



## **LE PRESSIONI AMBIENTALI DEI SITI MINERARI DISMESSI NELLE “COLLINE METALLIFERE” IN TOSCANA**

### **ENVIRONMENTAL HAZARDS IN ABANDONED MINING AREAS “COLLINE METALLIFERE” TUSCANY**

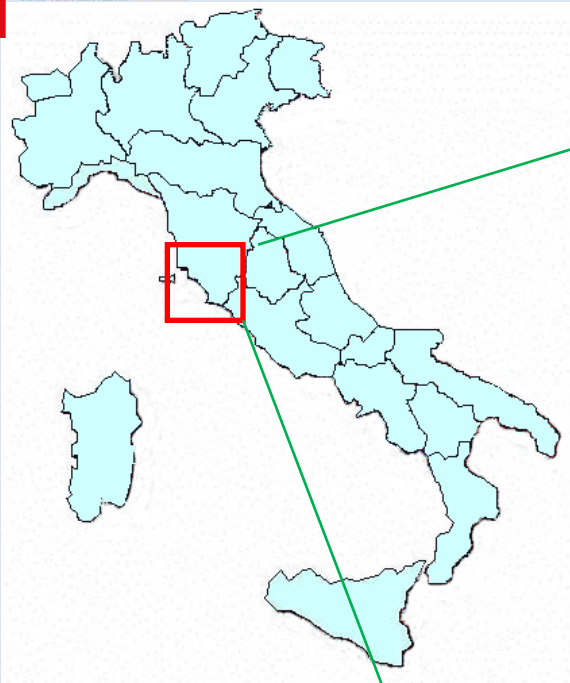
**WORKSHOP – Cagliari 22-23 marzo 2012**

***Bonifiche, procedure operative e possibilità di sviluppo delle AREE MINERARIE DISMESSE***

***Remediation, operating procedures and potential redevelopment of ABANDONED MINE SITES***



# Metal-Bearing Hills

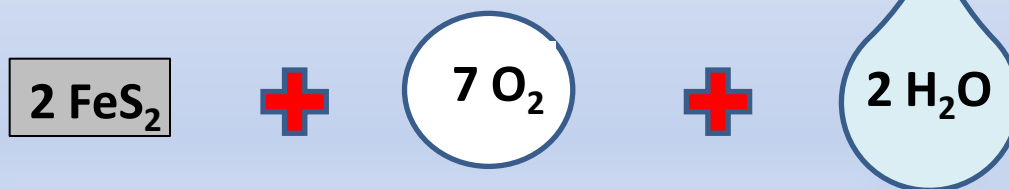


**over 50 sites**

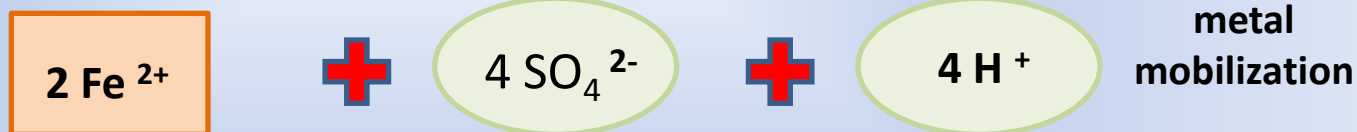


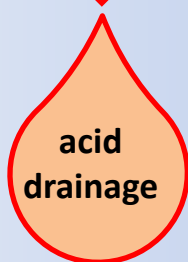
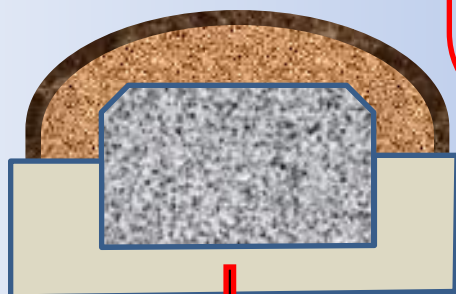


*ante*



*post*





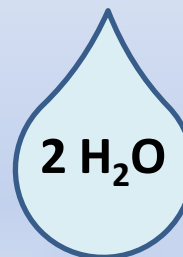
removal



exclude oxygen



stop water



burying

waterproofing

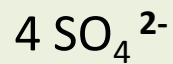
*ante*



iron  
precipitation



sulfate  
reduction



acidity  
neutralization



chemical and/or biological  
process

alkalinization

*post*

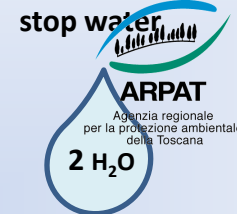


## SALCIAIA GR ns 6

removal



exclude oxygen

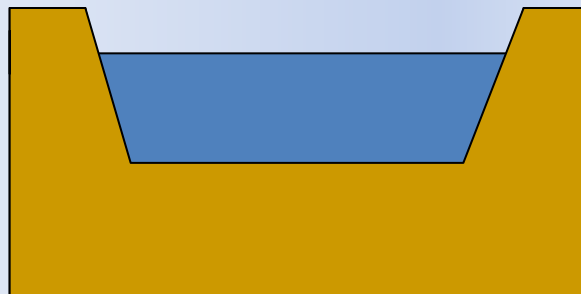


burying

waterproofing

\* stockpiling of pyrite ash - 2,5 ha

\* 1978 → 1980



removal

excavation

Concentration  
Target Level ?

**NO !**

Risk Analysis

Concentration  
Risk Level ?

