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Setting up a system for diagnosis of the type of contaminants in groundwater

Wojciech Irmiński - PP 5 Municipality of Solec Kujawski

Solec Kujawski case
- an example of creosote brownfield in Poland

Initial situation - the state of the area before the GreenerSites project

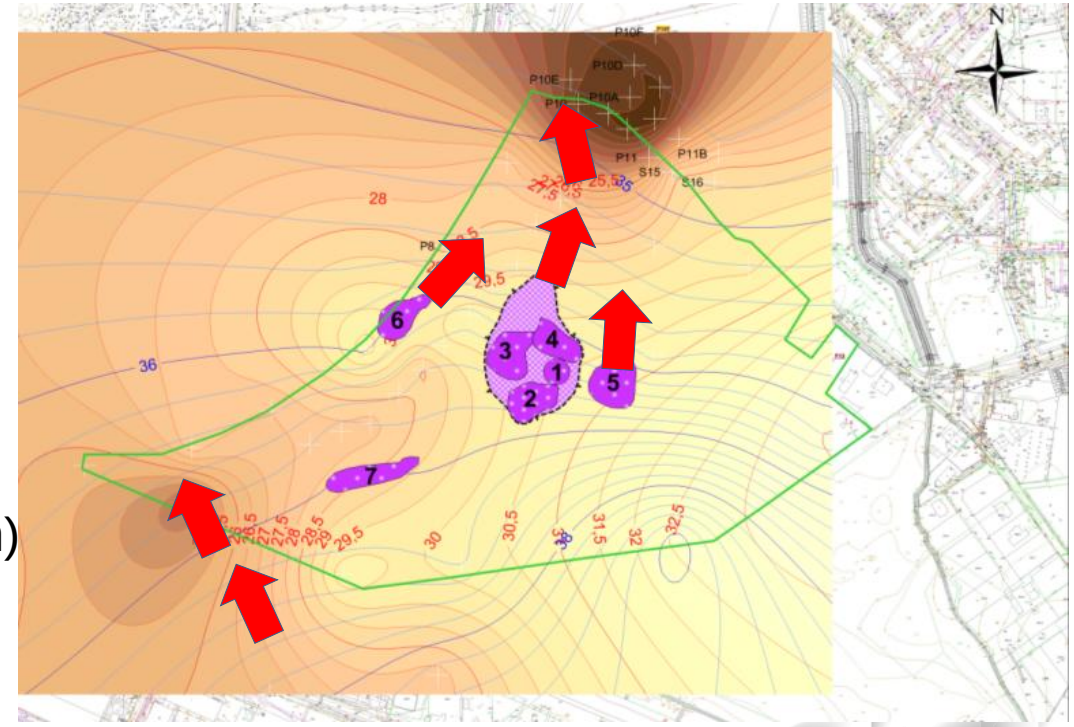
The reasons to clean the abandoned area – 16,44 ha in the city

Recultivation works (remediation) 2013-2016
-waste separation,
-soil washing,
-biodegradation

And step by step after the surface cleaning (soil and subsoil – in aerial zone)

