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The activity has been implemented within the framework of national project
***Information and providing advice on improving the quality of environment in Slovakia**.*
The project is cofinanced by Cohesion Fund of the EU under Operational programme Quality of Environment.

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Case Hystories of contaminated sites remediation and sediment management in Italy: technology and results

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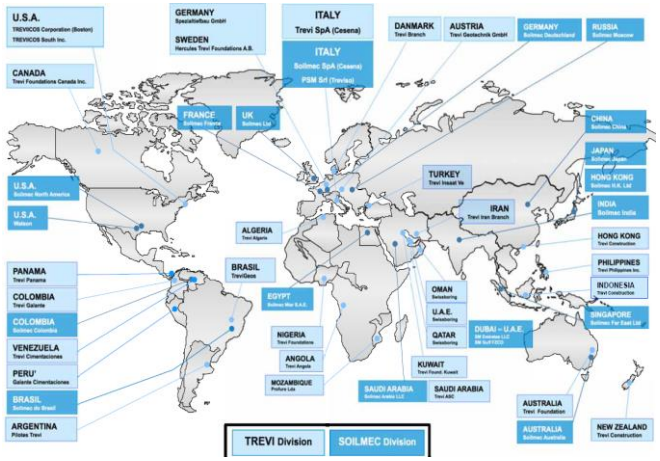
Agenda

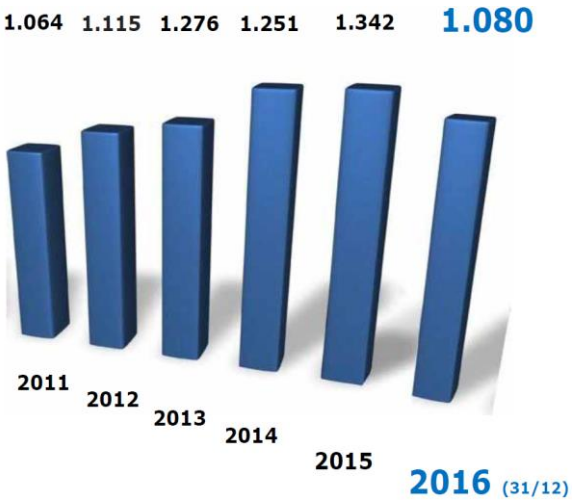
1. Who are we?
2. Case histories:
   - Description of the first full scale application of a zerovalent iron permeable reactive barrier in Italy.
   - Remediation of former landfills in Manfredonia (South Italy)
   - Encapsulation of contaminated soil under leaking tanks in Ravenna (North Italy)
   - Treatment of contaminated sediment and successful reuse of the sandy part in Palermo (Sicily)

Who are we

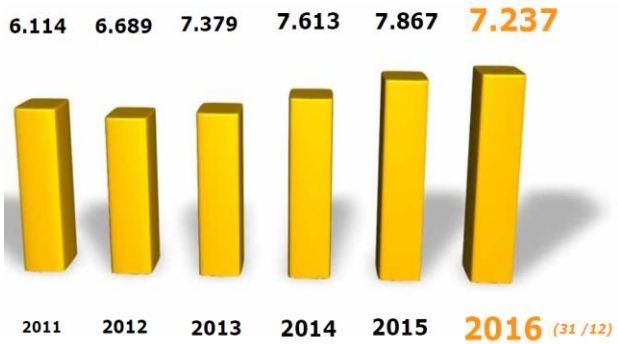
Model of UNIQUE BUSINESS

The continuous exchange between technological and process innovation strengthens the leadership in the fields of reference and creates new opportunities.





Covering more than 43 different ethnic groups



Marine works (port, jetty, bridges)

Transport & Communication lines

Dams & Levees

Civil & Industrial building field

Main restoration works

Special works

Environmental protection interventions

TREVIPARK, automated & undeground car parks

Geothermal

Permeable Reactive Barrier (PRB)

This is the description of the first full scale application of a zerovalent iron permeable reactive barrier in Italy.

The PRB was realized to remediate a chlorinated hydrocarbons plume at an old industrial landfill site, in Avigliana, near the city of Torino, in the Piemonte Region.