**YES** for  
underground water

**NO** for soil  
Contact and Ingestion

**BURYING**  
with clean soil





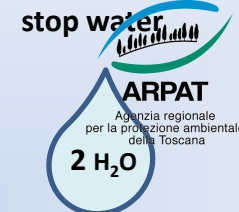


## SALCIAIA GR ns 6

removal



exclude oxygen

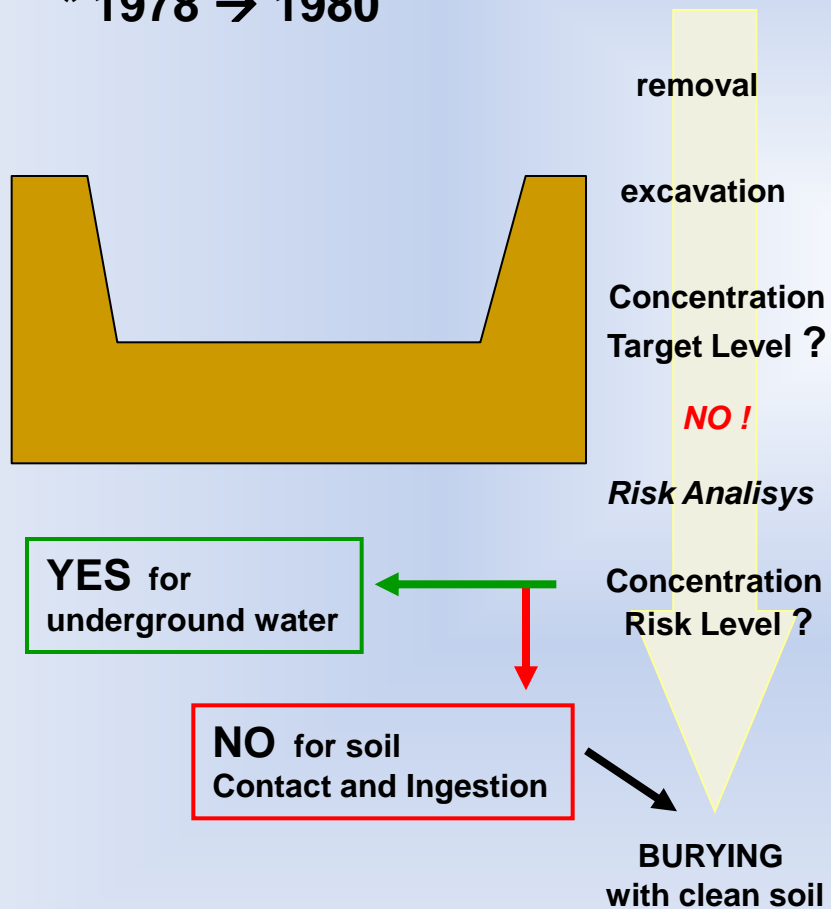


burying

waterproofing

\* stockpiling of pyrite ash - 2,5 ha

\* 1978 → 1980



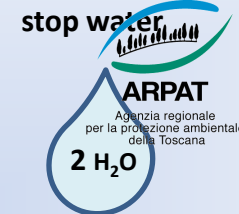


## SALCIAIA GR ns 6

removal

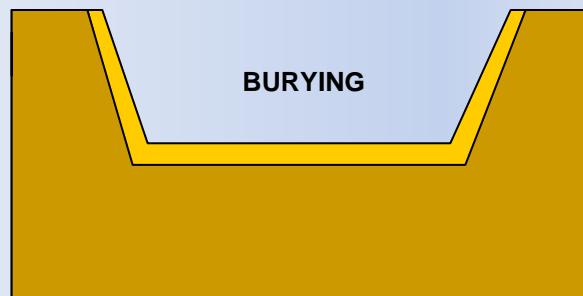


exclude oxygen



\* stockpiling of pyrite ash - 2,5 ha

\* 1978 → 1980



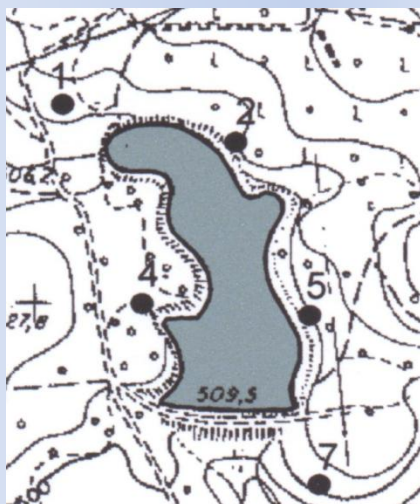
**Concentration Target Level**





## GABELLINO GR 82

- Tailing impoundment – *from flotation mill*
- 3,5 ha – 3500 mc
- 1953 → 1973



removal



exclude oxygen



burying



stop water



waterproofing

ARPAT

Agenzia regionale  
per la protezione ambientale  
della Toscana





## GABELLINO GR 82

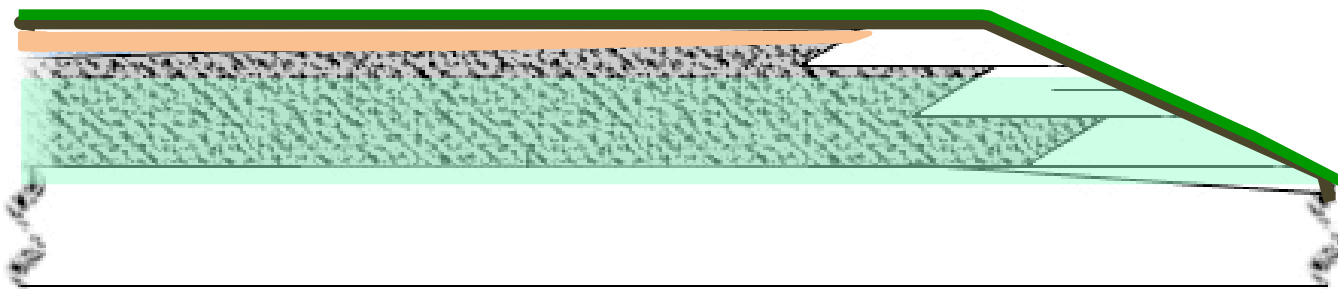
NOW



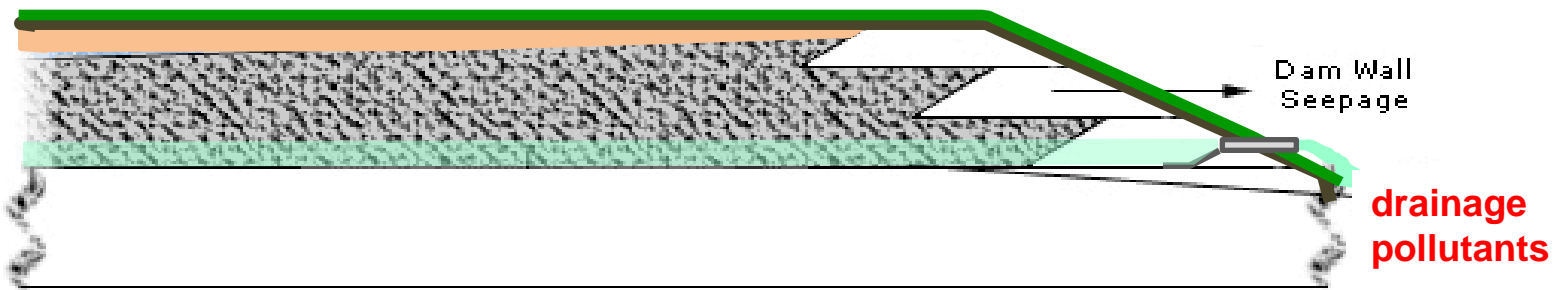


# ABOUT DAM !!!

## CLOSED DAM



## DRAINING DAM





**RECURRENT... *but* ..**

**IRREGULAR ..*and* ..**

**NO CONSTANT QUALITY**

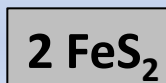


**PASSIVE  
TREATMENT**



## PREVENTION

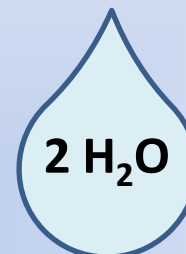
removal



exclude oxygen



stop water



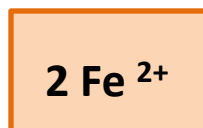
burying

waterproofing

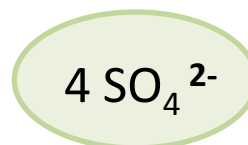


## TREATMENT

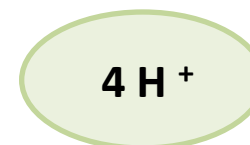
iron  
precipitation



sulfate  
reduction



acidity  
neutralization



chemical and/or biological  
process

alkalinization



# CAPPING and PASSIVE TREATMENT

## CASE 1- Fenice- Capanne

mixed sulphide  
Cu, Pb, Zn



- 12 ha tailing impoundment  
*from flotation mill*
- 6 ha tailing piles  
*waste rock and roasted pyrite*
- 1953 → 1973 ... impoundment
- .... oldest .... roasted pyrite