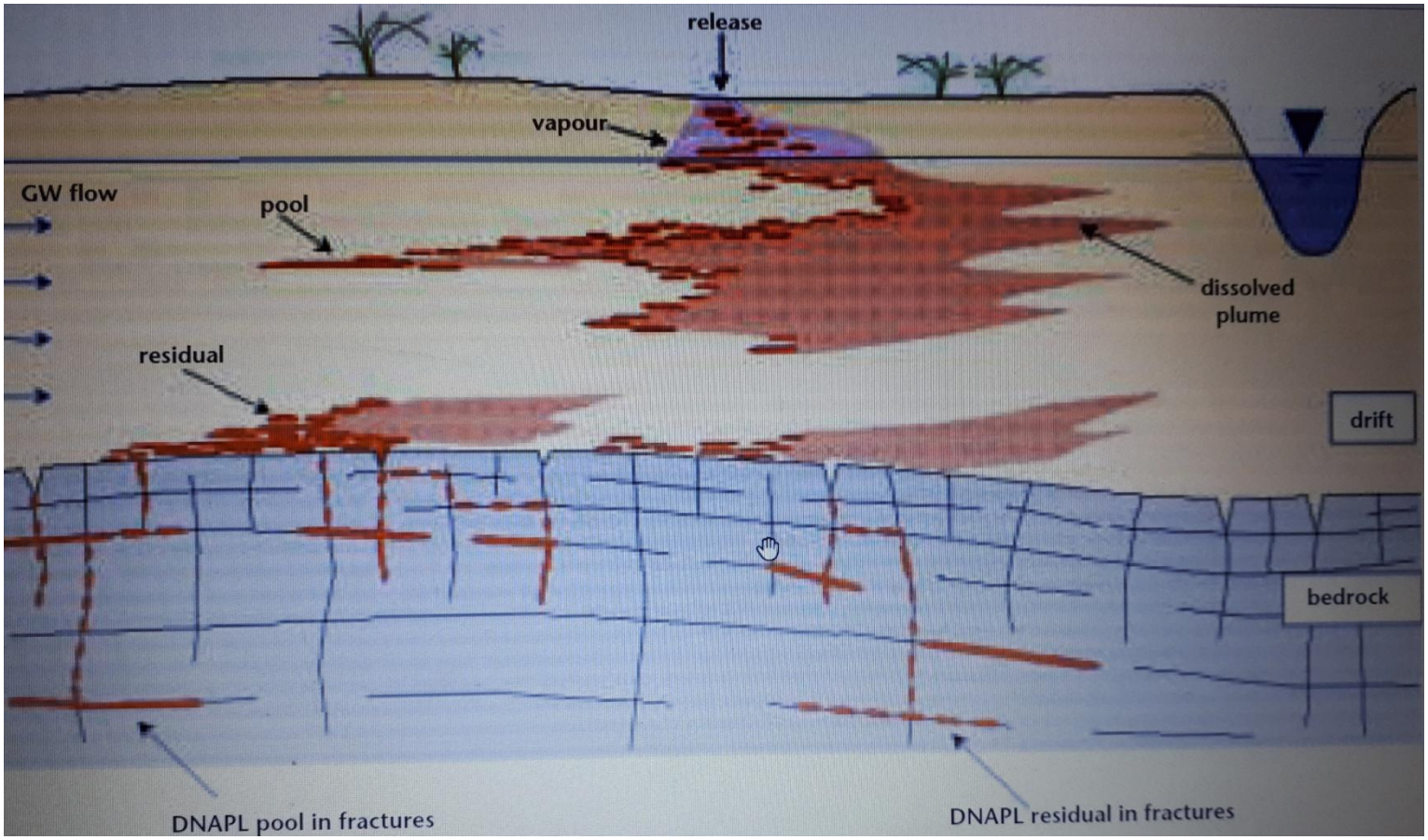
The location of pollution sources

One of the most important tasks of the GreenerSites project was the diagnosis type of contamination in groundwater, monitoring of concentrations, directions of migration, composition, etc. and development of a project to stop and eliminate the pollution.
For this purpose, a network of test boreholes and an existing monitoring network have been expanded. Research was carried out using standard methods (classic analysis of water samples) and passive samplers (PS).



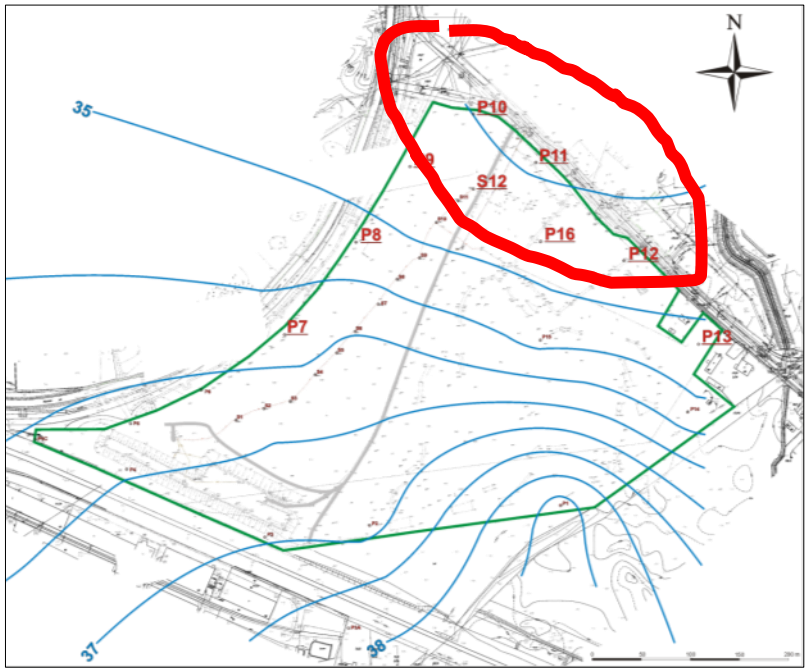
The pollution sources from non-saturated zone were eliminate during the reclamation (recultivation) works.
The common problem is the migration in the saturated zone.