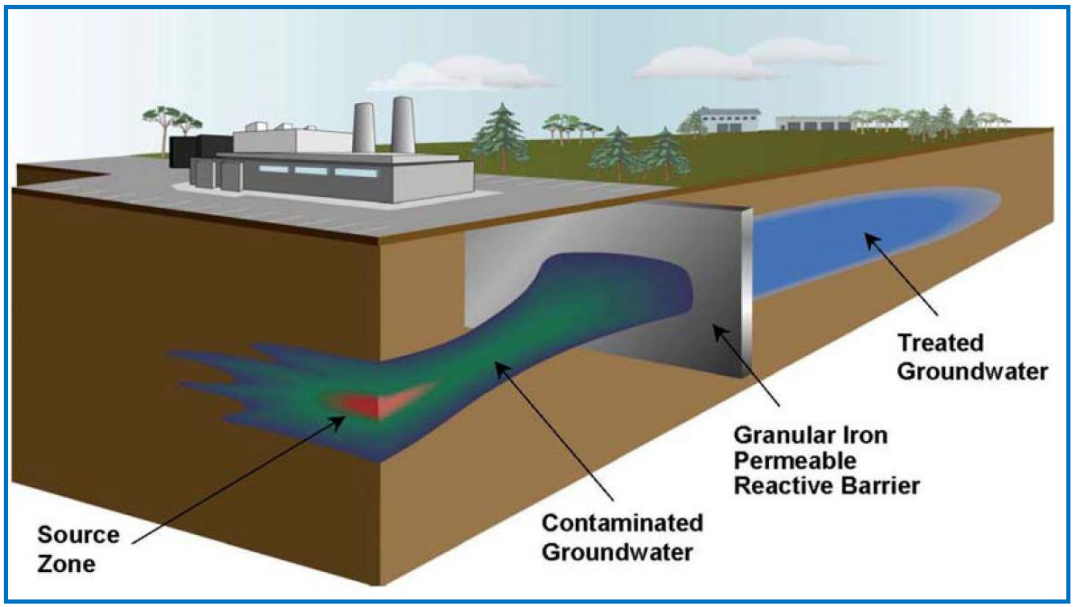
The dimensioning of the PRB was conducted by means of a three dimensional flux and multispecies contaminant transport model based on column degradation test.

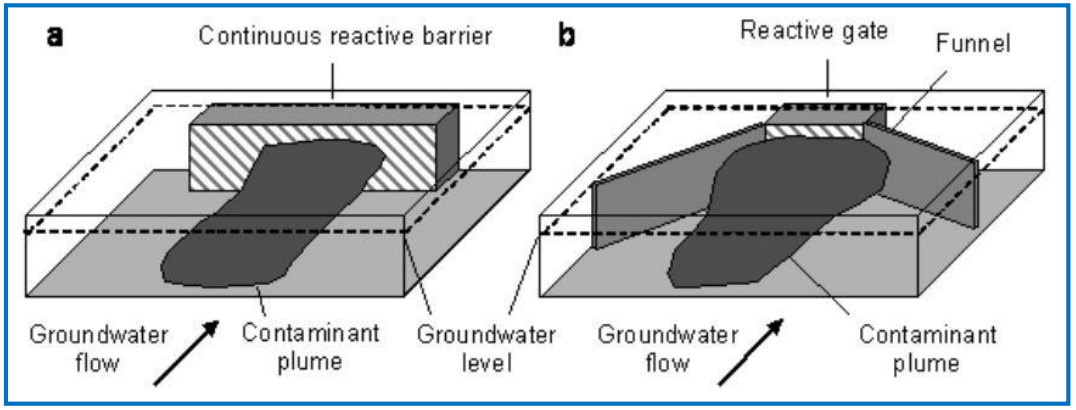
The excavation of the 120 m long, 13 m deep and 0.6 m thick barrier, was performed in just 8 days using a crawler crane equipped with a hydraulic grab and supported by guar gum slurry. After the excavation, the trench was backfilled with 1700 t of iron and the biopolymer degraded using enzymes.

The final configuration of the site will be characterized by a wide car park, a ciclo-cross track and a green capping to prevent the infiltration of water from the ground surface to the shallow aquifer.

So what's a PRB?

- It intercepts the contaminated water flow with a material capable of removing, through chemical reactions, precipitation or absorption procedures, the contaminants released into the water, to prevent them from further spreading.
- It doesn't significantly alter the local hydrological regime.
- This system is capable of avoiding contaminants' migration beyond the barrier and it also allows aquifer's reclamation over time.





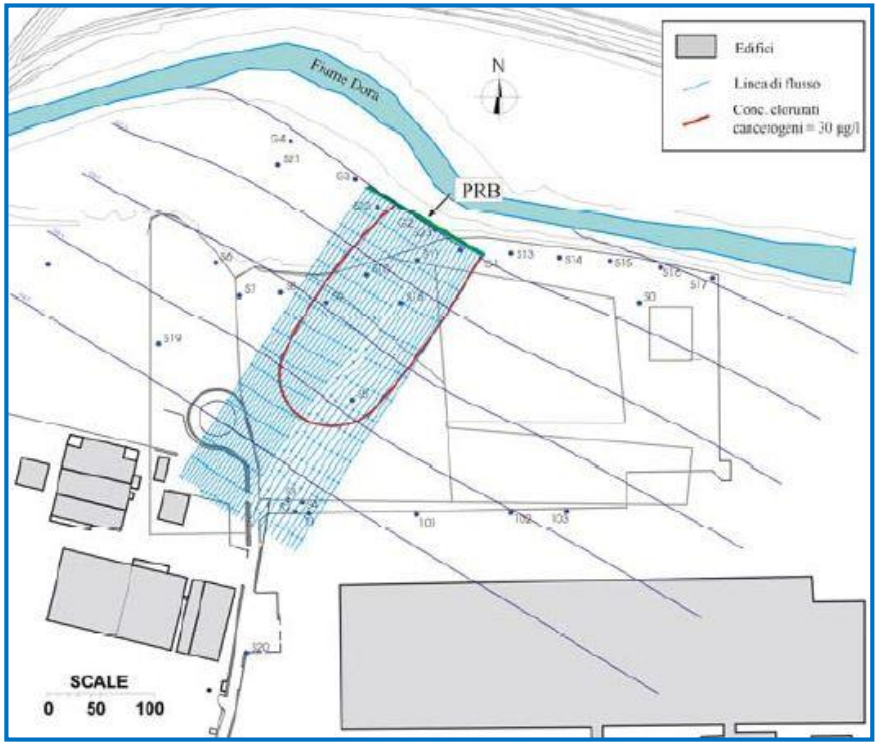
Permeable Reactive Barrier (PRB)

The area is located between Avigliana and Buttigliera Alta, near the city of Torino, in the north of Italy.