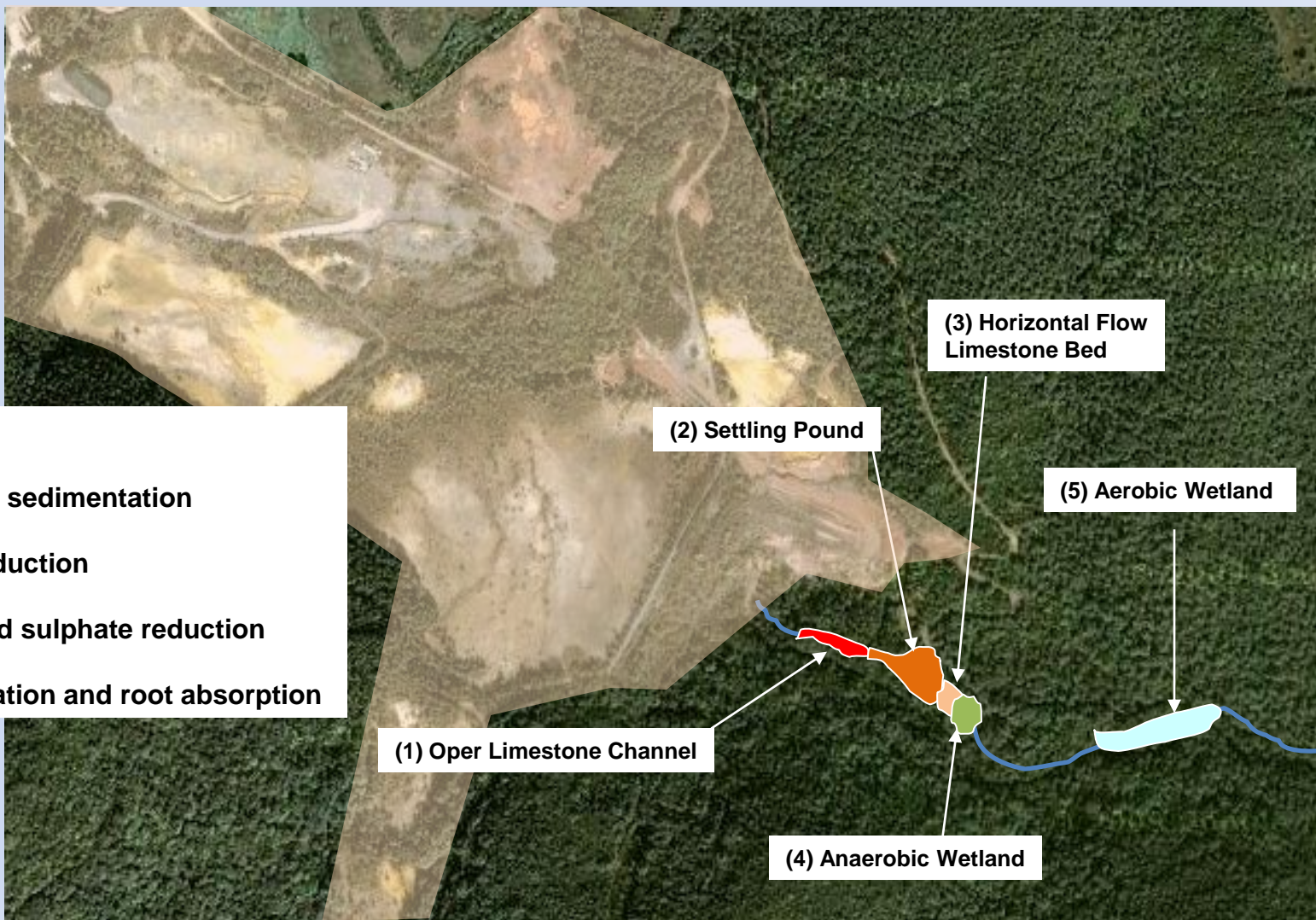
## Fosso dei Noni







## CASE 1- Fenice- Capanne







## CASE 2- “Roste “ - *Roasted Pyrite*

to combine

suggestive landscape

environmental protection







## CASE 2- “Roste “ - Roasted Pyrite

Sb mg/kg  
22 – 108

Pb mg/kg  
300 - 5000

As 200 - 1200

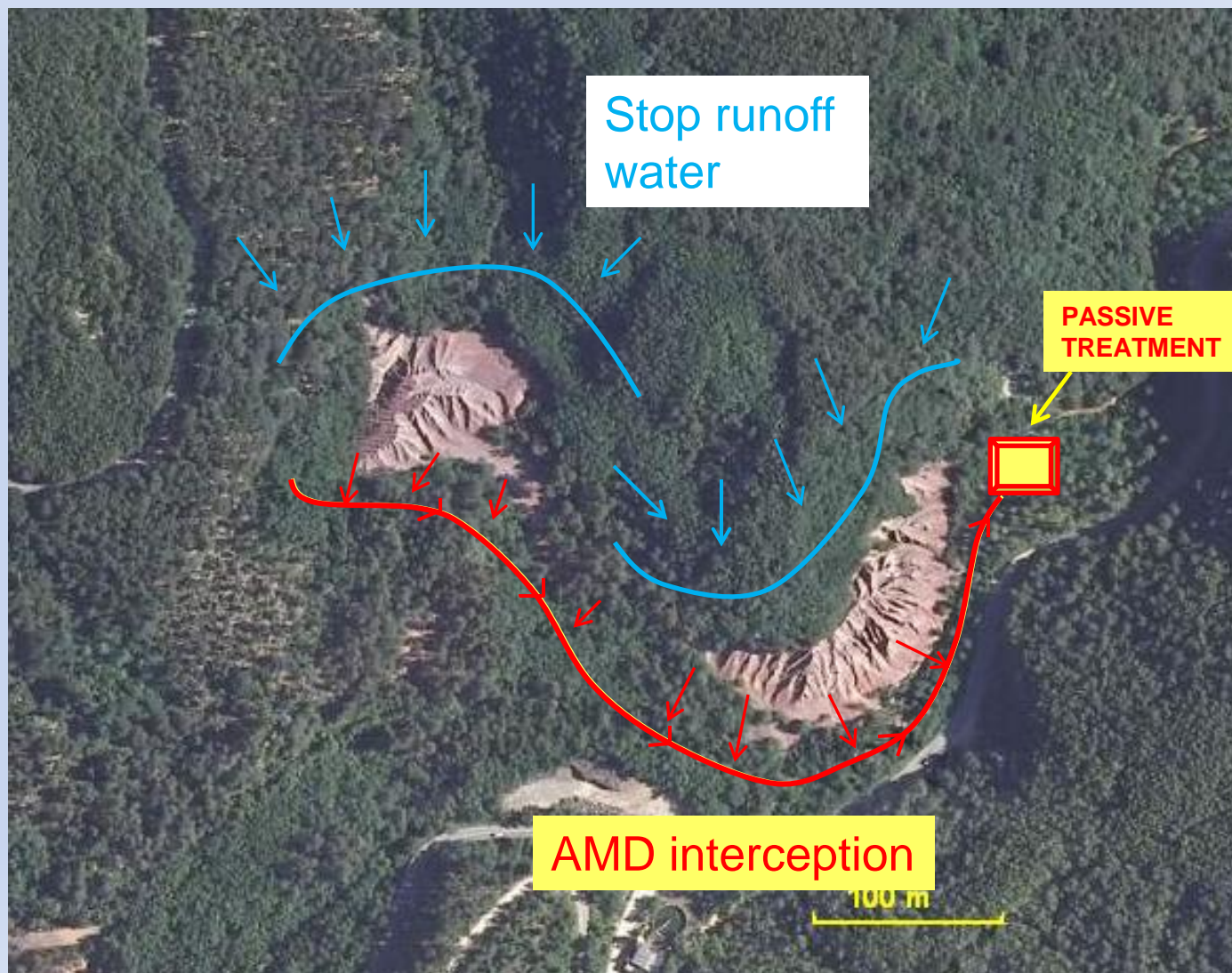
Cu 400 – 2700

Fe 100000 - 200000

	DAPHNIA MAGNA					VIBRIO FISCHERI				
	ELUTRIATE			ELUTRIATE (pH 7)		ELUTRIATE			ELUTRIATE (pH 7)	
	ENDPOINT %			ENDPOINT %		ENDPOINT %			ENDPOINT %	
	pH	immobility	EC50	immobility		pH	inhibition	EC50	Inhibition	
<b>Fenice-Capanne Donna Morta</b>	5,2	100	84,3	100		5,2	100	79,7	34,1	
<b>Fenice-Capanne Bacini</b>	5,0	100	84,9	0		5,0	100	83,2	14,7	
<b>Merse 1</b>	3,8	100	6,4	100		3,8	87	55	33,2	
<b>Merse 2</b>	3,9	100	8,7	100		3,9	91	40	35,4	



