



Environnement  
Géologie et géotechnique  
Génie civil  
Déchets et dépollution  
Gestion des eaux



# Landfill of La Pila

## Detailed investigation

March 26th 2009- Intersol

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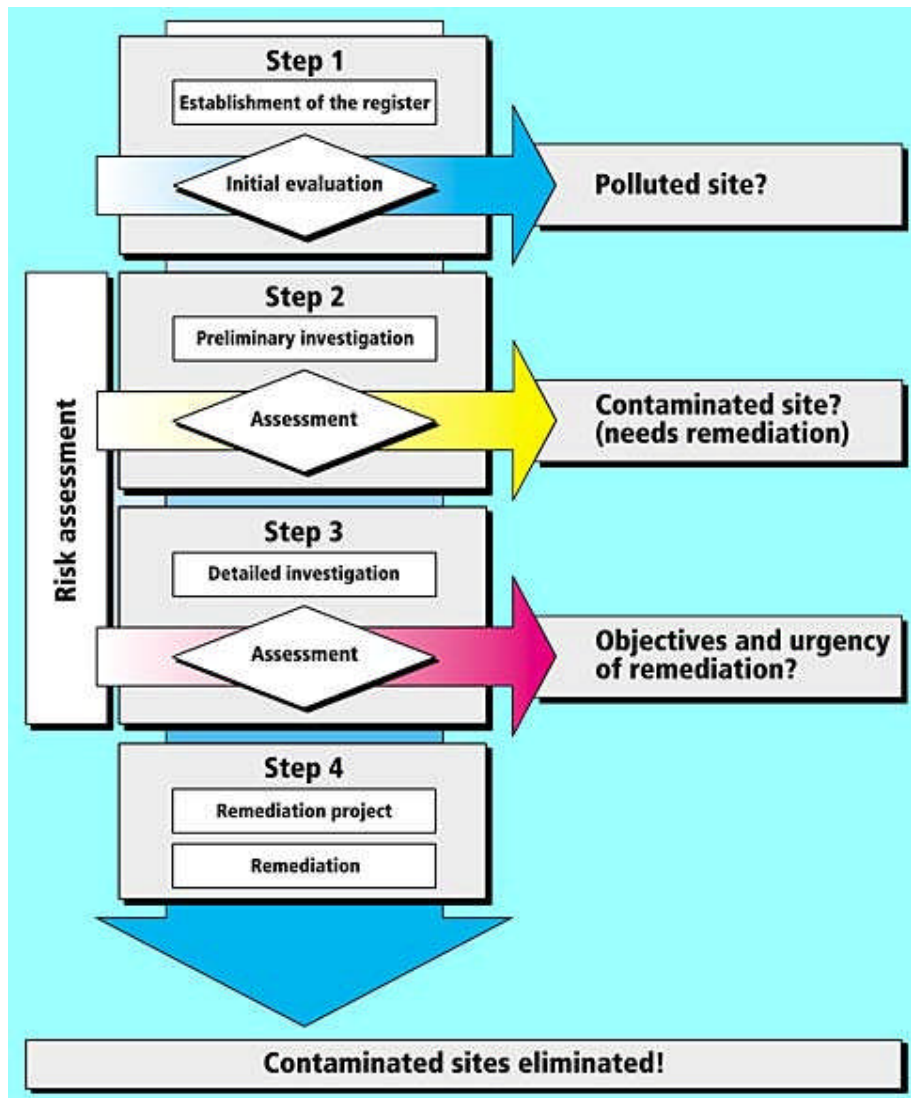
# Content

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- Management of contaminated sites in Switzerland
- The problem – Location and history
- Main results:
  - Pollutants, volumes, categories (treatment lines) and distribution
  - Origin of the contamination
  - Diffusion mechanisms
  - Pollutant transport estimation
  - Sediment transport
- Proposed measures:
  - Monitoring
  - Immediate measures
  - Securing measures
- Type of remediation
- Next steps



# Management of contaminated sites in Switzerland



Fundamental approach:

