MINES Saint-Étienne

Une école de l'IMT

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Using bioavailability assessment to better diagnose the contamination potential of industrial territories

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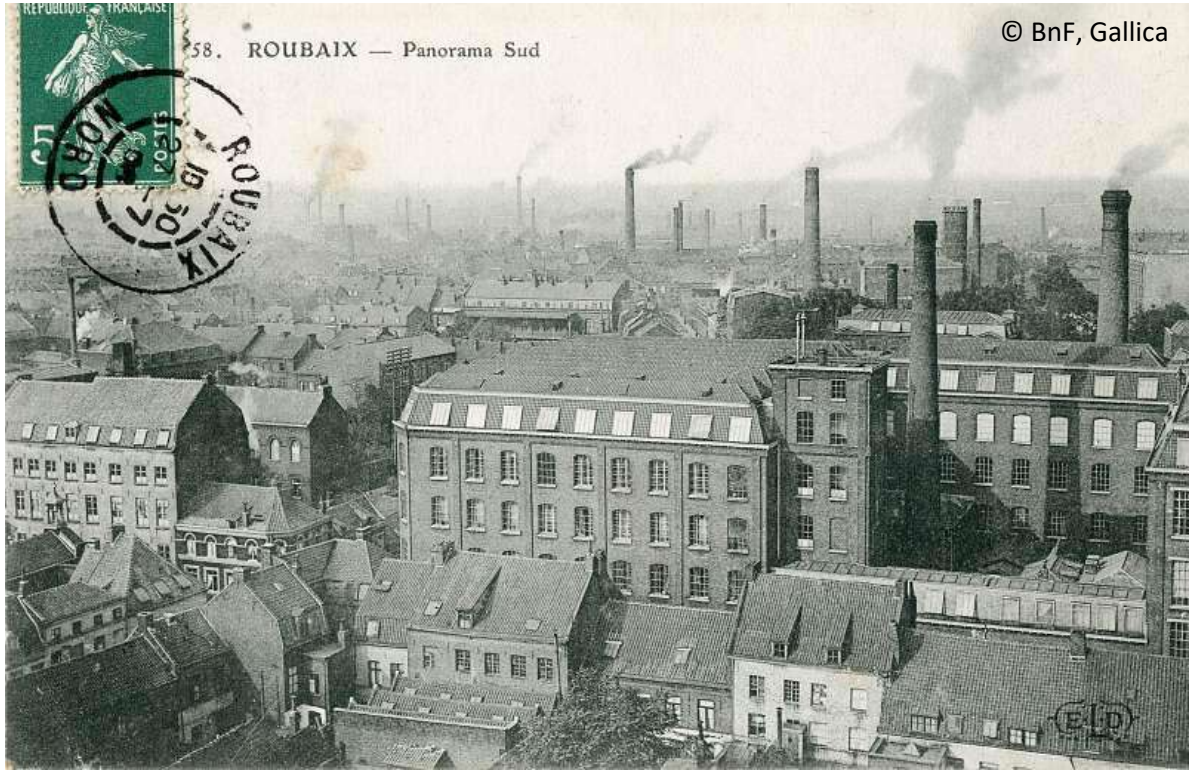
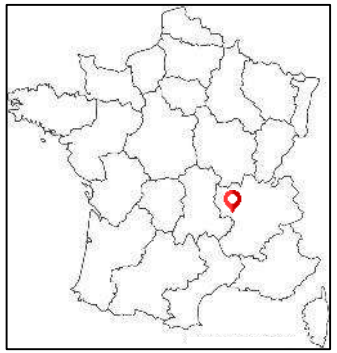
DVD Neyron -EPA-SAINT-ÉTIENNE-