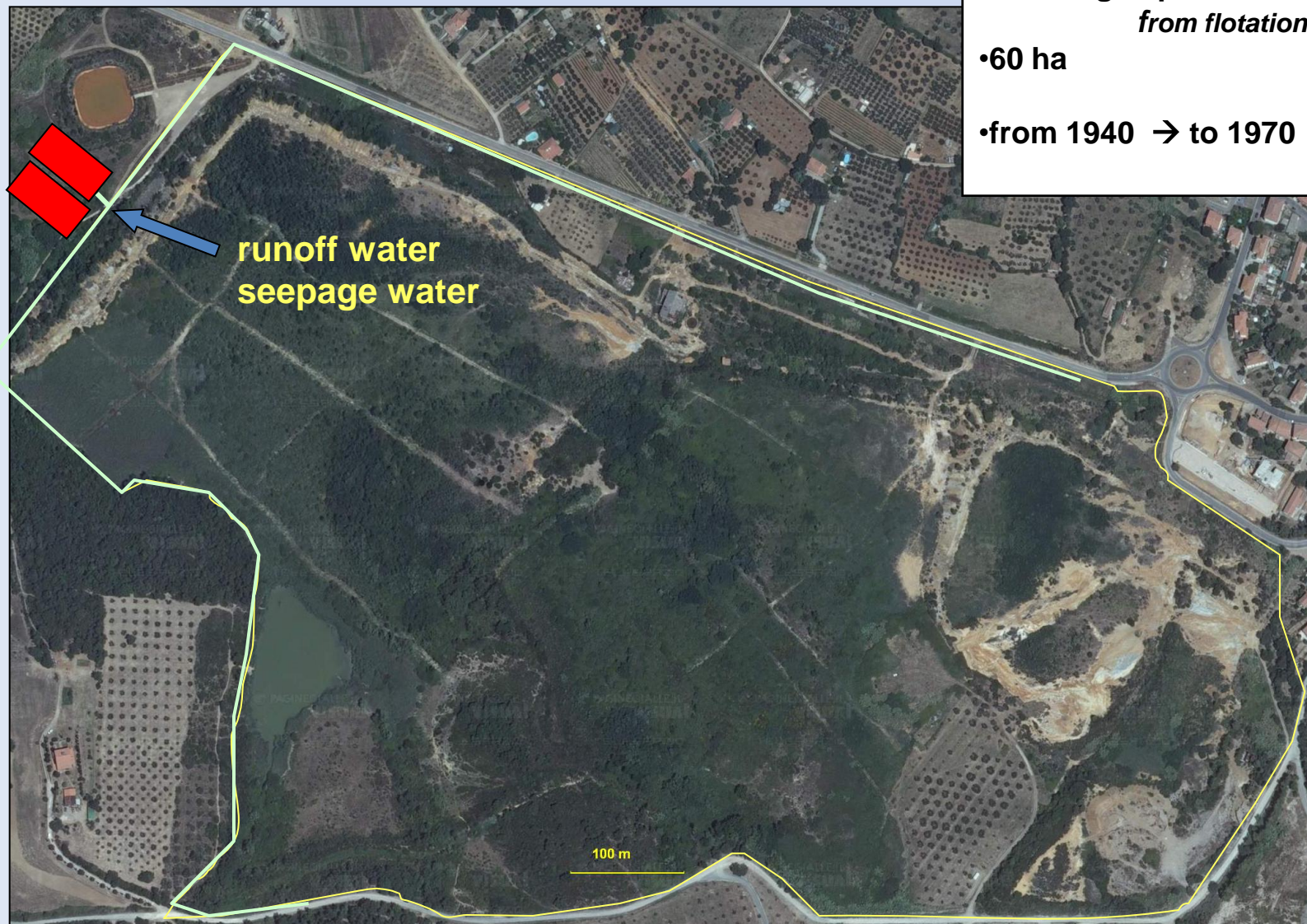
## CASE 2- “Roste “ - *Roasted Pyrite*





## Partial **CAPPING** and **PASSIVE TREATMENT**

- 9 tailing impoundment  
from flotation mill (pyrite)
- 60 ha
- from 1940 → to 1970







