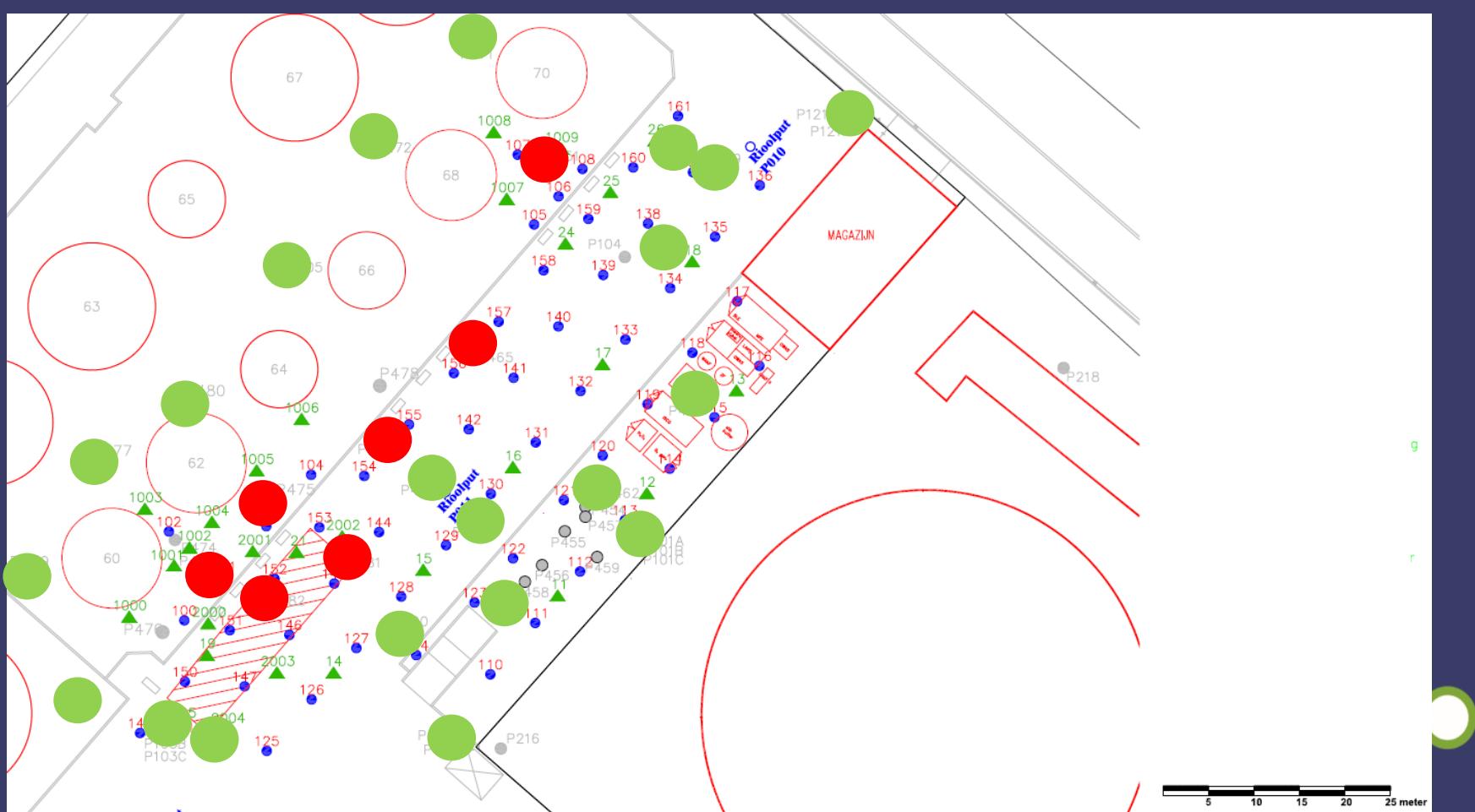
$$\text{O}_2 = 1.23 \text{ V}$$

Very high oxidation power!