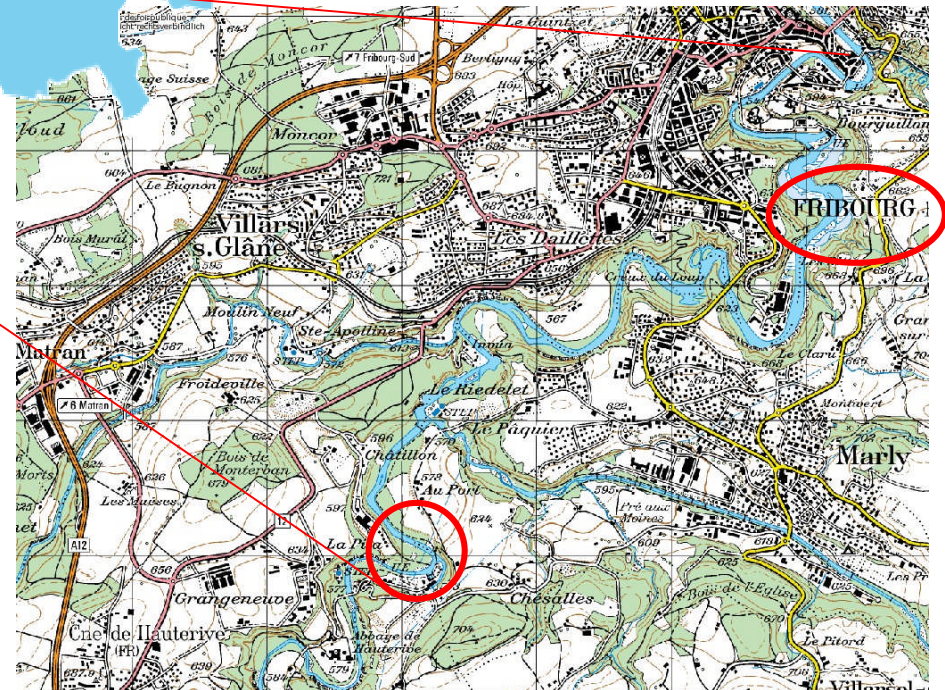
- Based on risk assessment
- Step-by-step approach
- Efficient and reasonable

# General situation



South-West of the town of Fribourg

Commune of Hauterive





# The problem



Contamination of the river Sarine and its fauna :  
prohibition of fishing since August 2007

- Landfill exploited by the City of Fribourg from 1952 to 1973
- Preliminary investigations 2004-2005
- Detailed investigations in 2 steps
  - 2006-2007
  - 2008



# Main pollutants

- In close relation with the waste type:
  - Household waste, construction waste, inert materials: ammonium and nitrite, hydrocarbons, heavy metals
  - Industrial waste : capacitors: PCB



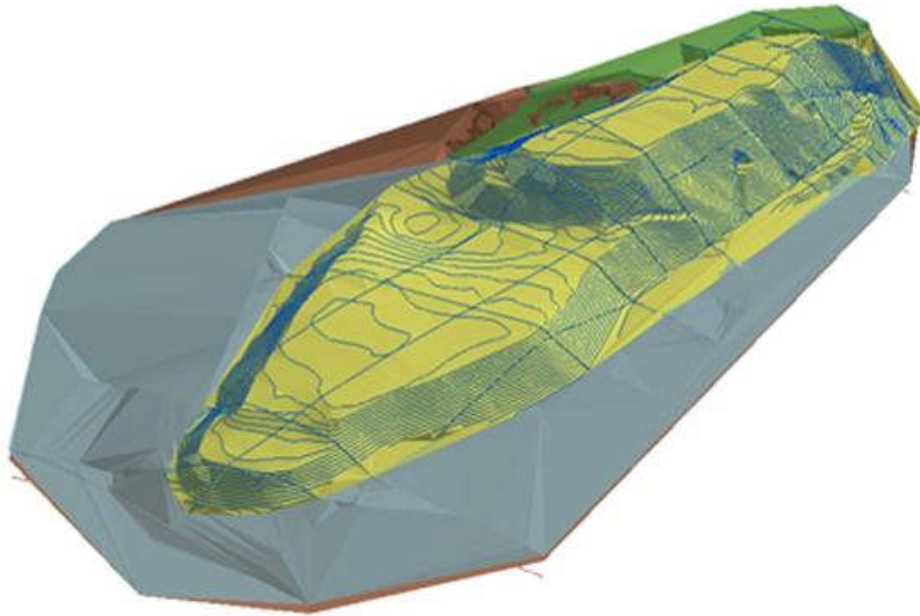
Capacitors of different types and sizes



Large amount of capacitors in some parts of the landfill

# Volume of waste and polluted materials

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Volume of waste: 195'000 m<sup>3</sup>

Total volume of polluted materials  
(with alluvial sand and gravel):  
270'000 m<sup>3</sup>





## Categories of materials and treatment lines

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- Categories of materials depending on:
  - Conditioning and transportation (ADR from 50 ppm, waste barrels of 200 l from 1000 ppm)
  - PCB and heavy metals content
- Treatment lines :
  - Landfill for inert materials: up to 1 mg/kg PCB
  - Bioreactor landfill : up to 10 mg/kg PCB
  - Incineration : from 10 to 50 mg/kg PCB
  - High temperature incineration : from 50 mg/kg PCB