## Partial **CAPPING** and **PASSIVE TREATMENT**



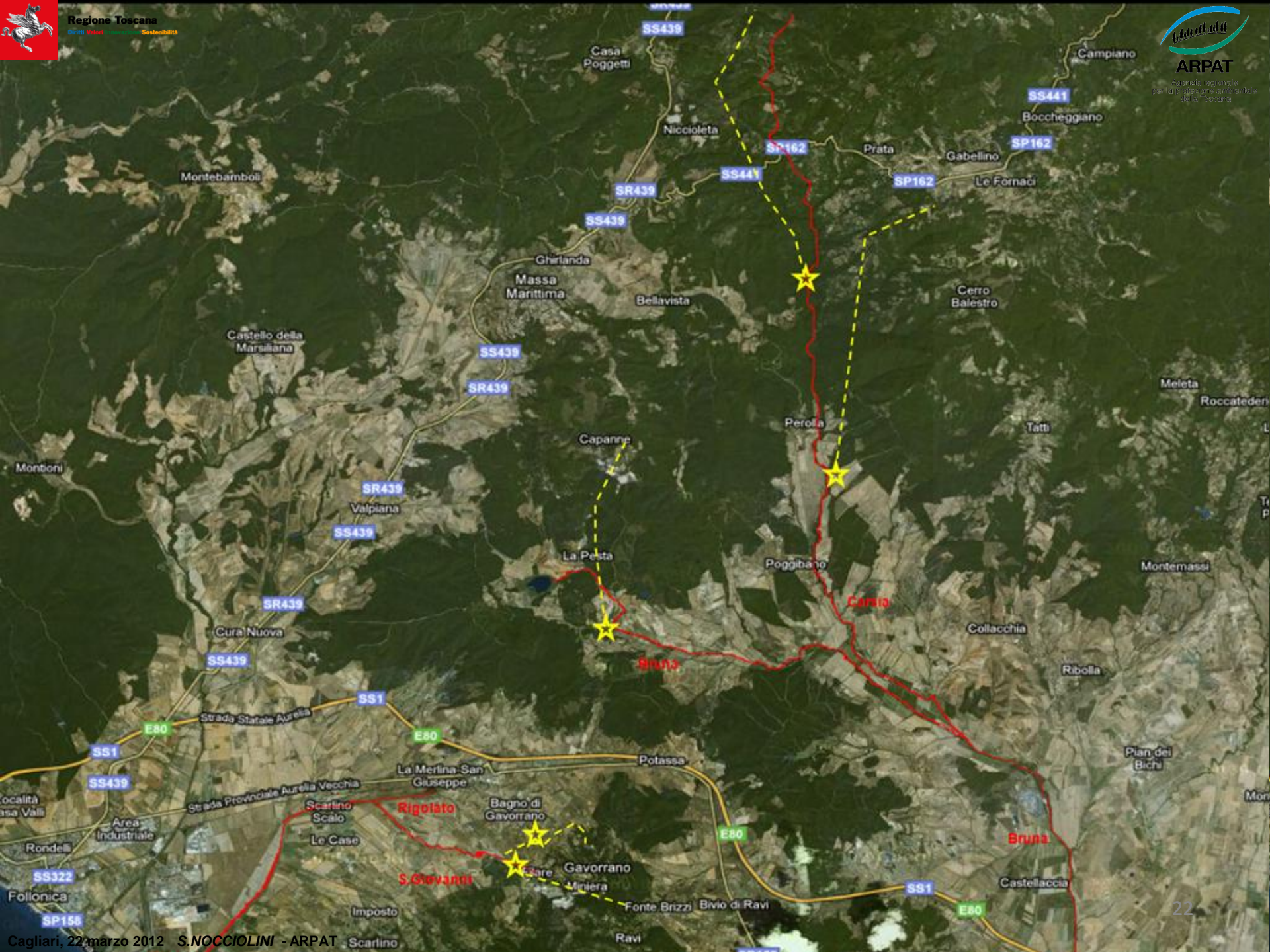


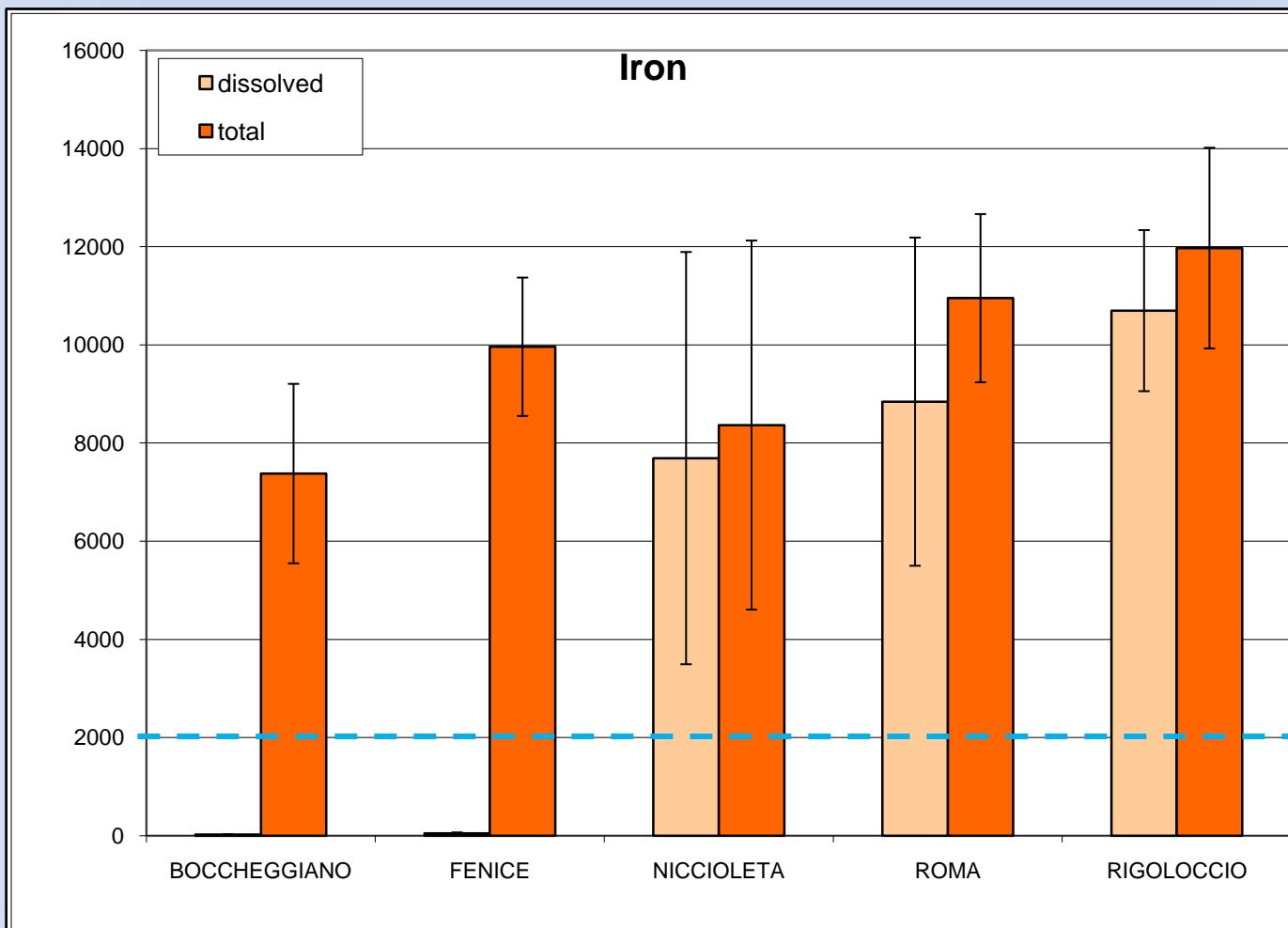