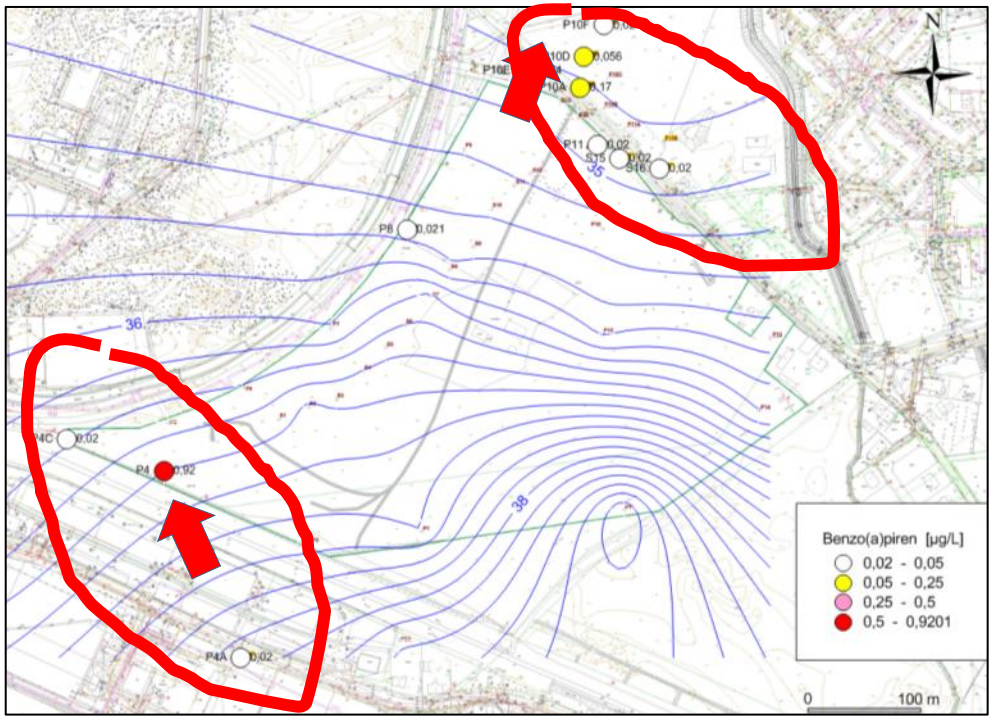
Significant difference in the location of pollution sources – theoretical part



DNAPL migration – conceptual model (after Pankow & Cherry, 1996)

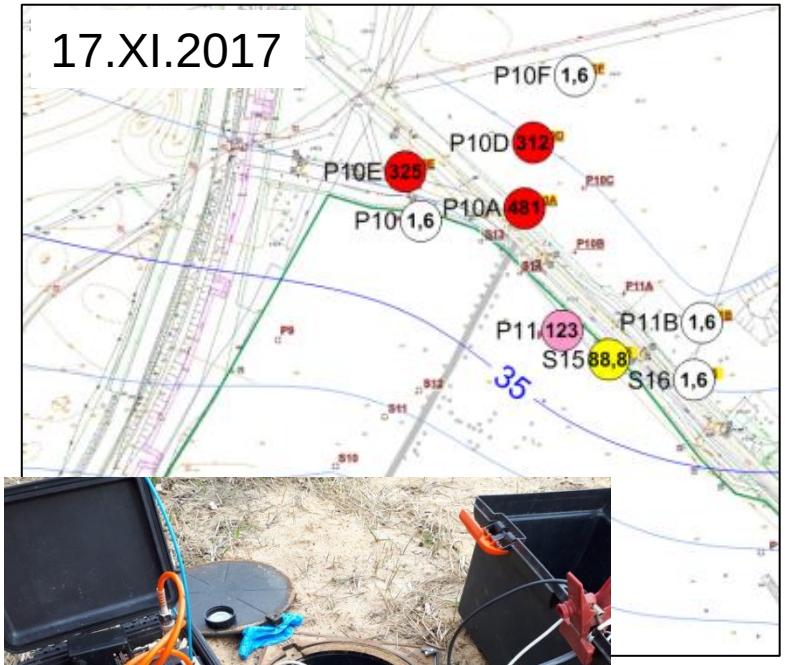
How to determine the path and extent of contamination in groundwater - A network of observation holes - substances identification and monitoring



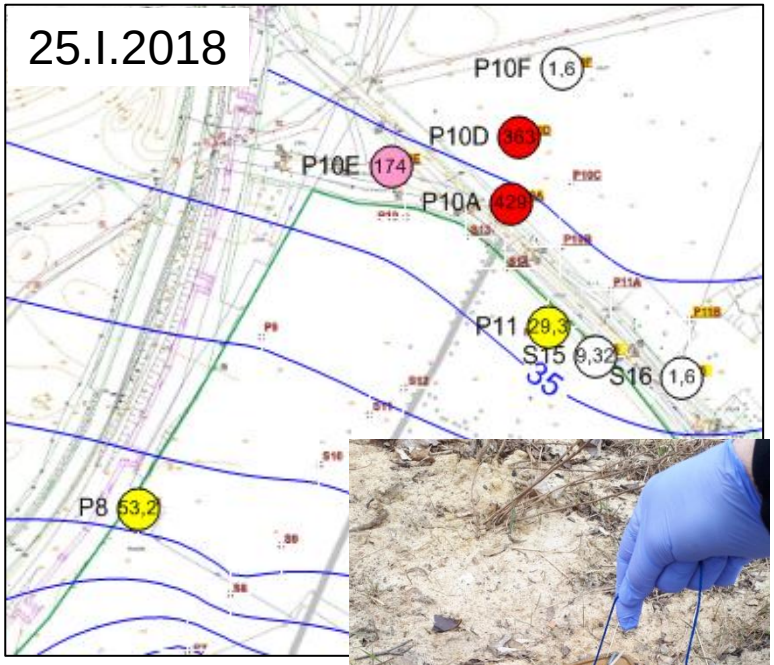


- an environmental monitoring system was extended,
- a geophysical study was used as a supplementing method,
- preliminary soil and water analysis was conducted,
- monitoring reports from water and soil analysis was carried out.

