

“Capacity Building and Strengthening Institutional Arrangement”

Workshop: Quantitative risk assessment of oil and gas plants“

## **Case Studies of Oil and Gas Major Hazard Risk Assessment**

**Mr. Francesco Astorri**

APAT

Agency for Environmental Protection and Technical Services

## Case Study

### Oil depot in Northern Italy

Logical Unit: Aboveground Gasoline Tank

Vulnerable receptor: Channel

Distance from Tank: 100 meters

Depth of water table: 2 meters

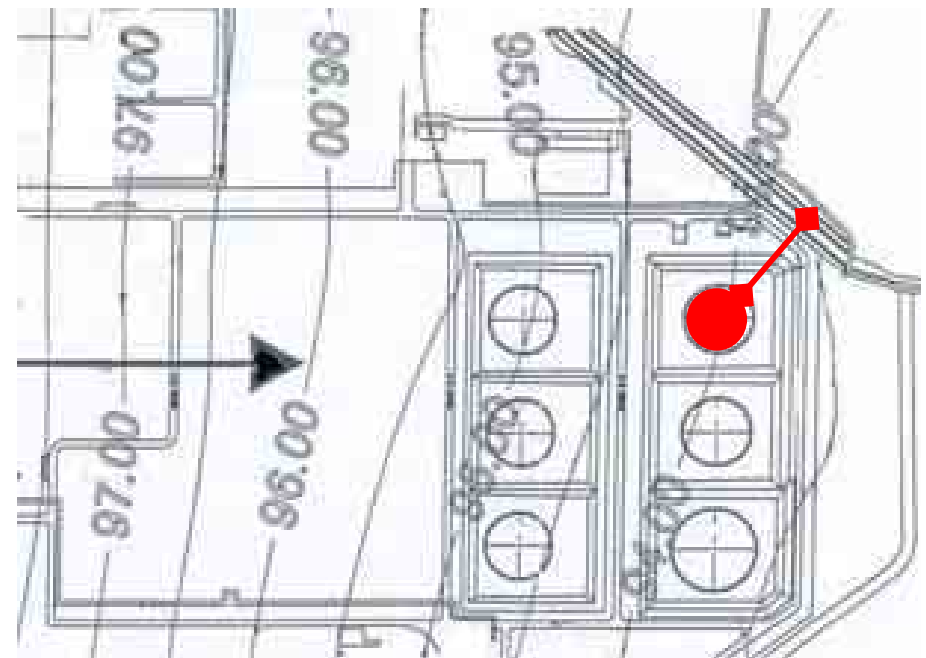
Hydraulic Conductivity =  $10^{-2}$  cm/s

Hydraulic gradient =  $5.4 \cdot 10^{-3}$

Effective Porosity  $\eta = 0.25$

Flow direction: downgradient

R.T.I Value = medium



## Case Study

### Evaluation of vertical time arrival (VTA)

$$\text{VTA} = \text{Depth of water table} / K$$

$$\text{VTA} = 2 \text{ mt} / 0,0001 \text{ mt/s}$$

$$\text{VTA} = 5,5 \text{ hours}$$

### Evaluation of Horizontal Seepage Velocity (HSV)

$$\text{HSV} = Ki / \eta \text{ (Darcy Law)}$$

$$K = 10^{-2} \text{ cm/s}$$

$$\eta = 0.25$$

$$i = \Delta h / L = (94.5 - 93.5) \text{ m} / 185 \text{ m} = 5.4 * 10^{-3}$$

$$\text{HSV} = (0,0001 \text{ m/s} * 5.4 * 10^{-3}) / 0.25 = 2,16 * 10^{-6} \text{ m/s} = 0.18 \text{ m/g}$$

## Case Study

### Vertical Time Arrival (VTA)

VTA = 5,5 hours

### Horizontal Seepage Velocity (HSV)

HSV = 0.18m/g

### Propagation Tendency Index for Vulnerable Receptors (PTIVR)

Level = 3

### Propagation Tendency Index for Groundwater PTIGW

Level = II

## Case Study

Results for preliminary assessment (IRA)