# Distribution of the PCB content

7 main hot-spots

25'000 to 30'000 m<sup>3</sup>

10-15% of the total volume

90 % of PCB content

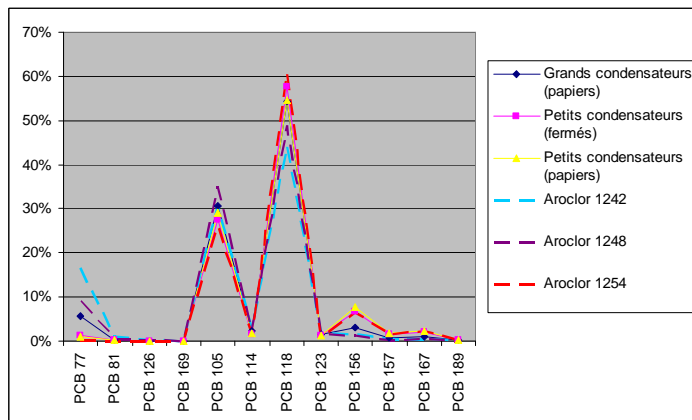


Total mass of PCB : 20 tons



## Origin of the PCB contamination

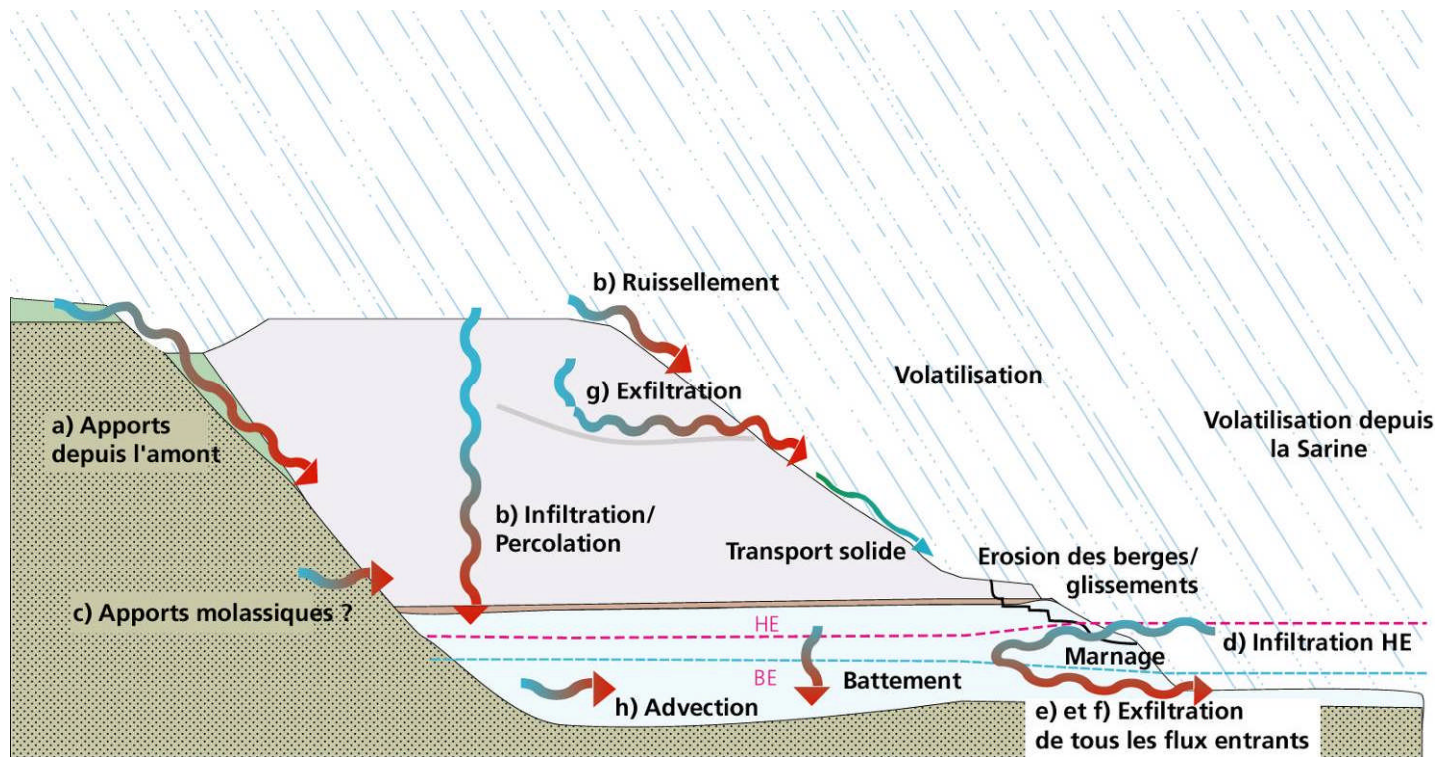
- Findings about the PCB mixtures present on the site:
  - Analysis of capacitors (18 congeners): presence of PCB confirmed
  - Comparison with profiles of three commercial products : good correlation, for the soils as well as for the capacitors.