The most superficial part of the lithostratigraphic sequence contains an unconfined aquifer, whose impermeable bottom layer consists of muddy clayey drifts found under 11-20 m of depth

The design phase was supported by numerical flow, particle tracking and multispecies contaminant transport simulations implemented by Politecnico di Torino.

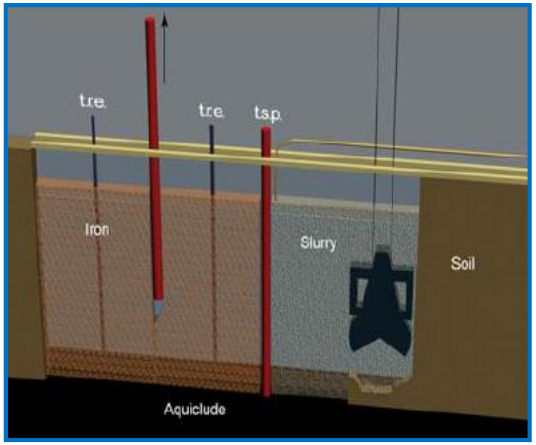
The site assessment, the flow and particle tracking simulations lead to the choice of a continuous reactive barrier configuration.



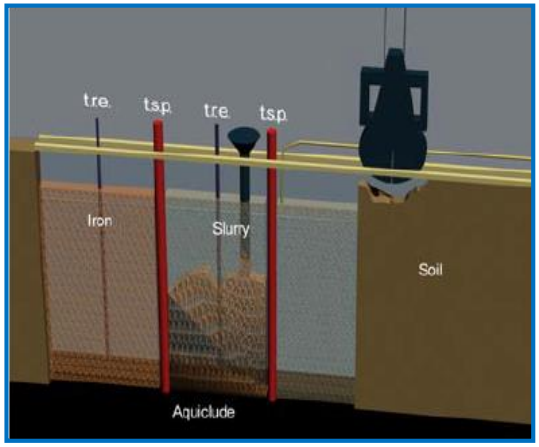
Permeable Reactive Barrier (PRB)

The excavation was realized using a crawler crane equipped with a hydraulic grab and supported by guar gum slurry until the backfill with ZVI.

The construction was performed by means of 17 panels whose average length was 7 m.



Credits: Rajandrea Sethi

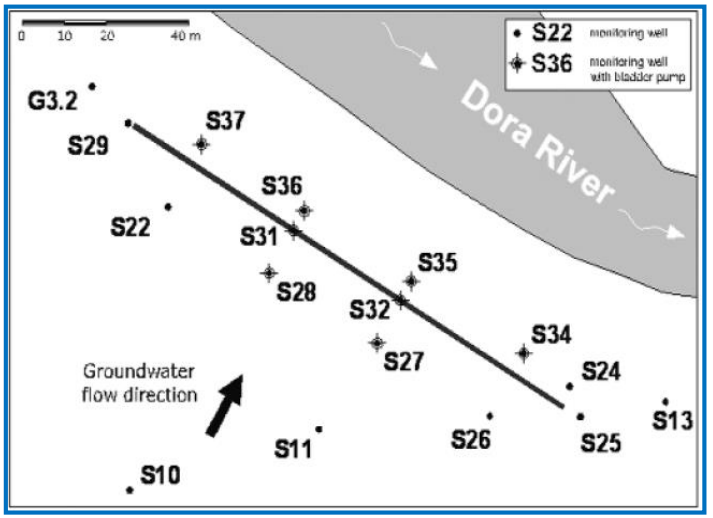


Permeable Reactive Barrier (PRB)

The residence time of groundwater inside the reactive cell is enough to decrease CAHs' concentration below clean-up goals, maintaining a good safety margin.

Output concentrations are largely below the limit of 30 μg/l of total carcinogenic compounds and also carcinogenic CAHs are below detection levels.

Reaction byproducts (VC, 1,1-DCE, 1,2-DCE) are nearly absent both inside and downgradient the PRB and this proves that the barrier is able to perform a complete dehalogenation process.