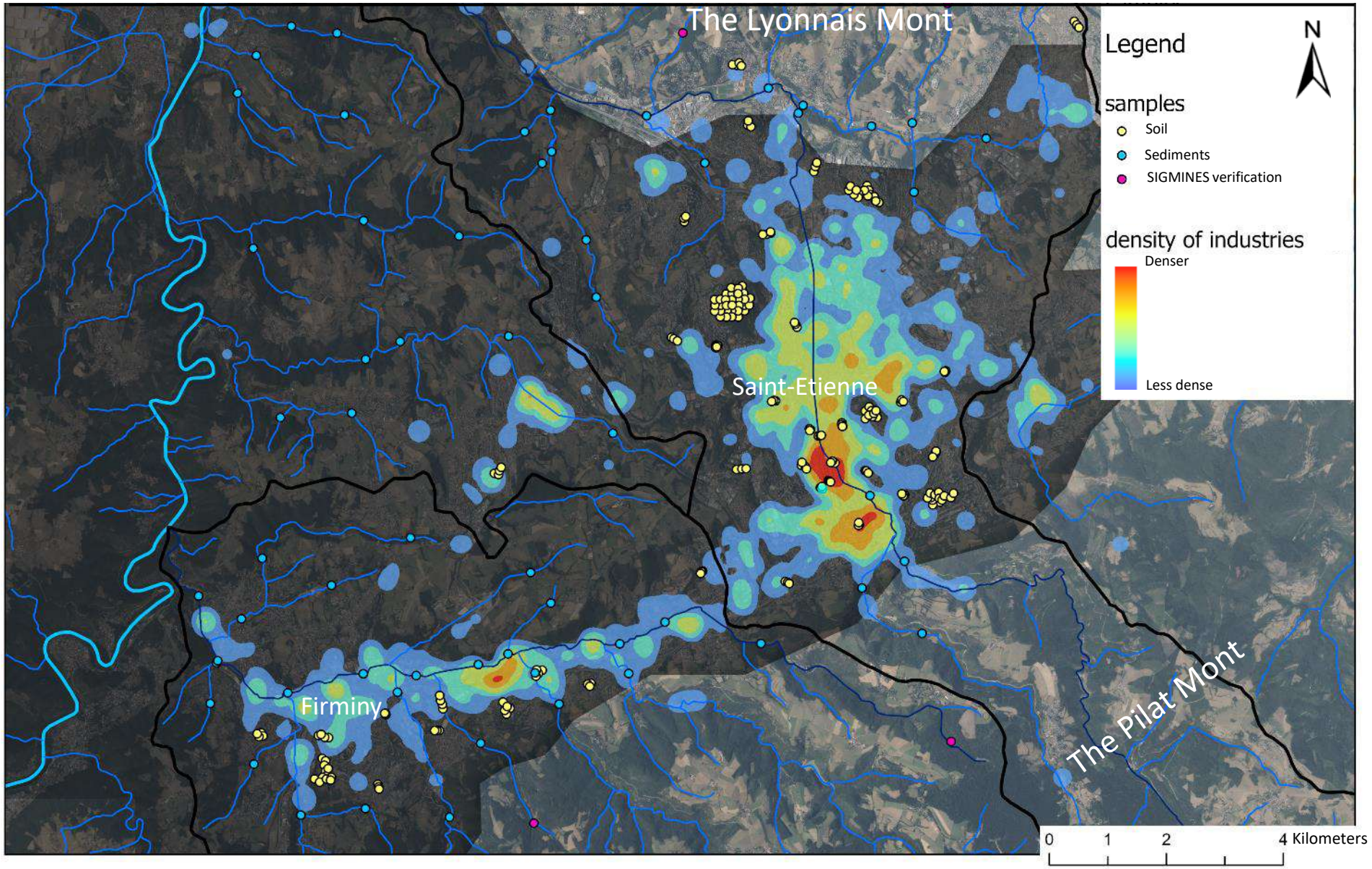
Industrial territories : past and present