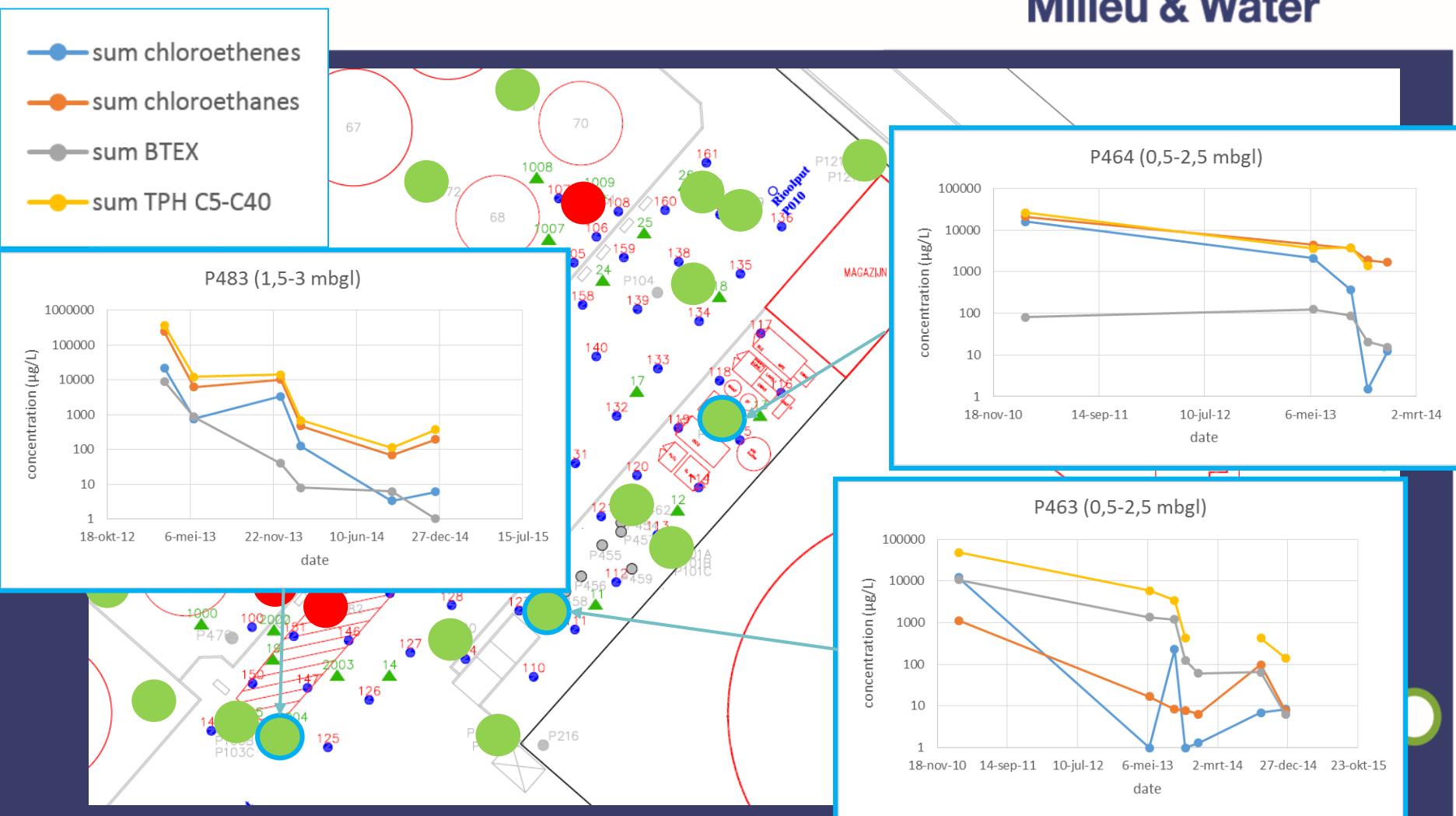
Pollution situation – Feb 2011



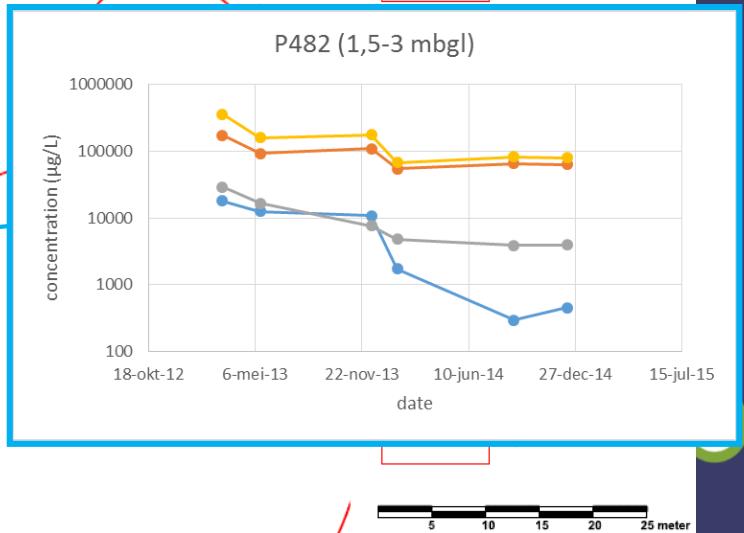