# BIG CHALLENGE

## Mine Drainage Water



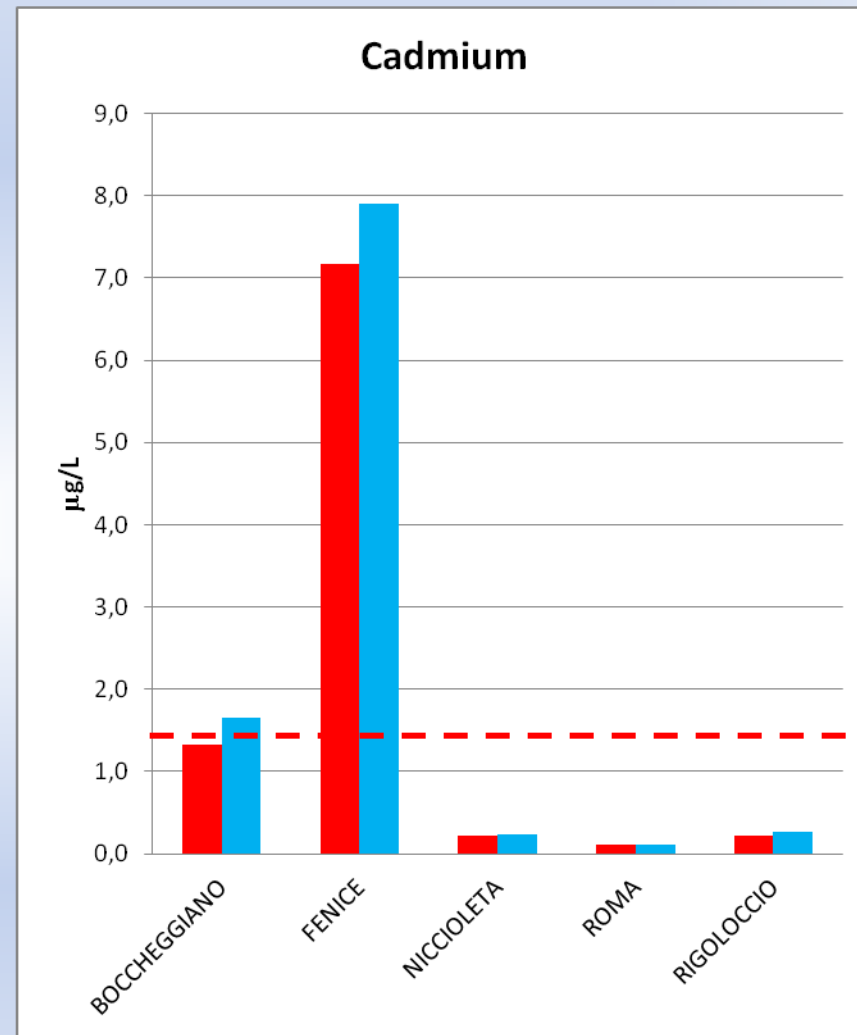
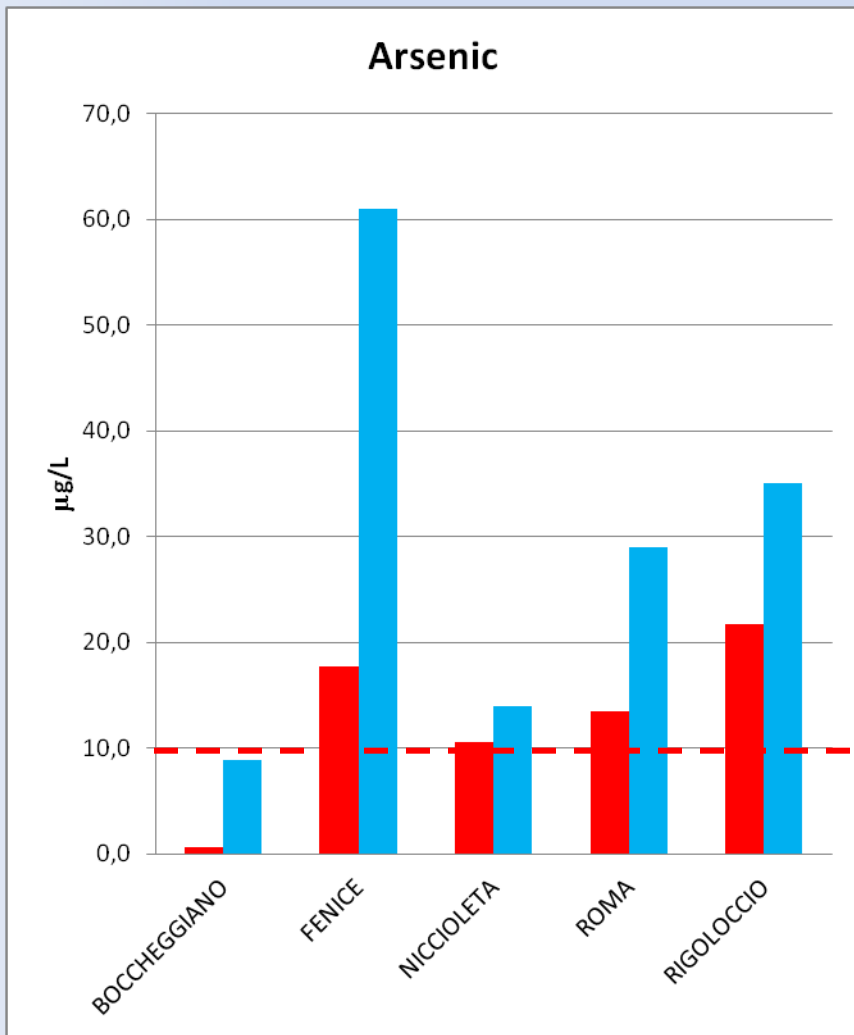