RTI = Medium

PTIVR = 3

Channel = Category C

Evaluated Critical Distance: 100 meters

RTI = Medium

PTVGW = II

No-critical scenario for groundwater

## Case Study

### Results for ARA by applying EPA-HSSM model (higher number of parameters to be used)

Distance covered in 6 months = 30 meter

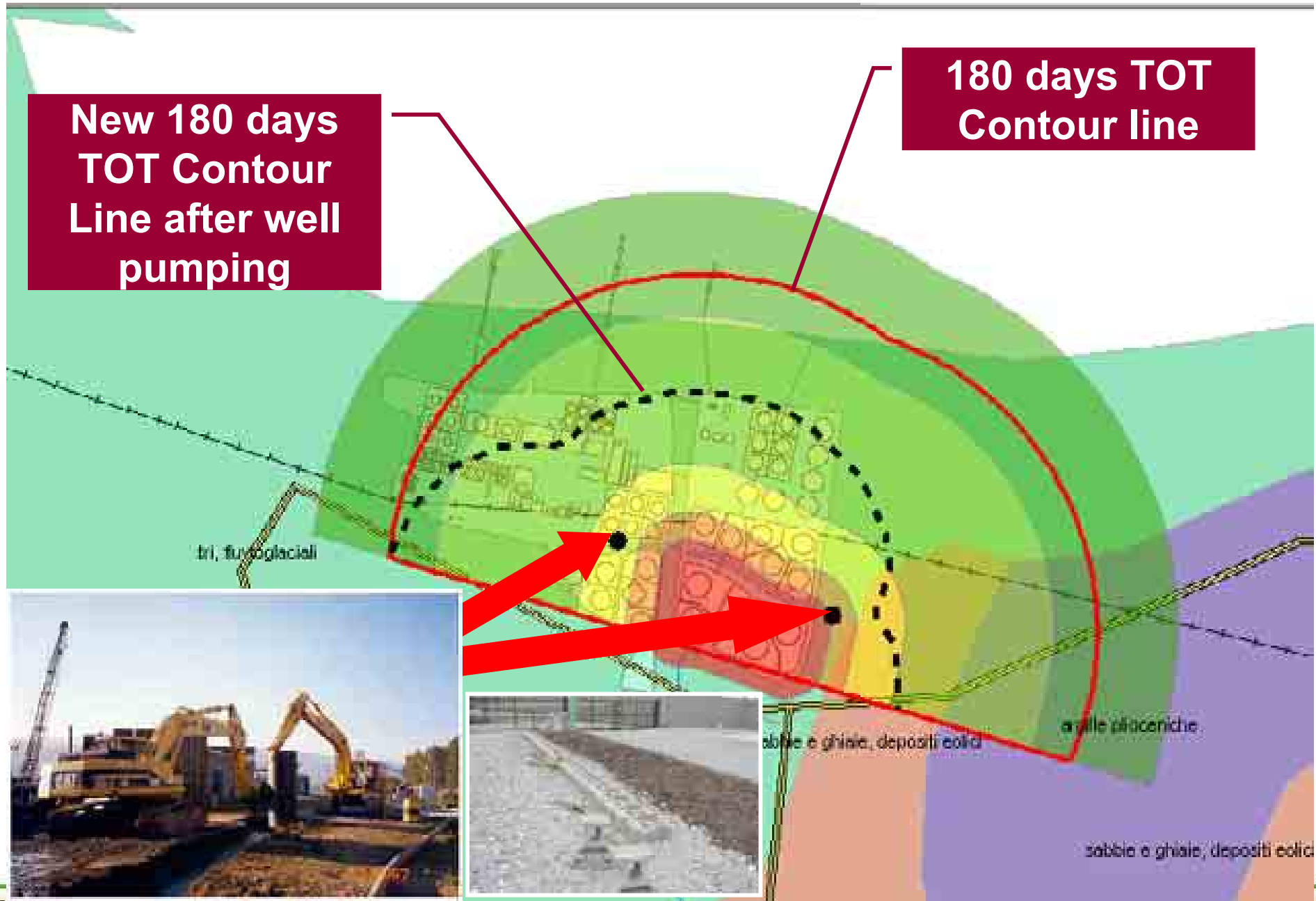
Effective Evaluated Critical Distance: 30 meters