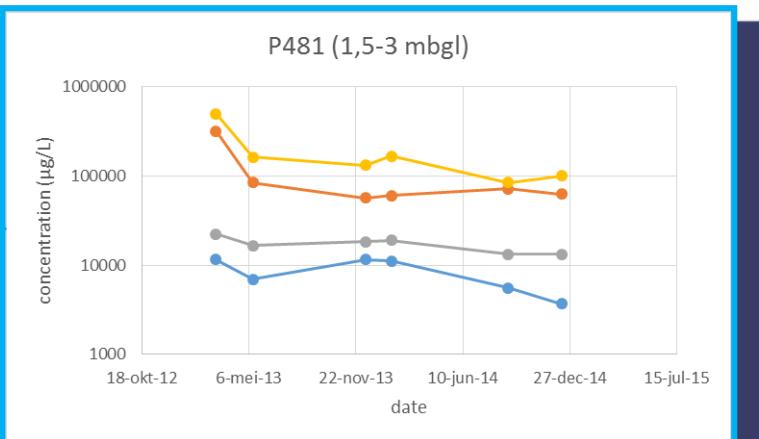
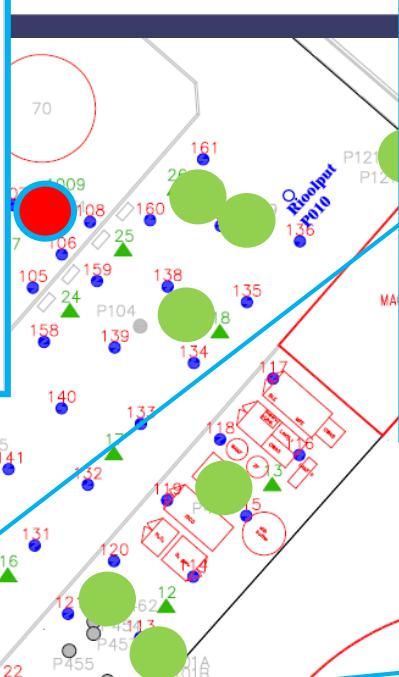
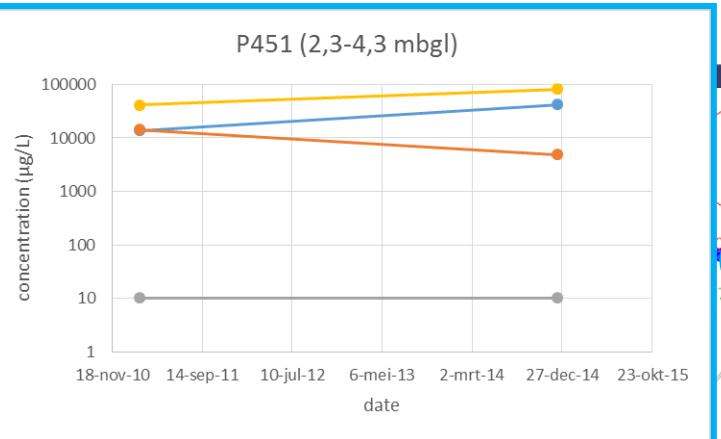
Pollution situation – Dec 2014



