



The Central Mining Institute (GIG), Poland, is a restructured scientific and development organization, subordinated to the Minister of Economy, working not only for the benefit of the mining industry, but also for enterprises representing different branches - including small and medium enterprises, state and local administration institutions and offices, and foreign partners. Central Mining Institute is the Lead Partner for FOKS project.



Institute for Ecology of Industrial Areas (IETU), Poland, is a research unit acting under the Polish Ministry of Environment. IETU's field of expertise includes: land and water resources management, environmental and health risk analysis and assessment, soil and groundwater remediation technologies. The Institute has an extensive experience in projects carried out under the 5, 6 and 7 EU Framework Programmes (total 29 projects) and Interreg Programme (IIIB CADSES, Central Europe).



Municipal Council of Jaworzno, Poland, is a local Authority which carries out the tasks set out for the town with county rights. Municipal Council is responsible for the supervision of, eg. geological work and activities in waste management within its territory. It is in charge of the contaminated sites, that is why, it is the initiator of action in order to solve the problem of hazardous waste collected in its pilot site as the FOKS Partner.



The Department for Environmental Protection - City of Stuttgart, Germany, was established in 1988 as a local environmental authority in the City of Stuttgart. About 130 employees take charge of the impacts on environment on behalf of a sustainable development in an integral way. Environmentally compatible inputs are elaborated for municipal planning and decision making processes. It is the main aim to preserve natural resources and to use them sparingly. Environmental damages should be avoided, existing should be reduced and negative impacts on environment minimalised.



Municipality of Milan, Italy, it is a local Authority. It takes part to FOKS project with 2 offices: Office for Reclamation Plans and Office for Public Water Management. The Office for Reclamation Plans has the role to authorize the remediation intervention on soil, subsoil and groundwater within municipal territory. The Office for Public Water Management deals with the management of surface waters and the interventions to contrast the raising of the groundwater level.



The Province of Treviso, Italy, is a territorial local body in an intermediate position between its municipalities and the Veneto Region. It represents the Provincial Community, looks after its interests and promotes its cultural, civic, social and economic development. It aims at the achievement of a balanced organization of its territory, of the quality of its environment and of the quality of living. The administrative functions of the Province of Treviso are a wider than the functions of the municipality, in fact they encompass all the territory of the Province. The duties of the Provincial Administration involve several aspects of the public sectors, ranging from territory, economy, culture, tourism, social policies, health, education, training and development.



The Institute of Public Health in Ostrava (IPH), Czech Republic, is a health care institute established by the Ministry of Health CR. IPH provides services in the field of health promotion and protection. The main activities comprise determination and measurement of the environmental and occupational conditions components, as chemical, microbiological and biological analyses, measurement of physical hazards in the environment and at workplaces, evaluation of environmental and occupational hazards etc. Seven National Reference Laboratories are working in the IPH, including NRL for determination of Persistent Organic Compounds.



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**CENTRAL
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COOPERATING FOR SUCCESS.



- Location of the Partner
- Pilot area



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Pilot area in Treviso

The subsoil of the Province of Treviso is composed of a blanket of alluvial deposits almost of fluvial and fluvioglacial origins, founded on a rock basement. Those deposits, that are directly in contact with the surface of the soil and efficiently fed by spread mountain basins, are big volumes of permeable and gravelly materials and represent the reservoir of the underground waters.

This area, selected as the pilot area for the FOKS project, belongs to the territory of Municipality of Arcade, one of the 95 municipalities of the provincial Administration.

This site is positioned in correspondence with the so called high plain, characterised by a gravelly undifferentiated mattress, formed by almost gravelly sandy matrix alluvium. The deposits composing the ground soil of the site are composed of a coarse granulometry, almost of calcareous dolomite nature, containing sand and a plentiful part of coarse material, together with rare thin silty - clay lentiform layers.

The values of permeability more frequently measured in the high plain go from 10^{-1} to 10^{-3} cm/sec. The site is featured therefore by a phreatic undifferentiated aquifer and is located in the so called recharge area of the aquifers, a vulnerable area, in which is registered the higher water infiltration directly from the surface.