Qualitfty standard for  
fresh water

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## Mine Drainage Water



dissolved metal

total metal



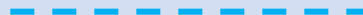


Qualitfty standard for  
fresh water

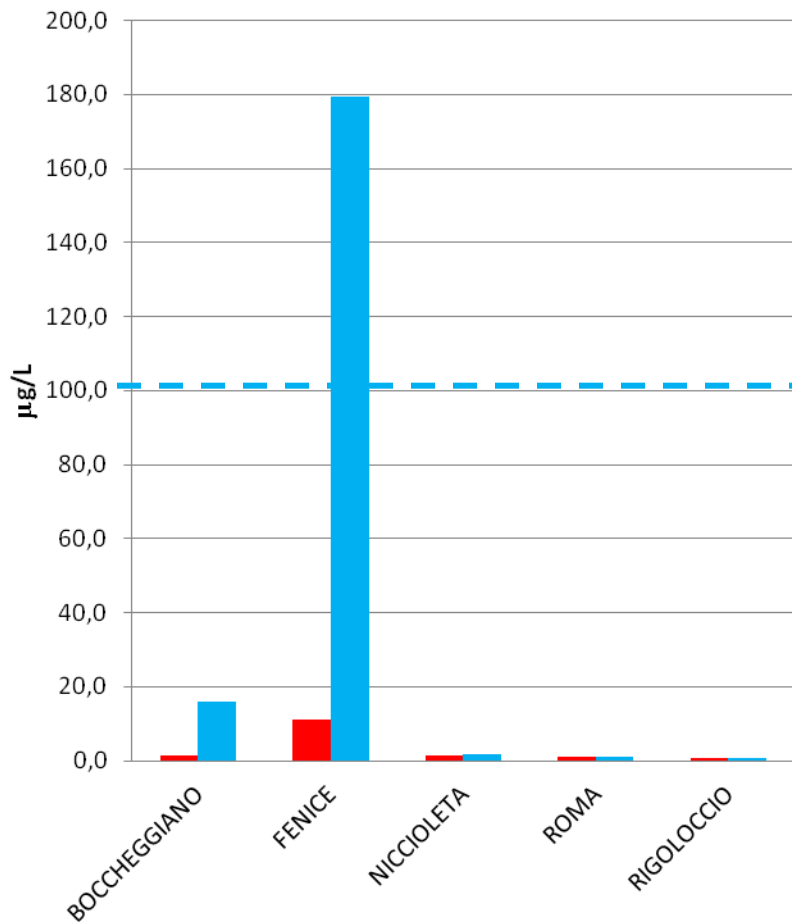


## Mine Drainage Water

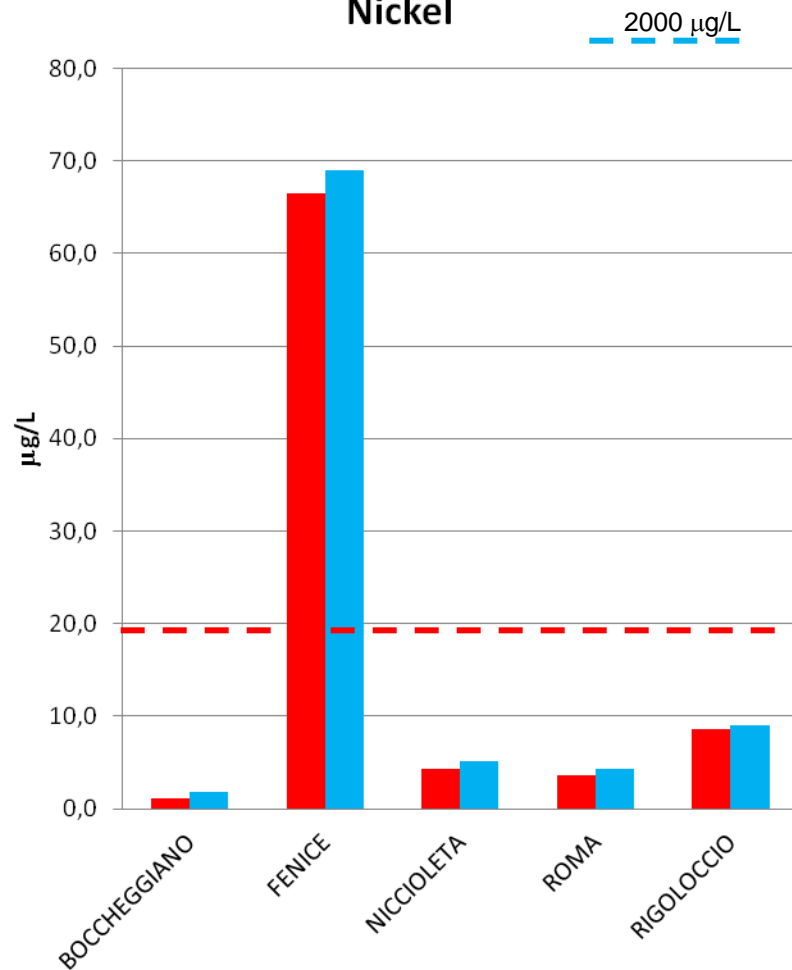