The mix of congeners gives à « signature » that could help to identify the users

## Diffusion mechanisms

- Two main paths of pollutant exportation :
  - Groundwater
  - Particle transport through erosion



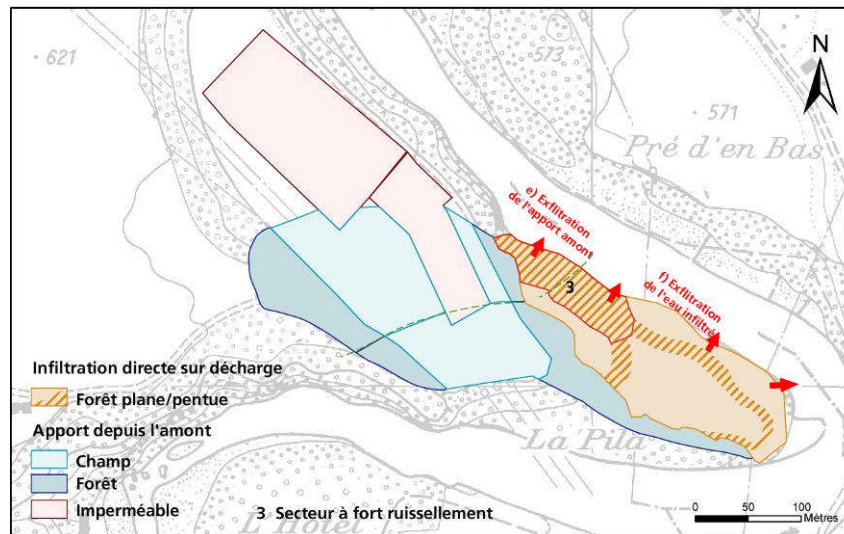
# Estimated PCB flux

Groundwater: env. 500 g/year

Particle transportation: env. 500g to 1kg year

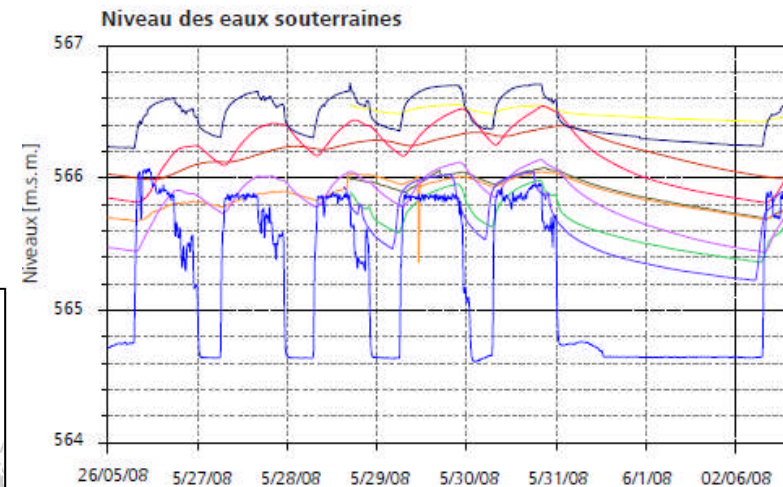
Other sources:

- Direct exfiltration of landfill leachate
- Bank erosion



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The variations of the water level of the Sarine river induced by the electric power plant influence the groundwater level in the alluvial deposits