In the pilot area one single monitoring well (depth aprox. 40 m and with a water table of 20 m from the top) is characterized by a persistent contamination of perchlorethylene above regulatory thresholds: since 2002 (first year of monitoring) with concentration above 35 µg/L. On the contrary in the other surrounding wells (both upgradient and downgradient) the concentration of total halogenated aliphatic compounds are negligible, almost in all cases lower than the detection limit.

This implies the need to improve the knowledge both of the hydrogeology and of the territory, in order to enlighten if there is a unique source, if this source is still active and if it is possible to identify the source liable for the pollution and the best actions for reclaiming the site or for limiting its possible use.

The planned actions consist of collecting all data that may already exist in other offices and bodies (characteristics of alluvial deposits, feature of the unconfined aquifer, hydraulic conductivity, etc.) and planning to drill further monitoring wells, using new investigation techniques like integral pumping test or trying to identify the most suitable technology for the site.



The following actions could be dealt with interpretation of the data, gathered from the pumping tests, elaborating a conceptual model of the site and interpreting the new hydrogeological and chemical data by means of a groundwater flow model, also setting up a database.

These results should lead to invest in further small-scale investigations and to carry out further water analysis and to define a specific methodology of sampling.

This kind of elaborations should lead to strengthen the knowledge about the territory, to identify the source of the pollution and to define a new remediation concept.

Hopefully, it will be possible to identify the liable for pollution, obliged to reclaim the site and sustain its whole cost.



Pilot area in Milan

The groundwater contamination within the city boundaries, due to past and current industrial activities, consists of a complex contamination pattern, characterized by different types of contaminants spread over large areas.

To understand the local groundwater condition, it is needed to know the main characteristic of the Milan groundwater. It is a multi-layer aquifer; in the north-east of the city there are some connections between the first and the second layer; this area can also be seen as a collecting point of the water upstream regions (where there is a high presence of brownfield).

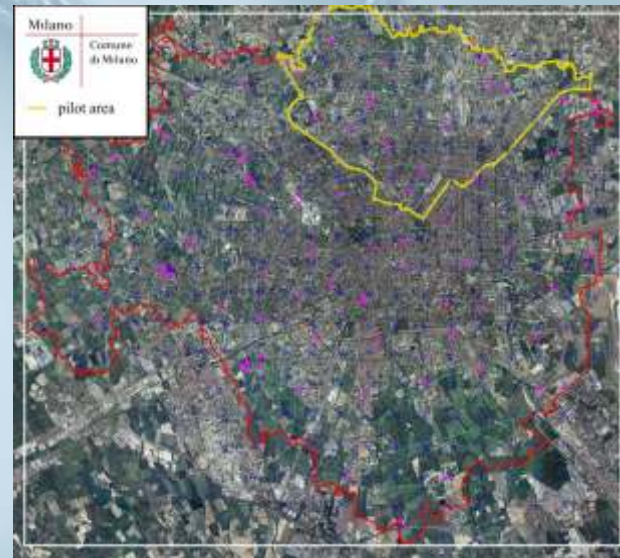
Protection of all the layers is particularly important. These characteristics are critical because the second layer is usually used as drinking resource - protection of the first layer means also protection of the drinking resources.

The distinctive hydrogeologic structure and the urban context lead together the high vulnerability of Milan groundwater.

For this reason, in 2003 the Office for Reclamation Plans has pointed out a Monitoring Civic System, made up by 100 wells, belonging to different bodies and offices. The aim of Monitoring Civic System is to have a direct control tool for first groundwater layer, which allows the management of the territory by the Municipality, and a direct acquisition of both physical (as groundwater level variations) and chemical data. Heavy metals (like hexavalent chromium) and a spread contamination by cancerous aliphatic chlorides are the main pollutants of Milan groundwater.