How to determine the path and extent of contamination in groundwater – Water testing methods

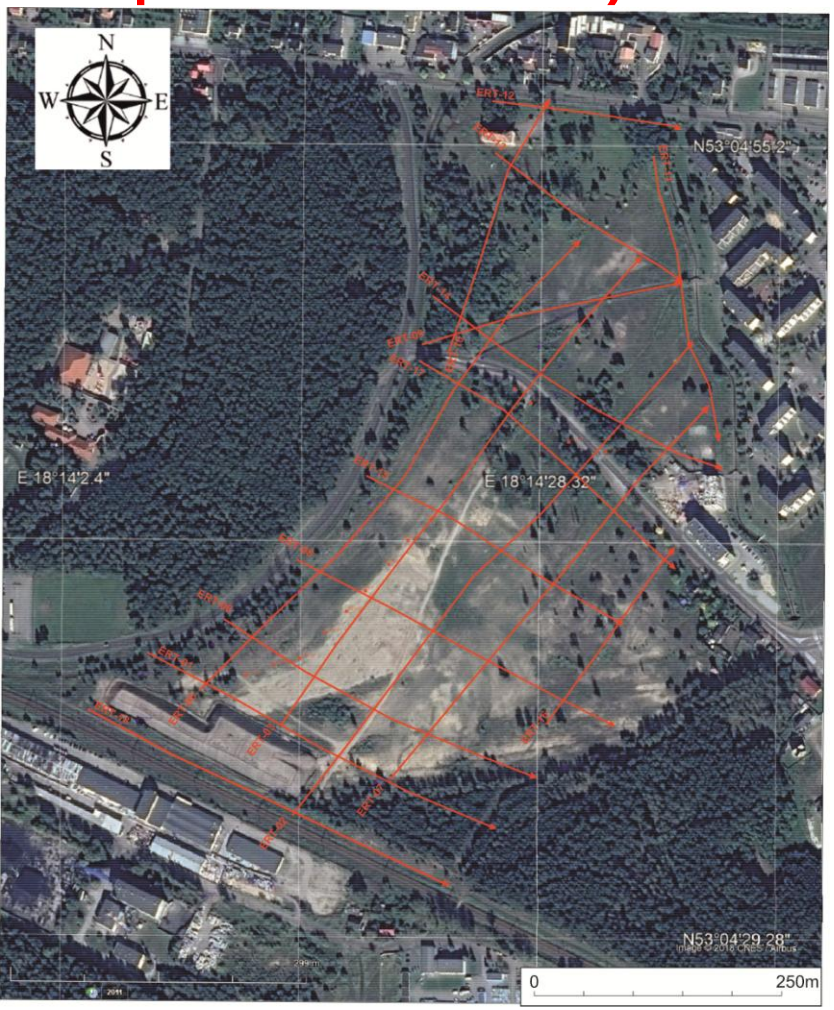


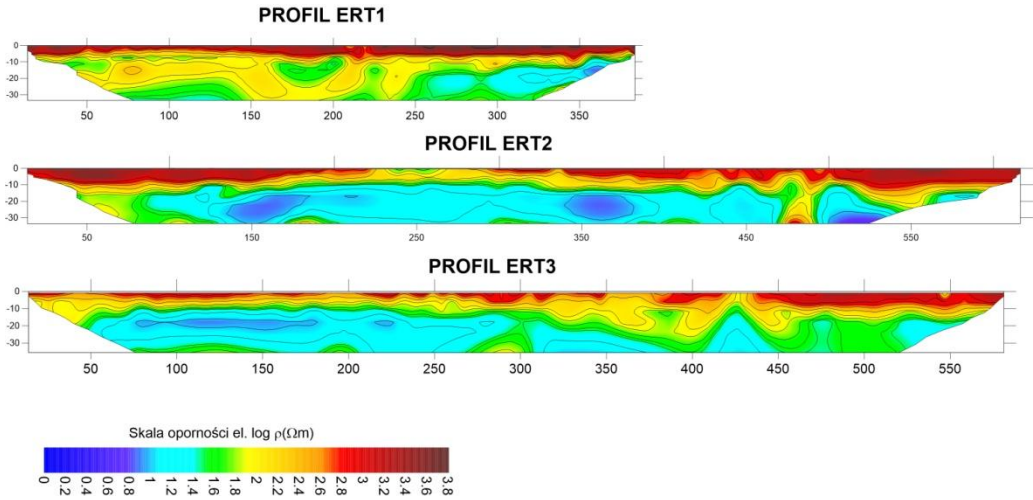
Classical methods



Passive sampling

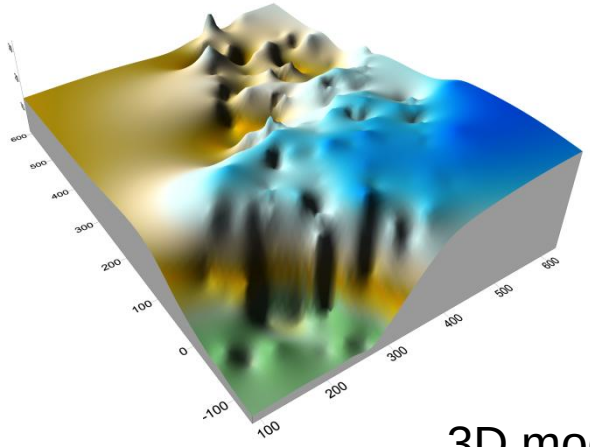
How to determine the path and extent of contamination in groundwater – Geophysical research (burried morphology: the shape of an impermeable horizon)



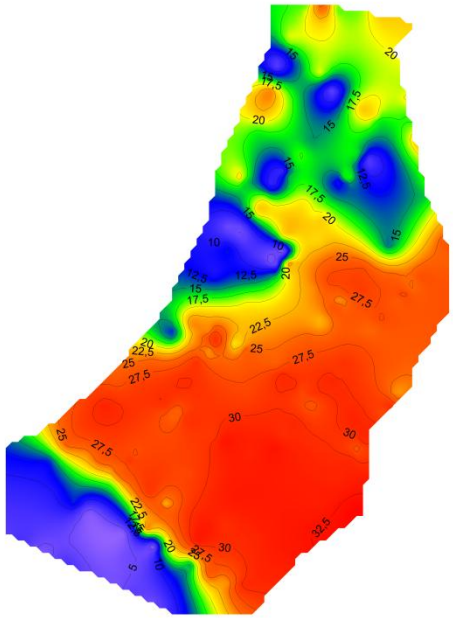


How to determine the path and extent of contamination in groundwater – Geophysical research (burried morphology: the shape of an impermeable horizon)