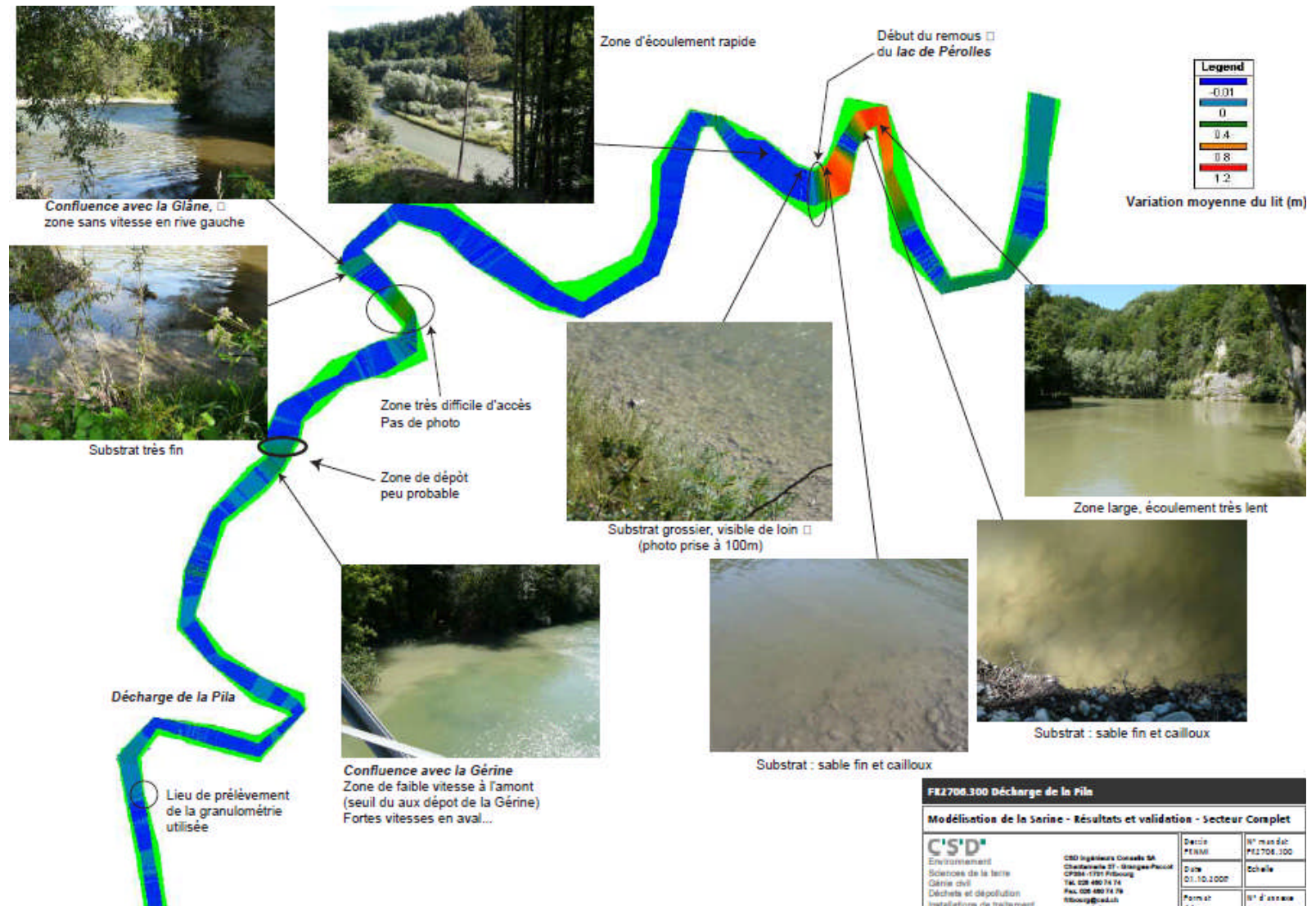
Primary reservoir: Landfill of la Pila

Secondary reservoir: Sediments of the Sarine river





# Sediment transport



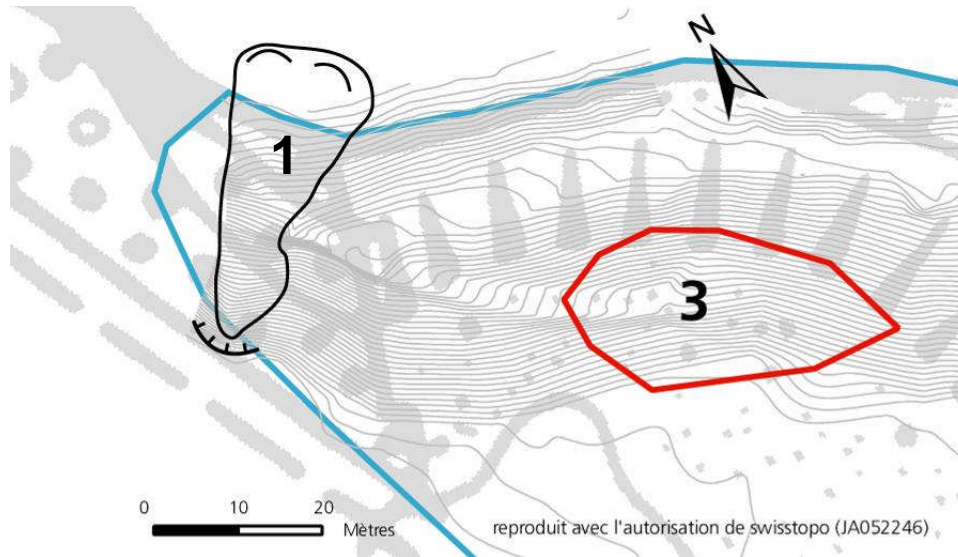
## Proposed measures

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- Monitoring:
  - Identify the actual effects of the pollutants on the Sarine river
  - Monitor the effects of securing measures
  - Monitor the impact of the construction work