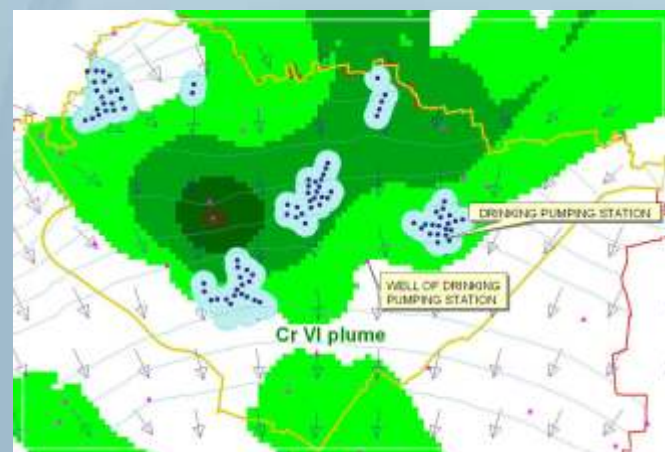
The pilot area is a wide zone of about 30 km², it has been chosen among the critical areas in the north-east of the city. It is characterized by a clear plume of chromium six, in the first layer, with a peak value of 27 µg/l which seems to threaten the pumping stations for drinking water nearby. In the pilot area there are already about 20 wells of monitoring civic network and five pumping stations for drinking water.

The project foresees an optimized investigation (Integral Groundwater Investigation), which will allow the evaluation of pollutant plumes and the identification of the contamination key sources on large areas. In the pilot area several groundwater drillings will be realized in the first and second level, needed to apply an Integral Pumping Test, which is the core of Integral Groundwater Investigation.



The IPT will allow to obtain the pollutant concentration, but also the mass flow rates of groundwater contaminants. The mass flow rate will later serve as a base for identification and ranking of key sources of groundwater contamination, and after all it will be possible to think about some hypotheses on remediation and mitigation measures.

The new approach could be useful both for public authorities, which have the task to investigate and manage soil and groundwater contamination on a large scale, and for private subjects because it would enable to restrict the source zone at sustainable costs.



Acronym FOKS stands for Focus on Key Sources of Environmental Risks.

The FOKS project general objective is to focus the remediation efforts in degraded areas on the key sources of contamination.

Specific objectives of FOKS project are:

- demonstration and application of innovative tools for integral groundwater risk management on degraded areas such as contaminated sites and brownfields;
- prioritization of mitigation measures on key sources of groundwater and soil contamination;
- performing of pilot applications and proposing the concepts for source remediation activities;
- downscaling the cornerstones of EU Groundwater Directive for the scale of contaminated sites and brownfields.

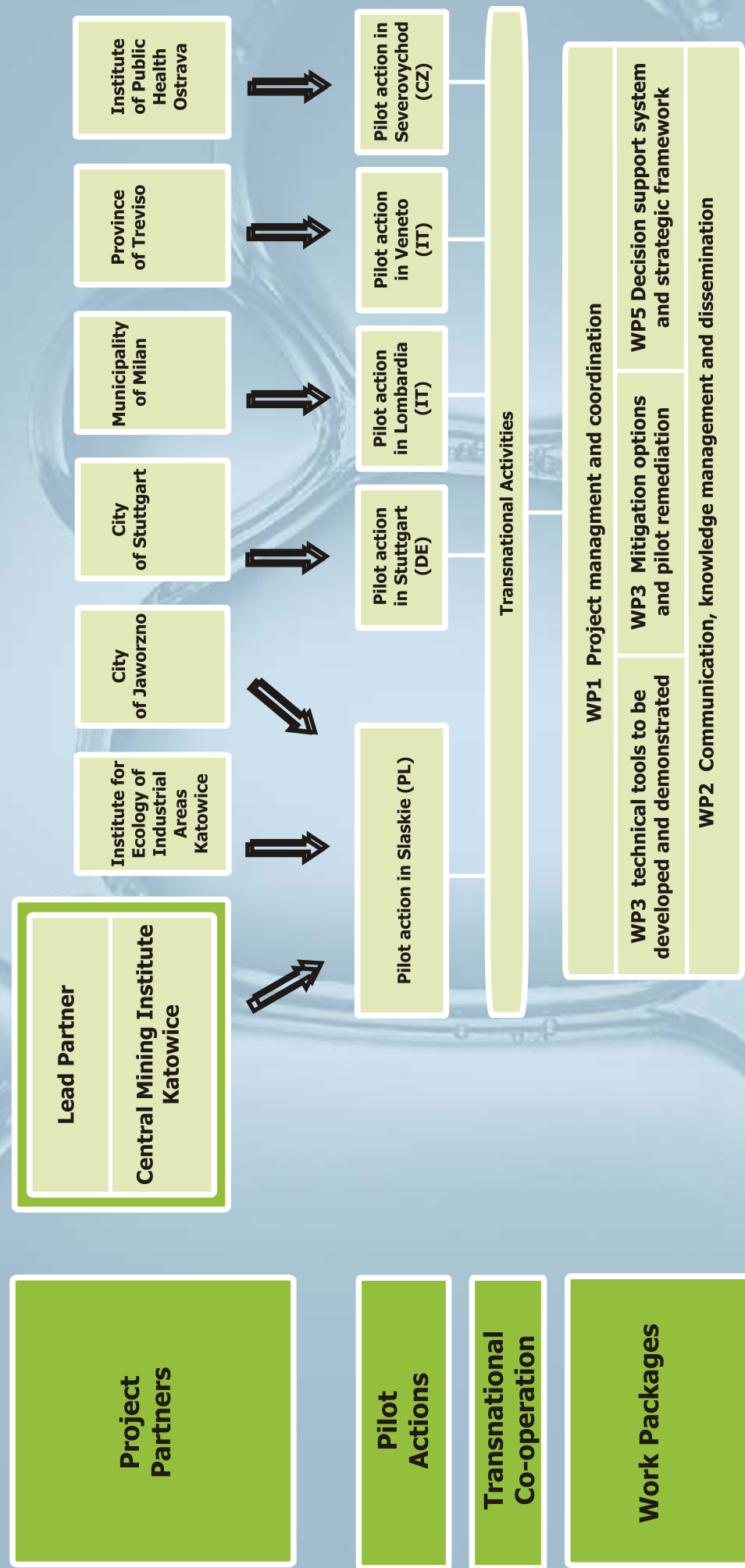
Key facts about FOKS project:

