

## ***Executive Summary***

The UNDP Country Offices in Albania, Bosnia and Herzegovina, Macedonia FYR, Montenegro, Serbia and the UNATSCR 1244 Kosovo developed a regional demonstration programme around demand driven projects in nine locations in the Western Balkans requiring environmental cleanup. The Project was implemented in a 30 months period and covered three areas: clean up (construction works), policy dialogue and supply of domestic professional services in the environmental management sector. While the main focus was on the physical works needed to mitigate the environmental problems, institutional strengthening and capacity building was an important subject running throughout the programme.

The capacity building project: “Assessment of Environmental Hot Spots– Hydrogeological Aspect , Pilot project “Southern Industrial Zone” Pancevo (SIZ) ” was developed in line with recommendations of the initial needs assessment study . The Southern Industrial Zone in Pancevo is host to the largest industries in Serbia. The production concept, unsolved issues relating to wastewater treatment for the overall complex, chemical accidents, wastewater spills in the regular operations, and the impacts of the large-scale spills during the 1999 NATO bombing, have made the SIZ an area of special interest from the aspect of environmental and human health protection. The SIZ is designated as one of the three national environmental hot spots.

The activities implemented within the Project include:

- Review of the SIZ groundwater quality monitoring results, and the proposal of the control monitoring for the entire area
- Analysis and interpretation of the results of the existing investigations and the available documentation with the outline of the SIZ hydrological and groundwater quality characteristics
- Establishment of the SIZ Geodatabase that includes all the available data from the ground water quality investigations conducted in the previous period and the supporting data (geodetic, hydrogeological, etc.)
- The training on environmental hot spots – hydrogeological aspect with examples including the pilot study results, for the staff in the Ministry for Environment and Physical Planning, and the Secretariat for Environmental Protection of the Pancevo Town Administration, and the training for the use of Geodatabase.

Based on the existing analyses, the technical report “Assessment of Environmental Hot Spots– Hydrogeological Aspect “Southern Industrial Zone” Pancevo” was prepared, comprising of :

Chapters 1, 2, and 3	Introduction, Implementation Methodology, Project Location and Boundary Description;
Chapter 4	Previous Investigations and Background Documents

Chapter 5	Geological Structure
Chapter 6	Hydrogeological Characteristics
Chapter 7	Groundwater Quality
Chapter 8	Theoretical Grounds for Polluters' Behaviour and Migrations
Chapter 9	Remediation Options
Chapter 10	Geodatabase
Chapter 11	Conclusions and Recommendations

Annexes I. to VI include The SIZ situation maps, geological, hydrological and groundwater quality reports.

Annex VII The SIZ Control Groundwater Quality Monitoring Programme

Annex VIII Geodatabase User Guidelines

In the course of the definition of the hydrogeological characteristics of the investigated site, the interpretation of the original data from exploratory boreholes, and the reinterpretation of the background documents developed under other interpretative studies were carried out. The groundwater flow directions in this area, as well as the groundwater table fluctuations, were defined on the basis of the existing investigation studies and the results of the regular groundwater level monitoring, combined with sampling for chemical analysis. The chemical groundwater characteristics and propagation of contaminants were specified in accordance with the results of the existing investigation studies and analyses of this type covering the period from 2001 to 2009. The Control Monitoring Programme is developed (Annex VI). In order to clarify certain illogicalities of existing monitoring results related to the degree of contamination and update the existing monitoring programme. A theoretical outline of the behaviour and migration of specific types of pollutants present in the SIZ was provided based on all known aspects of the SIZ groundwater quality. The overall outline of the remediation methodologies (techniques) both for groundwater and elimination of pollutants in the SIZ was provided, as well as a discussion on the prospective remediation options. Further, a database is developed and installed, it includes all the information collected from existing investigations, primarily the chemical analyses results of the samples under the monitoring programmes conducted in this area. The Geodatabase was developed in ArcGIS software and contains both the numerical data and illustrated appendices that should greatly simplify the future use of the existing information as well as future analyses. The envisaged Geodatabase concept allows easy input of new data on the characteristics of chemical composition of the analysed samples and identification of the increased concentrations of contaminants.

The conclusions are:

1. The latest investigations of the groundwater quality (2009), and the investigations in 2007 and 2008 in the SIZ that are included in the regular monitoring programme (Secretariat for Environmental Protection of the Pancevo Town

Administration), do not indicate the presence of contaminants above the intervention values.