Industrial territories : past and present



Saint-Etienne industrial territory



Industrial territories : past and present

Study site

Some metals found on site :
Zn, Ni, Cr

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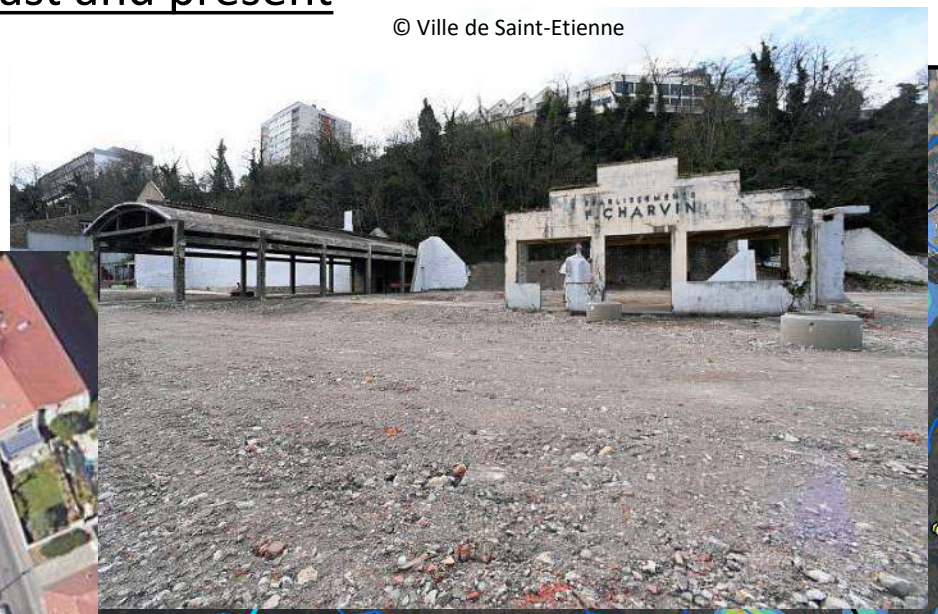

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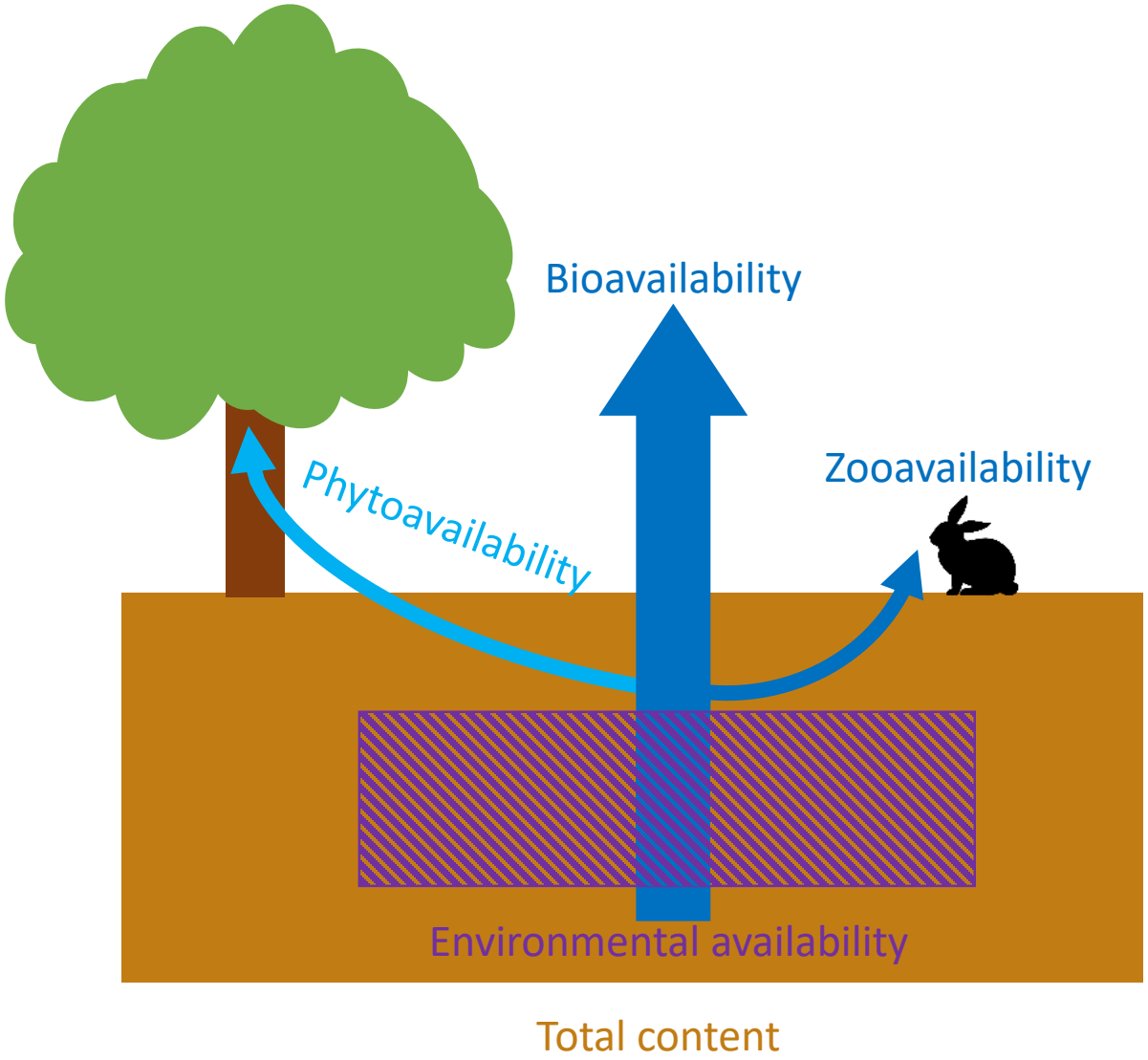
Transfer pathways : Explanation of key terms