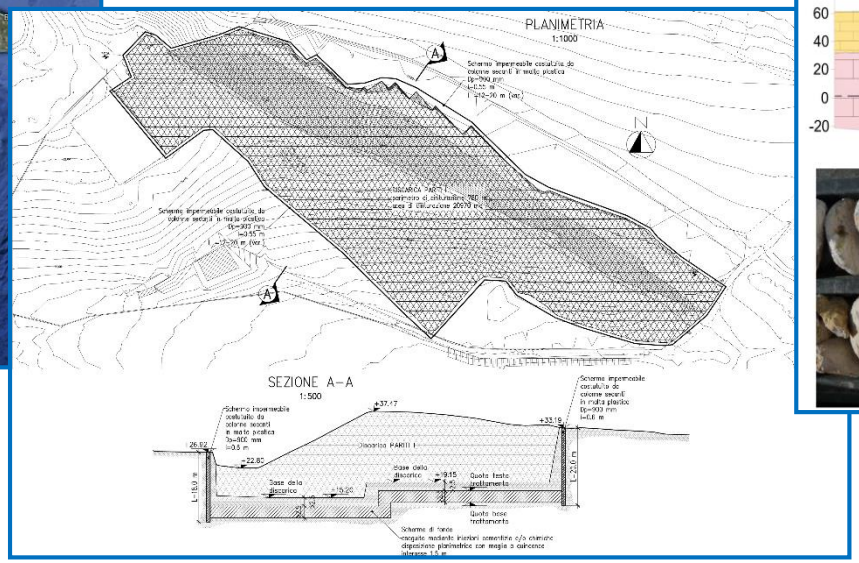
Credits:
Bortolami-dimolfetta.com

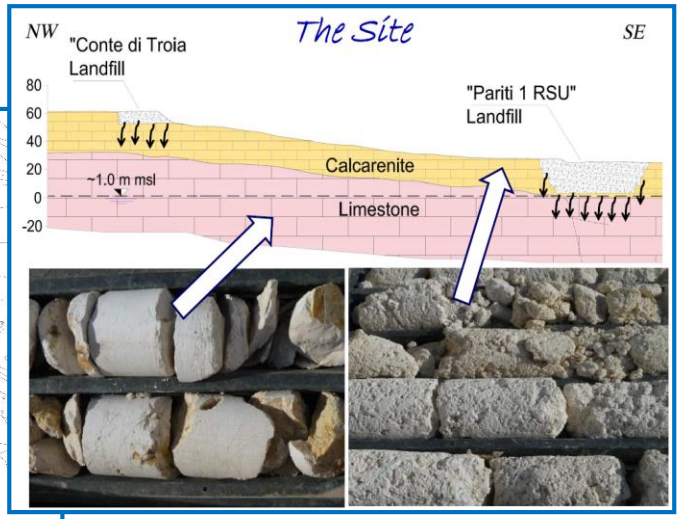
Remediation of former landfills in Manfredonia (South Italy)

The landfills are located in an area characterized by numerous gorges (small canyons) of erosive origin. The collected data show a 25-40m layer of soft rock (calcarenite). The calcarenite has macro-fissures that create a high (local) increase in conductivity. Calcarenites lie over a formation of whitish or pink limestone (calcilutites), well- stratified and highly fissured.

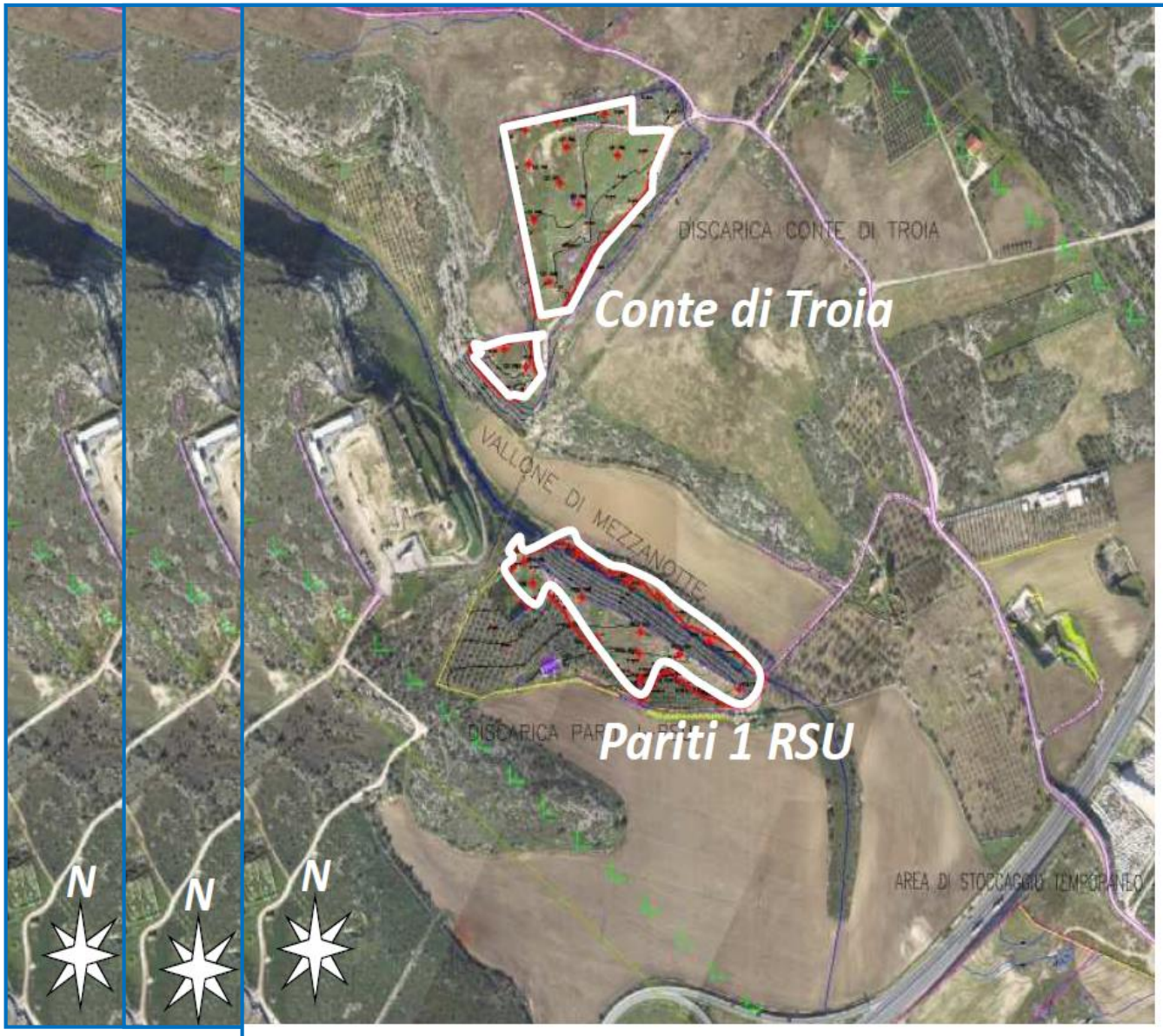
The construction of a screen through traditional techniques would have required thousands of vertical drillings crossing the waste to reach the rock layers to be injected.