All the contaminations registered to date within the area covered by the regular monitoring programme are from the period before 2007. Such results, when contaminants are registered in one period (2005 and 2006), and not registered at the same sampling points, in the next period (2007 to 2009), are causing certain confusion. These results indicate the need for the control monitoring and/or modification and updating of the regular SIZ groundwater quality monitoring programme.

2. The conclusions about the final level of groundwater contamination in the Southern Industrial Zone could be confirmed only after the control monitoring. The proposed Control Monitoring (Annex VII) is designed to provide the cross check of the SIZ groundwater quality status . Its function is not to control the regular monitoring implemented to date, but to ensure the maximum level of the groundwater quality information under the specified conditions.

In case the decision to implement the proposed control monitoring programme is not made, the first following regular monitoring sampling and analysis series should have the control monitoring function. The regular monitoring programme needs to be modified to ensure maximum reliability of the data for the purpose of decision making on the SIZ groundwater contamination treatment. The modifications and the necessary changes of the Regular Monitoring Programme need to be in accordance with the recommendations presented in Chapter 11. Based on hydrogeological characteristics of the SIZ, groundwater contamination, and other parameters (hydrology, groundwater drainage data, etc.), the remediation process should be implemented in two phases:

- a. **Phase I** – Isolation of the contaminated zone of the hydrogeological medium in the area of the industrial facilities, and soil and groundwater remediation at the site of the primary contamination. These two activities must be implemented at the same time. The preparatory activities for the implementation of the remediation Phase I are not conditioned, and could be undertaken immediately. According to the analysis of the investigation results and model research by the D'Appolonia, it can be concluded that the proposal for the remediation of the contamination from the direction of the NIS Rafinerija( Pancevo oil refinery) , is based on the background documents that were available at that time. The drawback of the D'Appolonia project from the aspect of the protection of the entire SIZ reflects in the fact that partial remediation and protection of groundwater against pollution from individual industrial facilities cannot ensure an integrated and adequate solution. In the course of the preparation of the future remediation plans and programmes, such analysis must cover the entire area including all the facilities, i.e. polluters at the same time (Integrated approach).

b. **Phase II** – Zone of regular groundwater quality monitoring in the SIZ

The remediation methods in Phase II deferred in relation to Phase I. These works could be considered subsequently, depending on the results of the regular-control monitoring. If the control monitoring confirms the results of the regular monitoring from 2007-2009, i.e. the absence of contaminants in the Phase II Zone, there would be no need to undertake remediation, and the monitoring would be continued in the same way. If the presence of contaminants is registered in this Zone, and the monitoring results from 2005-2006 confirmed, it is necessary to start the preparation works for the remediation.

3. It is necessary to make an effort to include the results of all the groundwater quality monitoring, including the programmes implemented within the industrial facilities in the CIP Petrohemija, petrochemical industry, NIS Rafinerija, oil refinery, and CIP Azotara, fertilizer industry, into this programme and ensure that they are regularly entered into the established Geodatabase. This would upgrade the groundwater quality monitoring and environmental management, and will provide a solid basis for future contamination monitoring and planning of possible remediation.

The training for the staff in the Ministry of Environment and Spatial (MoESP) of the Republic of Serbia and the Secretariat for Environmental Protection of the Pancevo Town Administration was focused particularly on providing the basic and necessary knowledge in the field of hydrogeology, groundwater quality, and use of the Geodatabase. The following themes were covered:

- a. Groundwater in Nature – The Basics of Hydrology: What is Groundwater – Basic Terms, Geological Environment and Groundwater, What is Aquifer and Types of Aquifers, Movement of Groundwater Through Aquifer and Porous Environment, Groundwater Exploitation, and Groundwater Regeneration.
- b. Groundwater Quality and Impact of Human Activities on Groundwater: Groundwater Contamination Sources (Polluters and Contaminants), Movement of Contaminants Through Groundwater, Groundwater Remediation and Options.
- c. Spatial Databases – General Information: Southern Industrial Zone Database Concept, Input of Data into Database, Use of Database and Practical Guidelines for Database Maintenance and Upgrades.
- d. Presentation of Project Outputs

In addition, an important part of capacity building (CB) was a training on how to use and work with the geodatabase, aiming to fully train the staff in Secretariat for Environmental Protection of the Pancevo Town Administration to use the Geodatabase.