Total content

Element content in all the fractions of the soil

Environmental availability

Element content in the most soluble fraction of the soil

Phytoavailability

Element content actually accumulated in plants

How to integrate available fractions into contamination diagnosis ?

Sampling strategy

anthropogenic anomalies

- Wastelands
  - Soils
    - surface soil (<15 cm) — < 2 mm fraction
      - Environmental availability
      - Total content
    - Subsoil (0-1 m) — < 2 mm fraction
      - Total content
  - Plants leaves
    - Pool (5 sp.) — ground
      - phytoavailability

Local geochemical background

- Parks
  - Environmental availability
  - Total content
- sediments
  - Total content

Geochemical background study : Determination of class limit

Environmental availability

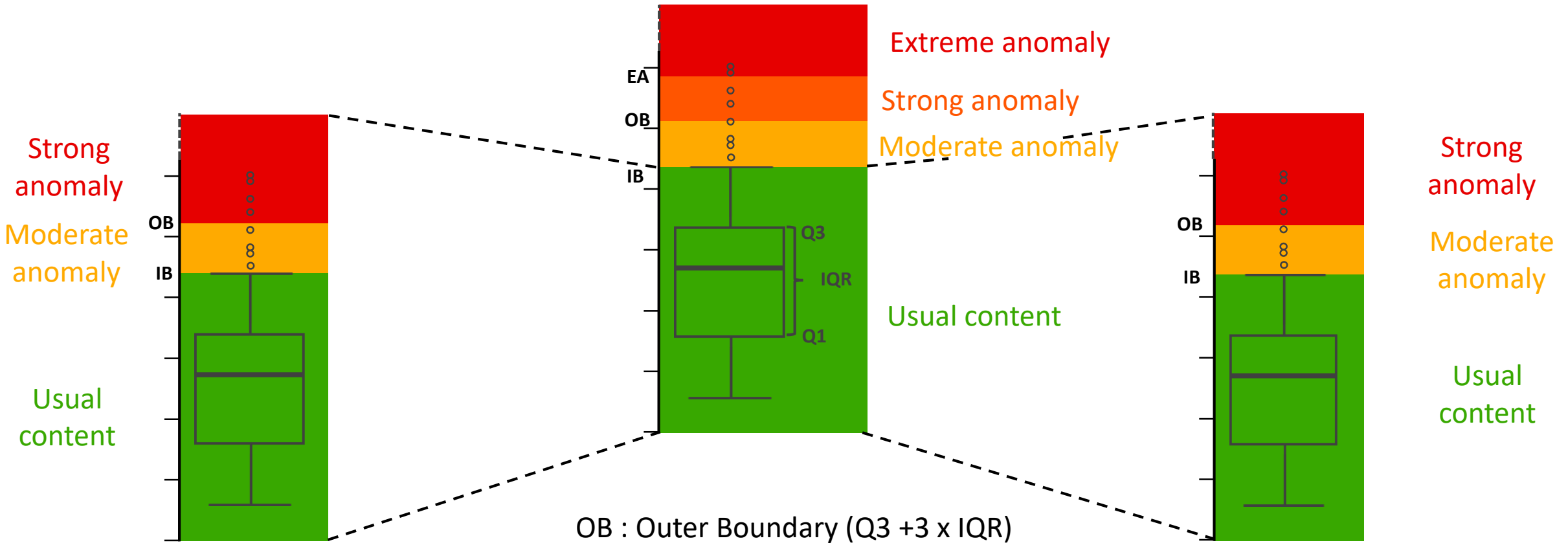
From "Bio indicator" project, ADEME

Total content

From National methodology for the management of polluted sites and soils (ASPITET project)

phytoavailability

From "Bioll" project, ADEME



OB : Outer Boundary (Q3 +3 x IQR)

IB : Inner Boundary (Q3 +1,5 x IQR)

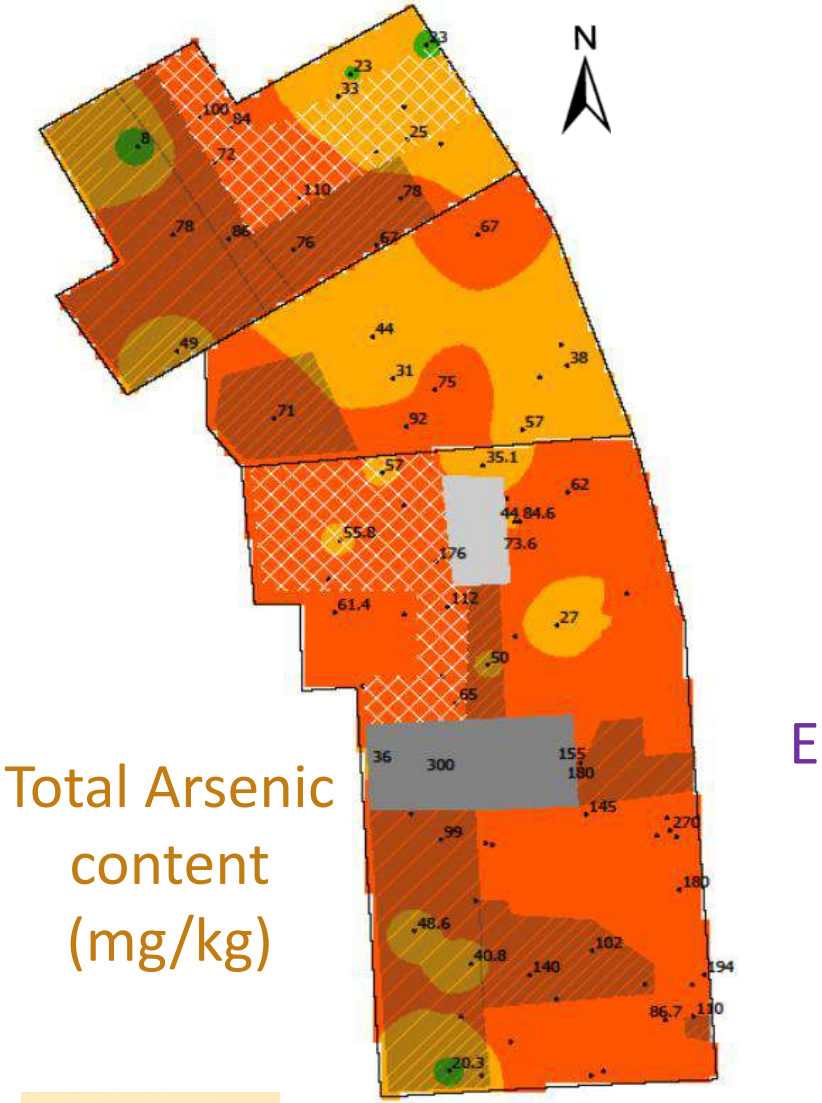
EA : Extreme value of natural soils (ASPITET)