Intervention based on the Horizontal Directional Drilling (HDD) techniques, which are widely used in the oil industry and for the installation of underground utility services, properly modified and integrated, TDDT: Trevi Directional Drilling Technology made it possible to drill sub-horizontal curvilinear boreholes up to 180m.





Remediation of former landfills in Manfredonia (South Italy)



The Infringiment

The European Union issued an infringement procedure against Italy.

End 2008:
the EU Court of Justice issued a Conviction for failure to complete the works aimed to restore safe environmental condition, and imposed severe sanctions.

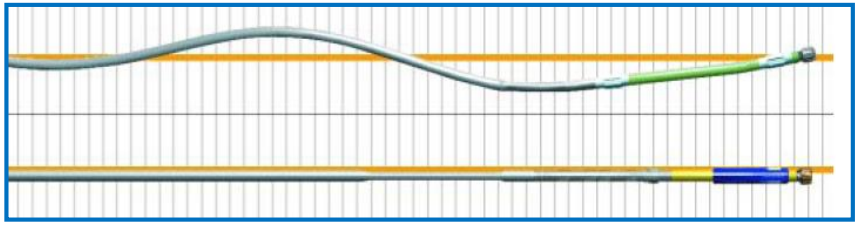
The sentence was suspended following the commitment by the Italian Government to complete the remedial work by 2010.

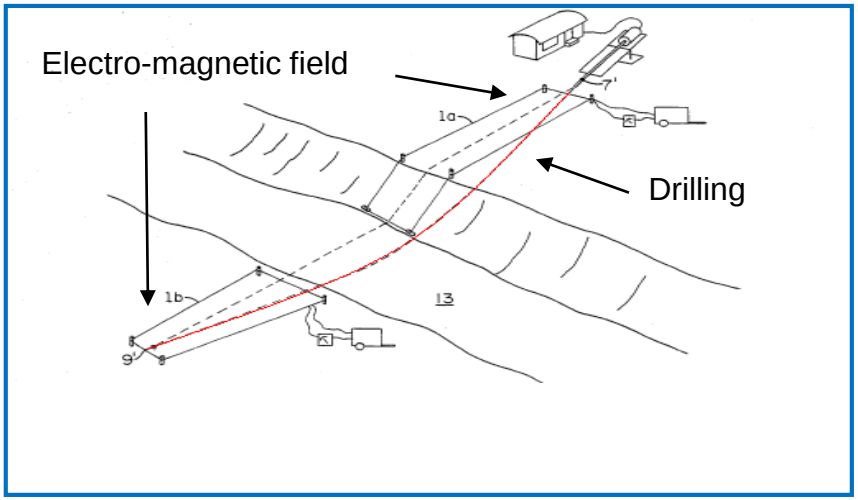
Following a series of legal issues and bureaucratic procedures, the remedial work started in early 2010, and was successfully completed in January 2011.

So what's TDDT?

TDDT (*Trevi Directional Drilling Technology*) is a set of technology that enables drilling of small diameters (50 – 200 mm) and long (from 25 m to a few hundred meters) boreholes with high-accuracy positioning (10 - 30 cm) for a wide range of applications.

If diameter and thickness of rods/pipes allows it, drilling can be either rectilinear or curvilinear, executed in all directions and in any soil type, including rocks.