- Implemented under Central Europe Programme – Priority 3 “Using our Environment Responsibly”
- 7 partners from 4 countries:
 - Central Mining Institute, Katowice, Poland – Lead Partner
 - Institute for Ecology of Industrial Areas, Katowice, Poland
 - Municipality of Jaworzno, Poland
 - Municipality of Stuttgart, Germany
 - Municipality of Milan, Italy
 - Province of Treviso, Italy
 - Institute of Public Health, Ostrava, Czech Republic
- 5 pilot actions:
 - Jaworzno (Slaskie region) (PL)
 - Stuttgart (Stuttgart region) (DE)
 - Milan (Lombardia region) (IT)
 - Treviso (Veneto region) (IT)
 - Klatovy / Novy Bydzov (Severovychod region) (CZ)
- Total budget: 3 319 050 EURO
 - Including: approx. 1 782 325 EURO for pilot actions
 - Including: 634 000 EURO for investment
- 36 months of project duration:
 - start: November 2008
 - end: October 2011

Protecting the environment now and for future generations is one of the pre-conditions for sustainable growth. Groundwater is a specific environmental medium. Its contamination occurs sometimes many years after the contamination of soil have occurred. On the other hand, once groundwater is polluted, it takes many years to remediate it. Therefore, groundwater on one hand is a secure source of drinking water for now (in most cases it cannot be damaged as fast as surface water); on the other hand preventing negative impacts on groundwater quality is crucial to preserve it clean for future generations.

FOKS aims at the implementation of the Water Framework Directive (2000/60/EC) and the Groundwater Directive (2006/118/EC) on national, regional and local level. Especially the new principles of the view on larger areas and water bodies require new and innovative implementation strategies. The FOKS concept to focus remediation efforts on the key sources of large groundwater contaminations perfectly fits to this European strategy. FOKS therefore provides required technical strategies and decision tools for the local implementation of the new principles. Due to the partnership of local, regional and national level a balanced procedure and a common understanding will be achieved.

FOKS PROJECT STRUCTURE



Pilot area in Klatovy

The town of Klatovy is situated in Western Bohemia, about 40 km southward from Plzeň (Pilsen). It has nearly 23,000 inhabitants.

The town was founded in 1260 by a Czech King, Přemysl Otakar II, with the aim of protecting the kingdom and trading way to Bavaria. During the Middle Ages Klatovy was enchanting and it developed into one of the most important towns in Bohemia. In the 17th century the town grew into a regional centre of knowledge thanks to the Jesuits, who came in 1636. In the same year they founded a secondary school and three years later The Baroque Pharmacy, which is marked as an UNESCO monument. Another important monument concerning the Jesuits is the Catacomb, where the richest citizens are entombed.