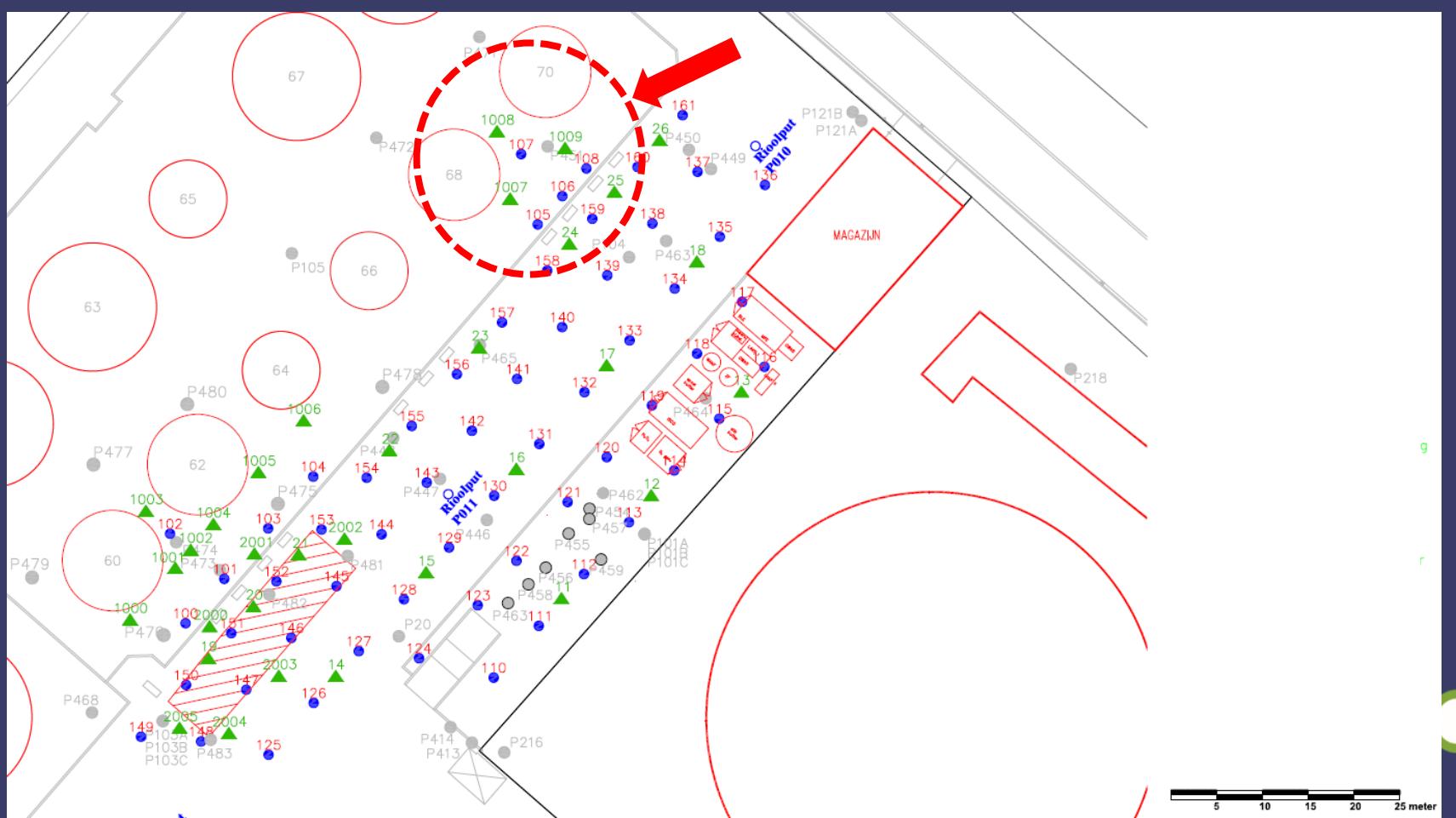
Monitoring well results



Monitoring well results (2)



Remediation phase II – Tank Farm (March 2015 -)



Safety

Avoid ozone emissions (corrosion of the installations/infrastructure)