Q1 : first quartile

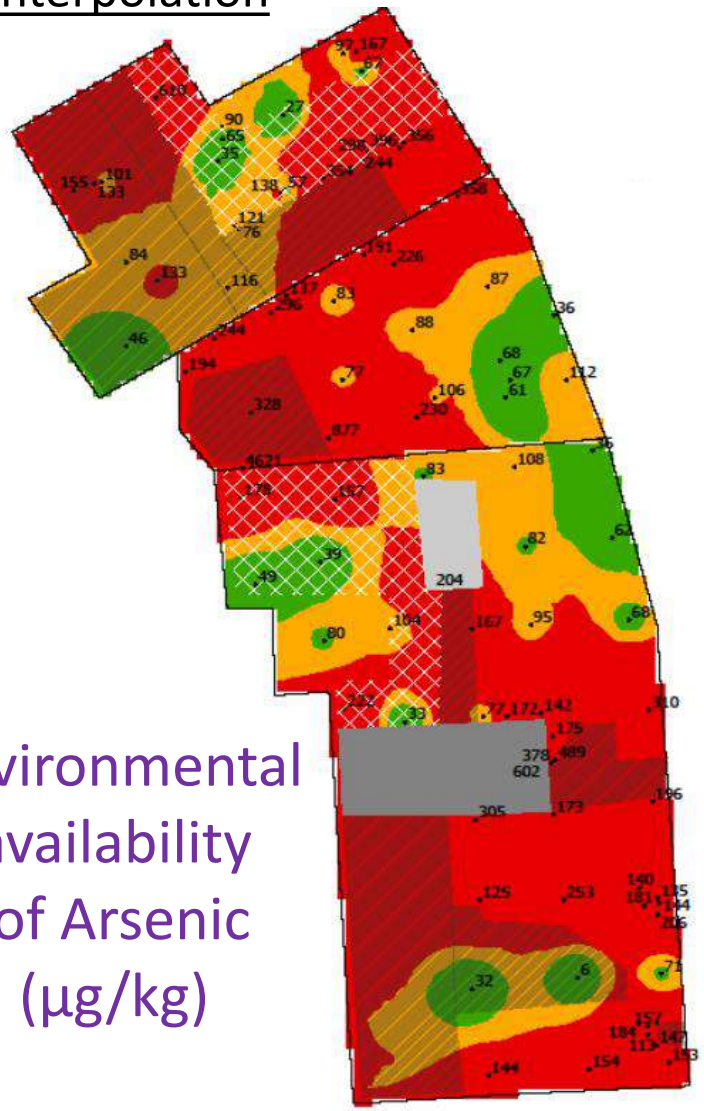
Q3 : third quartile

IQR : inter quartile range (Q3 - Q1)