The Site in Klatovy is selected for purposes of the project FOKS as it represents a hot spot polluted by persistent organic compounds (POPs). It was a former regional central depot of plant protection - herbicides were situated in an agriculture farm during the communism period. The farm was restored in a restitution process by its first owners in the nineties of the twentieth century. The owners identified serious damages on the property caused by the improper handling of hazardous compounds. A detailed investigation of POPs contamination was finished in 2008 by a tool of Risk analysis conducted by a specialized company according to the Czech Standards that assessed a high contamination of construction materials by POPs. A high level of POPs contamination in construction material, rubble and soil causes unacceptable pollution of indoor air and the property could not be used for residential purposes. Consequently risks of groundwater contamination caused by storage of herbicides in a underground depot should be assessed.



The owners of the property have been seeking funds and appropriate technologies to remedy this environmental damage and to restore the former utilization of the farm. They enabled the partner PP7 (Institute of Public Health in Ostrava) to test an innovated remediation technology CMD (Copper Mediated Destruction) on their property to initiate the solution to the problem. The CMD Technology uses the catalytic action of copper to destroy molecules by removing the halogen molecule (e.g. chlorine) from the molecules of the toxic compounds, like PCDD/Fs, PCBs, and OCPs. The method even eliminates all of the reactions where persistent compounds are formed (by the condensation reactions or the Nonhebel principle of chlorination through ArHCl intermediate products). The destruction efficiency does not depend on the level of chlorination POPs. The procedure has various patents.



The goal of the project FOKS at the site in Klatovy is to demonstrate the efficiency of the dehalogenization process on site-specific POP's using CMD technology. A prototype of a full-scale mobile unit will be tested at the site processing various materials, rubbles and soil containing POPs. An evaluation of the destruction efficiency of specific POPs, cost and reliability of the technology will be summarized, as expected output of FOKS project.



Pilot area in Jaworzno

The town of Jaworzno lies in the southern part of Poland, in the eastern part of the Province of Silesia (the most industrialised area in Poland), at the place where the regions of Upper Silesia and Lesser Poland meet; at the crossing of some major national and international lines of road, railway and air communication. In respect of area Jaworzno is among the largest towns in Poland - its area is 152,7 km² with more than 96 000 inhabitants. The town of Jaworzno is a member of the Metropolitan Association of Upper Silesia - the largest urban center in this part of Europe.

Jaworzno's economy is based on power engineering connected with the extractive industry. Centuries of activities of the extractive industry (coal, dolomite and sand), power engineering, cement and chemical industry have affected far-reaching transformations of components of the environment. The most significant transformations affected surface water, including the composition of ecosystems, changes in the river network and its nature (infiltration/drainage), mining drainage and the appearing of post-mining settlers, adverse changes in water chemistry. Equally profound, but much more harmful are consequences of the anthropogenic impact on the state of resources and quality of groundwater as a potable water reservoir. Jaworzno's biggest problem is the impact of pollutants from the chemical industry in the valley of brook W wolnica.

The brook of W wolnica is located in the south-western part of Jaworzno. W wolnica passes through the territory of the Chemical Plant, which was founded in 1917. Since this time there have been produced a lot of chemical substances and effectuated some synthesis.

As from 1928 to eighties of the twentieth century, the valley of brook W wolnica was the

site of hazardous waste collection from production, eg. plant protection products and preparations for hygiene. Irregularities in the way of waste collection has led to significant environmental pollution of soil and groundwater. Direct contact between pollutants and surface water cause cross-border pollution, which classify the Chemical Plant as an European hot-spot (one of seven especially severe sources of industrial pollution for the Baltic Sea), placed on the list of the Baltic Sea Joint Comprehensive Environmental Action Programme in the framework of the Helsinki Commission. Within the valley of brook W wolnica have being found out



compounds that pose high risks to ecosystems and human health. There have being inventoried 195 000 tons of hazardous waste so far (including HCH, DDT/DDE/DDD, dieldrine, endrine, metoxychlorine, benzene) - however, this figure does not reflect the actual quantity of pollutants in the pilot site, which area has being initially estimated to be 0,5 km².

Up to now, some investigations have being done in this area didn't show the whole picture of environmental impact of pollutants accumulated in the valley of brook W wolnica. In the FOKS project the integral approach will be applied to the investigation and assessment of the site to clearly define right solution.