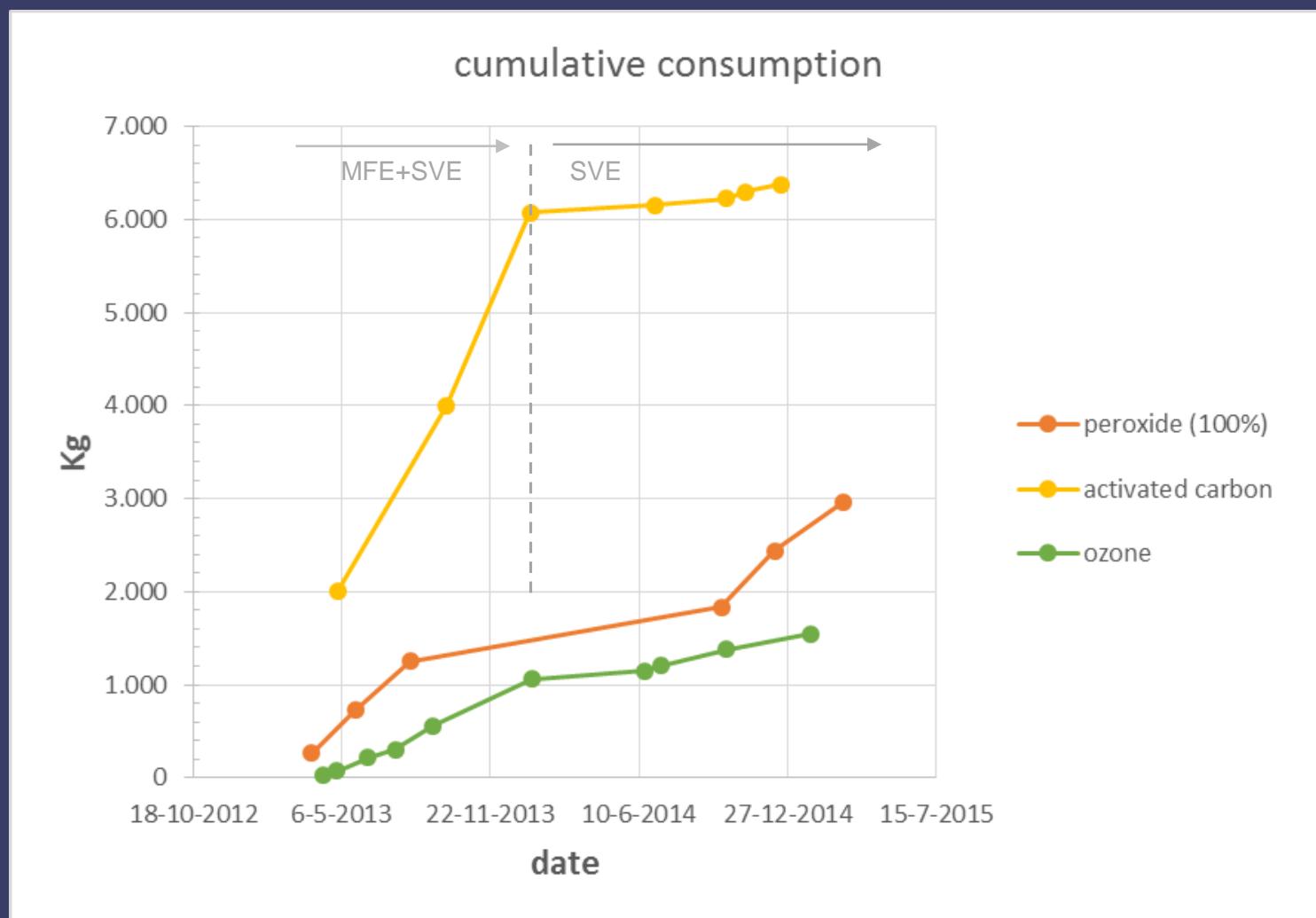
- Discontinuous air injection (2 Nm³/h/filter; 2 min on /16 min off)
- SVE continuously operational (rate 58x rate air injection)
- PID, LEL, O₂ and O₃ measurements in SVE influent air and monitoring wells
- pressure in observation wells (tank bases)
- leaks detection (visual and PID)
- ozone/peroxide (50 g O₃/h + peroxide 7% 120 mL/min)

Phased start-up !