Geological updating using examples



3D model

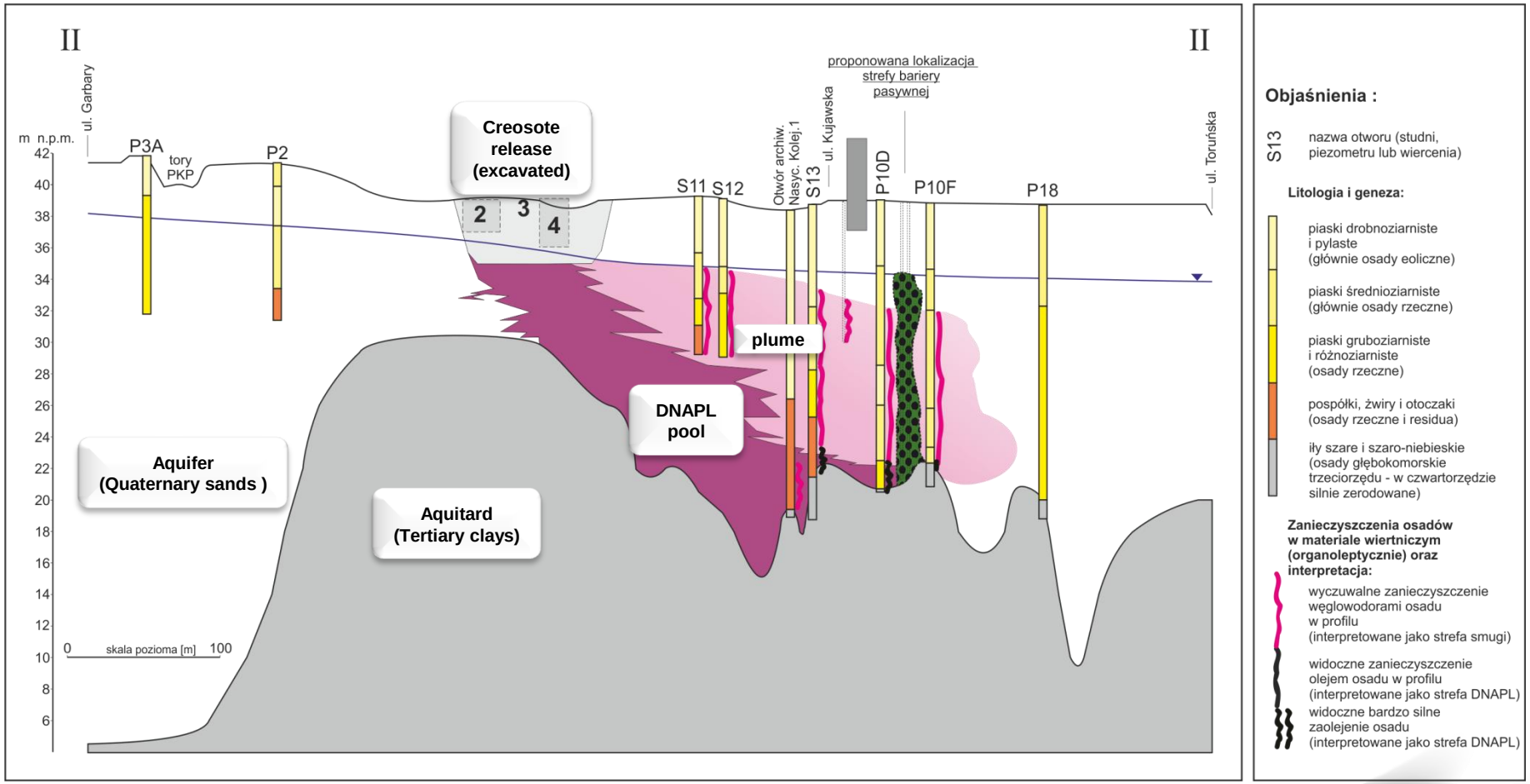


Map of impermeable layer (pre-glacial clays)

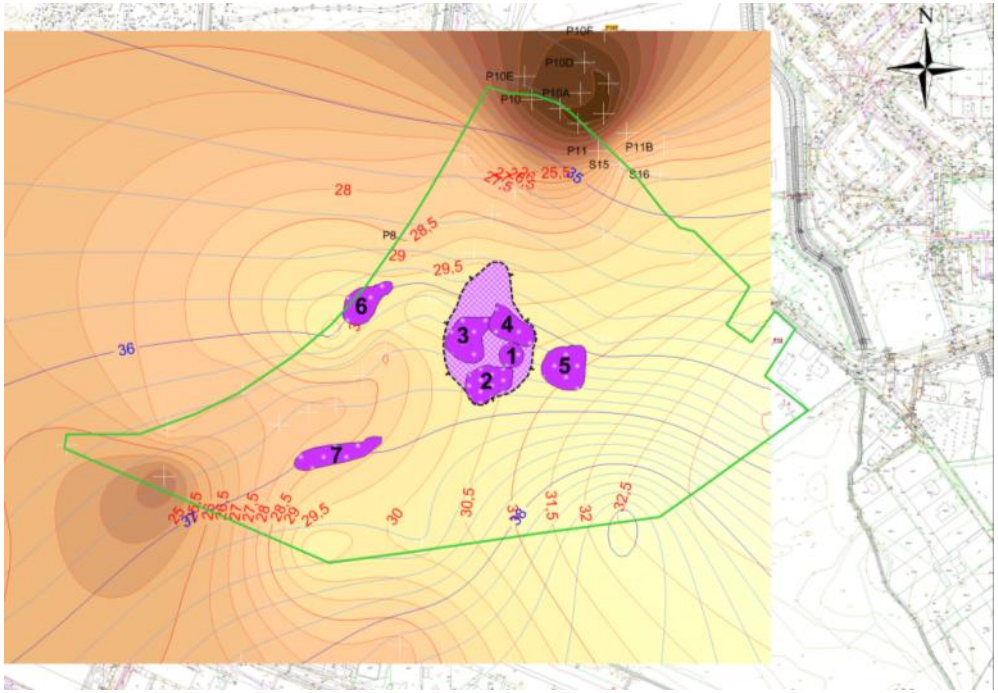
How to determine the path and extent of contamination in groundwater – Diagnostic drillings

Creosote oil in the sands and clays
- borehole profiles

How to determine the path and extent of contamination in groundwater – Hydrogeological crosssections