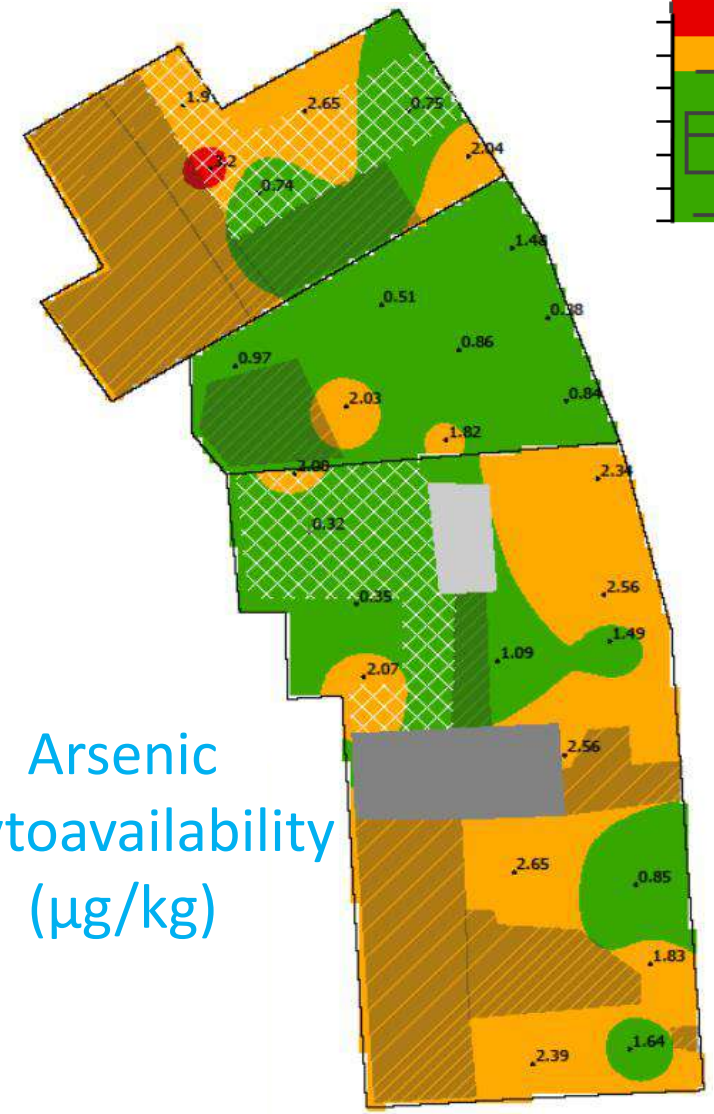
Study of contaminant pathways : As interpolation



Total Arsenic content (mg/kg)



Environmental availability of Arsenic (µg/kg)



Arsenic Phytoavailability (µg/kg)

→ Spatial divergence of anomalies according to the metal fraction under consideration

Study of contaminant pathways : Hazard Index (HI)

$$HI = \sum \left(\frac{C_m}{C_r} \right)_i \times k_i$$

modified from Contamination factor

toxicity constant used (Based on METOX index)

$k_{As} : 10$	$k_{Cd} : 30$	$k_{Cr} : 2$
$k_{Cu} : 5$	$k_{Hg} : 40$	$k_{Ni} : 5$
$k_{Pb} : 5$	$k_{Zn} : 1$	