max limit for sewage



### Copper



### Nickel



dissolved metal

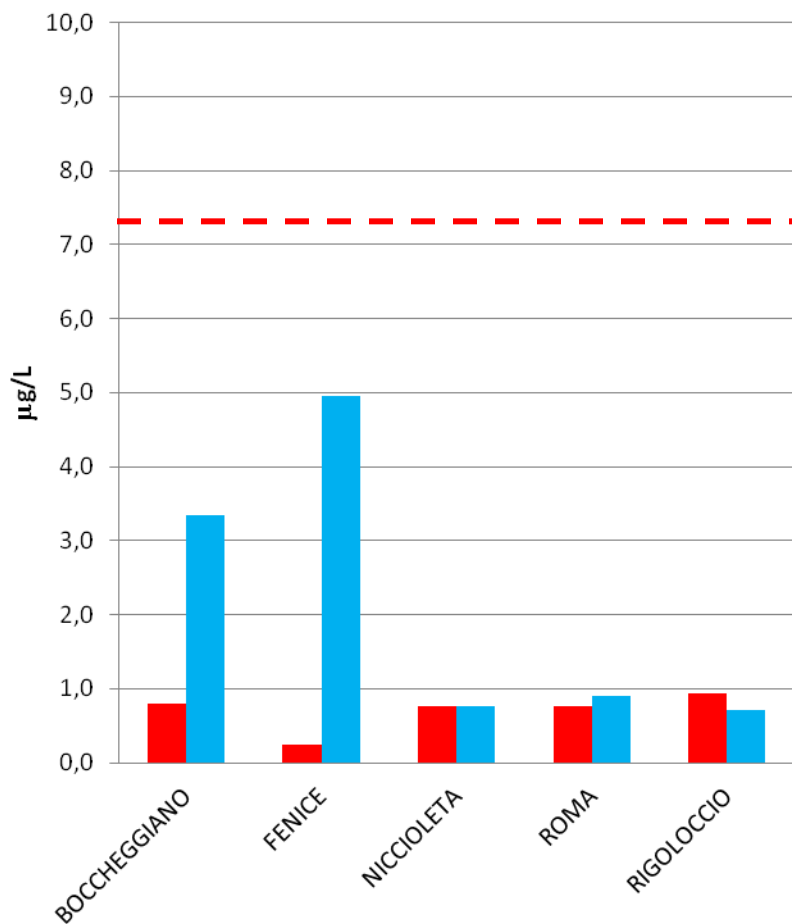
total metal



Qualitfty standard for  
fresh wate



## Lead

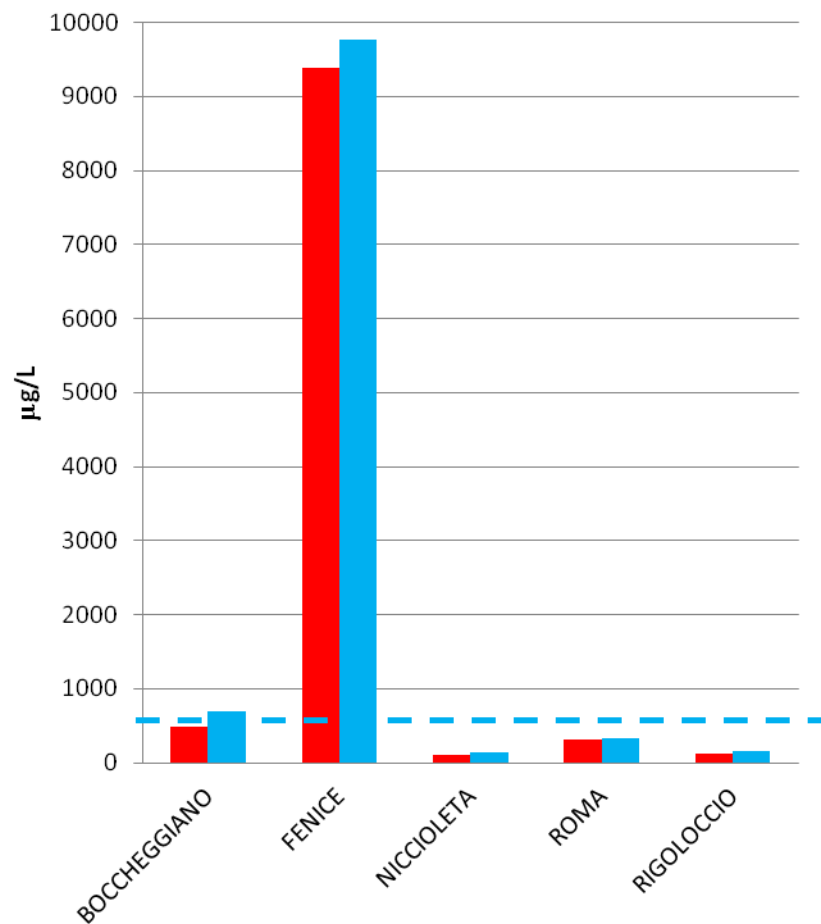



## Mine Drainage Water

max limit for sewage



## Zinc



 dissolved metal

 total metal