How to determine the optimal remediation strategy - first step



Removed the main sources of water contamination from the non-saturated zone

- Land reclamation was carried out (debris cleared, soil replaced where necessary, most trees were preserved)
- Introduced new, temporary land development plan: shaped terrain, built technical road and walking route, planted trees and shrubs,

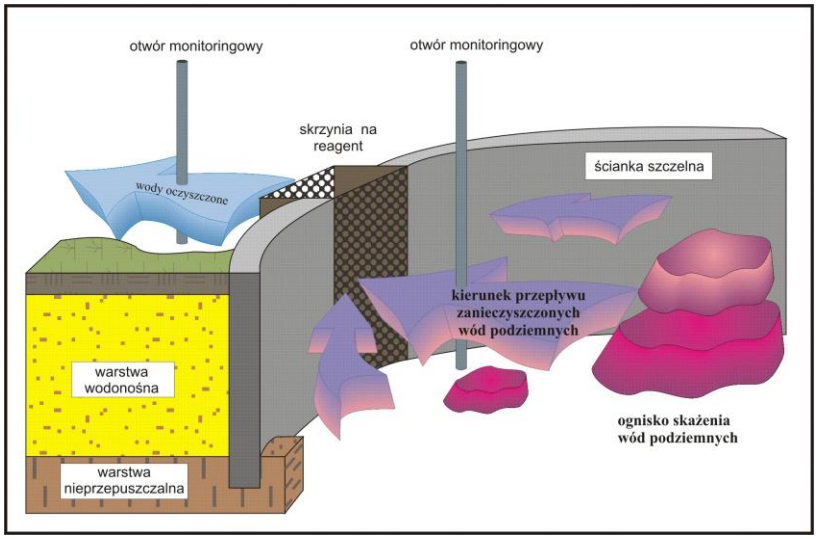
Created forms protecting long-term soil remediation