The marsh in the Central Landfill "Rudna Mountain"



Pilot area in Stuttgart

Stuttgart, the capital of Baden-Württemberg state, is located in the center of a densely populated region in south-western Germany. The FOKS project area of 533 ha is situated in the north of the city centre, in the valley of the Feuerbach River, a tributary of the Neckar River.

As many districts of Stuttgart, the district of Feuerbach is constricted by severe soil and groundwater contamination generated over decades of industrial and commercial use. Due to the structural change many former industrial sites now are converted into service and residential use. Numerous single site investigation and remediation activities took place in Feuerbach have been carried out since 1984. Thus 300 contaminated sites were identified. 193 of them are polluting or potentially polluting the groundwater by chlorinated hydrocarbons (CHC), which are known to generate long plumes.

Due to the neighbouring sources and overlapping of different plumes the identification of the liable polluters is a challenging task. Additionally the allocation of the groundwater damages is impeded by the complex hydro-geological conditions in the project area. The hydrology is engraved in the stratum of the Middle Keuper which is composed of numerous layers of mudstone with gypsum deposits (Gypsum Keuper) and sandstones (Schilfsandstein).

The solid rock layers are covered extensively by quaternary sediments which reach large thickness at slope base and in the plain tract. The investigation of singular contaminated sites has been inefficient in many cases due to the fact

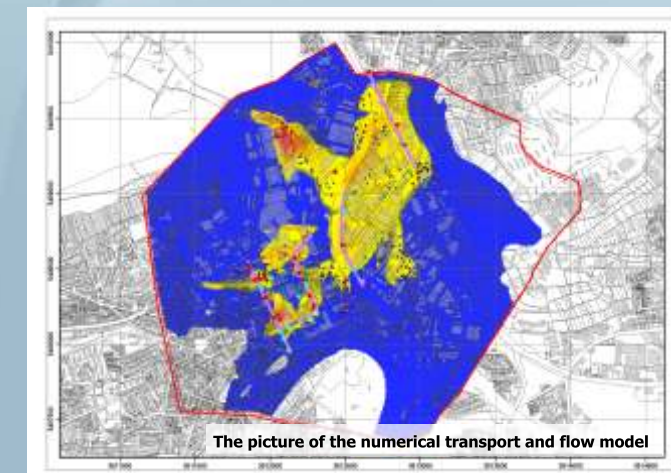
of the restricted view of consideration. Therefore the new integral groundwater investigation approach was applied during the project MAGIC (Management of Groundwater at Industrially Contaminated Sites) from 2005 to 2008.

On the basis of a detailed data collection and data evaluation a hydro-geological model was developed of the project area. Together with about 200 additional samples of groundwater and geophysical information from 8 exploration wells a numerical transport and flow model was set-up. On the basis of 37 immission pumping tests the numerical model could be validated. The most significant plumes of CHC in groundwater as well as

their related sources of pollution could be identified and mapped. In FOKS the integral investigation started in Feuerbach during MAGIC will be completed. Natural attenuation processes and the sources with the highest emission of CHC will be investigated to clarify the pathways from the place of contamination to the deepest affected aquifer and along the contamination plume in the groundwater. Most important will be the integral remediation plan for the whole project area with focus on the hot spots which will be developed. Realistic remediation targets for sources and plumes will be defined.



Aerial photo of Feuerbach



The picture of the numerical transport and flow model



Pilot area in Novy Bydžov

The town of Novy Bydžov is located in eastern Bohemia in the Hradec Kralove Region (Czech Republic). Novy Bydžov belongs to smaller towns in the Czech Republic; it extends to the area of 3,524 ha and about 7,200 people live in its territory. The town of Novy Bydžov was founded in 1305 originally as a royal town and it was an important administrative centre of the Cidlina Region.

Industry developed from the nineteenth century. Industrial plants such as machinery plants, metal cutting plants, metal foundry plants, plants for chemical treatment of metals etc., were in the past separately disseminated in the city and a lot of them were situated in the vicinity of residential areas. State owned enterprises were privatized in the nineties of last century. Some industrial plants were later abandoned or closed as a consequence of bankruptcy or economic inefficiency.