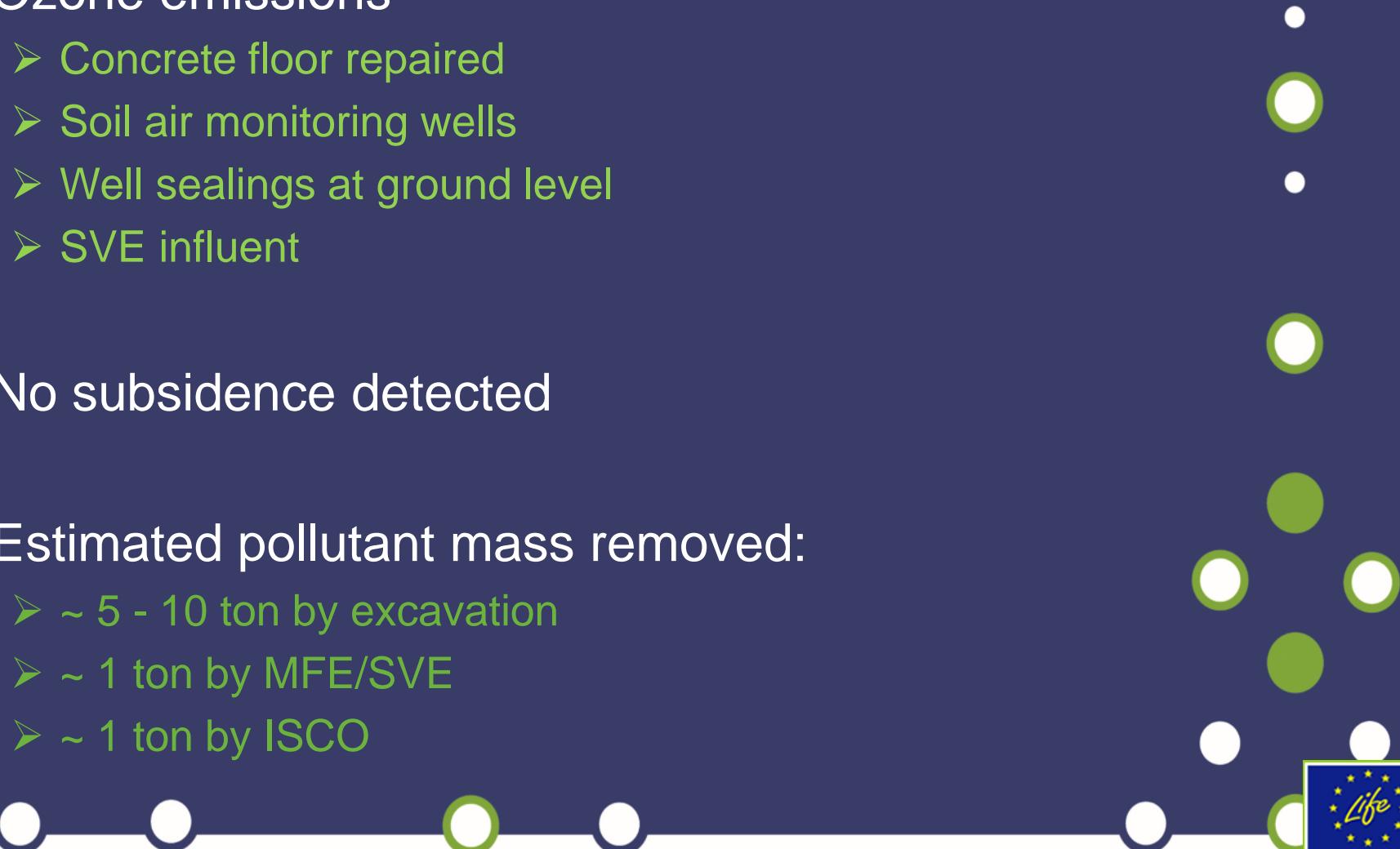
Subsidence monitoring of solvent tanks 68 and 70



Consumables



Results

- Ozone emissions
 - Concrete floor repaired
 - Soil air monitoring wells
 - Well sealings at ground level
 - SVE influent
 - No subsidence detected
 - Estimated pollutant mass removed:
 - ~ 5 - 10 ton by excavation
 - ~ 1 ton by MFE/SVE
 - ~ 1 ton by ISCO
- 
- 

Thank you for your attention!



Questions?

EU Life+ “VOPAK-EXPER03”