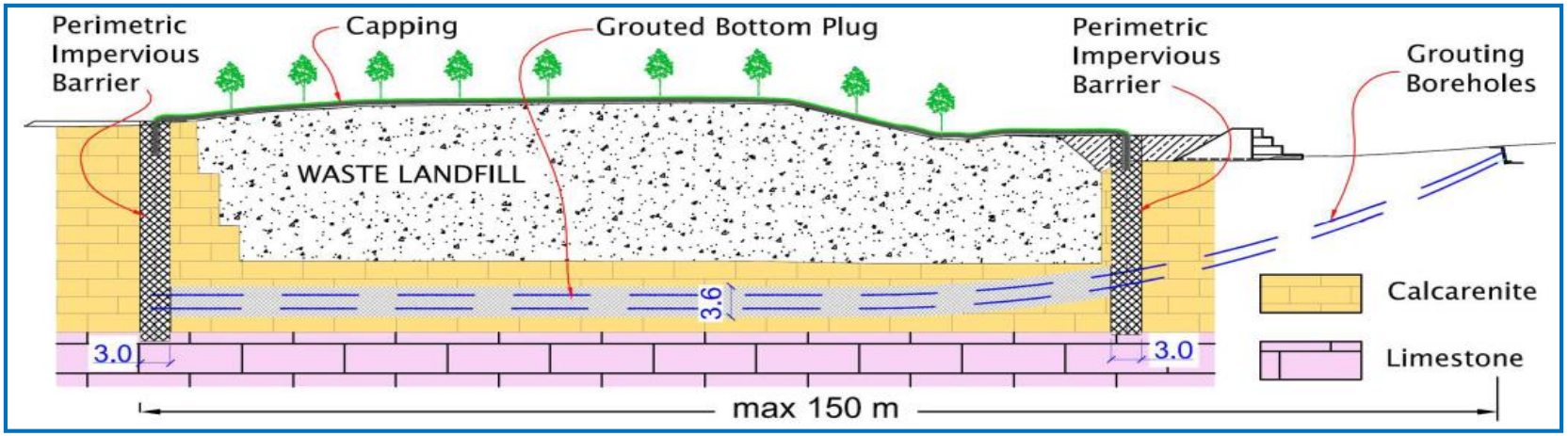


Remediation of former landfills in Manfredonia (South Italy)

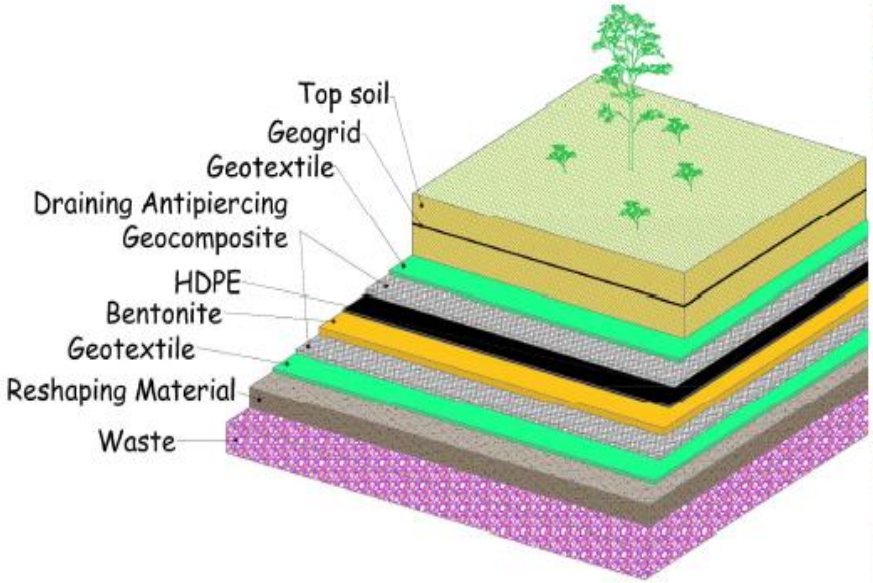
The directional drillings were performed from one of the sides of the landfill, intersecting the vertical perimetral screen. Steel sleeve port pipes were placed inside the boreholes for cement and silicate mix grouting.

Project specifications required a drilling directional accuracy of 30cm.

The screen was specially sized to match the contour of the landfill bottom and to be placed at a 2.5-3m distance from the waste bottom, seamlessly joined end-to-end to the perimetral barrier. The rock was treated along a thickness of 3 m.



Remediation of former landfills in Manfredonia (South Italy)