- Immediate measures:
  - Avoid the immediate exportation of pollutants in the river (unstable zone)
- Securing measures:
  - Reduce the polluted fluxes in the river



# Immediate measures



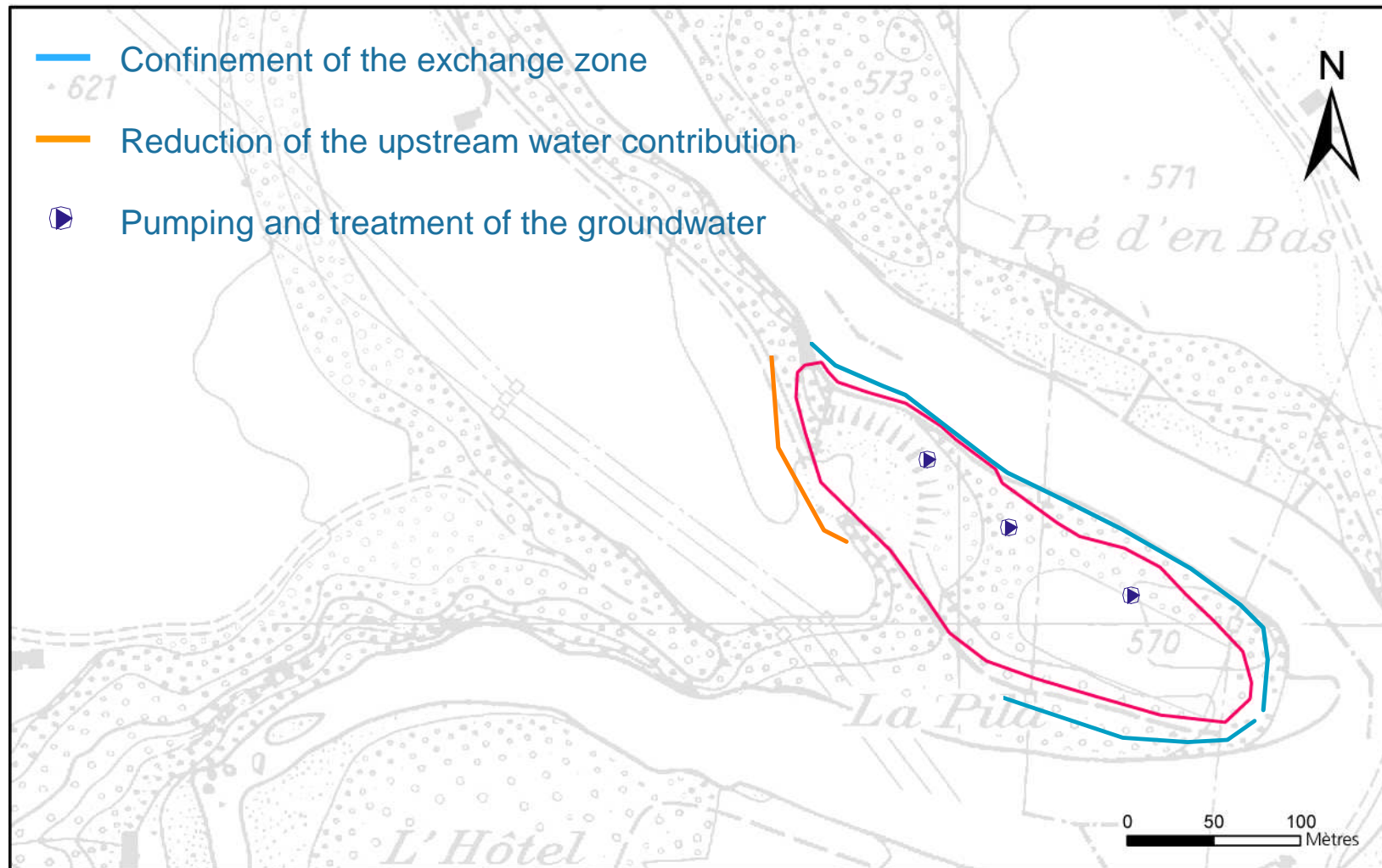
- Excavation of sector 1, unstable:  
Excavation of the materials and  
confinement measures  
Handling and conditioning in barrels  
(>1000 ppm)  
Estimated cost : 7 Mio CHF