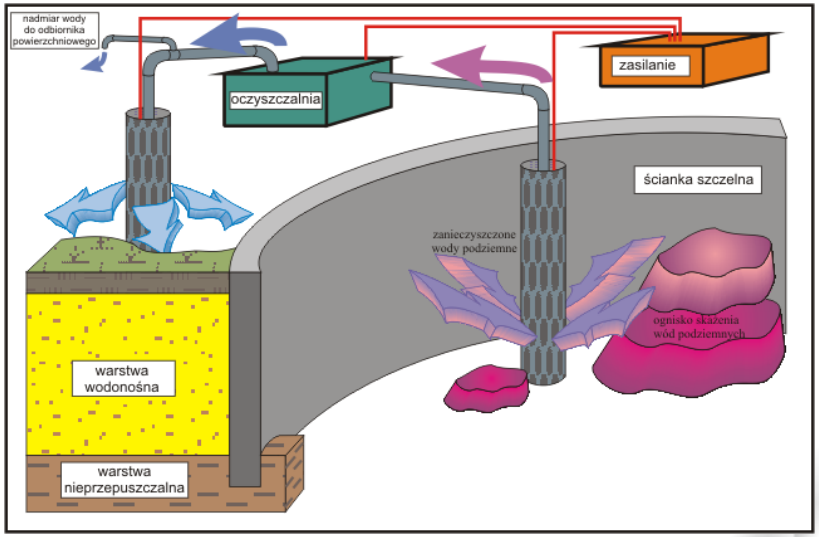
- bioremediation heap as a barrier against noise (acoustic screen)

How to determine the optimal remediation strategy - second step

Methods for removing or immobilizing organic contaminants in groundwater were considered

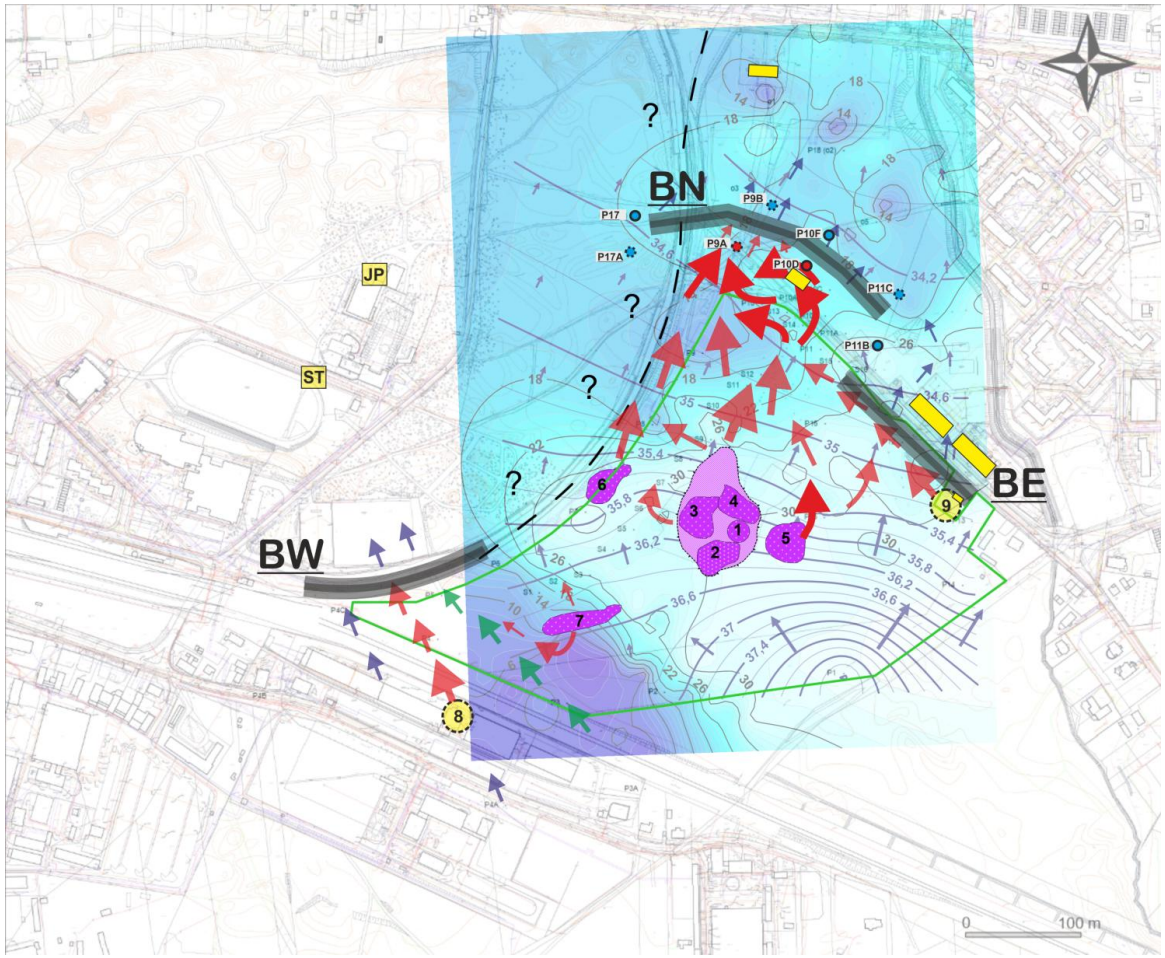
- Groundwater depressing and pump & treat method
- Alcohol flushing & surfactants
- Semipermeable barrier (funnel & gate metod)
- Semipermeable self cleaning barrier (active nanocarbon technology - PlumeStop®) (Sorption tests were carried out on the sample with nanocarbon particles)