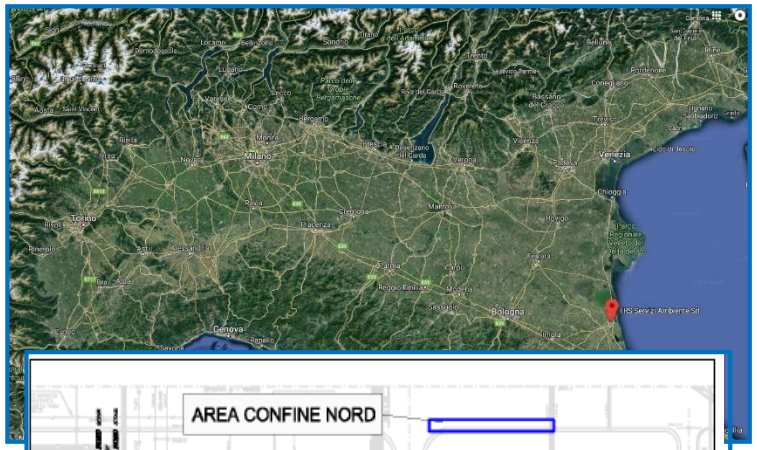


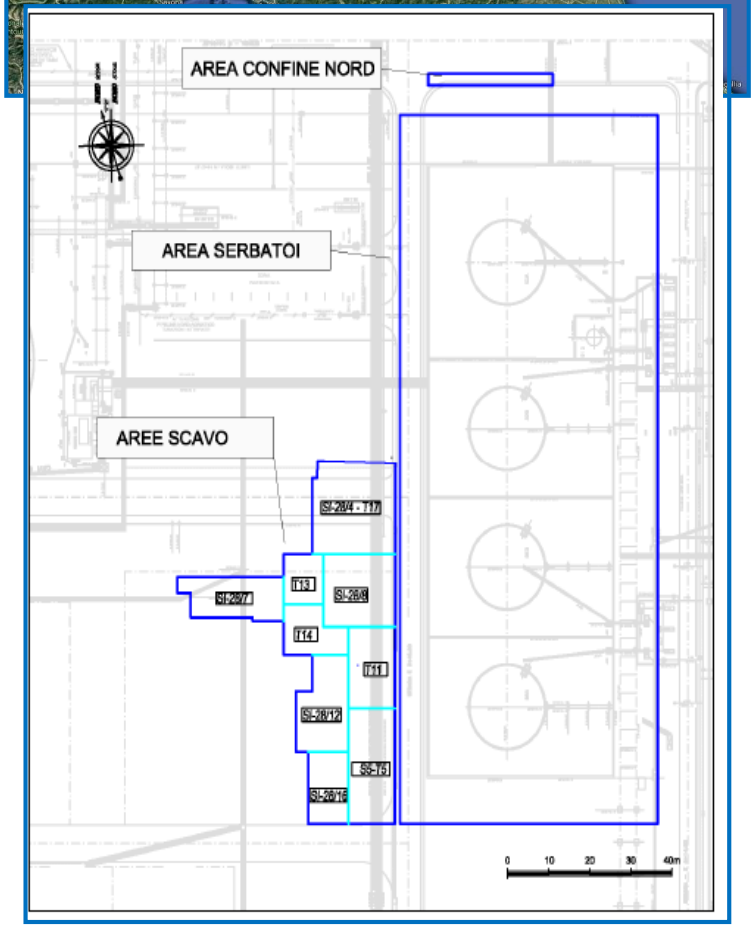
Encapsulation of contaminated soil under leaking tanks (North Italy)

The intervention was aimed to substitute a volume of contaminated soil and to encapsulate another volume under leaking tanks inside a petrochemical multi-company site, 4.5 kilometers away from the city center of Ravenna.

The surrounding territory is characterized by the presence of many wetland areas and pine forests with natural peculiarities.

The intervention mainly consisted in the construction of a diaphragm wall around the area occupied by the containment basin of 4 tanks filled with MtBE (metil-t-butil-etere, a chemical compound used as antiknock instead of other additives based on lead) and methanol.





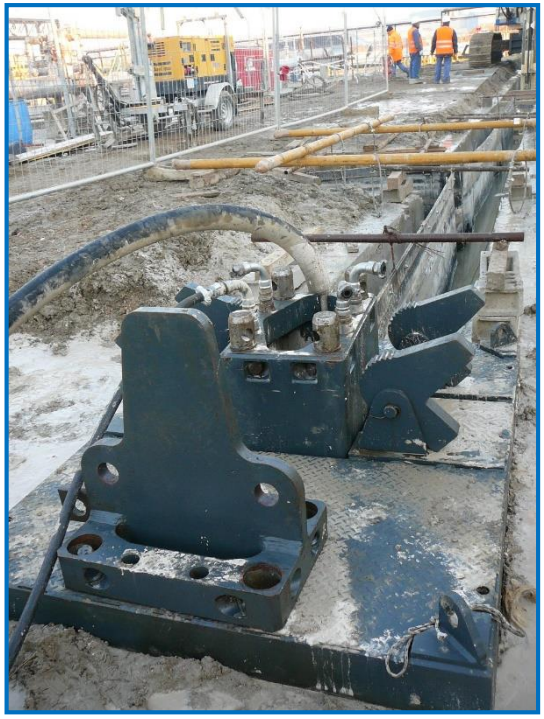
Encapsulation of contaminated soil under leaking tanks (North Italy)

Works basically consisted in a slurry wall. This barrier – whose total length was 460 meters – was executed with a plastic diaphragm wall with a HDPE layer along 445 meters and, for the remaining 15 meters, through jet grouting column treatments. The vertical barrier was embedded 3 meters down into the clayey layer located at about 30 meters from ground level.

Encapsulation of contaminated soil under leaking tanks (North Italy)

The following techniques were used for the project:

- Continuous 80 cm thick slurry wall made by pre-mixed self hardening grout and HDPE layer at a maximum depth of 33 meters. (Execution of 13.350 m2)
- Plastic cut-off wall with secant jet grouting columns with a diameter of 1000 mm. The jet grouting section has a length of approximately 420-450 m with a minimum thickness of 4.6 m.
- Site covering through capping complying wih the D.L. 36/2003, made up of different layers (Regularization layer, thickness greater than 5 cm; HDPE layer, thickness 1 mm; Bentonite geocomposites; Protection geotextiles; Reinforced concrete layer, thickness 15-30 cm).