i : chemical element

k : toxicity constant

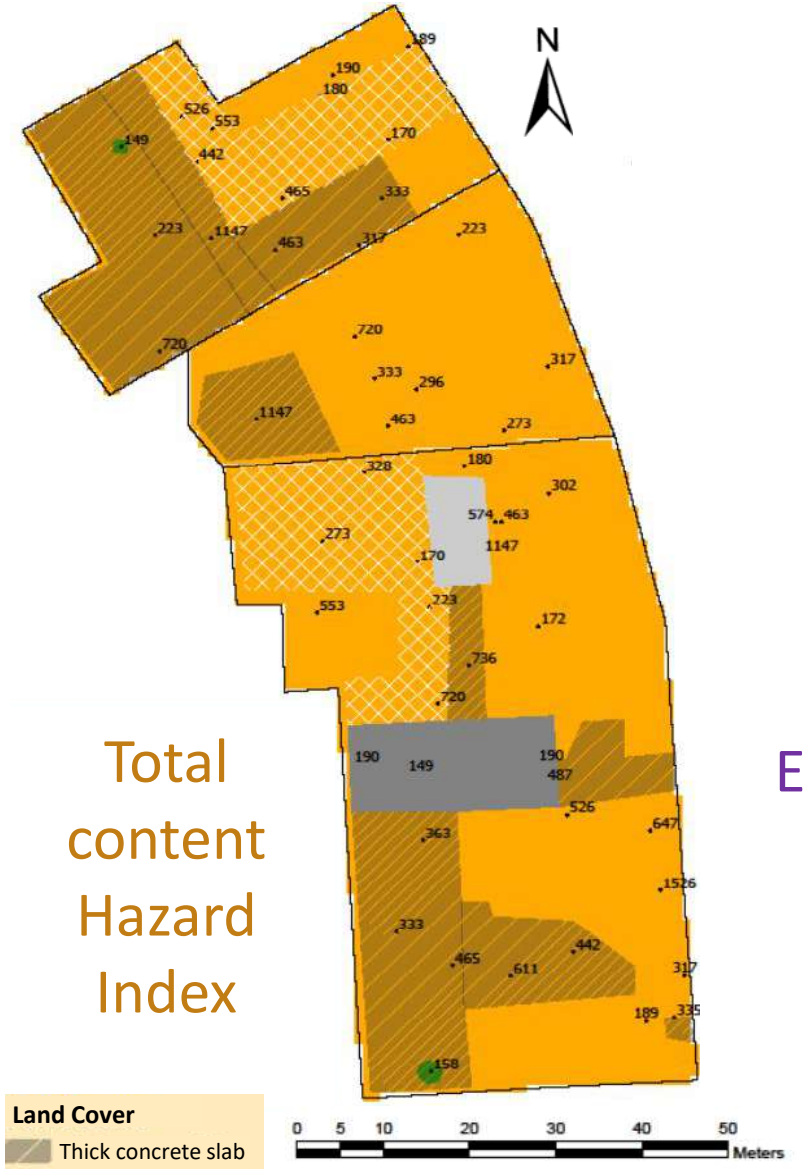
C_m : Measured content

C_r : Reference content Inner Boundary

Metal	Range of values commonly observed in "ordinary" soils of all grain sizes	Range of values observed for moderate natural anomaly	Range of values observed in the case of strong natural anomaly
Ni	2 to 60	60 to 130	130 to 2076

Example from the table of ASPITET project, values in mg/kg

Study of contaminant pathways : Hazard Index (HI)



Total content Hazard Index

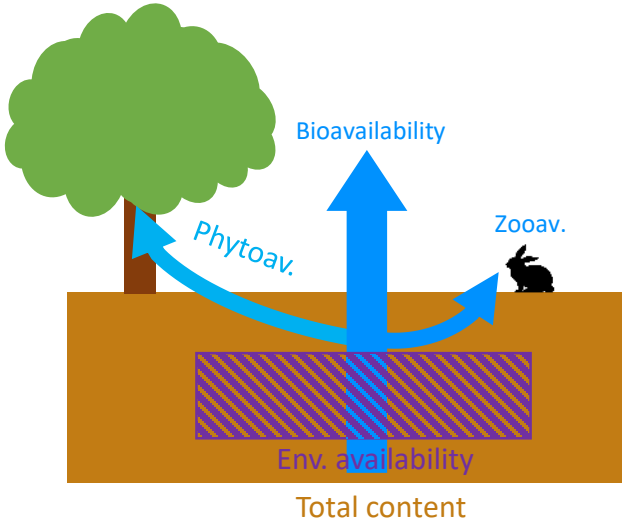
Environmental availability Hazard Index

Phytoavailability Hazard Index

→ **Better identification of the most hazardous area**

Conclusion

Environmental availibility ≠ 0 ➔ mobility of metals in wasteland soil



Total content anomalies → Overestimate → Environmental availability anomalies

Total content anomalies → Overestimate → Phytoavailability anomalies

→ Overestimation of risks

Using danger index helps site characterization to better rehabilitate wasteland according to its use

- *Using local soil-geochemical background as a reference (*Anthropogenic and natural)
- *Development of an index combining soil and plants metals contents*

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Thank you for your attention

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