- Optional: excavation of sector 3 (estimated  
cost 4 Mio CHF) or other measures





## Securing measures – Confinement

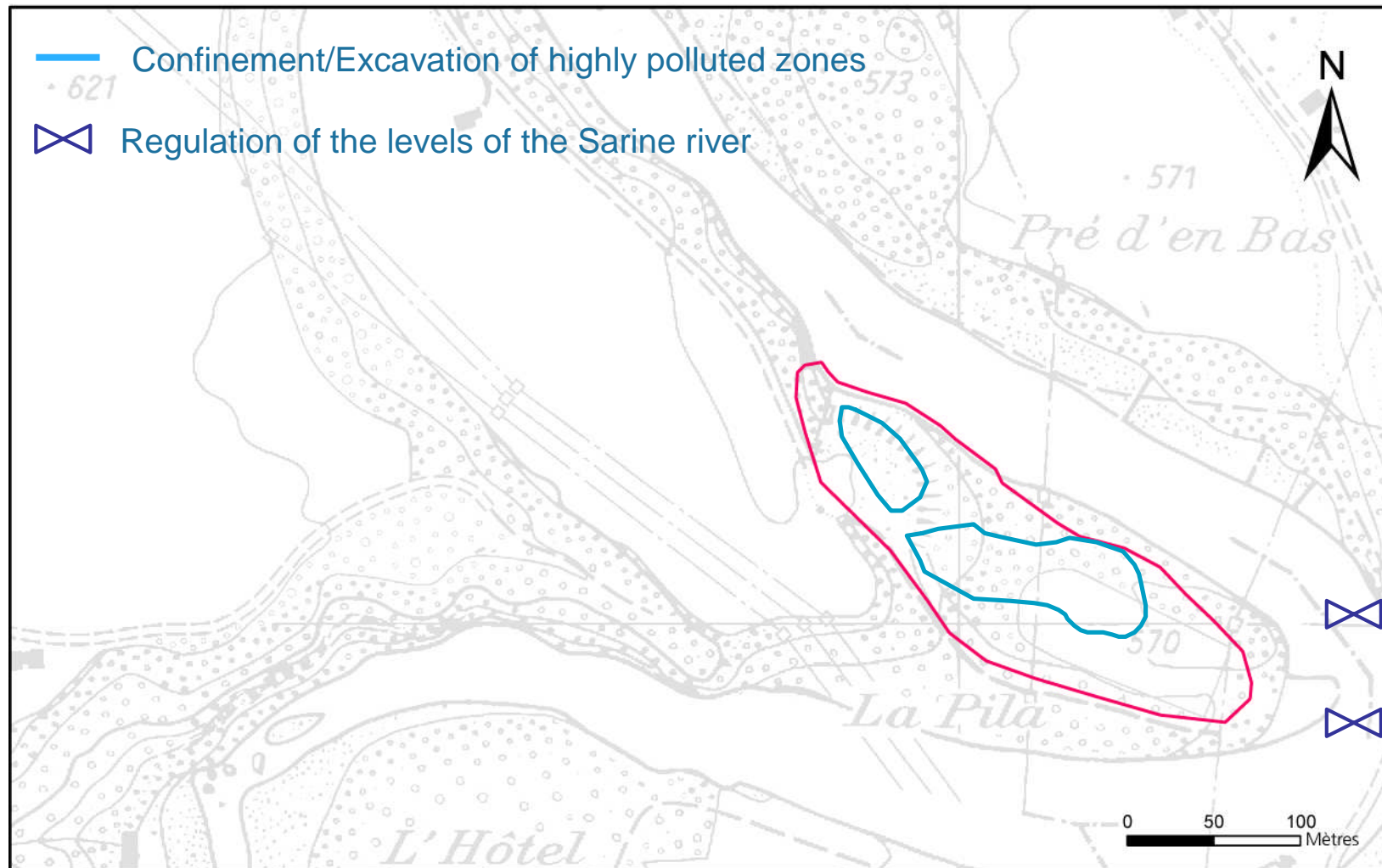


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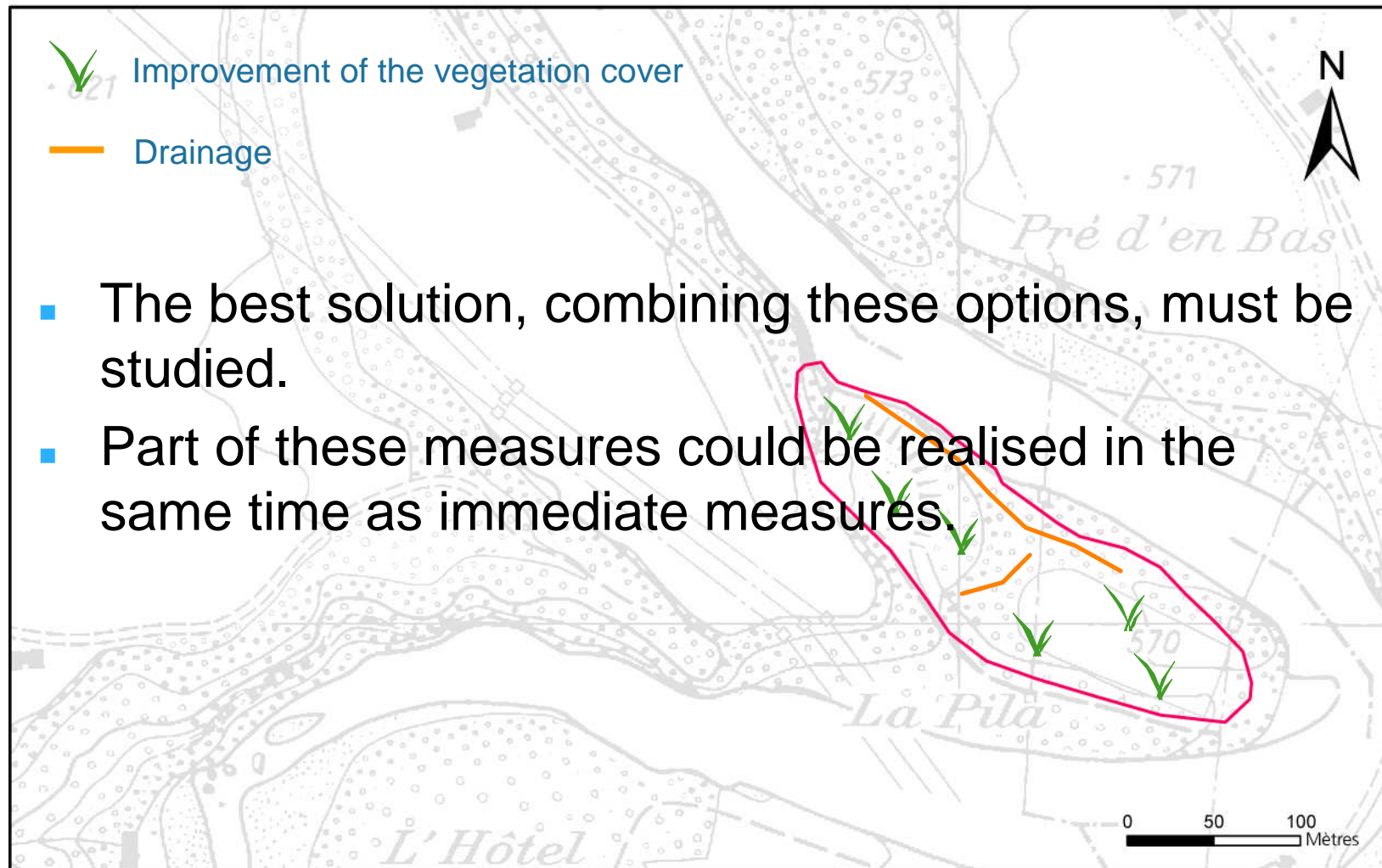
## Securing measures – Confinement



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## Securing measures– Infiltration, runoff, érosion



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# Remediation project

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- Feasibility study / Intervention modes :
  1. Measures that remove the danger over the long term in sustainable manner: sustainable options, to adopt for the remediation project:
    - Excavation of polluted soils with « off site » and «on site» treatment
  2. Measures that secure the site and avoid exportation of pollutants in the river (confinement): non sustainable options, must be considered as accompanying measures:
    - Hydraulic confinement
    - Physical confinement



## Next steps

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- Monitoring, complimentary investigations
- Immediate measures: project, call for tender and realisation
- Securing measures: study of different alternatives and feasibility
- Remediation alternatives: preliminary studies (preliminary draft)