The improper handling of hazardous compounds (as chlorinated hydrocarbons, mineral oils etc.) During the communism period caused an uncontrolled groundwater pollution. Although the majority of households in Novy Bydžov can access drinking water distributed by the municipal water supplying system, private wells are also used by some households as a drinking water source or for the purpose of irrigation of gardens. A serious health problem of a citizen living beside a broken and closed plant was discovered in 2007 as a consequence of drinking contaminated water from a private well. The level of groundwater contamination from chlorinated aliphatic hydrocarbons runs to a thousands micrograms per litre. The municipality of Novy Bydžov has started to initiate measures to protect the public health. Exploitation of groundwater from private wells in the area surrounding the plant was banned.



Simultaneously the municipality with the aim of the Government of Hradec Kralove Region has started groundwater investigation to precisely identify the source of contamination and to evaluate the range of contamination.

Other potential risks of groundwater contamination arise from the historical character and disposition of industrial plants in the city, Novy Bydžov. In addition to the identified contamination sources there are other potential hot spots in the area of Novy Bydžov that could represent serious threats for the groundwater quality as well as to the public health. One of these potential sources of chlorinated hydrocarbons contamination glassworks plant, is situated in the vicinity of the municipal drinking water resource.



An identification of hot spots and an evaluation of environmental and health risks caused by groundwater pollution currently represent a key priority for the municipality of Novy Bydžov and it resulted in an engagement of the municipality in the project FOKS.

The goal of the FOKS project will be an identification of hot spots using an integral groundwater investigation approach and an evaluation of environmental and health risks caused by groundwater pollution by a mean of risk analysis.

As required by Water Framework Directive and Groundwater Directive, significant upward trends of groundwater contamination of groundwater bodies have to be reversed until 2015. Most of groundwater bodies with poor groundwater status are those on degraded areas like contaminated sites and brownfields. In such cases, only elimination of groundwater contamination sources ensures meeting this objective. However, this operation is time- and money-consuming process - by the year 2015 it is impossible to remove them all. Therefore, prioritization of contaminant sources and remedial actions is urgently needed. The FOKS concept to focus remediation efforts on the key sources of groundwater contamination perfectly fits to fill this gap.

In most European countries there is still a wide gap between expectations concerning the groundwater quality and technical, as well as economical, feasibility of groundwater cleanup. Some EU countries have problems with identification, assessment and management of contaminated groundwater bodies. In the case of many industrial areas even large invested funds do not ensure the expected improvement of the groundwater quality. Therefore, it seems essential that some innovative technical and administrative tools for groundwater management at industrially contaminated areas should be provided.

To focus remediation works on the key sources, as proposed by FOKS project approach, is the most efficient and cost effective way. Large potentially contaminated areas would be screened, but ultimately only a small area may need remediation. Implementation of Integral Groundwater Investigation and other tools proposed in the project allows diminishing costs of the identification, assessment and management of contaminated groundwater bodies significantly in comparison with traditional methods of environmental risk assessment.

The actions of FOKS project will concentrate on:

- Development, application and demonstration of series of innovative transnational tools for assessment of large scale groundwater contamination at industrial areas. This will be summarized in WP3 Core Output: "Toolbox for identification of key sources of groundwater contamination";
- Elaboration of remediation concepts for key sources of groundwater contamination and performance of pilot remediation. This will be summarized in WP4 Core Output: "Transnational guidelines for implementing innovative tools for remediation";
- Development of decision support system and transnational strategic framework for administrators and decision-makers dealing with large scale groundwater contamination. This will be summarized in WP5 Core Outputs: "Strategic framework for the groundwater risk management" and "Decision support system for local and regional bodies".

Common interest of all partners is to make a step towards clean groundwater at industrial areas within CENTRAL EUROPE space. All partners will have opportunity to exchange their know-how in the projects thematic field, to implement pilot actions in their regions. Partners would also have opportunity to exchange the experience from pilot actions' implementation and from the beginning of FOKS project will work jointly on transnational project outputs and results, like e.g. guidelines helping the implementation of EU Groundwater Directive.

FOKS project partnership consists of seven partners from four countries (Poland, Germany, Italy and Czech Republic), representing five NUTS II regions: Slaskie (PL), Stuttgart (DE), Lombardia (IT), Veneto (IT) and Moravskoslezsko. The partnership is cross-sectional as there are four local authorities and three applied research institutes acting on national level.