Final remediation project

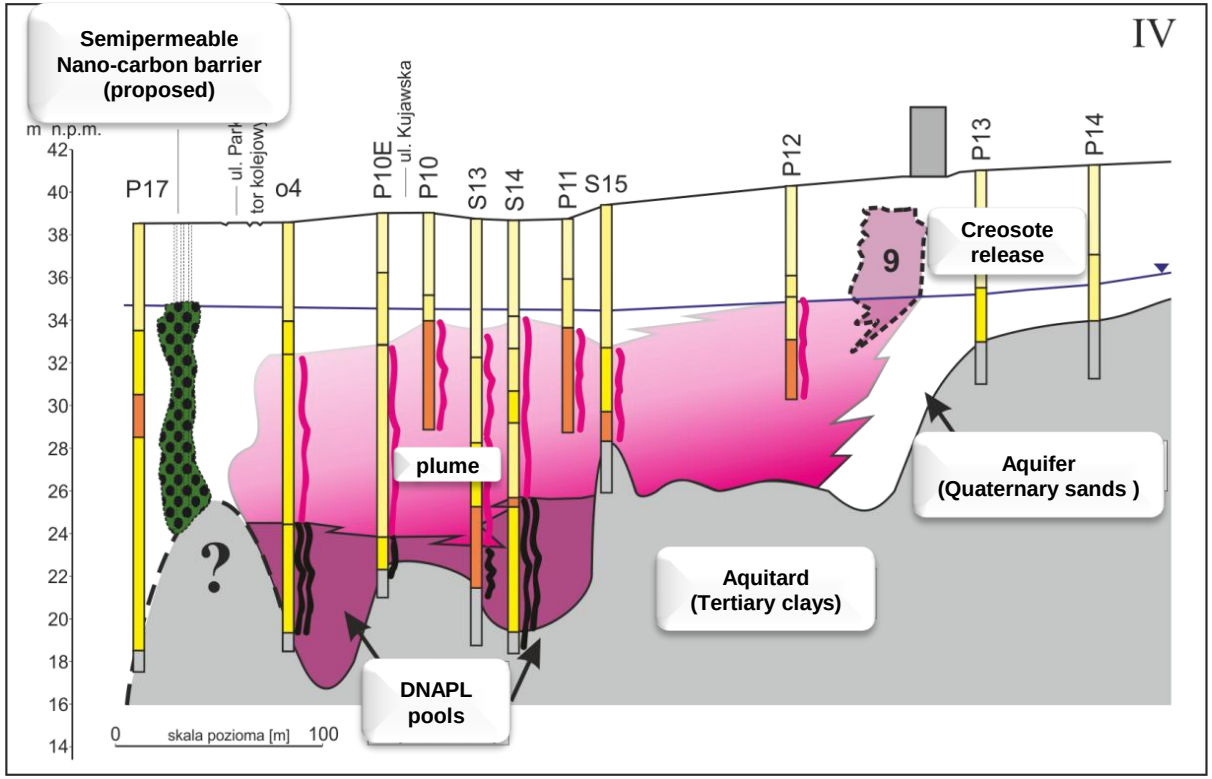
A concept for the construction of 3 barrier sections was developed



Final remediation project

Nano-carbon semipermeable barrier in the saturation zone

Long-term solution



Summary

Land reclamation and groundwater remediation are complementary methods, necessary for this type of geological structure and severe level of environmental contamination

The existing monitoring system is ready to use in case of semipermeable barriers.

Long-term monitoring metods were tested.

An important task – prospects and plans for land development of adjacent areas - the atmogeochemical research will begin soon.