Time arrival to Vulnerable Receptor:

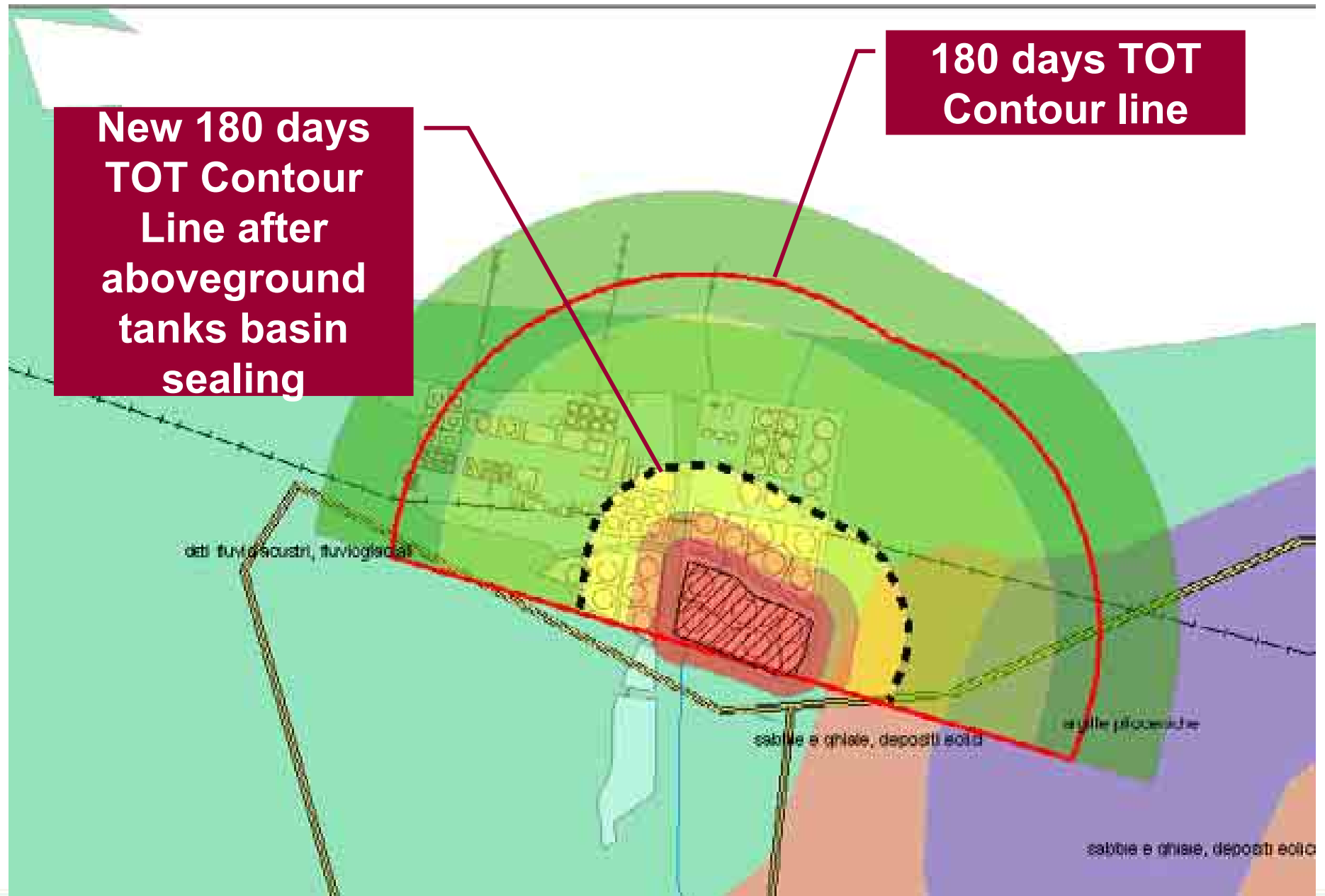
1) Groundwater = 1,5 years

2) Gasoline= 1,8 years

## Protection Measures - Dynamic Hydraulic Barriers

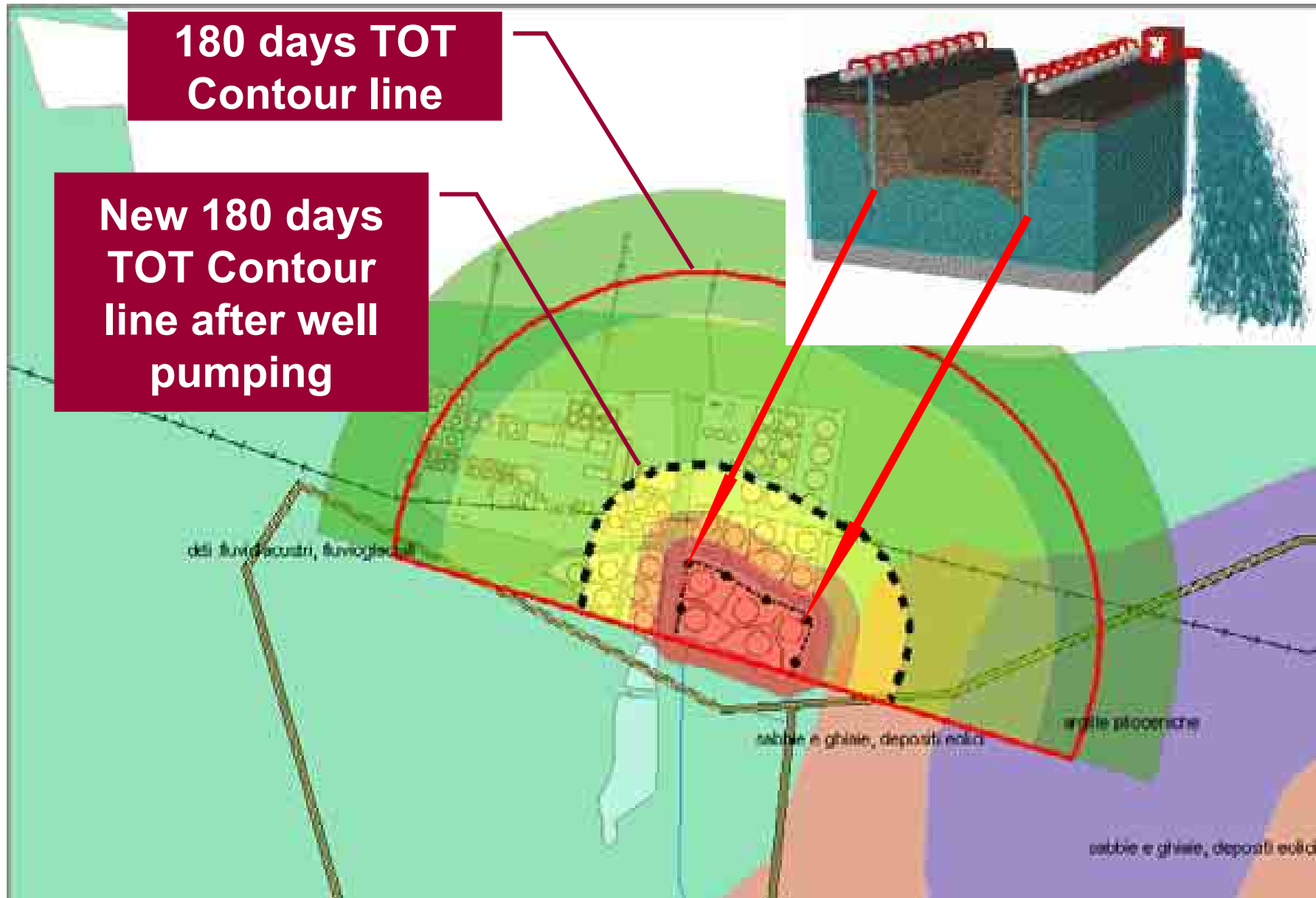


## Protection Measures - Tanks basin sealing





## Protection Measures - Well-point system



## Conclusion

This approach provide authorities with a comprehensive decision support tool aimed to the identification and ranking of critical scenarios associated to accidental hydrocarbons releases with high consequence for environment and at the same time helps in defining more effective solution for environmental high consequences risk attenuation.