Treatment of contaminated sediment in Palermo (Southern Italy)

At the end of the 80s Palermo Port Authority started works to construct the 150.000 DWT Dry Dock, within Palermo Industrial Port. Works were stopped due to a dispute arisen with the Subcontactor.

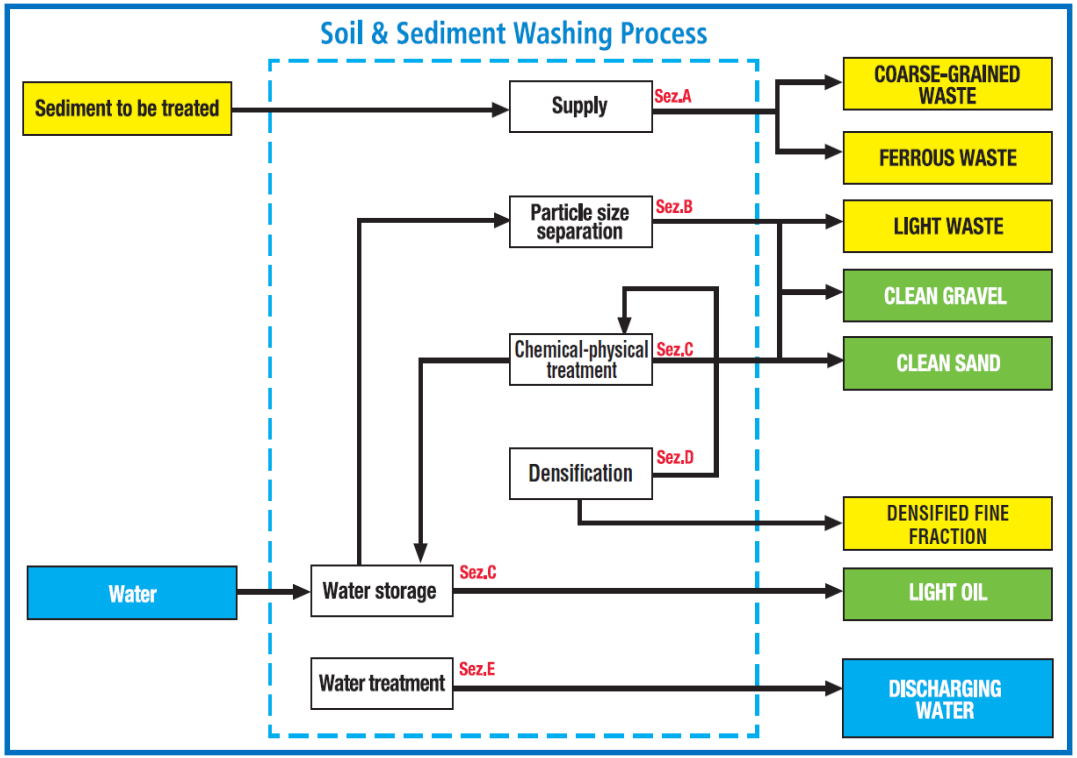
At the beginning of the 2000s Palermo Port Authority, after terminating the Contract, started to plan the completion works.

Works specified in the Contract included dredging of approximately 76.000 m3 of sediments and waste, for a total of about 117.000 tons of mainly sandy material, contaminated by hydrocarbons C>12, heavy metals and mixed waste, mostly conveyed by 2 sewage pipes (about 500.000 EI) which, until 2014, would discharge next to the Dock.

Once the works were finished, approximately 111.000 tons of waste were treated, recovering 41.400 tons of sand, 15.200 tons of gravel, while 25.400 tons of contaminated fine fraction were disposed of in an external plant.

So what's Sediment Washing?

The objective of the Sediment Washing treatment is the recycling of materials and subsequent reduction of waste to be disposed of. This technology, if properly applied, always reduces the amount of waste to be recycled/disposed of in external plants; for that reason it can be considered environmentally sustainable and developed in compliance with waste management regulations (Art. 179 of D.Lgs. 152/2006).



Treatment of contaminated sediment in Palermo (Southern Italy)

The plant has recovered material - R5 “Recycling/recovery of other inorganic substances” – from the waste’s sandy and gravelly fraction (Φ > 0.063 mm), according to previously designed specific purposes.

After undergoing a compliance audit at the jobsite, the sand achieves CE certification as recycled aggregate satisfying the technical requirements for the specific purposes, regulations and existing standards applied to products.

INLET	EER	Quantity (ton)	Notes
Dredged sediment	170506	111.000	
Water		*14.800*	*emicals*
OUTLET			
Sand			ggregate EN12620, 242
Gravel			Recyclable
Panels from filter press		25.400	
Other waste	191212 191209 170904	8.300	
Discharged water		12.100	According to national Law

- Recycled material: **51%** of the incoming waste
- Waste dumped: **30%** of the incoming waste (reduction of about 70%)

Treatment of contaminated sediment in Palermo (Southern Italy)

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